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Assessing the impact of Transnational Municipal City Networks on the provision of Global Public Goods

– The case of climate change mitigation

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Abstract

This dissertation explores the role of Transnational Municipal Climate Networks (TMCNs) in the context of social dilemmas with the example of a “climate-safe future” as a Global Public Good (GPG). The analysis is based on the concept of “willingness” in decision-making processes, and how TMCNs can influence their members to cooperate. Through an interdisciplinary approach incorporating Rational Choice Theory, New Institutional Economics, and Behavioral Economics, the study offers insights into the effectiveness of these networks in strengthening global public goods provision. As a method, a fuzzy set Qualitative Comparative Analysis (fsQCA) is applied, resulting in an analysis of TMCNs’ use of mechanisms to influence the willingness for commitment of its members, as well as indication of how to further improve the use of these mechanisms and increase the provision of the GPG. The research contributes to a deeper understanding of TMCNs' function within polycentric governance structures.

Table of Contents

Table of Figures

Table of Tables

Attachments

Attachment I - Questionnaire
Attachment II - Full list of TMCNs considered
Attachment III - Individual TMCN data sheets (containing results of the web content analysis and questionnaire for each TMCN)
Attachment IV - Truth table

Abbreviations

BE	Behavioral Economics
BP	Bloomberg Philanthropies
CCP	Cities for Climate Protection
CNCA	Carbon Neutral Cities Alliance
COICA	Coordinadora de las Organizaciones Indígenas de la Cuenca Amazónica
CPR	Common Pool Resources
C40	C40 Cities Climate Leadership Group
fsQCA	Fuzzy-set QCA
GCC	Green Climate Cities
GCoM	Global Covenant of Mayors for Climate and Energy
GPG	Global Public Goods
ICLEI	ICLEI – Local Governments for Sustainability
NDC	Nationally determined contributions
NIE	New Institutional Economics
PD	Prisoner's dilemma
RCT	Rational Choice Theory
QCA	Qualitative Comparative Analysis
TMCN	Transnational Municipal City Network
TCCG	Transnational Climate Change Governance
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

"Since people cause pollution", we are told, "people can stop pollution," Hardin (1982, p. 1) critically observes, pointing out the oversimplified belief that the simple will to solve issues like pollution is sufficient. However, Hardin explains that this is not necessarily true, as global challenges such as climate change, public health, or biodiversity are more complex. This is partly due to what Mackie (1967, p. 173) has identified as the "fallacy of composition", an inaccurate assumption that what applies to individuals will automatically also be true for a group. This fallacy is particularly apparent when personal and collective interests conflict, known as social dilemmas.

Social dilemmas, such as a conflict between "individual rationality" and "group rationality" (Dawes, 1975), or also between self-interest and longer-term collective interests (Van Lange et al., 2013), are at the core of public goods. Public goods exemplify this dilemma as they require individuals to give up immediate personal benefits for the collective good (Samuelson, 1954; Musgrave, 1959). Their characteristics of "joint consumability" and "non-excludability" mean that, in contrast to private goods, no one can be excluded from consuming the good, and one person's consumption does not diminish the availability for others. This leads to situations where individuals may choose not to contribute to the provision of the good, as they can still benefit from it even if they do not contribute, leading to a so-called free-rider problem and an under-provision of the good.

On a national level, these dilemmas are at least partially solved though national governments, with this task being one of its primary functions (Axelrod, 1984, p. 133). Public goods such as national defense or public infrastructure are often financed through taxes or other public funding sources, including all tax-paying citizens responsible for providing the good by leveraging collective contributions. On an international level, however, no such overarching authority can decide about and provide a solution to a social dilemma situation. Nation states and supranational organizations have, therefore, so far often struggled when it comes to the provision of Global Public Goods (GPGs) (Anand, 2002), as they do not have the mandate to impose and collect global taxes or use other enforcement mechanisms across international borders.

Nevertheless, all kinds of actors, including different levels of government, have become engaged in tackling global social dilemmas and contributing to providing GPGs. Cities have become active protagonists, especially in the case of climate change**.** Their increased engagement is in line with their role as key actors in the context of climate change: Although only two percent of the earth's surface is urbanized, cities are responsible for more than two-thirds of global energy consumption and around 70 percent of greenhouse gas emissions (UN Habitat, 2011). At the same time, around three-quarters of the world's major cities are located in coastal areas and are particularly exposed to the consequences of climate change, such as rising sea levels (UNEP/ UN Habitat, 2005). Urbanization is a major trend, with the proportion of the world's population living in cities expected to increase from more than half today to almost 70 percent in 2050 (UN/ DESA, 2018). Municipalities can, therefore, make a significant contribution, as they have considerable decision-making power over land use planning, waste management, transportation, and energy use, for example (Betsill and Bulkeley, 2006).

Cities and other local governments have emerged with new governance structures and are increasingly positioning themselves as global players. For example, they can also be encountered in the regular meetings around the Conference of the Parties (COP) gatherings, where they participate and put forward their own climate commitments. These commitments often go beyond the greenhouse gas emission reduction targets set by nation-states. A concept that captures this decentralized way of global governance is “polycentric governance” (Ostrom, 2010a). Essentially, overlapping decision units, such as government agencies or businesses, are understood to act and interact in a system, often without central coordination. In a polycentric system, actors do not necessarily act independently but are often organized through so-called intermediaries (Abbott, 2018). These intermediaries act on behalf of the actual actors, such as cities, and provide services such as setting standards, providing financing, or carrying out operational activities, such as exchanging information (Abbott, 2018). In the case of cities in the context of climate change, these intermediaries are “Transnational Municipal Climate Networks (TMCNs)”.

The phenomenon of TMCNs has already raised considerable attention from scholars regarding their role within global governance, the nature of these networks, the services

they provide, such as capacity building in cities, and their effectiveness. Their engagement has also been researched quite broadly in the context of climate change. Research has already produced insights into a range of aspects around the role and impact of TMCNs, for example, in areas such as learning through peer-to-peer sharing between cities and other capacity-building measures. Their actual impact and effectiveness have also been discussed. However, in cities where the battle for sustainable development is to be won or lost, city networks need to be integrated more seriously into multilateral processes (Acuto and Rayner, 2016). It therefore seems necessary to reassess what these networks actually do in order to then develop criteria to assess their performance or effectiveness.

Recent research hints at TMCNs having a particular impact through their influence on municipalities' political decision-making process (Busch et al., 2018). This specific perspective has gotten little attention yet. It is not clear yet how this influence is exerted, especially concerning decisions about commitments towards providing GPGs such as a climate-safe future. The analysis will, therefore, specifically look at the influence on decision-makers' willingness to cooperate or defect in a social dilemma situation.

In this dissertation, it is assumed that the TMCNs operate through mechanisms known to contribute to solving social dilemmas by increasing the number of actors that decide to cooperate instead of defecting. A mechanism in this dissertation refers to a process triggered by an activator that leads to a change in behavior or structure (Capano et al., 2019). These mechanisms can contribute to explaining how an intervention, or activator, can lead to a change and cooperation in a social dilemma. For example, a TMCN could publicly share the emission reduction targets of their members to increase the pressure on their commitments. The dissertation will seek to understand the mechanisms TMCNs use to influence this willingness and how these mechanisms can be improved to increase cooperation and, ultimately, the provision of this global public good. The focus will be on cities' "willingness" to cooperate, as opposed to their capabilities or opportunities (Klandermans, 1984; Michie et al., 2011). The research will, therefore, specifically analyze cities' decisions about whether they *want* to cooperate instead of if they *can* cooperate. The latter has already been assessed in various studies around cities' capacity improvement

through TMCNs, such as knowledge sharing between cities and facilitated through networks.

This dissertation uses an interdisciplinary approach that integrates economics and political science, aiming to capture the interplay between an economic perspective of decision-making and analyzing it within its area of impact in the political structures of a governance system. The interdisciplinary approach also integrates theoretical and empirical methodologies. The combination of theoretical depth and empirical insights ensures that the theoretical framework informs the empirical analysis, leading to findings that are more robust and applicable to analyzing how these networks influence their members and enhance the provision of Global Public Goods.

From an economic perspective, scholars in different disciplines research solutions to social dilemmas, mainly based on rational choice theory, new institutionalism, and behavioral economics. Rational Choice Theory assumes that individuals and organizations aim to maximize their utility, analyzing decisions as the product of cost-benefit calculations. On the other hand, New Institutionalism provides insights into how institutional structures and norms influence decision-makers' behavior, while Behavioral Economics offers a deeper look into the non-rational factors such as social norms. The mechanisms developed in these disciplines are also based on different assumptions, such as the characteristics of humans, for instance, the understanding of human rationality or the role of institutions in shaping decision-making processes. The different theoretical parts will contribute as a background to develop a theoretical concept in this dissertation, which can potentially also be used as a blueprint for further research in this area, as the theories collectively provide an understanding of the role of TMCNs in the dilemma. Ultimately, by improving our understanding of these networks and their operations, this research contributes to the broader efforts of ensuring a climate-safe future. The insights gained apply to other global social dilemma situations, providing learnings for similar decentralized governance structures.

The research problem, therefore, addresses the influence of Transnational Municipal Climate Networks (TMCNs) on member cities' willingness to commit to greenhouse gas

emission reductions within a social dilemma context of a "climate-safe future". The research question is:

“In what way do mechanisms within Transnational Municipal Climate Networks influence member cities' willingness to commit to the reduction of Greenhouse Gas emissions in a social dilemma to provide the Global Public Good “climate-safe future?”

The research question will be answered through three subordinate questions, as follows:

1. Which mechanisms are Transnational Municipal Climate Networks using to influence their member cities’ willingness to commit to the reduction of Greenhouse Gas emissions?

2. How can the effect of Transnational Municipal Climate Networks on the provision of the Global Public Good “climate-safe future” by cities be explained through these mechanisms?

3. How can the relevant mechanisms be improved to increase cooperation and, therefore, the provision of the Global Public Good “climate-safe future”?

To answer the research question, a range of cases of TMCNs is analyzed to find and explain the use of actual mechanisms that TMCNs apply, as well as potential opportunities for improvements. The following methodological steps are taken: Cases are selected based on cases that cover the most recognized TMCNs in terms of their presence in studies and are typical representatives of these cases in the sense of what is collectively shared (Lamnek, 2010). To find the cases, prior research is used and complemented with references to the networks made about each other and further online research about potential additional networks. Using criteria such as the need for the network to have an international membership, the original list of 74 TMCNs led to nine cases for the analysis.

A set of mechanisms is developed based on the theoretical framework that integrates Rational Choice Theory, New Institutional Economics, and Behavioral Economics, reflecting the multifaceted nature of city decision-making processes. Specifically, each field's perspective on solution mechanisms is reviewed and discussed to identify the most

relevant mechanisms for this context. In terms of the number of mechanisms, the selection needs to find the right balance between selecting enough mechanisms to provide a full account of the phenomenon and not selecting too many, avoiding complex results and difficult interpretation (Mello, 2021). The aim was to iteratively build a list of four to seven mechanisms, which, due to the richness of research around the topic and mechanisms, had first led to nine mechanisms. After collecting data, two mechanisms were dropped due to data gaps and the need to decrease the number, cutting eight, one partially already covered by another mechanism, and getting to a total number of seven mechanisms. An example of a mechanism is sharing information about the intention to cooperate between actors (Axelrod, 1984) or building "group identities" (Kramer and Brewer, 1984, 1986). Indicators are developed for each mechanism to identify the mechanisms throughout the cases. "City typology as limiting criteria for membership" to create a group of similar types of cities is an example of an indicator for the "group identity" mechanism.

Through a web content analysis and a questionnaire sent to representatives of all cases, data for all indicators is collected and then brought together in a data matrix. The data matrix is split into two sides. One side shows rows for scores for the application of the mechanism measured through the indicators. The other side shows an additional score for each TMCN that reflects the level to which their members are committed to reducing Greenhouse Gas Emissions. This allows us to respond to the first part of the research question. Additionally, it allows for the relationship between mechanisms and the performance of each TMCN in the sense of influencing their members' willingness to make this commitment and start tracking the causal relationship between the two sides.

The analysis then uses the fsQCA methodology (Ragin, 1987), which allows for the identification of causal configurations of conditions, which in this dissertation are the mechanisms that lead to the outcome. The outcome then is the level to which the TMCNs' members are committed to reducing Greenhouse Gas Emissions, as mentioned above. This approach is particularly suited to complex social phenomena due to its basis on equifinality, i.e., a scenario in which alternative factors can produce the same outcome, and conjunctural causation, where single conditions do not display their effect on their own but only together with other conditions (Scheider and Wagemann, 2012). This dissertation is going to apply

the more recent type of the method, a fuzzy-set QCA (fsQCA) (Ragin, 2000), which differs from the original, now called a crisp-set QCA, by overcoming one of QCAs main critics about its binary nature as it allows gradual values, and therefore offers more differentiation and more precise description (Sehring et al., 2013). The method is eventually complemented by an additional qualitative approach of applying a typology of TMCNs to the set of cases and developing ideal configurations of mechanisms for each typology to answer the second part of the research question. To answer the third part of the research question, the data that resulted from the fsQCA, as well as the ideal configurations, is compared and discussed in terms of opportunities for individual improvements of TMCNs, and especially also systemic improvements, considering differences in the role of each TMCN type within the ecosystem.

In terms of the structure of the dissertation, after the introduction, the dissertation presents and discusses the theoretical background, exploring relevant economic and political theories, such as Rational Choice Theory, New Institutional Economics, and Behavioral Economics, to precisely explain the terminologies used. The theoretical background also helps to connect the different fields of this interdisciplinary approach and describe the interdependencies between economic behaviors and political structures, which is essential for understanding the complex nature of Global Public Goods provision. Additionally, it sets the stage for analyzing how TMCNs utilize mechanisms to influence their member's ambition related to climate change.

In Chapter 3, the current state of research on TMCNs is presented, together with further details about the characteristics of TMCNs as networked organizations, the services they provide, and their role in a polycentric system. Chapter 4 then focuses on the state of research of solution mechanisms for social dilemma situations to discuss different mechanisms in Chapter 5. This also results in a set of mechanisms being applied to the analysis. Chapter 6 explains the methodology in detail, including a discussion of measurements of the impact of TMCNs and limitations. In Chapter 7, the methodology is applied by analyzing the collected data, and the results are presented together, followed by a discussion of the limitations of the research. Finally, the findings are summed up and discussed in Chapter 8. The chapter addresses the transferability of the findings and

suggests areas for further research. Recommendations are also provided for improving the operations and strategies of TMCNs to improve their influence on their members, considering their role as actors in a polycentric governance system.

2. Conceptualizing the context of city networks and the context of their impact

In order to develop a conceptual framework, the first chapters will present and discuss the context in which city networks are active, the implications of this context on the potential impact of these networks, as well as the networks themselves and the current state of research. First, we will look at a key part of the analysis as this is what city networks potentially aim to impact: The decision-making in cities about taking or defecting to a commitment to mitigate climate change. To have a clearer picture of how this process could be influenced, we will start by discussing the decision-making processes and potential areas of influence.

2.1 Shaping decisions – The evolution of decision-making theories

Chapter 2.1 of this dissertation discusses the complexities of decision-making processes, an important study area for understanding the influence and operational dynamics of Transnational Municipal Climate Networks (TMCNs). The chapter discusses decision processes from different points of view, which will later help identify different potential mechanisms that TMCNs could use to influence their members' decision-making. Three areas of research and their understanding of decision-making will be touched on: RCT will first be introduced as a foundational principle of neoclassical economics and a framework it relies on to explain how individuals make economic decisions in different contexts. New Institutional Economics, as one of the early theories in economics that attempted to assess economic and social phenomena closer to their actual reality than neoclassical economics, will then add on the perspective of decision-making, giving way to the concept of bounded rationality. This concept can be seen as a response to RCT and Neoclassical Economics, challenging some of the core assumptions or axioms, which allows us to broaden our perspective on decision-making to include mechanisms that can influence decisions and have proven effective, especially in experimental research. The concept of bounded rationality will then lay the ground for introducing Behavioral Economics, a central concept. These theories are highly complementary, and their integration will allow for a more adequate understanding of often complex realities. By integrating the perspectives,

the chapter discussed how TMCNs can influence decision-making processes and increase cooperation throughout their membership.

To start the discussion about decision-making in general, and from a rational perspective, decision-making can be seen as a "[…] process of choosing among alternatives in order to satisfy the objectives or meet the criteria of the decision goal" (Ngah et al., 2015, p. 3). Tversky and Kahneman (1981), with a more behavioral perspective, use a similar definition when they say that a decision problem is defined by the acts or options among which one must choose, the possible outcomes or consequences of these acts, and the contingencies or conditional probabilities that relate outcomes to acts. Simon et al. (1987) further differentiate decision-making from problem-solving. They use the work of managers, scientists, engineers, and lawyers as examples, whom they see "[...] choosing issues that require attention, setting goals, finding or designing suitable courses of action, and evaluating and choosing among alternative actions" (Simon et al., 1987, p. 1). While the first three activities - fixing agendas, setting goals, and designing actions, are called problem-solving, they refer to the last two - evaluating and choosing - as decision-making. This underscores the complexity of research around decision-making, as depending on the approach, aspects like learning from experience or social learning are part of the process, making assessments of the decision process more challenging when relaxing the assumption of perfect rationality. This also explains why there is no standard approach in decision-making theory besides decades of research. Hardin even states: "To attempt a complete decision theory of human behavior would be absurd [...]" (Hardin, 1982, p. 14), noting that many different variables influence decisions. In this next section, the interplay of Rational Choice Theory, New Institutional Economics, and Behavioral Economics are critically discussed to develop an integrated lens through which the decision-making within TMCNs can be understood. Chapter 2.2 then adds a deeper examination of the social dilemma in which the decision-making process takes place.

2.1.1 First developments of decision-making in Rational Choice Theory

We will introduce the most relevant theories in which decision-making, especially concerning solving social dilemmas and providing public goods, has been analyzed. The first assessments of social dilemmas were based on RCT. In this approach, political action

is interpreted by applying the theories and methods of neo-classical economics. Political decision-making from the viewpoint of RCT corresponds to a market (Knoepfel et al., 2007). Consequently, RCT is also described as a framework to explain human behavior and decision-making based on a cost-benefit analysis of options (Jonge, 2012; Hindmoor, 2006; Hindmoor and Taylor, 2015). It assumes individuals to be rational by applying reason while processing information, recognizing constraints in which they operate, and making choices based on their preferences (Cairney, 2020). Therefore, a typical mechanism to influence a decision-maker in RCT is a financial incentive.

RCT's understanding of decision-making is firmly based on rationality. Contrary to the more colloquial use of the term often used as reason opposing emotions, the essence of rationality in RCT is a consistent ranking of alternative preferences (Grüne-Yanoff, 2010). For instance, a consumer has a choice between three different types of the same product, A, B, and C, as per the 20th-century economists' view, would imply that the consumer can consistently rank these types as follows: A as their top choice, followed by B, and lastly C, based on individual preferences, features, and value propositions offered by each type of the good. It differs considerably from a more colloquial or philosophical notion of rationality that often includes judgments about a decision's ends or morality. Consequently, being rational also means "maximizing one's utility", identical to "choosing according to a consistent preference ranking" (Grüne-Yanoff, 2010, p. 63).

The assumption of a rational actor is explained by the need to avoid a certain arbitrariness, where if agents are not assumed to be reasonable, there would be no limit to the interpretations one could give of the agent's psychological states (Jonge, 2012). Consequently, there would be no way to explain human actions in terms of reasoning processes, as "[...] any act could equally well be connected with any belief and any desire" (Jonge, 2012, p. 7). Generally, in classical and neo-classical economics, individuals are essentially identified as rational and as a set of stable preferences (Hindmoor, 2006, p. 6; Teraji, 2018, p. 137). Thus, a choice is treated as rational "[...] if it is the one most likely to satisfy these preferences (Teraji, 2018, p. 137).

In RCT, Jonge explains decision-making as a two-step process. In step one, the rational agent selects from all possible (and relevant) alternatives that are feasible (restrictions can

be financial, legal, social, physical, and emotional) and then, secondly, chooses from this set of alternatives the preferred one. In this model, restrictions do not influence preferences, which will be one of the differences from other concepts presented below. Consequently, changes in behavior are therefore usually explained by changes in restrictions (Jonge, 2012, p. 8), such as, for example, financial difficulties. The three policy levers that have, therefore, been suggested in traditional economics are altering prices, providing information, and placing restrictions on purchasing and other behavior (Johnson et al., 2012). All three will also show the mechanisms influencing cities' decisions, which will be discussed further below.

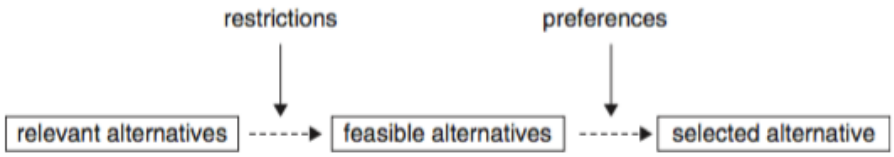


Figure 1: Choice making of an agent based on his preference (Jonge, 2012, p. 8).

The well-organized and stable system of preferences is a feature of the "economic man", a concept on which RCT is based. This man is also assumed to have a skill in computation that enables him to calculate which of the available alternatives will permit him to reach the highest attainable point on his preference scale. Simon (1955), who later contested some of the assumptions of RCT and traditional economic theory, describes this conception as a man who is "rational" in the sense that he is assumed to "[...] have knowledge of the relevant aspects of his environment which, if not absolutely complete, is at least impressively clear and voluminous" (Simon, 1955, p. 99).

In RCT, decisions can be modeled, and the models are used to analyze decisions and the influences that affect decision-making. The development of (simplified) models is possible through the assumption of the above-cited stable preference ordering. Therefore, in terms of methods, RCT is a deductive approach that uses these models to generate predictions of actors' behavior (Hindmoor, 2006, p. 2). Within the broader framework of RCT, an important modeling approach is game theory, as it specifically models situations that involve strategic interactions between individual decision-makers where their decisions

impact each other's outcomes. Game theory, originally, also builds on the assumption of rational agents who aim to maximize their utility. Amadae (2015) traces the origins of game theory back to the mid-twentieth century, when the Hungarian-American mathematician John von Neumann, a passionate chess player, found that the strategic underpinning of the game applied to nearly all situations in daily life. The prisoner's dilemma as a central model to capture a social dilemma, which we shall return to later in more detail, is a classic example of game theory highlighting the tension between rationality and collective outcomes. It can model situations where a group of rational utility maximizers act according to their individual benefit and disregard the interdependence with the other actors, leading to a situation where everyone is worse off.

An example of this is a climate-safe-future, where each individual is assumed to rationally pursue their benefits, such as the highest life quality, disregarding the impact of climate change, while everybody would be better off with a cooperative process to achieve a collective outcome of a climate-safe-future. This is also called a social dilemma, which we will return to in Chapter 2.2. It should be mentioned here, however, that even though having its origins in a military strategic context, the research based on the prisoner's dilemma in game theory has since developed not only into a range of other kinds of thematic dilemmas but also specifically into research around cooperation and provided valuable insights, which this dissertation is also going to be built on.

Another important feature of decision-making in RCT is self-interest. This perspective is rooted in the belief held by its developers that self-interest is a fundamental characteristic of human behavior and simply is how people actually are. Furthermore, it is also a methodological question, as it enables researchers to construct the above-cited simplistic models (Hindmoor, 2006, p. 2). It is noteworthy that rational choice theorists do recognize that there are behaviors that do, at the first view, not seem to be selfish, such as, for example, donating blood. However, instead of relaxing the assumption of self-interest, they have provided explanations of why such behavior can be seen as selfish, such as blood donors wanting to impress their friends (Hindmoor 2006, p. 5), and therefore keeping the assumption of self-interest alive even in situations where individuals seem to act selfless.

An additional important aspect concerns the question of who is making a decision. RCT builds on “methodological individualism”, where political outcomes are seen as the intention of an aggregate of individual actors (Cairney, 2020, p. 113). RCT, therefore, analyzes individual behavior and how people act and decide, even if a group makes decisions, understood as the aggregate of all individuals involved. An additional aspect of methodological individualism is that, although rational choice theorists recognize that structures limit the available options to individuals, they emphasize individual agency over structure (Hindmoor, 2006, p. 1). This last point, however, will be relaxed throughout the chapter when looking at New Institutional Economics, where the structure is considered to have a bigger impact, even though it also builds methodological individualism.

Even though RCT is built on strict assumptions, such as the economic man and features like complete information, it also recognizes some limitations or nuances to these assumptions. For instance, risk or uncertainty in the decision-making process, and with that, a scenario of a certain incompleteness of information, is also recognized. This was first reflected in the expected utility theory, introduced by von Neumann and Morgenstern (1944). They use a lottery as an example of a risk situation where potential outcomes are known but not which will occur. A rational actor, therefore, has to work with probabilities of each outcome to take place and estimate the expected utility of each potential outcome, also called prospects, by multiplying outcomes and probabilities to maximize expected utility. All information about options and probabilities is assumed to be known to the actor (Jonge, 2018; Teraji, 2018). As generally assumed in RCT, all actors have perfect information, except for the situation's outcome, and unlimited computing capability to deal with information and probabilities. Even though it provides an important feature of utility maximization, the concept has also been contested, and an alternative concept will be presented further below. Summing up, this example illustrates that there are also branches of RCT that try to incorporate more real-world understandings of human decision-making, moving beyond the oversimplified notion of the “economic man”. Despite these advances, the shortcomings of RCT in explaining many real-world phenomena still led to alternative explanations in other disciplines or variants of RCT.

RCT has two main variants, with a trade-off between accuracy and generalization (Cairney, 2020, p. 113). The first one is used to predict behavior by assuming optimally acting individuals based on modeling, allowing for easier generalization. The second one builds on more detailed assumptions around preferences and the role of institutions, reducing the potential for generalization but allowing for a more accurate analysis of institutions as providers of incentives for decision-making and how changing institutions can also change incentives. For example, in addition to that connected to Rational Choice Institutionalism (Cairney, 2020, p. 84), also a branch of New Institutionalism that will be discussed next, does employ methodological individualism as well but assumes individual preferences as the motivation for individual action and institutions as the context in which they operate. It, therefore, recognizes the influence of institutions on decision-making. In this setting, following Cairney, individuals would ask themselves, "Which action produces payoffs closest to my preferences?". At the same time, institutions provide that payoff or other information regarding the consequences of the individual decision, for example, through incentives, punishments, or enforcement mechanisms for agreements (Cairney, 2020, p. 84). Additionally, Rational Choice Institutionalism shows that the disciplines of RCT and NIE are closely linked through specific mechanisms such as incentives, norms, and information provision through which institutions influence decision-making processes.

2.1.2 Widening the perspectives of decision making through New Institutional Economics

Now, looking at decision-making from a second perspective, New Institutional Economics (NIE) accepts some core aspects of neoclassical economics but rejects other assumptions, such as that of perfect information and instrumental rationality (Menard and Shirley, 2008). Ostrom, for example, sees RCT as useful for constructing clear, unambiguous predictions that serve as a reference point but rejects using RCT as a single explanation for behavior. She agrees with the theory of rational choice that individuals are partially selfish but also acknowledges that there might be more than one single goal. She also acknowledges the role of heuristics and norms, such as reciprocity, especially within collective action, giving way to additional mechanisms that can potentially influence decisions. For Ostrom, preferences may be modeled as stable and complete only in simple and restricted situations.

She also believes that the hypothesis of complete information available to an actor is rarely true (Lara, 2015).

As in RCT, methodological individualism is also an axiom of the NIE (Richter, 2005). In NIE, first of all, institutions matter in the sense that approaches of the leading scholars of the field do not assume the institutional framework as given but make it into the object of research and how these frameworks influence economic behavior (Richter, 2005). Institutions in this context are seen as the "humanly devised constraints that shape human interaction" or the "rules of the game" in a society (North, 1990, p. 3).

Besides also criticizing the lack of attention to institutions in neoclassical economics and, with that, the relevance of other constraints than budgetary ones, the critique was also directed towards an assumption of static models instead of dynamic situations as well as the insistence on stable preferences (Nabli and Nugent, 1989b). The critique is, however, a quite positive one, and NIE has ended up broadening the mainstream toolkit and analytical framework to explain phenomena that "[...] had previously seemed impenetrable" in various approaches for analyzing institutions (Nabli and Nugent, 1989b, p. 1336), such for example why people do not necessarily always act to maximize their self-interest independent from financial incentives. Using the example of blood donation again, NIE does not explain the decision to donate as the result of assessing utility maximization or a cost-benefit analysis. It recognizes that other factors like altruism or social norms, for example, when people believe donating blood is right, can play a role. Crucially, these factors are part of the institutional environment where a decision maker is embedded, influencing the decision. For example, an organization can appeal to the belief in contributing to a greater good to influence its members instead of using mechanisms like financial incentives, as seen in TMCNs below.

The area of NIE, therefore, we want to look at specifically, though, in this thesis, is collective action, which Nabli and Nugent describe as one of the two broad and general approaches of NIE together with transaction cost economics (Nabli and Nugent 1989b, p. 1336). NIE assumes that choices are made within a context of given institutions and "macro rules", such as property rights or laws, where individuals or groups that are discontent with any part of this context can engage in collective action to change the institutions (Nabli and

Nugent, 1989b:1340). Following Nabli and Nugent (1989b), the theory of collective action concerns public goods not only of a physical character, such as parks or highways, but also of an abstract character, such as a higher wage rate, a higher price, or a regulation. The key issue in the collective action literature is to "explain collective outcomes in terms of individual motivation" (Hardin, 1982, p. 2) or, as Nabli and Nugent put it, "to explain the likelihood of success or failure of a given set of self-interested individuals in undertaking actions that may benefit them collectively" (Nabli and Nugent, 1989b, p. 1338). Thereby, the theory of collective action has also been concerned with finding out what kind of behavior can result in cooperation, as well as the identification of conditions under which free-riding can be avoided and cooperation can be achieved (Nabli and Nugent, 1989b, p. 1338).

NIE has also provided clarification in terms of terminologies, as the term "institution" is sometimes used loosely, with a lack of consistency and clarity, often seemingly to mean "organization" (Bremer et al., 2021; Dovers and Hezri, 2010). North, therefore, makes what he considers a crucial distinction between institutions and organizations. He writes, "Like institutions, organizations provide a structure to human interaction"; however, they are distinct as they are generally a group of people bound by some common purpose (North, 1990, pp. 4-5). He uses a game as an analogy to distinguish the rules from the players, where the latter, the "team" as the organization, aims to win the game within the set of rules. Organizations include, for example, political bodies, economic bodies, social bodies, and educational bodies (North, 1990, p. 5). Furthermore, once they exist, they can influence the existing institutional framework through lobbying efforts towards national governments or supranational entities such as the UN and its different branches. Organizations can, therefore, be institutions due to the quality of governing relations between individuals and groups (Nabli and Nugent, 1989b), but that does not mean that all institutions are organizations, nor that all organizations are institutions. In the case of this dissertation, TMCNs are therefore defined as organizations that act within an institutional setting and can create institutions such as rules for cities that want to become members.

This also touches on why certain organizations, and in this case TMCNs, come into existence and how they evolve. Following North's understanding, the emergence of

organizations is fundamentally influenced by the institutional framework and the opportunities it offers. He also describes this as organizations taking the opportunity that arises from the existing set of constraints (institutional ones and the traditional ones of economic theory). Organizations can, on the other hand, also influence the institutional framework (North, 1990, p. 5) if they have sufficient bargaining strength and can "[...] use the polity to achieve objectives when the payoff from maximizing in that direction exceeds the payoff from investing within the existing constraints" (North, 199, p. 79). TMCNs might, therefore, be looked at from this perspective as well. The transaction costs approach might explain their existence as they can lower transaction costs of city cooperation, for instance, by providing low-cost opportunities for exchanging information and using their collective power and strategic influence on global governance. This can enable TMCNs to advocate for policies and initiatives that individual cities may not be able to push through, influencing national or international policy in the interest of cities.

The formality aspect should also be highlighted as it will be important to this dissertation, as TMCNs might use both in their operations. Formal institutions such as contracts, laws, and a country's constitution (Erlei et al., 2007) are characterized by the fact that they function as a statutory right of sanctioning power and can, therefore, be changed relatively quickly (North, 1990). For example, in a TMCN, this could be a sanction imposed on members if they do not commit to a common target to reduce greenhouse gas emissions. On the other hand, informal institutions take more time to be changed or might be very hard to change at all and are understood to mean non-codified patterns of action such as norms, religious beliefs, conventions, or rules of conduct (Becker et al., 2015). This could, for example, be the use of a naming-and-shaming strategy against the members of a TMCN that do not commit instead of direct sanctions.

An important distinction can here also be mentioned between two types of norms: Norms that might very well be in line with an individual's self-interest as assumed in RCT, such as following a fashion through a descriptive norm, while social norms can go against self-interest as "[...] when we are required to cooperate, reciprocate, act fairly, or do anything that may involve some material cost or the forgoing of some benefit" (Bicchieri, 2006, p. 2). A social norm is a "rule of behavior such that individuals prefer to conform to it on the

condition that they believe that (a) most people in their reference network conform to it (empirical expectation) and (b) that most people in their reference network believe they ought to conform to it (normative expectation)" (Bicchieri, 2016, p. 35). In that sense, empirical and normative expectations are social in that they refer to others' behavior or beliefs (Bicchieri and Dimat, 2022). A social norm can also be defined as "[...] rules guiding social behavior, the deviation from (or adherence to) which is negatively (or positively) sanctioned" (Jann and Przepiorka, 2017, p. 4). However, as North (1990) also highlights, the distinction between formal and informal is not always clear-cut, and institutions do not stand side by side but interact. The result of this interaction is just as diverse as the institutions themselves. Institutions are tied back to the respective social and cultural contexts. Becker et al. put this interplay under the concept of culture (Becker et al., 2015).

Finally, institutions have specific ends within NIE, one of which is crucial in the context of this dissertation: According to North, institutions (constraints) should reduce uncertainty by establishing a stable structure for human interaction and exchange (North, 1990, p. 6, 16). This structure (together with the technology employed) determines the cost of transacting and the cost of transformation (North, 1990, p. 34). North argues that institutions provide a stable and predictable framework for human interaction by establishing rules, norms, and procedures that help to reduce uncertainty and minimize transaction costs, such as information, negotiation, and enforcement costs. For North, the institutional structure's central role is based on the assumption that institutions reduce the uncertainty that creates transaction costs and allow scope for social cooperation (North, 1990). Lower transaction costs can result from constraints like rules for exchanging information. For example, a TMCN can provide these institutions with rules by requiring each member to publish standardized information about their commitment to reduce GHG emissions. They also provide structure, an important element in solving social dilemmas. Ostrom believes that it is not the individual's extraordinary abilities but rather a structure, such as the market, or in the present case, an organization providing a platform for exchange, that leads participants to make efficient decisions (Lara, 2015). Organizations can, therefore, impact decisions through the environment they set and influence social dilemma situations.

Relaxing the assumptions around rationality as one of the reasons for NIE's development is also a central aspect of this dissertation. TMCNs might be using a range of mechanisms to influence their members' decision-making based on this alternative view of the assumption of perfect rationality. Rationality, as understood in RCT, is questioned in NIE and other theories due to doubts about its ability to reflect real-world phenomena. There have also been doubts related to the fact that this understanding of rationality can be found in experimental data. Guillermo and Gobet (2010) state that when perfect rationality gets tested experimentally, predictions about the behavior and decision-making of agents have not tended to prove theories based on perfect rationality, as will further be discussed below from the field of Behavioral Economics. For example, we seem to not be very good at judging probabilities or risk, nor do we apparently order our preferences consistently (Teraji, 2018), which might, among other factors, be related to limitations of our information processing capacity (March, 1978, p.598). Instead, it has been shown that there are certain restrictions or "bounds" on rationality. These restrictions or "bounds" on rationality led to a new concept called "bounded rationality", trying to offer "[...] psychologically more plausible models of human decision-making without giving up on the notion of rationality altogether (Grüne-Yanoff, 2010, p. 61)". The concept was coined by Herbert Simon (1957) as a behavior that is "intendedly rational, but only limitedly so" (Simon, 1961, pxxiv as cited in Williamson 1996, p. 6). Regarding the limitations hindering rational behavior, he distinguishes between constraints in the environment and constraints arising from the actor's limitations as an information processor, whereas the latter qualifies as bounded rationality (Simon, 1964). He illustrates this difference with an example, where he says that an "[...] ant, viewed as a behaving system, is quite simple. The apparent complexity of its behavior over time is largely a reflection of the complexity of the environment in which it finds itself" (Simon, 1969, p. 52). Also true for human beings, as opposed to neoclassical assumptions, humans do not know all of the alternatives for action available to them, and they cannot make the calculations that would support optimization (Teraji, 2018).

Simon, Teraji, and other scholars highlight that decision-making that deviates from neoclassical rationality does not imply irrationality; instead, bounded rationality is an alternative conception of rationality that incorporates the cognitive processes of decision-

makers more realistically (Simon, 1985; Teraji, 2018; Selten, 2001). It is a weakened form of rationality that considers the decision-makers cognitive limitations concerning the maximizing behavior assumed by expected utility theory, and aims at describing the real processes that individuals use to make actual decisions (Teraji, 2018, p. 142). Capturing the notion of a process, Simon (Simon, 1976) also distinguishes between substantive rationality as "simply choosing the best action" (Tillett, 2004, p. 1) in the sense of RCT and "procedural rationality" as "finding the approximate best action" (Tillett, 2004, p. 1). Substantive rationality, therefore, can be understood in the traditional sense of rationality, where "[...] agents are assumed to have unlimited reasoning power and to be willing to use all of their reasoning resources to extract more payoff" (Tillett, 2004, p. 1). Procedural rationality, on the other hand, aims, as the terms suggest, at the specific decision-making process. In this sense, a decision can also be distinguished from a choice as a selection of one, among numerous possible alternatives, while a decision is a process through which this selection is performed, and as a consequence, a behavior then is a process through which this selection is performed (Teraji, 2018, p. 143). Procedural rationality, therefore, suggests the presence of a search process and can be seen "[...] as the process of finding reasonable solutions, given limited information and computational capacities" (Teraji, 2018, p. 143). This can be a great advantage in a social dilemma, a very complex situation where calculating the best cost-benefit relation might be difficult and not the only rationale for the decision-makers, as we will see below. Tillett, who researched the implications of bounded rationality in the prisoner's dilemma, also highlights an important aspect: "When players are thus bounded, predictions about the analysis players engage in to select and implement strategies is changed, and one can begin to consider outcomes which were previously considered irrational" (Tillett, 2004, p. 1). This makes the perspective of bounded rationality, additional to the perspective of RCT, a valuable lens to analyze mechanisms within the present GPG model of this dissertation, as explanations can be found beyond mere cost-benefit factors, such as fairness considerations by the decision maker.

This also has consequences for the very process of decision-making. The aspect of the limitation to processing information renders utility maximization impossible, as assumed in expected value theory. Instead, decisions are based on the assumption that decision-makers

have restricted information and computational ability to process the information, which makes them use a sequential process to search for a solution until they find a satisfactory choice instead of an optimal one (Simon, 1957). Also, contrary to RCT, the alternatives are not simply given but found in a search process (Selten, 2001). Hence, people also do not carry out a full cost-benefit analysis of the possible options, and they choose a good enough option, not the best option (Guillermo and Gobet, 2010). Decisions are made according to the available capacity and an aspirational level the actor strives to "satisfy". The aspirational level can also be considered an adequacy criterion (Guillermo and Gobet, 2010) to decide whether an alternative is satisfactory. This also means that contrary to traditional models of RCT, where all alternatives are evaluated before a choice is made, "[...] actual human decision-making alternatives are often examined sequentially," and the first satisfactory alternative that is encountered is also actually selected (Simon, 1953, p. 12).

The concept of satisficing also allows for the aspirational level to change. If an individual's examination of alternatives leads to an easy discovery of satisfactory alternatives, his aspiration level rises, while if the examination is difficult, the aspirational level falls. In this sense, satisficing also does not mean that decision-makers are not goal-oriented; they are (Simon, 1997, p. 293). However, "the decision-maker looks for alternatives that satisfy goals, rather than trying to find the best imaginable solution" (Teraji, 2018, p. 144). Furthermore, in some cases, in which alternatives do not have a definite sequence, it is also hard to predict which alternative will be chosen, as no theory predicts in which order alternatives will be examined (Simon, 1953). Decision-making can be based on different assumptions in terms of temporal direction when analyzing collective action. Rational choice models are primarily forward-looking (for example, Olson, 1965), where actors formulate expectations about future payoffs for their decisions. In contrast, backward-looking models are based on experimentation, where agents decide based on the rewards each strategy has produced in the past. A third option is sideways-looking models, where agents look around at their peers in observational learning, comparing their outcomes to those of their peers and imitating those who do best (Heckathorn, 1996).

2.1.3 Understanding human decision making with Behavioral Economics

An additional perspective about decision-making and how decision-makers can be influenced comes from Behavioral Economics, where contesting pure rational choice also led to developing new concepts about the influence on decision-makers. Bounded rationality first indicated pathologies of human decision-making (Hindmoor, 2006, p. 16), also known as biased rationality (Guillermo and Gobet, 2010). The latter term was mostly coined by Amos Tversky and Daniel Kahneman, who tested predictions of perfect rationality theory empirically and showed that the predictions did not hold in most cases. For instance, they showed that, as opposed to the expected utility theory, an individual's utility is linked to absolute wealth and the initial state of wealth as a reference point. Changes away from this point then are not judged the same, as people feel more pain by losing, for example, half of their possessions than they feel pleasure in gaining an additional half. This so-called prospect theory (Kahneman and Tversky, 1979) shows that individuals have an aversion to risk in the sense that they prefer avoiding losses over potential new gains. Contrary to expected utility theory as a normative theory that prescribes how individuals should make decisions that involve risk and uncertainty, providing a set of principles for making rational decisions, prospect theory (or behavioral theory) is a descriptive theory (Jonge, 2012, p. 4) as it aims to describe and explain how people actually make decisions under risk and uncertainty. Another example is the so-called framing effect, where, through experimental research, Tversky and Kahneman (1981) showed that preferences are relative. They use the example of someone passing by two mountain peaks, which can reverse in their height when one passes by, and compare it to a change of perspective on a decision problem. These insights can provide additional understanding of real-world behavior and, therefore, help to design interventions more effectively, as done in TMCNs.

While NIE is based on an attempt to find an adequate approach to traditional economics through engagement with disciplines like sociology or history, Behavioral Economics (BE) has had much influence from psychology. Also, challenging the assumption of rationality and other axioms of traditional economics led to additional understandings of how decisions are made. As new understandings largely influenced BE in psychology, it allowed identifying anomalies in decision-making as compared to RCT while also proposing alternative models such as “framing” (Tversky and Kahneman, 1981) or “reciprocity”

(Bolton and Ockenfels, 2000; Truc, 2021). Individuals are assumed to have bounded rationality as an "[...] attempt to construct a more realistic theory of human economic decision-making" (Selten, 2001, p. 5).

Additionally, the influence of psychology also impacted the discipline's idea of human traits in the context of decision-making. This also had wide-ranging consequences for assessing decision-making when actors decide to cooperate. Kollock (1998), for example, refers to research aiming at different psychological types of personalities, which act in a specific way when confronted with decisions about benefiting oneself or a partner. He sums up the most important types that have been researched in four different types of orientations in decision-making: One such option is that an individual might aim to maximize joint outcomes in a cooperative orientation or, on the contrary, in a competitive orientation on maximizing the relative difference between self and partner. A decision maker could also maximize the partner's outcome in an altruistic orientation or, on the contrary, in an individual orientation on their outcome. For example, contrary to a homo oeconomicus, who would only cooperate in situations to his/ her benefit, some individuals are willing to contribute to a public good when believing that others will also contribute, so-called conditional cooperators (Fischbacher et al., 2001) or a homo conditional cooperativus (Morner and Wälder, 2013). Empirical research shows that depending on circumstances such as different cultures, as much as half or more of the participants in a public goods game can be categorized as such, while between ten percent and one-third are classified as free riders (Fischbacher et al., 2001; Kocher et al., 2007; Rustagi et al., 2010).

An essential aspect in that regard is social preferences, which can be explained through an example used by Choshen-Hillel and Yaniv (2012) in their research about the effect of agency on social preferences: They imagine a scenario where after buying a camera, you find out that a colleague of yours bought the same camera. When you ask how much she paid, they assume two conflicting reactions might surface in your mind. Either you might worry that your outcome would look poorer by comparison, and thus, you would prefer to find out that she paid the same price. Alternatively, you might hope to find out that she paid less since this benefits her and does not cost you anything. The result of the conflict of these two social motives - avoidance of inferior social comparisons and concern about the

well-being of others - defines the decision makers' social preferences. In this case, the social preference is whether one hopes for a smaller or higher price the colleague has paid for the camera. Selten (2001) laments that there is no clear understanding of the interaction of these different motivational forces and inner conflicts that can arise through some decision problems. This also explains one of the anomalies found by behavioral economists in experimental research that RCT cannot explain in dictator games: One player (the dictator) unilaterally decides how to allocate a fixed amount of resources between themselves and another player. Contrary to the assumption in RCT, actors in the dictator's role have been observed to give a substantial amount of their endowment to others (Camerer, 2003).

Social preferences assume people are "self-interested, but are also concerned about the payoffs of others" (Charness and Rabin, 2002, p. 1) as a form of bounded selfishness (Dold, 2022, p. 8), where the assumption of selfishness is relaxed just like it has also been for rationality. According to Fehr and Fischbacher (2022, p. 2), "a person exhibits social preferences if the person does not only care about the material resources allocated to her but also cares about the material resources allocated to relevant reference agents." Three of the main types of social preferences that have been proposed are (1) efficiency, where people get utility from aggregate welfare (2) inequity aversion, where people get disutility from unequal payoffs and thus may be willing to pay to reduce the difference between their payoff and the payoffs of others; and (3) reciprocity, where people get utility from cooperating only with those who are cooperative (Caprap et al., 2014). Purely economic incentives, such as a company matching contributions to achieve 100 % participation in savings programs for their employees, might not be enough to change behavior (Johnson et al., 2012). Rather, it appeals to the three types of references, such as telling employees that a savings program also creates a collective benefit, which might work depending on the context. Furthermore, it is also important to note that "[...] social preferences are, at least to some extent, dynamic in that they are reactive to the behavior of interaction partners" (Ackerman and Murphy, 2019, p. 3). Consequently, BE recognizes self-interested and other-regarding behavior, allowing for a more nuanced understanding of the mechanisms driving people's decisions than RCT. Fehr and Fischbacher (2002) highlight the importance of including social preferences in economic reasoning to address questions that otherwise

cannot be explained, especially to adequately understand laws governing cooperation and collective action. The self-interest hypothesis otherwise rules out understanding behavior that is not only based on the individual perspective but also regards the other as an influencing factor. Including social preferences, therefore, also contributes to developing new models that can better reflect the complexities of human behavior, ideally leading to more accurate predictions and policy recommendations for cooperation in social dilemma situations.

Lastly, BE also challenges an additional principle: The principle of social change is based on the assumption that restrictions, or constraints (institutions) such as norms and rules, do not influence preferences. They only influence the options, but the individual's order of preference remains the same independently. Dold explains that BE expands this principle by including the idea that individuals respond to economic incentives and non-economic factors (Dold, 2023). For example, risk preferences are directly influenced by how they are framed as potential gains or losses (Tversky and Kahneman, 1986). Consequently, contrary to the static understanding of preferences in RCT, the institutional context can also influence preferences and, in a certain way, limit individual decision-making. Dold (2023), therefore, argues that the relaxation of the social change principle, much more than in the case of the other two principles, has pushed the boundaries of individualist methodology to a bounded individualism and has led to the so-called strand two Behavioral Economics (Hoff and Stiglitz, 2016) in the last years. Hoff and Stiglitz suggest that contrary to standard economics, the original strand one of BE's conception of agents is that of a quasi-rational actor. However, strand two of BE work with encultured actors whose "preferences, perception, and cognition are subject to two deep social influences: (a) the social contexts to which he has become exposed and, especially, accustomed; and (b) the cultural mental models - including categories, identities, narratives, and worldviews that he uses to process information" (Hoff and Stiglitz, 2016, p. 1). In this sense, Dold (2023, p. 13) concludes that strand two argues that "[...] institutions and the wider socio-cultural environment are not only regulative (in the sense that they affect relative prices and constraints), but they are also constitutive (in the sense that they affect people's preference development)". An example is an experiment run by Falk et al. (2006). The change they introduced was a temporary introduction of a minimum wage, which changed the subjects' preferences for

fair remuneration by creating entitlement effects, as they favored higher reservation wages after the temporary change. This recognition also leads to concrete consequences (Dold, 2023): If not (only) individual cognition, but rather social factors matter, then policy discussions might shift from "micro-interventions" that help individual consumers to overcome their biases to institutional reforms, such as structural reforms for poverty alleviation instead of interventions that aim at individual actors such as the unemployed. This also means that choosing between institutions is not just a question of efficiency, which is also a common question within NIE, and much more also one that "[...] becomes a choice of sets of preferences individuals will likely develop" (Dold, 2023, p. 20). Dold uses the example of "competition" as an organizing factor of social affairs and highlights that the consequential meritocracy principle might also impact various areas of social life, e.g., by inculcating habits of rivalry and resentment. Overall, this also means that, from this perspective, preferences are unstable and can be influenced by their context. Therefore, strand two BE brings the perspectives of BE and NIE into increasingly close alignment.

The structure in which decisions are made in BE is often the so-called choice architecture, initially developed by Thaler and Sunstein (2008). The two describe this as a setting similar to actual architecture, where the architect develops a building based on constraints such as a maximum number of bedrooms or legal and aesthetic requirements and influences the user's behavior in the building later on. This is parallelled with the design process in BE, where the way of presenting a decision, for example, the number of alternatives one presents to a decision maker or setting a default option (Johnson et al., 2012), can influence the actual decision. The concept has generated criticism due to the understanding that the choice architect influences or manipulates the decision-maker. Thaler and Sunstein's response to this criticism does not negate this influence. Instead, they point to the fact that there is no such thing as neutral choice architecture, and any set of choices that are presented to a decision maker automatically entails a certain setup with some kind of influence over the decision, such as a tendency to maintain a status quo if there is a default option set for it (Thaler and Sunstein, 2008; Johnson et al., 2012).

Summing up, BE tries to look at decision-making through a descriptive lens to uncover the complexities and mechanisms behind behavior in a decision process. The discipline has

developed many of the solution mechanisms of social dilemmas available in literature today, especially those that look beyond utility maximization, such as social preferences, and will be an important background for the analysis. Integrating the different perspectives on decision-making will help explain this dissertation's phenomena more adequately. This is primarily due to the theories of NIE and BE relaxing or substituting core assumptions and principles of RCTs' definitions, mainly that of rationality, self-interest, stable preferences, availability, and full capacity to process information or social change. BE and NIE have contributed significantly to a more realistic understanding of decision-making. Generally, NIE focuses on how institutions shape behavior and outcomes, such as rules, laws, regulations, and social norms. On the other hand, BE examines how actual human behavior differs from the assumptions of rationality, the impact of these differences on outcomes, and how to potentially influence behavior accordingly.

The following example also shows how important integrating these different perspectives can be to fully capture a phenomenon. Fehr and Fischbacher (2002) use a prisoner's dilemma to illustrate a situation that can have the same starting conditions but opposite outcomes depending on the conditions in which the game is played. They imagine a conditional cooperator, a reciprocal subject, and a selfish subject as the two players. They also suppose that the subjects' type is common knowledge and, therefore, known to the other player. If those two now start a simultaneous prisoner's dilemma game, the reciprocal type knows that the other player will always defect, and therefore, he/ she will also defect [defect, defect], and both players end up worse. If the same game is played sequentially instead, with the selfish player making the first move, this player will always choose to cooperate, as he knows that the other will reciprocate [cooperate, cooperate], since mutual cooperation is better than mutual defection for the selfish player. They conclude that this example not only takes account of the heterogeneity of the population but also illustrates how institutional details, such as who starts a game, can change the outcomes of such a setting in important ways. Setting these rules in a facilitation process between actors could be part of TMCNs' work.

Fehr and Gächter, also scholars of BE, again highlight the importance of the institutions in their research around reciprocity when they say that "Details of the institutional

environment, like the presence of incomplete contracts or of costly individual punishment opportunities, determine whether the reciprocal of the selfish types are pivotal" (Fehr and Gächter, 2000b, p. 160). They find evidence that, for example, when there are strong material incentives to free-ride and a punishment mechanism is available, contrary to the assumption of self-interest where there would be no cooperation, reciprocal actors use punishment, and high level of cooperations can be achieved.

Finally, all three theories use methodological individualism as a fundamental principle. While RCT applies the principle most straightforwardly, the other two each apply institutional and psychological complexity variations. This dissertation will also use this perspective because the decision-maker will be the city. This can be explained as follows: In the case of a city, the decision-making process is not a decision based only on one individual alone but generally by a council or similar. This fact does, however, not mean that the decision needs to be assessed for each individual involved, although there are differences in decisions taken by several individuals together. Research on decision-making in aggregates has, for example, been done on organizations, where differences between individual decision-making and organizational decision-making are characterized as follows (Shapira, 1997): (1) There is ambiguity in the sense of uncertainty, vagueness, or lack of clear information. While an individual can often rely on their knowledge and preferences, organizational decisions involve multiple stakeholders, complex dynamics, and diverse perspectives, and therefore, complexity can result in a higher degree of ambiguity. (2) Organizational decision-making is embedded in a longitudinal context or an ongoing process over time rather than a one-time event. (3) Incentives play an important role and are intensified due to their longitudinal nature. (4) Decisions are often repeated, such as, for instance, decisions about giving someone a loan, and are therefore often guided by specific rules. (5) Conflict can lead to power considerations and agenda-setting determining decisions rather than calculations based on the decisions' parameters. Notwithstanding these differences that need to be considered, research on decision-making, specifically social dilemma research and collective action, is widely used for individuals and organizations. Capraro (2013, p. 1) highlights that even though individual behavior in social dilemmas and the connected decision process cannot be predicted due to several factors that influence individual behavior, such as family history, age, culture, gender,

university course, religious beliefs and decision time, a population average behavior can be modeled. As in methodological individualism, which explains political outcomes "[...] as the aggregate of the intentional actions of individual actors" (Cairney, 2020, p. 113), city governments can also be seen as aggregates. Additionally, there is also research that explicitly does not make a difference between decision-making by individuals or in organizations. Simon states that the difference can be neglected in most cases, as there are many similar factors, such as goal conflicts (Simon, 1964). Furthermore, as Hardin describes, contrary to the group theories of politics, where the difference between an interest group and an organization is a central issue, this is not the case for the logic of collective action. Rather, he explains, collective action theory looks at individual motivations to determine which kinds of collective action are likely and therefore whether there will be interest group organizations or any collective action (Hardin, 1982, p. 14). Other scholars have historically also analyzed decision-making on multiple levels besides individual ones, such as countries in an arms race and other international conflicts or negotiations between groups (Zeng and Chen, 2003). It is, therefore, a common approach to decision-making in an aggregate. We will look at the actions of cities here and not the actions of specific mayors or other individuals in the city's government. Cities can be seen as complex actors, constellations of several individual actors with an ability for intentional action above the participating individuals (Scharpf, 2000, p. 97, 101). TMCNs generally focus on the aggregate of a city's administration, government, or highest level of political authority. The management of a city can be seen as a complex and disorderly action net, a seamless web of inter-organizational networks, wherein city authorities constitute one point of entry (Czarniawska, 2002, p. 4). Some TMCNs also target actors beyond the city administrations, such as local businesses, as solution providers when implementing climate action. However, the author of this dissertation will focus on the interaction with city administrations here, as those are the directly responsible actors in deciding on cooperation or defection. In contrast, other groups are seen as actors that can only indirectly influence the decision process and the context.

2.2. About climate change mitigation as a social dilemma and the provision of Global Public Goods

Now, we want to take a closer look at the nature of social dilemmas, their relation to GPGs, and specifically the problem of climate change. The problem of social dilemma situations is explained and discussed concerning GPGs. Nuances in the different approaches and definitions will be discussed for GPGs, especially to clarify the term and how it will be used in the analysis.

Russell Hardin's example captures the essence of the dilemma at hand very well when he points to the misunderstanding: "Since people cause pollution, we are told, people can stop pollution" (Hardin, 1982, p. 1). As we know from experience, the argument does not necessarily hold, which lies in the false analogy of assuming that if everyone can decide how to act, humankind will also be able to decide how to act. This so-called "fallacy of composition" (Mackie, 1967, p. 173) becomes evident in social dilemmas at the core of public goods.

The concept of public goods has been known for centuries and goes back to classical writings in the history of economics with David Hume (1739) discussing the difficulties inherent in providing for "the common good" in his "Treatise of Human Nature" in 1739. Shortly after, Adam Smith (1776), in his "Inquiry into the Nature and Causes of the Wealth of Nations" from 1776, defended a need to provide public goods through the state only in rare cases such as national defense, the administration of justice, or the erection and maintenance of certain public works and certain public institutions (Kaul et. Al., 1999, p. 3). Public goods, however, have some challenges, which become more evident when showing their difference from private goods. Private goods are goods with excludable benefits, such as a bicycle, which allows for their provision and consumption to be managed through the market. While private goods are an important part of societies' well-being in many respects, public goods - with their counterpart being public bads - are no less essential. Common definitions of a public good go mainly back to economists Paul Samuelson (1954) and Richard Musgrave (1959), as well as Mancur Olson (1965) (Nabli and Nugent, 1989a, p. 80). They use two different criteria, with "joint consumability" or "collective consumption", which "[...] all enjoy in common in the sense that each individual's consumption of such good leads to no subtraction from any other individual's consumption of that good [...]" (Samuelson, 1954, p. 387). "Non-excludability" in the sense

that “[...] those who do not purchase or pay for any of the public or collective good cannot be excluded or kept from sharing in the consumption of the good [...]” (Olson, 1965, p. 14) is the second criterion. Nabli and Nugent further elaborate that “[...] a good is “excludable” if for any given group its use is made available to some members of the group but can be withheld from other members” (Samuelson, 1954, p. 387). If one of the two conditions is not completely satisfied, the good is called an “impure public good” (Kaul et al., 1999, p. 3).

Collective action failures are mainly related to the free rider problem, which stems from the public goods aspect of group action (Nabli and Nugent, 1989a). The fact that nobody can be excluded from the usage of the public good leads to an inherent incentive to not contribute to the provision of the public good, the so-called free rider problem. Samuelson explains free riding as "[...] the selfish interest of each person to give false signals, to pretend to have less interest in a given collective consumption activity than he has [...]" (Samuelson, 1954, p. 388), eventually leading to market failure and an underprovision of the public good.

The challenge of providing public goods has increasingly been recognized in the last decades as having a larger significance. With the increase in globalization, a range of public goods also further increased their effects beyond national borders, requiring settling policy questions that were traditionally domestic at an international level (Kaul et al., 1999). Various studies have extended the concept to an international context, arguing that the so-called Global Public Goods could, too, be under-supplied (Anand, 2002). Morrissey et al. define an “international public good” as “[...] a benefit providing a utility that is in principle available to everybody throughout the globe” (Morrissey et al., 2002, p. 5). They highlight that “international” can be used interchangeably with “global”; however, the first one highlights their understanding that a good does not necessarily provide equal benefits for everybody in every country or nation. Although the concept requires that benefits be available to the global public, the utility depends on one's preferences and the capacity to consume the good. For example, parts of the global population with less education are also constrained in their ability to benefit from globally available knowledge. The focus on “benefits” in this definition also leads Morrissey et al. to differentiate between the

consumption and production of the public good. The direct benefits are, of course, more closely related to the actual consumption, making it necessary to consider the enabling or "complementary" expenditures of creating access to the goods, an important inequality between different income groups globally. Consequently, Morrissey et al. also highlight poverty as a condition that prevents people from benefiting from public goods, and poverty reduction is a public good. This difference adds to the complexity of the topic in the sense of looking not only at the provision but also the access to public goods. To reduce this complexity, this dissertation will focus on the provision aspect, although not completely excluding the aspect of access. The actual benefit derived from the good also influences, for example, the willingness to contribute to their provision and can, therefore, not be analyzed completely independently.

Adding a further aspect, Kaul et al. not only elevate the term from a local to a global level but go beyond a mere geographical dimension, also including sociological and temporal dimensions by establishing a criterion of universal benefit for all countries, people and generations (Kaul et al., 1999). They also differentiate and define a pure GPG as being marked by universality, i.e., it benefits all countries, all people, and all generations. At the same time, an impure GPG would only tend towards universality, i.e., it would benefit more than one group of countries and would not discriminate against any population segment or generation. As a further criterion, they establish their place in the production chain and differentiate between "final" and "intermediate" global goods. Final goods are outcomes such as peace. On the other hand, intermediate GPGs contribute to the provision of final GPGs, such as an international regime (Kaul et al., 1999, p. 13). An additional subdivision is explained by Marwell and Oliver (1993). A step-level good requires a certain amount of collective contribution, such as a bridge, to start existing. Having a part of the bridge is as good as not having a bridge. On the contrary, continuous good increases can be used according to the contributions made, such as in the case of national defense. 20.000 Euros might pay for one soldier and 40.000 for another, which is better than none. Although these are ideal types and in real life, most public goods are a combination of the two (Pavitt, 2018), for a safe climate, a definition as a continuous good will be more adequate, as the aim is to avoid as much of climate change as possible, with the benefits materializing gradually. Although there are also "tipping points" with the potential to

accelerate negative consequences of climate change over proportionally, it can still be seen as gradual development, and actors are required to contribute as much as possible, while not fully contributing actors will not lead to the inexistence of the good, but to an un underprovision.

Public goods have also been regarded as "trouble makers" as they cause market failures, but their basic availability and non-discriminatory access characteristics can also be seen as particularly suitable for sustaining a well-ordered society (Kallhoff, 2014). With this rather positive perspective, Kallhoff has found that public goods generate benefits beyond just their content, such as providing health care through a public health system, but also strengthen solidarity and enhance a shared sense of citizenship or identification with the accomplishment of a nation-state.

This dissertation will focus on the GPG "climate-safe future." The term has been increasingly adopted throughout research institutes and implementing organizations as a goal to strive for. A Google search for the term shows only 44 results for 2017, with a steady increase, reaching 189 matches in 2022. The term is used by research institutes such as the Potsdam Institute For Climate Impact Research, the UN Department of Economic and Social Affairs, the US-American NGO National Resources Defense Council, and other key actors around climate change globally. Other scholars also use different definitions for a GPG that averts climate change. For example, Bernstein and Hoffmann (Bernstein and Hoffmann, 249) use the term "stable climate" instead. Mueller (2018, p. 13) cites climate stability as one of the most prominent GPGs and, therefore, takes a similar approach, defining climate stability as "[...] stabilizing greenhouse gas emissions at a safe level to contain temperature rises".

The GPG "climate-safe future" will be defined as being in line with the Paris Agreement (UN/Framework Convention on Climate Change, 2015) in the sense of the established targets. A climate-safe future is a classical GPG, as it is non-rivalrous in its consumption and non-excludable (see also Pittel and Rübbelke, 2012, p. 26). As Mueller (2018) highlights, individual actors reducing emissions bear the full cost, while benefits are shared globally, creating incentives to free-ride. The mismatch between individual and collective goals creates a global social dilemma. Mueller (2018) also highlights that it can be

interpreted as an impure GPG, as its impact varies across different parts of the population globally, who, depending on factors such as geographic location or income level, will suffer in different intensity from the lack of the GPG. It is also a continuous GPG, as it increases with the number of cooperators and according to the contributions made. This also means that adaptation measures to climate change will be excluded from the definition, as adaptation creates benefits mainly on a local level and will not be considered a GPG in this dissertation, focusing purely on mitigation.

One more aspect that will be useful to highlight is the distinction between a concept closely related to public goods: "Common Pool Resources" (CPR). CPRs "[...] refer to a natural man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use" (Ostrom, 1990, p. 30). With this definition, Ostrom aims explicitly at the excludability characteristic of CPRs, slightly amending it to real-life CPRs such as fish stock, where initially everybody interested has access, but in fact can be excluded by setting up systems for the restriction such as (international) contracts, monitoring systems, etc. Ostrom had originally developed the concept with a focus on local resource management. However, together with Keohane (Keohane and Ostrom, 1995), Ostrom explored how the polycentric approach to governance might also successfully operate at the international level, and she later also turned to public goods (Ostrom, 2009; Ostrom, 2010b) in her analysis of climate change (Cole, 2015).

Both concepts, CPRs, and public goods, share their characteristic of non-excludability, and based on this, together make the category of "collective goods". However, common pool resources are additionally not jointly consumable. This distinction is important, as both categories are part of collective action, but the required action differs for each. CPRs mainly suffer from overusing existing resources, while the challenge for public goods is rather underprovision. The classic representation of this overuse problem has been described as the "tragedy of the commons" by Garrett Hardin (Hardin, 1968). Hardin describes a scenario where two shepherds bring their cattle to the same pasture and try to keep as many cattle as possible to maximize their profit. The increase in the number of cattle results in a positive benefit of +1 for each of them due to income from the sale of the

additional animals. However, all shepherds share the adverse effects of overgrazing, so the negative benefit is only a fraction of -1. Both shepherds find themselves in a dynamic that drives them more and more to overgraze. A consequence of this difference is that some mechanisms might apply more strongly in one case than the other. For example, co-benefits as secondary benefits to action might be more relevant for public goods and the challenge of their provision, as they can help create a more compelling case and trigger action to achieve those benefits.

Public goods are not subjected to rivalry in their usage and, therefore, have no depletion problem. However, due to the non-excludability, the challenge and action needed here is to get people to cooperate in terms of contributing to provide that good instead of depleting it. As mentioned, both concepts, however, share their characteristic of non-excludability and the incentive for free riding as a consequence, leading to a situation where an optimal outcome could be achieved if most of those involved "cooperated" for a collective benefit. Because rational individuals will suppose that most other individuals could freeride, they end up defecting and acting in a way that leads to a suboptimal payoff for others or also themselves instead (Lange et al., 2013; Dawes, 1975; Ernst, 1997, Ostrom, 2009).

This situation is a so-called social dilemma, a conflict between "individual rationality" and "group rationality" (Dawes, 1975), or also between self-interest and longer-term collective interests (Van Lange et al., 2013), with the latter also capturing the temporal dimension as consequences can often be delayed. For example, not contributing to voluntary tasks in a sports club can deteriorate the club's culture in the long run. Research on social dilemmas has been developing for around a century, especially in experimental gaming, developed during heavy East/ West tensions (Pruitt and Kimmel, 1977). These types of dilemmas have since, however, been discussed in "almost all [the other] social sciences" (Dawes and Messick, 2000, p. 111) and can still be further distinguished. Platt (1973) initially made a distinction between "social trap" and "social fence". The former refers to usage dilemmas where each owner continues to do something for his or her benefit that is collectively detrimental to the group. He cites non-renewable resources as an example, which applies to the above-cited concept of CPRs. The social fence or contribution dilemma, on the other hand, is that individual benefit discourages contributing to the greater good of a group, as is

the case for public goods such as a climate-safe future. All of these are, therefore, also mixed-motive situations, where participants stand between cooperating and competing with one another, and there is the constant possibility of betrayal by others through defection (Schelling, 1960).

The most simple model for a social dilemma is the prisoner's dilemma (PD). The structure of the PD goes back to 1950, as part of the Rand Corporation's investigations into game theory and its possible applications to global nuclear strategy, while the actual title and the version with prison sentences as payoffs were first used by Albert Tucker (Kuhn, 2019). In this version, two criminals get arrested, but there is no evidence for their conviction, so the police depend on the criminals to confess. Both are in solitary confinement with no means of speaking to the other and get offered to walk free for confessing and, therefore, incriminating their partner if the partner stays silent. If both stay silent, though, they will get the smallest punishment. If both confess, they get a medium punishment. The PD inverses Smith's logic of the invisible hand in that individuals acting in their self-interest in a free market will ultimately not lead to the best overall outcome for society in certain situations. Both would be better off staying silent and "cooperating" with each other. However, the dilemma generates a situation where it is always better to confess due to the incentives, causing a situation where if the other stays silent, the criminal walks free, and if the other confesses, the criminal only gets a medium punishment. The same logic can also be applied to bigger groups in so-called N-person dilemmas, for example, in a "commons dilemma" reflecting Hardin's tragedy of the commons (Dawes, 1973) or specifically aiming at public goods in "public goods games". The latter is a model where, in its simplest form, the game has two strategies: cooperate or defect. It is played in an N-sized group, where each cooperator decides how much of his available endowment to contribute. Each contribution increases the common resource by a certain factor that depends on the efficiency of investments and the attractiveness of the public good. The total amount of endowment contributed by the cooperators is multiplied by that factor, and the public good is distributed equally among the N members of the group. From the viewpoint of RCT, it is rational to freeride, and cooperation is doomed (Ledyard, 1995; Camerer, 2003; Hauert et al., 2008). Olson (1965, p. 25) provides a view based on a utility function where individuals will compare costs and benefits on an individual and the group level and only cooperate if

the benefit outweighs other options. Therefore, the public goods game emphasizes the dilemma between the individual and the collective benefits, as opposed to the outcome of two individuals that are not that expressively viewed as a collectivity in the PD, even though the result is the same. Besides these two games, a few others are sometimes used to analyze social dilemmas and specific aspects of, specifically, the phenomenon of climate change (see Heckathorn, 1996). For example, the chicken game, a situation where two cars are racing towards each other, and the first driver to veer off is seen as a coward, but if neither driver swerves, they both face a potentially disastrous collision, can be used to specifically look at the bargaining issue. The so-called assurance game, framed initially as a stag hunt by Jean-Jaques Rousseau (1754), in which two players must decide between cooperating to hunt a large stag or independently pursuing a smaller hare, which provides a lower payoff individually, focuses much more on the risk of coordination failure, as both players must trust that the other will also choose to hunt the stag for the optimal outcome to be achieved. All of these games, such as the public goods game, happen under certain conditions, which Ostrom has summed up as follows:

1. All participants have complete and common knowledge of the exogenously fixed structure of the situation and the payoffs to be received by all individuals under all combinations of strategies.

2. Decisions about actions are made independently and simultaneously.

3. Participants do not communicate with one another.

4. No central authority is present to enforce agreements among participants about their choices (Ostrom, 2009).

The public goods game can be used to model the cooperation problem within climate change. It is a situation where several N actors must decide whether or to which degree to cooperate in contributing to the aversion of climate change. The higher the number of cooperators, the higher the provision of the continuous public good. The individual cost-benefit analysis, however, includes high uncertainty about the results and very little control

due to the immense size of the group of actors, leading to the theoretical result of the model with all actors free-riding.

The fact that we see cooperation happening in experiments and real-life dilemmas, such as climate change, is not foreseen in an RCT model composed of rational actors, where everybody is doomed to defect. We know that actors cooperate in varying degrees, although seldom to the extent of reaching the maximum level of cooperation that would benefit all participants. This paradox is at the core of the analysis of this dissertation. The explanation for the paradox will be derived from RCT, for example, by different incentives that can be set to influence the behavior of rational actors. Additionally, the above-introduced disciplines of NIE and BE will provide further explanation and help to explain the phenomenon of cooperation, as well as help to understand what kind of settings can enable cooperation more strongly beyond setting incentives within a cost-benefit logic. Jann and Przepiorka (2017), for example, also highlight that "[...] the analysis of institutions is key to understanding the evolution of cooperation (emphasis in original)" and, therefore, what kind of mechanisms have strengthening or weakening effects on level of cooperations.

To understand how to enable cooperation, Hardin (1973, p. 229) and other scholars answered the question of a solution to social dilemmas with two alternative proposals: Either by delegation to a coercive force (Ophuls, 1973, p. 228), in Hobbes' terms a "Leviathan" such as a central government to prevent people to "[...] seek their good and end up fighting one another" (Hobbes, 1668), or by privatization and the allocation of property rights (Smith, 1981). Ostrom (1990, pp. 8-14) raised doubts about both solutions in her book "Governing the commons. The evolution of institutions for collective action". She also presents an alternative that will shortly be looked at more closely. She criticizes the first solution of a centralized coercive power by stating that a central government can only generate an optimal equilibrium under the assumptions of their accuracy of information, monitoring capabilities, sanctioning reliability, and zero-cost administration - all of which she heavily doubts to exist, in line with the assumptions of NIE. The second solution, through the use of property rights, would, according to Ostrom, not only allocate the risks of usage individually to all actors but also decrease their resiliency against changing

circumstances, such as a lack of rainfall on the shepherd's grazing area. Property rights would also require setting up markets for trade between the shepherds and insurance schemes, which she assumes to be more costly and less effective than jointly sharing a larger grazing area. Jann and Przepiorka (2017) conclude that in order to overcome the social dilemma, regulation of actors' behavior is needed. Such regulation, they continue, can be formal and manifest themselves in terms of legal codes and other institutions providing selective incentives and emerge as social norms that prescribe certain behaviors enforced by positive and negative peer sanctions.

The question about how to solve a social dilemma is also related to starting the provision or production of the good. For this reason, Oliver et al. argue that free riding is not the only problem in the public good provision when it is really also related to a start-up problem and finding a "critical mass" as "[...] some threshold of participants or action [that] has to be crossed before a social movement "explodes" into being" (Oliver et al., 1985, p. 523). These participants are a "[...] small segment of the population that chooses to make big contributions to the collective action while the majority do little or nothing" (Oliver et al., 1985, p. 524). This is also related to social dilemmas not being a static situation. They are dynamic and can change throughout action from initiation to an eventual stabilization of production of the common good; therefore, they render different depictions of collective action that validly apply to distinct phases (Heckathorn, 1996, p. 253). Heckathorn (1996, p. 272) suggests three phases of collective action, with an initial phase where "zealots" (Coleman, 1990, p. 490) or a "critical mass" (Oliver et al., 1985) make the initial contribution. In an intermediate phase, contributors grow due to greater marginal returns on cooperation or different mechanisms such as sanctions. During the final and mature phase, the limits of collective good production are approached.

To take collective action, two distinct levels are required, the first one referring to the personal contribution as a "first order dilemma (Van Lange et al., 2013, p. 126)", where an individual decides between cooperating (C) and defecting (D) to the actual "first order public good" such as a climate-safe future. Cooperation can vary in degree from small to big contributions that might even be bigger than the average contribution needed by each participant. The second level is the "second-order dilemma" (Van Lange et al., 2013, p.

127), which is the "[...] system that might promote cooperation in the first-order dilemma" (Van Lange et al., 2013, p. 127), such as an organization that can facilitate cooperation between the participants or a monitoring system. In the decision process about the social dilemma, the strategy as "[...] a rule specifying what choices to make in each possible situation" (Heckathorn, 1996, p. 254) can hence vary between CC, CD, DC, and DD. Besides fully cooperating (CC) or defecting (DD) on both levels, actors can also decide to be cooperative by contributing to the public good but reject the influence of other actors' decisions on the second level (CD) or defect at the first level but cooperate at the second to compel others to contribute (DC) (Heckathorn, 1996, p. 254).

The second-order dilemma also relates to our subject of investigation: Actors that facilitate the solution of a first-order social dilemma, which, in the present case, are TMCNs. This discussion leads us to the analysis of the emergence or efficiency of institutions (Bate, 1988), which are primary questions in NIE but shall only be briefly mentioned here. There is no consensus about the emergence of institutions in NIE. While North (1990), for example, asserts that humans consciously design institutions to help them efficiently meet their goals, DiMaggio and Powell (1983) argue that institutions are not human designs but rather evolve out of the particularities of a given historical and cultural context (Friel, 2017). Assessing how TMCNs come about and how to potentially increase their coverage throughout the global governance system might be subject to further research.

To further assess the dilemma's solution, defining what cooperation means is important. While there are several definitions for cooperation in different areas of research, such as in the cooperation between organizations (Smith et al., 1995; Zeng and Chen, 2003) or in international relations (Keohane, 1984, pp. 51), Messner et al. present two different definitions of "cooperation", which are both relevant in the scope of this dissertation (Messner et al., 2013, p. 9). The first one is based on Melis and Semmann (2010, p. 2663) and sees cooperation as "[...] behaviors which provide a benefit to another individual (recipient) or are beneficial to both actors and the recipient", allowing for both a purely altruistic and an impure altruistic perspective on cooperation. Pure altruism is understood to be the motive of people simply demanding more of a public good, for the good of the public much more than for their good specifically, while impure altruism implies that

people get some private benefit from the cooperation, also named a warm glow (Andreoni, 1989). This definition allows for looking at both situations and mechanisms based on the assumption that cooperation will improve one's situation (potentially) or also at motivational aspects beyond the “rational” maximization of payoff. The second definition by Coakley and Nowak (2013, p. 4) highlights a different aspect when defining cooperation as “[...] a form of working together in which one individual pays a cost (in terms of fitness, whether genetic or cultural) and another gains a benefit as a result.” The cost aspect is also important, as it expresses a participant's willingness to invest a part of their endowment - with defection as the opposite of cooperation being the free-riding alternative with no costs. However, as Cronk and Leech (2013, p. 7) note, it is essential to differentiate the action of cooperation from helping, highlighting the actual phenomenon of “[...] people (and other organisms) working together”. Pavitt (2018, p. 63) provides a definition that makes this difference more explicit with cooperation occurring when “[...] members of a collectivity are interdependent and share a goal only achieved through coordinated action when these two facts are common knowledge among the members, and when they have an agreed-upon action plan”.

The interdependency aspect is also important to highlight in that cooperation requires a process of negotiation (Keohane, 1984, p. 51), also referred to as “policy coordination” (Lindblom, 1965, p. 227). In this sense, cooperation does not occur simply by each actor making an isolated decision; instead, it requires a process that considers the interdependence of each actor’s decision. This means that, for instance, one city might decide to comply with the Paris Agreement on its own following a perceived moral obligation, but it might also consider how many others are doing the same and the chances of achieving the cooperative target. This process can happen completely isolated in terms of an organizational form. For example, a city might not cooperate with any other and may follow the developments through news channels. It might also happen in closer contact, where the negotiation process includes direct conversations between actors, such as through TMCNs.

Cooperation can be informal, based on adaptable arrangements and behavioral norms, or formal, with contractual obligations determining the contributions of each party (Smith et

al., 1995, p. 10). An example of informal cooperation could be a group in a community garden that helps each other out based on reciprocal norms. At the same time, a formal regime could determine specific rules for obligations such as watering common areas or a tax for each party in the garden to then contract a gardener for those obligations.

In this dissertation, cooperation in a social dilemma shall therefore be defined as "Behaviors of individuals, in which they invest in providing a benefit to a collectivity or to both actors and the collectivity, which are interdependent and share a goal only achieved through coordinated action." In this sense, the definition of a cooperator in this thesis is going to follow the Paris Agreement and its goal to "limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels" (UNFCCC, 2015). A cooperator is, therefore, a city that commits to the goal of the Paris Agreement. Although the commitment to this goal by a city might not be a perfect target due to methodological challenges such as excluding scope three emissions associated with the consumption of food and materials that are produced outside of the municipality (Gordon and Johnson, 2018; Chen et al., 2016) or cities being unable to provide reliable or comparable data (Dahal and Niemelä, 2017), it is still a useful tool as an internationally agreed apon objective.

We have now explained the dilemma that we want to analyze and found the mismatch between individual and collective goals. In the quest for understanding how to solve this dilemma, the institutionalist perspective offers an option to look at an institution as a "[...] means to reconcile the inherent contradiction between individual and collective interests" (Holm, 1995). Bates (1988, p. 396) highlights the important perspective that "[...] new institutionalists view institutions as a means of altering incentives such that individual self-interest becomes consistent with the collective welfare", which is undoubtedly also true not only for incentives but also in the case of other mechanisms such as sanctions or rules. Overall, global institutions, in the sense of constraints or rules of governance, can provide a structure to solve the dilemma. TMCNs might be seen as one option to bring about these constraints. The findings of this body of research and the deduced solutions to social dilemmas will then be analyzed in Chapter 4.

2.3 Polycentric systems as a governmental structure for the provision of Global Public Goods

In this chapter, the focus will be on governance arrangements that can contribute to the solution of social dilemmas. It is widely recognized that mitigating climate change requires some form of global collective action (Dorsch, 2023). What is less clear is which type of governance structure is the best fit. In the absence of even a perspective of a centralized global governance structure, the approach of polycentric systems allows us to go beyond a top-down perspective of different levels of government. Dorsch and Flachsland highlight that the approach offers high descriptive value for understanding current climate governance's horizontal and vertical differentiations, eventually enhancing the design of the emerging global climate governance architecture (Dorsch and Flachsland, 2017). Furthermore, it provides a unified conceptual framework to better understand "spontaneous order" phenomena, understood as "different forms of social self-organization as special cases of a more general unique evolutionary phenomenon" (Aligica and Tarko, 2012, p. 251), which is also the case for TMCNs. In the context of climate change, the polycentricity of climate change governance has been increasing as climate institutions have become more numerous and diverse (Ostrom, 2010b; Abbott, 2018). For example, the shift away from a monocentric regime by the United Nations Framework Convention on Climate Change (UNFCCC) towards an emergence and growth of transnational climate change governance (TCCG) has brought new actors, including the civil society and also local governments, into an active position (Bulkeley et al., 2018).

The concept of "polycentricity" had originally been envisioned by Polanyi (1951) and was later applied to governance studies by Elinor Ostrom (2010a). Ostrom was one of the first scholars who started to analyze how cooperation in social dilemma situations can be achieved even in the absence of a central coordination entity (Ostrom, 1990) and located this situation in "polycentric systems" (Ostrom, 2010, p. 552). In this approach, the coordination between the various units does not function via a centralized bureaucratic control unit but rather through inter-organizational arrangements that, like a market, favor both efficiency-enhancing and error-correcting behavior (Ostrom, E. and Ostrom, V., 1965, p. 135-136). Polycentric systems assume that many independent decision-making units

consider the other units in their decisions through processes of cooperation, competition, conflicts, and conflict resolution (cf. V. Ostrom, 1991, p. 225). Following Carlisle and Gruby, a system can be considered a polycentric governance system "[...] if the decision-making centers take each other into account in competitive and cooperative relationships and are capable of resolving conflicts" (Carlisle and Gruby, 2017, p. 2). Through mechanisms for mutual monitoring, learning, and adaptation of better strategies over time, polycentric systems tend to enhance learning, trustworthiness, levels of cooperation of participants among other benefits (Ostrom, 2010b). From a psychological point of view, increasing decentralization could also positively affect the individual's autonomy and psychological sense of community (Fox, 1985). According to Fox, this could make a decentralized society of federated autonomous communities with better means of dealing with global and individual problems at their source a much better fit than a centralized one (Fox, 1985).

Elinor Ostrom and her husband, Vincent Ostrom, became interested in the subject during the discussion about metropolitan reform, where the mainstream assumption was that overlapping entities, such as district or federal agencies, were leading to inefficiencies and that the bigger the governing unit, the higher its per capita output. Contrarian to this perspective, the two argued that this might be true for some cases but in no way a general assumption for some urban public goods and services (Ostrom, 1972). Competing decision centers, which develop in a trial-and-error evolutionary process, are believed to lead to various advantages, such as systems with higher learning and an environment that can benefit collective action and solve social dilemmas. However, the overlapping units, agencies, and businesses need coordination to create both efficiency-inducing and error-correcting behavior (Aligica and Tarko, 2012). Vincent Ostrom summed up that a polycentric political system would be composed of:

> "[...] (1) many autonomous units formally independent of one another, (2) choosing to act in ways that take account of others, (3) through processes of cooperation, competition, conflict, and conflict resolution." (V. Ostrom, 1991, p. 225)

Jordan et al. (2018) use a similar description and explain the characteristics of polycentric governance in five key propositions. (1) Local action, sometimes also called self-

organization (Dorsch and Flachsland, 2017), assumes that organization emerges from the bottom (as opposed to a top-down process), where individual actors plot their actions based on their preferences. They are open to information and will adjust their behavior ("coordinate") with others. In this setting, public goods are assumed to be able to be provided by different combinations of agencies that self-organize on different scales, from which the individual actors can then choose. It is assumed to be more efficient as "[...] responsibilities at different governmental levels are tailored to match the scale of the public services they provide" (Cole, 2015). An important assumption here is that there is no expectation for all actors to have the capacity or the motivation to self-organize, which is why facilitators or civic (or policy) entrepreneurs are needed in some situations. (2) Mutual adjustment is understood as a natural interaction process between constituent units once they have emerged. Abbott (2018, p. 203) suggests that coordination does indeed happen in the area of climate change, though sometimes only modestly. He cites secretariats and scientific bodies of the Rio Conventions, including the UNFCCC, which coordinates through the Joint Liaison Group (CBD, 2013), National governments that can coordinate within COPs, or subnational governments that collaborate through transnational associations. What concerns the competition aspect, as mentioned by V. Ostrom above, it is seen as a relatively positive feature through the competition of ideas and methods that would eventually drive the self-organizing tendencies of the system, for example by municipalities being forced to compete for residents through their mix of public goods or services offered (Carlisle and Gruby, 2017). (3) Experimentation is seen as likely to facilitate innovation and learning, which can happen more efficiently in a more robust system, and as failures can be used to learn and improve response in the future. (4) Trust is not only assumed to be building up more likely through self-organization and the local level, where actors are more likely to meet face-to-face, but also decreases the risk of free-riding. The argument is that the standard assumption of RCT might not apply, and actors refrain from maximizing their short-term interest. Cole (2015) offers an additional aspect by pointing to the role of trust in cooperation (see Chapter 5). The lack thereof in big fora such as the UN climate meetings, in his view, could best be generated in smaller settings in a polycentric system, where frequent and varied opportunities to engage in face-to-face communication, often also outside the spotlight of big international meetings, can

accelerate trust building over time. In his view, bilateral or smaller-scale negotiations might, due to this issue, not only be desirable but even a necessary condition for more successful negotiations of the climate change problem. (5) Lastly, overarching rules are seen as both a goal the different agencies aim to achieve and a means to settle disputes. There is no agreement yet on the exact character of those rules, which might be informal norms and values or formal rules and state organizations such as courts. Jordan et al. (2018) suggest that the latter would appear more counterintuitive, given that this interpretation would cause a higher degree of monocentricity in a polycentric context. They also add the interdependence of this proposition with the one on trust, which would benefit from options for settling disputes and experimentation, which might be limited by rules that are too rigid.

This leads to a range of consequences that Dorsch and Flachsland (2017, p. 50) describe in three categories for the area of climate change. First, from an actor perspective, a polycentric approach explicitly considers the diversity of governance from small to large scale, from the local to the trans- and international levels, and from general-purpose central governments to highly specialized agencies (Aligica, 2003). It might be interesting to highlight that polycentric systems are explicitly about governance, not governments, and can encompass private actors such as companies or, for example, families who decide to install solar panels (Cole, 2015). Another example Cole cites is the World Business Council for Sustainable Development (WBCSD), a network for businesses where some of the largest companies globally work together on their sustainability agendas. In this sense, national governments are part of the governance system as much as local governments, supranational agencies such as the UN, NGOs, or businesses. Second, from a problem perspective, the approach does not neglect the existence of a dilemma but assumes the possibility of its solution. Lastly, regarding the governance vision, the approach focuses on the enabling capabilities of self-organizing actors and their coordination. It, therefore, allows one to look at a single institution or organization and its impact and interdependence with others in a more systemic view. This is especially relevant in the context of climate change, as the provision of the GPG, a climate-safe future, depends on the action of key actors on different levels of government, from local to national, but also others such as NGOs, the private sector, private households and so on, putting all of them in the difficult situation, in which none of them have enough power on their own to accomplish the

provision of the GPG. This is also true for TMCNs themselves. They do not work as closed groups and are not able to decide about and provide a particular public good for their group on their own. They only represent a fraction of all actors, excluding other cities inactive in any TMCN, other levels of government, businesses, or consumers that need to cooperate to provide the GPG. It should also be noted that polycentric systems do not need to be fully set or recognized by all actors to be considered a polycentric system. For decarbonization, as in our specific case in this dissertation, Bernstein and Hoffmann (2018) explain that we only have a weak or nascent polycentric governance system. A system might, however, already be polycentric if only rudimentary coordination is in place between a range of overlapping decision-making centers, even if less successfully so (Marshall, 2015).

Dorsch and Flachsland (2017) further explain the adequacy of a polycentric system for climate governance by recognizing the specific capabilities of individual actors and their potential to cooperate. They argue that instead of abstracting away from site-specific conditions as in traditional nation-state-centered approaches to climate governance, polycentric systems recognize (1) heterogeneous preferences of actors (by asking “who wants to do what”), (2) heterogeneous competencies and constraints (by asking “who can do what”) and (3) the interactions between actors that can cause side-effects, such for example a regional emission cap that ends up resulting in emission growth outside the region. Other actors or units that play a "critical supporting role" (Carlisle and Gruby, 2017; McGinnis and Ostrom, 2011) not only moderate the processes between the participants but also create the arenas in which these processes occur. There are overlaps between these arenas and thus interdependencies, so they can also be seen as “double-polycentric systems” (Jordan et al., 2018). Dorsch’s and Flachsland’s first recognition will be an important reference in this dissertation, as the focus will be on decision-making and the willingness of actors, in this case, of cities, to cooperate.

In general, actors in polycentric political systems engage in a series of simultaneous games, where each action has the potential to be an action within each other's simultaneous games. Consequently, predictive inferences in games can only be made if the arenas can be specified and conceptualized as a series of simultaneous games (Ostrom, V., 1999, p. 58). According to this background, van der Heijden (2018) sees cities as actors in local and

international climate governance as illustrative of polycentric governance. Acting as (partly) independent actors, city governments are seen to organize themselves around specific urban climate challenges on regional, national, and international scales, following more or less formalized rules and exercising considerable independence in making and implementing norms and rules in line with the definition of polycentric governance. TMCNs are not separate decision-making units within a polycentric system but critical supporters of the unit "city". As so-called “intermediaries”, they also set standards for private behavior, provide financing, carry out operational activities such as registering CO_2 compensation payments, and promote the exchange of information (Abbott, 2018). Intermediaries can interact with their target entities in various ways, for example, by formulating target content and activities, various forms of persuasion such as advocacy or lobbying, making voluntary commitments and monitoring them, providing resources, or providing information (Abbott and Hale, 2014). From previous research, it is already known that TMCNs in fact interact with their members through these kinds of activities, as we will see further below.

Intermediaries themselves are also subject to influence by other organizations, which are the so-called orchestrators. Abbott defines orchestration as an “[...] indirect mode of governance that relies on inducements and incentives rather than mandatory controls” (Abbott, 2018, p. 188). Techniques for orchestration are, for example, convening of actors, persuasion, reputational incentives by showcasing success, ideational support through guidance or information, or steering through specific criteria or priorities (Abbott, 2018). An orchestrator (O) supports intermediary actors (I) to address target actors (T) in pursuit of governance goals in the so-called O-I-T model (Abbott et al., 2015). Gordon and Johnson (2017) also highlight that there are different modes of orchestration within the field of urban climate governance, ranging from being complementary to formal practices and rules of nation-states in a multilateral regime over a coordination function alongside the multilateral regime to emergent orchestration that aims to render cities observable, comparable and governable through a wider set of norms, structures, and expectations. Overall, they highlight that this concept raises a set of interesting questions, such as the mechanisms used by the orchestrators and intermediaries (Gordon and Johnson, 2018, p. 3).

As shown in the table below, TMCNs such as C40 can be considered an intermediary, while, for example, Bloomberg Philanthropies (BP) acts as the network's orchestrator. An example of a technique (besides direct funding, which is the case for BP and C40) is the C40 Cities Bloomberg Philanthropies Awards, where the orchestrator, BP, can use a set of criteria to steer the intermediary, C40 towards showcasing action of their target actors, the cities (Bloomberg Philanthropies, 2022).

Orchestration mode	Orchestrator	Intermediary	Logic	Objectives
Complementary	UNFCCC Secretariat, UNSG, EU Commission	IPCC, ICLEI, Green Climate Fund	Inclusion, Participation	Bolster regime Capacity and legitimacy
Concurrent	Bloomberg Philanthropies, Individual cities	C40, CDP, cCR	Autonomy, recognition, enhanced capacity	Augment governance capacity, political capital
Emergent	Siemens, World Bank	ISO, GHG Protocol for Cities, City Credit Ratings	Competitive standing, development, trustworthiness	Enhance return on investment and impact of capital investments

Table 1: Three modes of orchestration (Source: Gordon and Johnson 2017, p. 10).

Polycentric governance systems have some pitfalls, such as not sufficiently holding decision-makers accountable due to the dispersion of responsibilities or potentially high transaction costs associated with coordination, especially when systems are very large or geographically dispersed (Carlisle and Gruby, 2017). In the case of TMCNs, both challenges certainly apply. The first can be related to TMCNs not having sufficient coercive power towards their membership. The second one probably depends on which other constellations TMCNs in a polycentric system are compared with. Compared to one global organization for all cities, such as a UN for cities, might become more costly than a networked structure, which will be discussed further below. Not having any organizational

structure and therefore lacking the force to negotiate cooperation around climate change would certainly be more costly than additional transaction costs through TMCNs. Another challenge can arise from intense competition, especially for resources, which can eventually impede cooperation and undermine self-organization (Carlisle and Gruby, 2017). Conflict resolution might additionally be more difficult when there are differences in power and values (Carlisle and Gruby, 2017). A "race to the bottom" is a general risk in the sense of a dynamic in which standards are lowered to attract resources (Jordan et al., 2018), which, in the case of entities like TMCN, can lead to turf wars in which the survival of the network becomes an end in itself (van der Heijden, 2018). On a general level, most scholars studying polycentric systems highlight that it is no silver bullet for realizing collective action and should be considered "[...] complementary rather than antagonistic to standard approaches, especially to strong multilateralism" (Dorsch and Flachsland, 2017, p. 60).

3. Transnational municipal climate networks (TMCN) and the current state of research

This chapter will focus on TMCNs, their evolution in international cooperation, definitions and typologies developed over the last decades and research trends. This will help to draw a picture of how these networks have been interpreted and how a different perspective could contribute to understanding and further improving their role.

In the second part, different organizational forms, from markets to hierarchies and especially networks, will be presented and connected to the discussion about TMCNs as actors in social dilemmas. The network will be compared to more formal institutions as a specific organizational form that might be able to contribute to the provision of GPGs through promoting different function, such as increasing reciprocity, trust or altruism as well as the reduction of transaction costs.

3.1. The current state of research on characteristics of services provided by TMCNs

Although only two percent of the earth's surface is urbanized, cities are responsible for more than two-thirds of global energy consumption and around 70 percent of greenhouse gas emissions (UN Habitat, 2011). At the same time, the proportion of the world population in cities is expected to increase from around 50 percent today to 68 percent by 2050 (UN/ DESA, 2018). Given cities' immense impact on the emission of greenhouse gasses, they can make a significant contribution to global sustainable development and the provision of public goods, especially in the area of climate change, also because they have considerable decision-making power over climate-relevant areas such as land use planning, waste management, transport or energy use (Betsill and Bulkeley, 2006).

The role of cities has changed since the 1990s in three broader trends (Van der Heijden et al., 2019): First, decentralization and liberalization shifted the role of local governments from little more than service-delivery branches of national governments to delivering local services. Second, local governments have been observed adopting targets for reduced greenhouse gas emissions or waste production well beyond their nation-states and are actively involved in urban climate governance. Lastly, this is also matched with an

increasing recognition internationally that local governments need to be involved in the politics of urban climate futures.

Cities have also developed into significant players in international cooperation, primarily through networks aiming at various topics, such as environmental issues as the main topic, energy, inequality, culture, gender, and peacebuilding (Acuto and Leffel, 2021). While some networks date back to the beginning of the last century, the vast majority have been founded after 1985 (Acuto and Rayner, 2016). This also coincides with the (local) Agenda 21, which, in line with the subsidiary principle, had recognized local governments as strategic places of global sustainable development (Bouteligier, 2013). Some of the prominent TMCNs date back to as recently as 2005, with the “C40 Cities Climate Leadership Group” (C40) or the "Global Covenant of Mayors for Climate and Energy” (GCoM) founded in 2016. The number of urban networks tripled in about 15 years, with about 160 networks in 2015, and continues to rise (Acuto and Rayner, 2016; Acuto and Leffel, 2021).

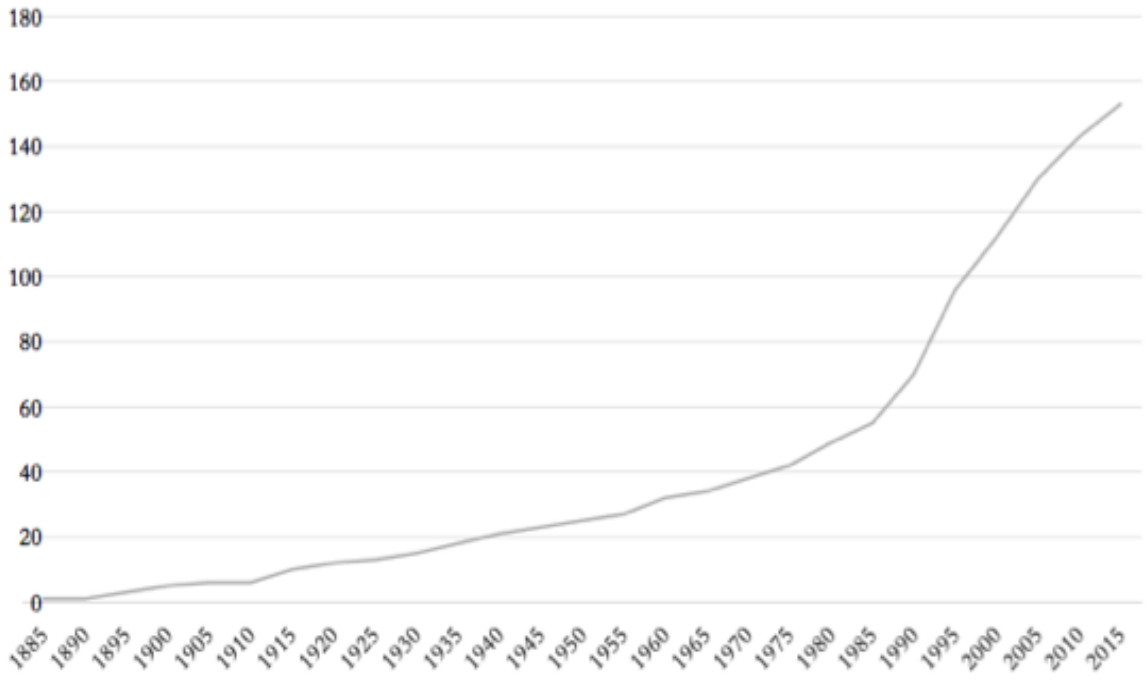


Figure 2: Number of networks per year, 1885 - 2015 (Acuto and Rayner, 2016, p. 1156).

Definitions of these types of networks have also been changing along with the interpretation of their role. Keck and Sikkink developed an early definition of transnational networks as “forms of organization characterized by voluntary, reciprocal, and horizontal patterns of communication and exchange” (Keck and Sikkink, 1998, p. 8). This comprehensive definition has recently been amended by Acuto and Rayner for “city networks” as “formalized organizations with cities as their main members and characterized by reciprocal and established patterns of communication, policy-making and exchange” (Acuto and Rayner, 2016, p. 1149). Nielsen and Papin (2020, p. 3) sum up a broad definition by scholars of TMCNs as ”[...] spaces that cities from two or more countries create or join to exchange on diverse urban issues”. A specific focus on climate-related issues is added by Busch (2015, p. 215), then defines “Transnational municipal climate networks” (TMCN) as “[...] institutionalized spaces where local governments from different countries come together as equitable partners in an exchange on climate related issues”. For this dissertation, Busch’s definition will be used and slightly amended to highlight municipal governments as primary but not necessarily exclusive members. The definition is, therefore, going to be set as follows:

Transnational municipal climate networks” (TMCN) are institutionalized spaces (a) where local governments as the main members, (b) from different countries come together as equitable partners, (c) in an exchange on issues concerning a climate-safe future as the priority subject”.

An important typology that will be useful for the interpretation of the results of the analysis is the difference between big tent and high hurdle networks (Lusk and Gunkel, 2018). This typology is especially relevant in the present context, as it aims at differentiating city networks through the level of commitment by their members and correlates this with the networks’ size. Big tent networks generally bring together broad coalitions without requiring hard commitments such as reporting or aggressive targets and, therefore, have low entry barriers for cities in varying stages. On the contrary, high hurdle networks are more exclusive and have high hurdles or competitive processes to become members. This results in generally smaller numbers of their membership, but also a membership of more ambitious members. High hurdle networks can also be seen as more formally

institutionalized, as they seem to have and use more rules-like mechanisms than appeals and preferences in extensive tent networks. In the same direction, some of the "networks" could also be seen as "climate clubs" (Unger and Thielges, 2021). These "coalitions of the willing" also explain why outcomes can be expected to be relatively high. This is confirmed in the data of this dissertation. Interestingly, most have either set a high ambition not required to sign upon entry and can be delivered later on or a more flexible target requested right upon entry. Especially the ones that do not require commitment upon entry but have high commitments to sign up, which seem to all successfully convince their membership quite broadly or attract those cities already convinced about ambitious climate goals.

The substantial increase in TMCNs has also led to considerable interest and research. A keyword search on Google Scholar, for instance, shows 13.900 results for "city networks", which is often used without further adjectives such as "transnational" or "international" in the area of research. The term "transnational" has its roots in various publications from political sciences and international relations scholars, and definitions have included activities beyond national borders and governmental scope (Busch, 2015, p.216). In this dissertation, transnationality is, however, going to be based on a primary condition that networks have membership across national borders, with membership in at least two countries. The term "international" is often used in research and will be considered equal to "transnational" in this dissertation. Combined with "climate change", there are still 4.100 results. Narrowing the search further, the combination of "climate change" with "transnational city networks" still shows 511 results, while the combination with "international city networks" shows 284 results.

A common recognition (Busch, 2015; Nielsen and Papin, 2020) is that research started with a strong prominence of multilevel governance from political sciences and international relations scholars as a background on TMCNs. TMCNs appeared as a new actor within the policy arenas that had been exclusive to nation-states, questioning their performance of top-down governance through a networked approach of autonomous, polycentric, and voluntary institutional arrangements with self-governance and self-execution (Bulkeley and Betsill, 2003; Bulkeley et al., 2003; Kern and Bulkeley, 2009, Bouteligier, 2013; Derudder et al.,

2012). Foster and Swiney (2021) notice that most scholars are, however, also careful to note the still ongoing relevance of the state-based Westphalian system, which continues to define the overarching rules and framework in the legal world order, besides confirming that this reality has morphed and stretched. In terms of the role of TMCNs, research also indicates that strategies of TMCNs have been changing over the years, for example, by shifting from an emphasis on the importance of cooperation between cities, such as city twinning, to an emphasis on the importance of strategy and alliance capability (Acuto and Rayner, 2016). Especially the more recently founded networks have also started to move further away from a "laissez-faire approach" (Kern and Bulkeley, 2009) to a command-and-control approach and give more importance to the elaboration of membership terms, assumedly to furthering their network goals (Nielsen and Papin, 2020). Acuto and Leffel also draw attention to their finding that networks "[...] exist in an "ecosystem" of networked connections, not in isolation from either each other or other actors in global and local urban governance" (Acuto and Leffel, 2021 p. 1771).

In research on TMCNs, concepts that aim to classify their different services are already available. In some cases, the authors also assess the weight of each of these services in TMCNs to show differences in their profiles. Some might, for example, have a strong focus on facilitating learning among its members, while others might have a stronger engagement in lobbying toward other levels of government, such as the European Union. While these studies identify different types of services, they also highlight that their boundaries are not always clear-cut and might overlap. Some studies have, for example, focused on the early recognized role of TMCNs as platforms to exchange information and learning between cities (Kern and Bulkeley, 2009; Papin, 2020). Another branch of research is trying to capture the complexity of TMCNs in terms of different characteristics and types, such as their membership, organizational characteristics, or activities (Labaeye and Sauer, 2013; Acuto and Rayner, 2016; Cortes et al., 2021). TMCN's activities have been classified in different ways, for example: internal, through the development of projects and funding opportunities, cooperation, awards, standard setting, certification, and external, through influencing governmental organizations at different levels, cooperation, and competition between different networks and the mediation between the network and a larger political arena (Kern and Bulkeley, 2009, p. 319). Three very broad categories of TMCNs'

"aspirations", as in, what they aspire to offer as services, have been developed by Bouteligier (2013, p. 21) with (1) exchange and information, knowledge and best practices, (2) increase cities' capacity and (3) voice cities' concerns in international arenas. Andonova et al. (2009) offer three similar categories: (1) information-sharing, (2) capacity-building and implementation, and (3) rule-setting. In both cases, very clear categories are aimed at increasing cities' capacity for implementation, including information-sharing categories. While Bouteligier added a focus on TMCNs' role as advocates for their members in (3) and did not include any that aims at cities' decision-making, Andonova et al. have instead included a category with (3) rule-setting that is, however, not specified as one that is related to any level of ambition towards the goals of a TMCN in terms of something like expectations of cities making commitments towards common goals or goods.

An additional concept with more granular categories has been developed by Kern and Bulkeley (2009, pp. 319), dividing TMCNs' governance structure into an internal one through the categories (1) information and communication, (2) project funding and cooperation and (3) recognition, benchmarking and certification, as well as an external one, through the (intertwined) categories (1) influence, (2) interdependence and (3) intermediation, influencing governmental organizations at different levels, cooperation and competition between different networks and the mediation between the network and a larger political arena. Some of these categories might contribute to facilitating commitment by increasing cities' willingness as opposed to their capacity to commit, such as the internal category (1) information and communication, which might inform others about the commitments already made by others. The two other categories that most directly aim at the decision-making process are, first, the internal category (3) recognition, benchmarking, and certification as "rewards for performance" (Kern and Bulkeley, 2009, p. 322), as those can serve directly as incentives to increase willingness to make commitments. Kern and Bulkeley describe them as the most interventionist strategy that creates peer pressure, which they see as difficult to implement because of TMCNs' lack of authority. The second category is the (3) intermediation between the respective TMCN and the broader local policy networks around climate change - they highlight that if the intermediary is influential within the local policy network, including local policy entrepreneurs, there is a better chance that initiatives from TMCNs get picked up (Kern and Bulkeley, 2009, p. 326).

This aims specifically at the influence of the TMCN as an intermediary on the local decision-making process and policy-making.

Heikkinen also assembles a range of different services discovered by previous research, such as access to resources, city branding, individual networking, information sharing and learning, legitimacy of action and motivation, lobbying and city advocacy, as well as policy initiative creation and goal setting and monitoring (Heikkinen, 2022). This perspective also highlights that cities' motivation to join TMCNs can follow a different logic than that of measurable output, as is the case, for example, in using transnational municipal networks as sources of internal and external legitimacy to legitimize position in domestic politics and international position among other global cities (Gronnestad and Bach Nielsen, 2022). Heikkinen makes a similar division into the political and practical role of TMCNs: In the first one, networks create political support and strengthen the city's brand as a climate actor, while their second role is to offer practical support such as the already mentioned information exchange. Based on her data, she concludes that the political role is more visible, especially in international and national networks, than in local or organizational networks.

The practical sphere has been gaining much attention in research, as seen in the above-cited studies. The political sphere is, however, also gaining more traction more recently. For example, Heikkinen analyzes three cities' experience in TMCNs, concluding that their practical role, such as resource or information exchange, seems less important than their political role. In this role, cities can use TMCNs "[...] strategically to create support for climate action at different levels of governance" and strengthen the brand of the city as a climate actor (Heikkinen, 2022, p. 11). Busch et al. conducted exploratory research to answer if and how local climate governance has been influenced by municipalities' memberships in TMCNs in all German cities above 50,000 inhabitants with membership in a TMCN. They found that cities mostly use TMCNs for internal political purposes such as internal mobilization, formulating emission reduction goals, and institutionalizing climate trajectories, much more than other services provided by the networks. They conclude that TMCN membership plays a vital role in internal decision-making processes in municipalities (Busch et al., 2018).

Bulkeley and Betsill (2003, p. 184), furthermore, in their research on the Cities for Climate Protection Program (CCP), encountered key factors that shaped the impact of the program, with capacity factors, such as funding, being complemented by factors that are more relevant in the political decision-making process. Political will and how the issue is defined and understood, including advantages of local action such as co-benefits of emissions reduction, for example, reducing local pollution, is critical. In further findings on that same program (Betsill and Bulkeley, 2004), limited capacity to address climate protection locally is less a lack of information and knowledge and rather a lack of resources or power to act as well as tensions over how urban sustainability is to be interpreted. They conclude that if local policy entrepreneurs are missing or marginalized, influence by TMCNs on changes on the ground is nearly impossible. TMCNs, in their view, are therefore instead held together through the creation of financial, political, and discursive "glue", while exchanging information related to capacity building and other material resources is more of a means to secure connections than an end in itself. Barbi and Macedo (2019) also highlight that the CCP Campaign, one of the earliest networks, firmly focused on implementation at its earlier stages but later recognized that political commitment is crucial to projects' success. For this reason, they argue that the methodology of CCP has changed to commitment and mobilization more recently in the follow-up campaign Green Climate Cities (GCC).

Busch (2015), in his research, also categorizes TMCN's services that more explicitly focus on the level of the decision-making process. The four categories for functions of TMCNs aim at a capacity angle in the first two, with (1) networks as platforms as a space to exchange information and know-how between members and (2) networks as consultants to support members in implementing solutions. Busch also suggests that the two might go hand in hand as information-sharing functions. The third function with (3) networks as commitment brokers sees TMCNs as providers of a commitment that is formalized to a certain degree, such as a commitment to be a specific target, like the 1.5 degrees Celsius target being part of the conditions to joining, or offering resolutions or declarations to their members, creating an "[...] atmosphere of transparency and accountability that helps to reduce the fear of free-riding behavior" (Busch, 2015). He also states that the importance of this function was confirmed in interviews, and commitments made upon joining a TMCN played out as an argument in favor of ambitious climate measures in local politics. The

brokering of commitments is, therefore, directly related to the decision-making process in a city. Lastly, Busch's fourth function is (4) networks as city advocates, which is very similar to prior advocacy categories and can be seen as an endeavor to influence the broader ecosystem in which TMCNs are active.

The effectiveness of city networks has been discussed in research for several years. Results depend largely on the approach taken. Van der Heijden notes that there is no criterion for "good performance" in this context. This, in turn, makes it difficult for the cities and their networks to implement truly transformative measures at the local level (Van der Heijden, 2018). Scholars have tried to assess the causality between membership of cities in TMCNs and an actual reduction of GHG emissions, with moderate results and calls for further investigation (Bansard et al., 2017; Gordon and Johnson, 2018). Bouteligier (2013, p.155) concludes that TMCNs perform well in their output by successfully setting up a structure to organize their activities, such as the confirmed ability to exchange knowledge between their members. However, they perform less well regarding their outcomes and impact, translating the acquired knowledge into behavioral change and environmental improvement. This finding might also be a reason for the change in strategies in the last years. Gordon and Johnson (2018) also assessed how precisely TMCNs are achieving verifiable emissions reductions at the urban scale, with moderate results about their impact. They conclude, however, that a more recent body of scholarship that congregates around the conceptual framework of orchestration, "[...] in which global objectives are pursued through the use of governance intermediaries rather than by the direct imposition of rules on target audiences" (Gordon and Johnson, 2018, p. 39), raises new questions, such as which mechanisms are used by orchestrators. These findings hint at an essential yet underexplored area of the role and impact of TMCNs using mechanisms to enable cooperation as intermediaries in the social dilemma related to a climate-safe future.

Fay (2007) focuses on city networks as a collective action problem. In his view, the collective action problem applies to city-level action in two ways. The first is through the potential for free riding due to cities competing with one another to attract investment. Second, as national governments, cities understand that their actions will not be enough to successfully confront the matter and are, therefore, faced with a collective problem. He

concludes that in his case study, the CCP Program, both are solved through an approach of using co-benefits as the main argument for action, as co-benefits are assumed to provide cities with a better position in competition and also reduce the reason to free-ride in the collective effort, as they will gain some benefit either way, independent from the collective action problem. A further point he mentions, in line with Olson's (1965) understanding that collective action becomes less likely in big groups, points to an important recognition that will be further pursued in this dissertation. The number of actors needed to provide the GPG with a "climate-safe future" is enormous and poses a challenge to achieving collective action. Additionally, none of the TMCNs is anywhere close to comprising a large enough number of cities. On the other hand, TMCNs form smaller groups in which cooperation, in theory, becomes more likely, and they are then again connected, as in a typical polycentric setting.

Gordon (2016) aims similarly when he assesses whether city networks can address collective action barriers and focuses specifically on internal governance within a network's membership instead of attempting to influence external governance on a national or international level. He suggests that networks can employ four distinct levers to steer their members toward common and coordinated action. (1) Information-based learning through the curation of information such as best practices, (2) altering the shared understanding of what is possible or appropriate as persuasion/ socialization, including convening the concept of co-benefits, (3) epistemic or financial enabling of members for example for policy entrepreneurs to make the case locally, as well as (4) soft-coercion through positive or negative recognition (such as naming and shaming).

Another piece of research that complements these two was done by Busch (2015), who does not explicitly look at the role of TMCNs as providers of a GPG. However, he does include this view in his research. He frames "mitigation" as a public good and points to TMCNs potentially serving in two ways in this context:

> (1) The great number of other municipalities could work as an indicator of climate solidarity. Knowing that others are on board creates the notion of being part of a bigger movement.

(2) Municipalities that join a network openly commit to the goal of cutting emissions. Therefore, it is much less likely that these municipalities will indulge in free-riding behavior (Fay, 2007).

Unger and Thielges (2021) have not analyzed TMCNs specifically, but so-called climate clubs, where they have included a TMCN with the Under2 Coalition. All of the three cases they assess, following Unger and Thielges, share the fact that they "build on the willingness of individual members to realize emissions reductions" (Unger and Thielges, 2021, p. 14). Specifically, the "willingness" aspect will be picked up again below as a central aspect of the research design. They have assessed these clubs as contributors to a GPG in the form of emission mitigation, supporting policy-making by establishing an institutional mechanism such as reduction commitments and creating opportunities for dialogue and bargaining through informal discussion arenas. Overall, they find that the biggest value-adding feature of climate clubs is their ability to influence political agendas by strengthening strategic dialogue.

If services are assessed as parts of mechanisms in a decision-making process between cooperation and defection in a social dilemma, it might help to look at TMCNs' role in a new light, advance the understanding of TMCNs' role, and contribute to further defining expectations about their performance and limitations, specifically their role as intermediaries. The author will build on the characteristics and differences already found between TMCNs by scholars and first understand the complexity of TMCNs as an ecosystem.

3.2. The role of TMCNs as networked organizations

At this point, we want to look at an additional key characteristic of TMCNs: their organizational form as networks, specifically with the premise of how this form might enable collective action and contribute to the provision of GPGs. To discuss the role of networks, we will refer back to NIE, where the emergence of different organizational forms for transactions has explicitly been analyzed, using three main forms of organization: markets, networks, and hierarchies. Before anything else, this will also shed some light on why TMCNs might have emerged in the first place and their role in a social dilemma.

In 1937, Ronald Coase published his article “On the Nature of the Firm” (Coase, 1937), which years later had become one of the founding works for NIE, and with this, a school of thought that sees organizational forms as a key determinant. In the article, he challenged the traditional belief that firms exist solely to minimize production costs and emphasized the significance of transaction costs, defined as the costs of running a system (Arrow 1969, p. 48, cited in Williamson 1996, p. 93), such as information, negotiation, and enforcement costs for the existence of firms. Williamson essentially argues that transaction costs arise from the imperfections and uncertainties in the market, and their existence gives rise to the need for governance structures like firms. This explains why economic activities are organized within firms instead of relying solely on market transactions. According to Coase, firms bring activities under one organizational structure to minimize transaction costs. The article, therefore, also explains why firms and markets are alternative means of organizing similar transactions. While initially, the definition of a firm, or also a *hierarchy*, was really an analysis that focused on the private sector and the dichotomy between markets and the firm, it was soon applied to political context and governance questions. In this case, a hierarchy can be a firm and the state, understood as any level of government from local, such as municipal governments, to supranational ones like the United Nations.

The core of Williamson's argument is, therefore, that those transactions that involve uncertainties about the outcome, that are frequent and require substantial "transaction-specific investments" (money, time, or energy), and that cannot be easily transferred are more likely to take place in hierarchically organized companies. In other words, transaction costs are said to be greater when transactions are 1) frequent, 2) complex (for example, through bounded rationality), and 3) require transaction-specific investment (asset specificity, for example, through research and development) (Gilligan, 2014). These transactions are removed from the markets as the knowledge specific to a transaction is built up in a hierarchy (Powell, 1990). Ultimately, one of the core statements of the theory is that transactions take place in the institutional structure that most minimizes transaction costs.

The discussion about markets and hierarchies eventually also gave way to networks as organizational forms. Other forms of organization are understood to lie between the

opposites of markets and hierarchies, sharing semi-versions of both attributes (Williamson, 1996, p. 105). However, this has been discussed in various ways by scientists, and others argue that organizational forms could be independent of this binary structure and represent a form in their own right. Specifically, networks are seen, on the one hand, as a hybrid form between market and hierarchy (Williamson, 1996; Powell, 1990). Powell (1990) suggests in his article “Neither market nor hierarchy. Network forms of organization” that there is no such thing as a continuum between the forms, which fails to capture the complex realities of exchange and neglects the role played, for example by reciprocity and collaboration as alternative governance mechanisms in networks. Powell, therefore, defines networks as a “distinctive form of coordinating economic activity” (Powell, 1990, p. 301). He sees networks as a mode of exchange representing a particular collective action.

Castells, who is recognized for his extensive work on networks in a context of changing economies and societies, define networks as “sets of interconnected nodes” and describes them as "[...] open structures, able to expand without limits, integrating new nodes as long as they can communicate within the network, namely as long as they share the same communication codes (for example, values or performance codes)" (Castells, 1996, p. 470). Van Dijk defines networks as a “collection of links between elements of a unit”, where elements are called nodes and units are often called systems. He says that the smallest number of elements is three, the smallest number of links is two, and that a single link of two elements is called a relation(ship). Following van Dijk, networks are a “mode of organization of complex systems in nature and society” (van Dijk, 2012, p. 28). Bouteligier comes to a similar definition as Castells: “A network is an ongoing pattern of interaction between heterogeneous actors who define each other (identity). They coordinate based on common protocols, values and goals (process). [...]" (Bouteligier, 2013).

An important point is also the differentiation between networks and groups. The nodes in a network, per definition, form a structure where not everyone is connected to all other participants unless indirectly. This has different consequences; for instance, larger amounts of elements, or especially people, can be engaged in such structures before the structure starts to lose its effectiveness based on relationships between these people. For example, Parianan (2021, p. 51) highlights that we cannot remember more than 150 contacts on

average. However, a group of that size would hardly be sufficient to provide a global public good or even build a critical mass to start a dynamic in that direction. Networked structures, however, allow for bigger nodes without the need for all individuals to manage relationships with all of the actors involved, and in that sense, therefore, offer a clear advantage compared to normal groups.

A characteristic of networks is their “weak ties” (Granovetter, 1973), as opposed to strong ties, as they occur in groups. Granovetter argues that community organization would be severely inhibited in a community where only strong ties between cliques exist and no outside connections. Specifically on the connections in networks, Granovetter has provided a complementary perspective in his essay “The strength of weak ties” (Granovetter, 1973), where he suggests that weak ties between individuals play a crucial role in social networks and information diffusion. He defines the “strength” of interpersonal ties through a “[...] combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie” (Granovetter, 1973, p. 1361). Following this definition, weak ties are, for example, connections with acquaintances, distant friends, or people with whom an individual has infrequent interactions or a low level of intimacy. Granovetter argues that weak ties are particularly valuable because they bridge different social groups or communities and, with this, create interaction beyond strong ties between individuals or within a group, allowing for exposure to diverse information and opportunities that may not be accessible within one's immediate social circle, such as job opportunities, new ideas or social movements from one community to another. Granovetter argues that these weak tie relationships are critical for collective action.

Another concept that is very much connected to Granovetter’s weak ties is the concept of a "small world" developed by Stanley Milgram (1967) in the 1960s. Milgram discovered that individuals could reach any other individual in a network in only “six degrees of separation”. This is possible through weak ties that serve as connectors in the network, reducing the path length between individuals enabling information or influence to spread more efficiently. Both concepts point to the importance of network structures as enablers for cooperation, especially also when looking at networks that are interconnected to each

other. For TMCNs, it can hint to them explicitly creating, maintaining, and, to a certain degree, institutionalizing weak ties throughout their organizations and as an environment of interconnected small worlds, such as the different TMCNs themselves. Again, this helps to create small sub-entities in a global setting, enabling higher levels of trust, flow of information, etc., which, as we will see below, are essential mechanisms to stimulate cooperation.

Van Dijk, in his book "The Network Society", also highlights that humans have always lived in social networks (see also McNeill's five worldwide Webs, Van Dijk 2012, p. 26) and that those who cooperated most improved their position and chances of survival. Following Van Dijk (2012), Networks are organizational forms and an infrastructure of society that characterize and link society at every level: individual, group/ organizational, and societal. Individuals in these networks are social agents, and links are created through communicative (inter) actions. Van Dijk uses the concepts of control (the management of economic processes by decisions to allocate resources) and coordination (the division and synchronization of tasks) to explain the difference between markets, hierarchies, and networks (also see Table 2). Following Van Dijk, in markets, control is achieved by contracts and coordination through prizes. All actors are equal, so control and coordination are horizontal. In hierarchies, control is effected through vertical command, coordination through vertical formalization, standardization, and division of labor, also called a "bureaucracy". Network forms of organization can use horizontal and vertical control and coordination, making them more flexible and adaptive. There are also different types of networks, distinct in their degree of formality and openness (see Figure 3 below), where TMCNs can be said to be part of intergovernmental organizations or multi-stakeholder networks well in the middle of the two opposites.

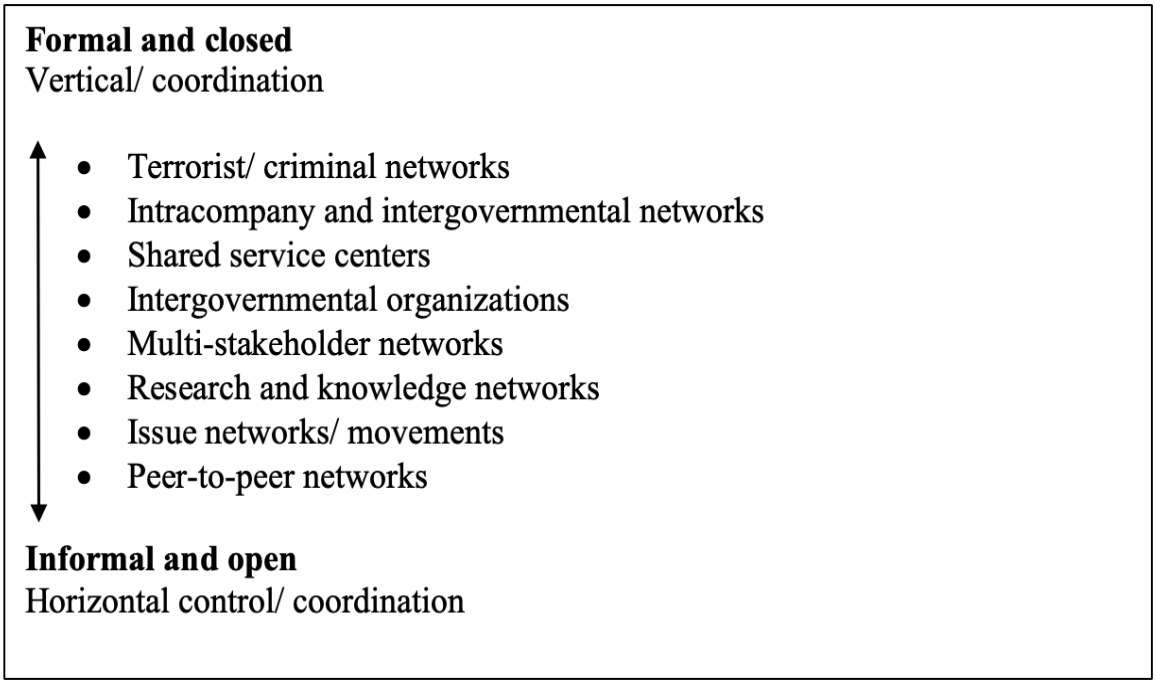


Figure 3: Network configuration, formal and closed versus informal and open (Van Dijk, 2012, p. 76).

To further look at networks' characteristics and how they might be enablers for collective action, it will be useful to use the perspective of NIE once again: Powell (1990) differentiates markets, hierarchies, and networks through various features (see Table 2). According to him, markets do not require any trust, as agreements are bolstered through legal sanctions. In contrast, networks do require trust and generally rather work through normative instead of legal sanctions, such as, for example, downgrading relationships. Hierarchies use administrative fiat as a sanction, and relationships do matter; however, they are extremely shaped by the position within the hierarchy, and communication or exchange often serves as a tool to improve one's position in the hierarchy (career advancement). An advantage of markets is that they are open to all comers, require no future commitments, offer choice, flexibility, and opportunity, and compared to hierarchies, no system-wide governance or control is necessary. However, while markets generally deal with goods or services clearly specified and captured by prizes, they often fail to deal with higher complexities of services that are not easy to measure or capture by a prize, such as know-how. Hierarchies, or organizations, on the other hand, often come into existence when exchange becomes more frequent and complex, and the costs of monitoring increase. Clear

lines of authority allow for high volume and speed for mass production and distribution. Their strengths are high reliability and accountability. However, hierarchies are quite inflexible, for example, when sharp fluctuations in demand occur. In networks, transactions occur through individuals engaged in reciprocal action, where "[...] one party is dependent on the resources controlled by another, and that there are gains to be had by the pooling of resources. In essence, the parties to a network agree to forego the right to pursue their own interest at the expense of others" (Powell, 1990, p. 303). Networks deeply depend on relationships, trust, and reputation and have a high degree of interdependence. Networks can also stimulate prosocial behavior when agents observe the actions of neighboring agents, and behavioral effects and preferences may also spread throughout the network (Grad, 2021). Powell also highlights that these relationships require investment, and with their evolution over time, voice becomes more advantageous than exit. Compared to market exchange and hierarchies, different forms of behavior are required in networks to maintain relations and motivation, such as friendship or altruism, which can become a liability in a market scenario. Lastly, it is important to highlight that markets, hierarchies, and networks are ideals of three typologies that do not always exist in their strict sense in reality, and this is also true for TMCNs. Some TMCNs might have a more open, informal modus than others, making them more similar to markets or the other way around, bringing them closer to hierarchies and the behavioral patterns of their actors.

	Forms		
Key features	Markets	Networks	Hierarchy
Normative Basis	Contract - Property rights	Complementary strengths	Employment relationships
Means of communication	Prices	Relational	Routines
Method of conflict resolution	Haggling - resort to courts for enforcement	Norm of reciprocity - Reputational concerns	Administrative fiat - Supervision

Degree of flexibility	High	Medium	Low
Amount of commitment among the parties	Low	Medium to High	Medium to High
Tone or climate	Precision and/or suspicion	Open-ended, mutual benefits	Formal, bureaucratic
Actor preferences or choices	Independent	Interdependent	Dependent
Mixing of forms	Repeated transactions (Geerty, 1978) Contracts as hierarchical documents (Stinchcombe, 1985)	Status hierarchies Multiple partners Formal rules	Informal organization (Dalton 1957) Market-like features: profit centers, transfer pricing (Eccles 1985)

Table 2: Stylized comparison of forms of economic organization (adapted from Powell, 1990).

Networked organizations, however, might also bring some disadvantages compared to markets or hierarchies in general and specifically when solving social dilemma situations. Powell (1990), for example, mentions that each contact in a network has the potential to be a source of harmony and conflict. Furthermore, he also points to difficult power relationships in networks and the fact that access to networks by no means is automatically open to newcomers, bearing the risk of creating exclusive clubs that can, for example, dictate the adoption of particular technologies through subcontracting. Lastly, he also points to the high level of interdependence, leading to decreased autonomy for the network participants and less ability to dictate their future. These aspects are certainly also a concern for TMCNs and will be discussed further below.

Another debate revolves around the actual volume of transaction costs related to networked structures. In general, the costs of collective action in providing the deliberative fora where action is negotiated can often be considerable (Hanna, 1995). Transaction costs, such as

costs of searching for potential partners, communication, or monitoring, can be especially substantial. For example, McCann and Easter found that 38% of total costs for an agricultural technical assistance program were transaction costs (McCann and Easter, 2000). Kaul et al. see action taken globally as a B-solution since international cooperation leads to high transaction costs due to negotiations between many actors (Kaul et al., 1999, p. xxix). Especially in polycentric governance systems, the transaction costs associated with coordination can be quite high, particularly in larger or geographically dispersed systems (Huitema et al., 2009; Wyborn, 2015).

However, to prevent collective action problems and achieve fair burden sharing, these costs are unavoidable and likely to be small compared to the costs of inaction (Kaul et al., 1999, p.xxix). As Kaul (1999) highlights, in general terms, global regime building contributes to enhanced predictability in international relations and transborder activities, which reduces the risk of conflict and misunderstanding. As a result, she adds, transaction costs are reduced, encouraging cooperation and improving efficiency (Kaul, 1999, p. 14). This rationale is also well-known from the discussion about climate change, where inaction is estimated to be considerably more expensive, apart from other non-monetary effects, such as the loss of lives, than the costly mitigation action. However, it also comes from the mere coordination efforts such as running huge events, for example, the conferences of COP or innumerable others, and maintaining institutions to negotiate and coordinate action. Powell adds another perspective by stating that even though transaction costs in networked forms of governance might be high, they offer a range of benefits or intangible assets like the reduction of uncertainty, fast access to information, reliability, and responsiveness as the paramount concerns that motivate participants in networks (Powell, 1990).

Additionally, Sandler (1997) highlights that if the institutional structure providing the public good can remain “loose” or unstructured, this will economize on transaction costs. According to Sandler, a structure is loose if there is no need for an enforcement mechanism, decisions are unanimous, meetings are infrequent, and participants’ autonomy is preserved. Gilligan (2014) also refers back to Coase to demonstrate that international cooperative transactions with relatively low transaction costs should be undertaken via relatively simple negotiated agreements, in analogy to a market, while those with high

relative transaction costs should occur within international institutions. A "transaction" in the international political context can be simply an agreement or treaty, where, for example, two (or more) countries, or in our case, cities, agree to change their policies in exchange for changes in the policies of another country, or city, such for example the Kyoto Protocol on the level of nations (Gilligan, 2014, p. 6). There are, therefore, special circumstances where networked forms of organizations might be the most advantageous, while it might not be in other circumstances. The network structure of TMCNs, sitting between markets and hierarchies, might contribute to lowering costs in some perspectives. For example, contrary to a "group," the definition of networks does not require all members to be in touch with every other member. It can be based on a loser structure and knots for different kinds of interaction, concentrating resources on where they can have an impact.

By economizing on transaction costs, these structures can be viable because transaction benefits do not have to be very large to justify the institution (Kaul, 1999, p. 43), increasing the legitimacy of TMCNs existence. As Keohane also highlights, however, institutions themselves must be negotiated. They will only come into existence if the relative transaction costs of creating them, amortized over the expected lifetime of the regime, are also sufficiently small - if transaction costs are extremely high, it might not be feasible to build institutions (Keohane, 1989, p. 166-67). Overall, lower costs, considering transaction costs, of networks might also be the reason for their very emergence, as compared to markets, such as in ad hoc cooperation between cities or a hierarchy such as a United Nations body to assemble all cities globally. The transaction costs to found and run such an organization with many thousands of participants would be extremely high if we only think about the costs of a yearly gathering, for example, or including the voice of each member in a negotiation process, which has already been shown to be a complicated and resource intensive task for all members of the UN - an infinitely minor group of members. Networks might, therefore, have started to develop exactly as an intermediate step between a potentially very costly global organization for local authorities that, however, still allows to go beyond the ad-hoc transactions of a market-like situation, with no organization at all.

An additional perspective around the emergence is also related to the above-discussed second-order social dilemma. Due to a second-order social dilemma, institutions that

facilitate coordination might not even be founded. As Bates explains (1988), new institutionalists would argue that in such situations, rational players would prefer some institutions to none, for example, to reduce transaction costs. He points to a solution that new institutionalists have analyzed: Third parties as the suppliers of institutions, such as political leaders, also called political entrepreneurs (North, 1990), are assumed to be founded institutions. Furthermore, although these entrepreneurs might possess a vested interest in the outcome (Bates, 1988), they might develop a more advantageous structure. Levi gives the example of a monarch as a typical institution provider who implements a tax instead of just confiscating any desired value, as the incentive for a constant revenue then allows the monarch to establish a more economically sustainable production system (Levi, 1988). Following Levi, the vested interest, however, does not have to be one related to pure self-interest as in the example and can also be altruistic, such as wanting to contribute to a climate-safe future and establishing an enabling structure for that end. The intermediaries mentioned above, or orchestrators in polycentric systems, can be seen as a kind of organizational form founded by political entrepreneurs, such as Michael Bloomberg, who had key roles in the foundation of the TMCN C40 Cities.

Network forms of exchange, therefore, unite a range of features that can be seen as enabling factors in an organizational form for the solution of a social dilemma, especially also on a global level, considering their characteristics to, for example, stimulate prosocial behavior, and therefore foster cooperation, influence decision-making, and contribute to the global response to climate challenges. Networks might, therefore, be specifically adequate to provide GPGs, especially in the absence of a centralized global hierarchy. As we will further see below in Chapter 5, higher levels of trust in smaller groups, such as through the small world phenomenon, are such factors. TMCNs create these kinds of institutional structures within a global polycentric governance system.

Reduced Transaction Costs	Potentially lower transaction costs than more centralized or market-like systems by economizing on information, negotiation, enforcement costs, etc.
Promotion of Trust and Reciprocity	Foster an environment of trust and reciprocity, leading to more cooperative member interactions.
Flexibility and Adaptiveness	Adapt quickly to changes and integrate new information or members, which is beneficial in dynamic and complex environments like social dilemmas.
Prosocial Behavior and Cooperation	Structurally encourages prosocial behavior and cooperative exchanges, leading to more cooperative member interactions.
Weak connections	Promote the wide spread of information and influence across the network, reducing the degrees of separation among actors.

Table 3: Potential advantages of networked organizations in social dilemma situations.

Summing up, this research works with the premise that organizations can influence the institutional framework (North, 1990, p. 5) if they have sufficient bargaining strength and can "[...] use the polity to achieve objectives when the payoff from maximizing in that direction exceeds the payoff from investing within the existing constraints" (North, 199, p. 79). TMCNs are more than a group of cities in the sense of the sum of their members, as are organizations in general (Thompson, 2003). Even though in a restricted way, they have actor qualities that enable them as networks to act as influential participants in global climate governance and towards the solution of the related social dilemma situation. This is clear from the point of view of TMCNs being networked organizations with their specific characteristics that enable them to act, such as by increasing prosocial behavior thoughout their network. Their strategy and operations, in terms of their services, such as setting standards for their members and potentially beyond, also show that TMCNs do have agency. TMCNs make their own distinct strategic decisions, for example, about their advocacy efforts towards higher levels of governance, such as the UN. For example, C40 Cities has a steering committee comprising 15 of their nearly 100 member cities, which all members elect. The same is also true internally, starting from the fact that most of the cases presented in this dissertation have higher ambitions for the commitments of targets to

reduce GHG emissions and use mechanisms to influence their membership in this direction. These means and mechanisms will now be further discussed in the next chapter.

4. How to solve social dilemmas and provide GPGs

This chapter presents an overview of the research around different methodological approaches to solution mechanisms for social dilemmas, paving the way to examine a spectrum of concrete solutions later on. The concept of "willingness" is explored as a critical factor influencing individual and institutional behavior within social dilemmas, emphasizing its role as a key determinant in the effectiveness of solution mechanisms. Lastly, the theoretical background will be brought together with the research around TMCNs in the form of a concept that displays the researcher's understanding of the context in which the assessment in Chapter 7 will be done.

4.1 Approaches to solutions of social dilemmas

From the last chapter, we have a clearer picture of the situation at hand when a social dilemma appears and organizational forms that can act within these dilemmas. In this next chapter, we want to move one step further ahead and look at solution mechanisms for social dilemmas from a conceptual point of view.

As shown in the previous chapters, the provision of public goods creates a social dilemma. North (1990, p. 12), however, points to the fact that we have an idea of the conditions that contribute to solving those dilemmas and establishing cooperation. However, the opposite of these conditions is mostly found in real-life situations. There is already a wide range of literature available on how to induce group members to cooperate in a social dilemma, analyzing specific mechanisms that enable cooperation and attempting to schematize those mechanisms. When the term mechanism is used in this dissertation, we use it in the sense that Capano et al. (2019) suggest in the context of policy making. They distinguish between first- and second-order mechanisms, whereas both are a consequence of an activator. They explain the difference by introducing a new national research standard to measure the quality of university research. The research standard as the activator, a policy intervention, triggers the mechanisms, activating the causal forces. The first-order mechanism in their example is institutional competition, altering the behavior of individuals, or in this case, also of the institution. The second-order mechanism, which is assumed to go beyond triggering changes in an individual's behavior, aggregates the effects of the first-order

mechanism, producing a structural or contextual effect. In the example, this could be a learning effect or blame avoidance caused by the original activator, leading to institutionalizing the new situation.

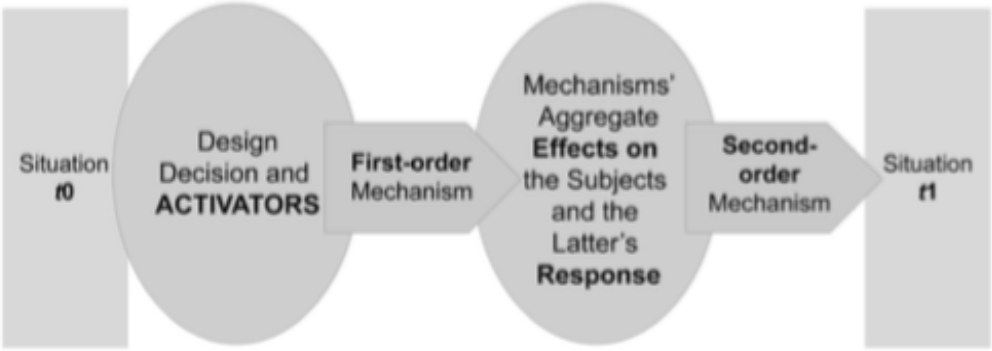


Figure 4: Stylized comparison of forms of economic organization (adapted from Powell, 1990).

Capano et al. (2019) highlight that this way of reasoning has the advantage of clearly distinguishing between the effects of the components and how policy interventions work concerning the causal forces. Both in analysis and in the design of policy interventions, they point to the advantage that this avoids potential confusion around expectations of interventions creating causal reactions instead of the actual mechanisms, as well as clarifying the process of causation between the two levels of mechanisms. Therefore, this differentiation will also be used in this dissertation and applied in the next chapter to develop a list of activators and mechanisms to assess TMCNs.

In the next step, we can now look more specifically at the spectrum of research around solution mechanisms, where mechanisms have been characterized in different ways. Klandermans, as one of the first, analyzed the decision to cooperate or defect in the context of a social dilemma related to creating social movements and has made the following differentiation of conditions to the decision to cooperate: “A person will participate in a social movement if s/he knows the opportunities to participate if s/he is capable of using one or more of these opportunities, and if s/he is willing to do so” (Klandermans, 1984, p. 584). From the three conditions, he concentrates on the third one. Klandermans bases his research at least partially on RCT when he defines “willingness” as “[...] a function of the

perceived attractiveness or aversiveness of the expected consequences of participation" (1984, p. 586). This, again, is split into two parts, where the willingness to participate is a function of (a) a collective motive, with the expectation that participation will help to produce the collective good and its value, and (b) a reward motive, calculating the expected costs and benefits. He also highlights that, since the different motives combine in an additive way, they can compensate one another: If the collective motive is strong, the reward motives can be negative without making a person unwilling to participate.

Another widely cited article is from Kollock: "Social Dilemmas. The Anatomy of Cooperation" (Kollock, 1998), which establishes three categories for solution mechanisms, distinguishing them based on whether actors are assumed to be egoistic and whether the structure of the situation can be changed. The first category comprises structural solutions, defined as those that can change the game's rules in a social dilemma or eliminate it entirely, such as allowing iteration of rounds of negotiations. Making interactions more durable or frequent (Axelrod, 1984), for example, can encourage the development of reputations and provide social information and identifiability of actors, which was found to increase cooperation in various studies (Kollock, 1998, p. 199). The other two categories do not assume that the structure can be changed. In the second one, motivational solutions, individuals are not assumed to be completely egoistic and take their partners' outcomes into account when making a decision, as opposed to completely egoistic actors. With this, Kollock already includes additional views to RCT. The third category are strategic solutions that assume egoistic actors and rely on the ability of actors to shape the outcomes and behavior of other actors. A famous example is the tit-for-tat strategy, where an actor cooperates on the first interaction and after that simply does whatever their partner did on the previous round in a situation where a decision process is happening repeatedly (Axelrod, 1984).

Zeng and Chen (2003) use a similar approach to Kollock, although they only use two categories of solution mechanisms: motivational solutions and structural ones. Following their understanding, structural solutions focus on how structural parameters of a dilemma, such as group size impact individual behavior. In contrast to motivational solutions, structural ones can change the dilemma's parameters and directly change a participant's

payoff. All categories also directly influence only the willingness of an actor, not the opportunity or their ability to cooperate.

Mitchie et al., scholars of BE, have developed a framework to characterize and design behavior change interventions. It is important to highlight that these interventions aim at all kinds of situations of decisions about behavior, assessing social dilemmas as one line of research. Therefore, some aspects aim at behavior where decisions do not influence other actors, as in a social dilemma. A mass media campaign as a communication mechanism (Mitchie et al., 2011, p. 7), for example, might aim to change consumers' behavior towards a certain good. They can, however, also focus on the behavior of consumers that is relevant to a social dilemma, such for example reducing food waste in households, which also contributes to reducing methane emissions and, therefore, climate change. At the framework's core, they suggest three factors, very similar to the ones Klandermans suggested, in the so-called behavioral change wheel: Opportunity, capability, and motivation (Michie et al., 2011). The three factors are also interlinked to a certain degree and work as follows:

The first one, “opportunity” is defined as the external factors to a decision, which make the behavior possible or prompt it. It can create favorable opportunities that make it easier for individuals to adopt and maintain desired behaviors. They distinguish between physical opportunity (for example, the amount of available time) afforded by the environment and social opportunity (for example, the words and concepts that make up our language) afforded by the cultural milieu that dictates how we think about things. In the present context, this could, for example, be a special event happening in a city, like a disaster that is potentially related to climate change, and creates a general environment to discuss a bigger commitment of the city to reduce emissions.

The second one, “capability”, is the psychological and physical capacity to engage in the activity, including knowledge and skills. In the context of TMCNs, this could correspond to a city’s technical expertise in developing a sophisticated waste management system. As we have seen in Chapter 3, this is one of the main or most researched services provided by TMCNs. As mentioned, it has already been shown that TMCNs offer options for their

members to increase their capacity, for example, through peer-to-peer learning about the implementation of specific projects.

"Motivation" as the third factor is defined as all those brain processes that energize and direct behavior, not just goals and conscious decision-making, but also including habitual processes, emotional responding, and analytical decision-making (Michie et al., 2011). Mitchie et al.'s definition, therefore, expands the assessment of motivation beyond a rational perspective of seeing decision-making as choosing among alternatives to satisfy objectives (Ngah et al., 2015, p. 3) to one that also includes decisions under bounded rationality.

Messner et al. (2013) also focus on actor's willingness and go in a similar direction with their characterization of solution mechanisms to social dilemmas. They focus specifically on international cooperation and highlight insights gained by the behavioral sciences beyond rational choice. Built on the recognition that humans are not necessarily only selfish but rather inclined to cooperate, they conclude that there is a need to provide the basic mechanisms of cooperation. Their basic assumption is that people can and do cooperate if we recognize that how we frame situations influences people's behavior and then frame situations accordingly. In order to do this, following the authors, it is necessary to understand how these mechanisms can be used as criteria for designing better institutions for global governance. They suggest using a so-called cooperation hexagon with seven fundamental mechanisms that affect whether and how cooperation takes place, with importance declining from the first to the last one: reciprocity, trust, communication, reputation, fairness, enforcement, and we-identity.

What especially stands out between all of these categorizations is that for social dilemmas and the related decision process, the focus on whether an actor *wants* to "cooperate" or "defect" is of prime importance. Even though there is research that also includes aspects around the ability and opportunities of actors to cooperate, the objective in social dilemma research is generally not related to understanding how to improve an actor's situation so he can cooperate, and rather, under which conditions the actor wants to cooperate - the actor's willingness. An example of this perspective in research is the following one: Hargreaves Heap et al. (2016) study two games, wherein the first one, everyone starts in an equal

condition with the same endowment, and in the second one in an inequality condition, where players start with different endowments - which might also lead to the understanding that one actor can cooperate more easily than the other. The result is that the rich - the players with the highest endowment - contribute less than the poor for every total endowment level and that this pulls down overall contributions under inequality. The most remarkable consequence they draw from the result is not about how to lower inequality but the recognition that inequality of endowments has an impact on the willingness of players to contribute and, therefore, the solution to the social dilemma situation. Changing the condition of inequality is then not necessarily the main focus of research in the social dilemma paradigm per se, but rather a secondary analysis in development economics or similar, for example, by looking at options to reduce poverty through changes in the tax system and as a consequence increasing the total level of contribution to solve the social dilemma.

Willingness can be seen as a superordinate term for motivation. It is rather a psychological state and "reflects an individual's openness to opportunity, that is, his or her willingness to perform a certain behavior in situations that are conducive to that behavior" (Pomery et al., 2009, p. 895). Willingness is more of a readiness to do something, while motivation is the driving force that propels one to do something. Motivation is then more related to reasons (rational and irrational) for a behavior, "something to help choose among the options" (Baumeister, 2016, p. 3). In this sense, both apply to the question raised in this dissertation, and the term willingness will be used as the more general one, which also includes motivation.

4.2. A concept for TMCNs and their impact

All of the theoretical background has now been carefully explored. It has also been critically discussed in each chapter in terms of the benefits and limitations of different approaches to contribute to the provision of GPGs and the solution of social dilemma situations. The theoretical background can, therefore, be brought together in a concept, providing a picture of the situation at hand. This picture will then serve as a starting point and background to the empirical part of the dissertation.

The following section is an interdisciplinary synthesis and application from the different disciplines that have been introduced and discussed so far, of creating a new understanding of how these different views interact concerning the role of TMCNs in providing a GPG. It integrates economics and political science, aiming to capture the interplay between an economic perspective of decision-making and analyzing it within its area of impact in the political structures of a governance system. Additionally, the concept aims at not only theoretical but also practical relevance, being directly applicable to real-world scenarios. It allows for analyzing specific cases and developing recommendations and strategies that policy-makers and representatives from TMCNs can implement. Furthermore, it also serves as a blueprint for further research in this area, as the theories collectively provide an understanding of the role of TMCNs in the dilemma situation at hand.

The available research on solution mechanisms to social dilemmas is done by scholars in different disciplines, which have been explored with Rational Choice Theory, New Institutionalism, and Behavioral Economics. They have all contributed to understanding decision-making, specifically in the context of social dilemmas. Rational Choice Theory assumes that individuals and organizations aim to maximize their utility, analyzing decisions as the product of cost-benefit calculations. New Institutionalism, on the other hand, provides insights into how institutional structures and norms influence the behavior of decision-makers. At the same time, Behavioral Economics offers a deeper look into the non-rational factors such as social norms and cognitive biases in decision-making. Collectively, the theories can improve our understanding of decision-making processes within TMCNs and their role in addressing social dilemmas, each contributing distinct perspectives, as follows.

Consequently, the integration of these different perspectives, therefore, shows that TMCNs can use a variety of mechanisms around economic incentives, institutional settings, or behavioral insights to influence decision-making in cities. Therefore, this synthesis can provide a better understanding of how TMCNs can interpret and structure their operations and interventions to further increase cooperation throughout their membership. The approach eventually allows TMCNs to design economically rational interventions, but also institutionally supported and behaviorally informed, depending on their analysis of which

ones resonate best throughout their membership to eventually further increase their ability to influence the social dilemma at hand.

The concept now brings together the following discussions, applied to the specific case of TMCNs: RCT assumes that individuals, or aggregations of individuals such as cities, make decisions by weighing the costs and benefits to maximize their utility. In the context of TMCNs, RCT helps explain the economic calculations behind cities' decisions to cooperate or defect in climate change mitigation. For example, a city might calculate its individual potential economic loss due to climate change and compare it to the investment needed to commit to the target of the Paris Agreement. RCT suggests that a city would defect, as the cost-benefit ratio can be assumed to not being beneficial. However, RCT also suggests that cities might commit if other benefits from committing are sufficiently high, such as co-benefits generated through investments that reduce emissions and positively impact local heat or pollution levels, for example. NIE, relaxing some of the core assumptions of RCT, highlights how institutional structures within TMCNs, such as governance rules, standards, and norms or structural features, can improve cooperation beyond RCT. TMCN can reduce transaction costs and manage collective action problems by establishing a stable framework for interaction. For example, standardized reporting requirements and shared climate action frameworks within TMCNs can decrease costs for individual cities, making cooperation less costly. Defining a smaller size of a group to create traceability of the action of each member of the group can end up directly increasing the level of commitment of the group's members. In terms of formality, TMCNs might be able to allow both formal cooperation through actual commitments and informally through members-only making minimal formal or no formal commitments but still reducing their emissions. BE, with its assumptions around bounded rationality, others regarding behavior or framing, helps explain why cities might commit to climate actions that do not have immediate economic benefits and allows us to understand mechanisms of TMCNs, for example, based on altruism or efficiency, which can all influence municipal decisions beyond mere economic calculations.

From all three theories, we can learn that different understandings of human behavior in general and social dilemmas in particular also lead to different views about mechanisms that can be used to influence decision-making. For example, while RCT and its

assumptions like rationality and self-interest explain cost-benefit calculations and might lead to a co-benefits mechanism to influence a decision process, conditional cooperators might benefit from learnings from NIE with the need for the right structure in which the negotiation about committing takes place. Furthermore, the recognition that people do not necessarily have stable sets of preferences also leads to the assumption that their preferences can also be influenced through the context, such as through BE-based narratives about the impact of a group through its size or through a more moral appeal to contribute to a greater good. Additionally, just like individuals, cities also pass through a process of decision-making, as opposed to a prompt decision, as explained in satisficing, and TMCNs are assumed to influence this process during different points of time. This means that the membership of a city in a TMCN also exposes the city to the influence, which could take the city on a path from starting with lower targets and, over time, increasing their ambition, for example, in line with the ambition the TMCN requires. This also reflects that a climate-safe future can be classified as a continuous GPG, as opposed to a step-level GPG, which allows it to increase over time. Furthermore, the differentiation of GPGs from a CPR helps to understand that in this scenario, a focus might be set on emphasizing global standards and collective benefits. In contrast, for CPRs, the focus could shift towards localized management practices and regulations to prevent depletion.

It is also assumed that different types of networks apply different sets of mechanisms due to their very different strategies. For example, big tent networks with fewer first movers to commit might build less on sanctions and more on other mechanisms like positive selective incentives. It is also assumed that this is partially compensated through TMCNs together providing an **ecosystem** where cities can be members of more than one network or change their active membership to the/ those network(s) that are most adequate for a city's needs at different times. A city might, for example, start in a big tent network, where lower commitments are required, and increase its ambition to also move to a TMCN with higher ambitions as part of a global frontrunners. The different roles, such as “zealots” in critical mass development, can also explain the role of frontrunners, such as CNCA, in high hurdle networks and big tent networks.

We know that decentralized solutions to social dilemmas are possible from the discussion about collective goods. TMCNs are assumed to act as intermediaries (Abbott, 2018) in a polycentric setting (Ostrom, 2010a). TMCNs are pictured as intermediaries, which create different arenas where the decision about cooperation or defection is negotiated simultaneously and dynamically along a certain period that is still going on. As some cities have more than one membership in TMCNs, overlaps between TMCNs occur. Therefore, cities as actors are also interdependent in the negotiation process not only within one TMCN but potentially across different ones, and the decision about cooperation or defection in its varying degrees depends on the decision of their peers. The overlap also shows the competition between the intermediaries, where there is also a need for coordination, for example, to avoid unproductive competition for the same resources or to not simply repeat the same activities or characteristics throughout the networks. There are also cities outside of the arenas that are not members of any TMCN. This is at least partially explained through the second-order dilemma, where there are gaps in the existence of TMCNs, for example, regionally as there are more TMCNs in the US or Europe than in Africa. Assumed that the mechanisms that TMCNs use have an impact, those cities should increasingly also be attracted to TMCNs, either existing ones or new ones, depending on characteristics such as the region of the city. Other actors that also cause emissions and play a similar role in the dilemma as cities, such as businesses, are left out of the concept for simplicity and clarity, so the focus of the analysis lies on cities and TMCNs specifically.

The solution to the social dilemma at hand, here a climate-safe future, depends on three different components: opportunity, capacity, and willingness. The assumption is that TMCNs go beyond providing opportunities or capacity-building, which scholars have analyzed extensively. It is also assumed here that TMCNs take action towards the social dilemma by politically influencing the decisions about the climate commitment of their members. For this, they use mechanisms to influence their member's willingness to cooperate, and with this, help to solve the social dilemma, such as by fostering "group identities" (Kramer and Brewer, 1984, 1986).

Furthermore, TMCNs, as networked organizations, seem to offer specific characteristics that benefit the social dilemma at hand. Besides potentially reducing transaction costs, as

mentioned above, they might also be more adequate than other forms of organizations to leverage mechanisms specifically known to contribute to the solution for a social dilemma, such as through the promotion of trust, reciprocity, or, in general, a more prosocial behavior. Their flexibility and adaptiveness can also help to accompany the dynamic development of a dilemma that is extremely complex through the involvement of the entire global population, different understanding of historical and current responsibilities, huge income differences, and so on. The weak connections in the TMCNs can also help to increase the spread of new dynamics through the networks, such as, for example, what is considered to be an ambitious commitment.

The concept is the researcher's understanding of how the components presented so far interact in a social dilemma situation, as visualized in Figure 5. The figure is the integration of the economic and political perspective, in the sense that a polycentric world is pictured, where the influence of TMCNs on cities is pictured as discussed through the approaches of RCT, NIE, and BE. It shows cities from 01 to 21, symbolically for all cities globally. All of them are subjected to the same social dilemma situation, visualized through the black frame, through the challenge of providing the GPG with a climate-safe future. There are three exemplar TMCNs included as nodes. Some cities are located within more than one TMCNs. This shows the fact that the different arenas, the TMCNs, in which the negotiation about committing to their targets takes place, happen in overlapping arenas, where some cities are subjected to influence from more than one network. Additional actors that are also concerned with the social dilemma and add to the multiple layers of the situation, such as businesses, national governments, etc., are left out for simplification and to focus on the role of cities and TMCNs.

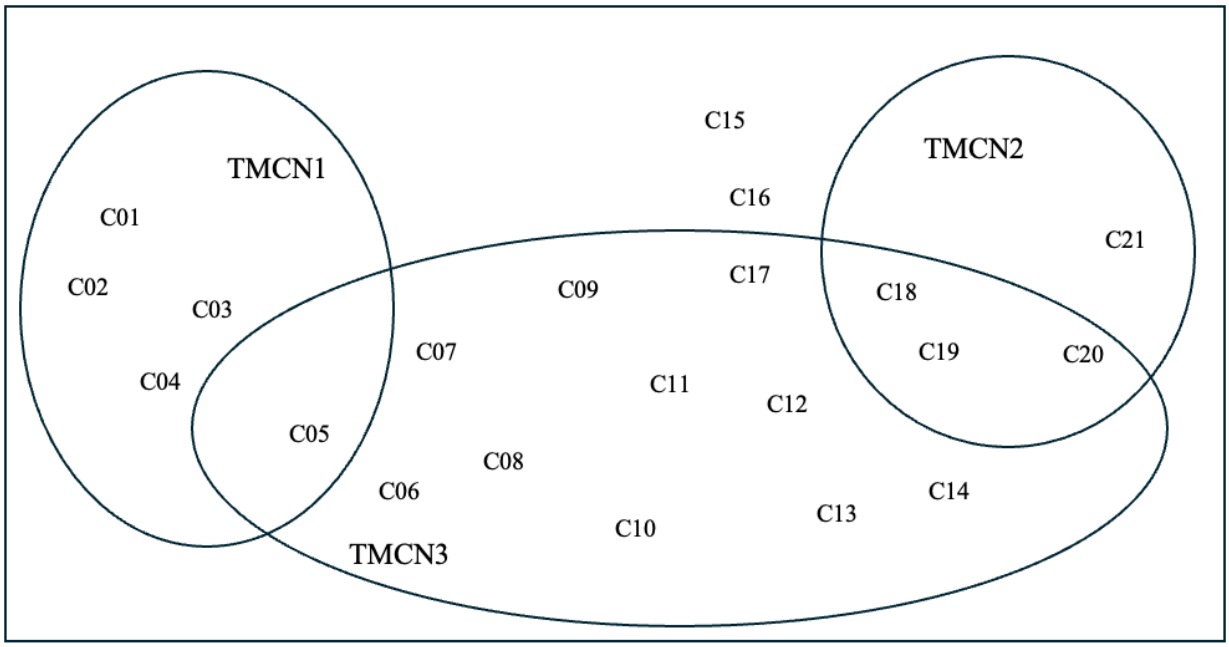


Figure 5: Visual representation of the concept of TMNs within a polycentric system for the provision of a global public good (author's illustration)

Finally, the concept is also practically oriented to directly apply to the analysis. With the understanding of the role of TMCNs and the context they act in, this concept allows for analyzing how TMCNs can effectively improve the provision of Global Public Goods by increasing the level of cooperation throughout their membership. The concept shows cities and TMCNs within a broader governance context, highlighting the multiple dimensions in which city decision processes take place. It also brings the interdependence between cities and TMCNs to the front. TMCNs as intermediaries can, therefore, be seen as active agents of influence on decision-making in cities, although the multidimensional influence from other agents, such as, for example, local interest groups, must also be taken into consideration. The gaps in the governance system, shown through cities that are not connected to TMCNs and therefore not subject to influence, also delineate limitations and potential for future improvements.

This conceptual framework is used as a starting point to guide the development of a proposition and hypotheses for the research below. To get there, in the next chapter, various

possibilities known from the literature to solve social dilemmas will be discussed and serve as the basis for the hypotheses, as well as the selection of mechanisms to be analyzed in this dissertation.

5. Solving the social dilemma - solution mechanisms in general and in the context of TMCNs

In this chapter, a range of different activators and mechanisms that can contribute to the solution of a social dilemma will be discussed. To assess available research, the above-cited overviews and categorizations on solution mechanisms will be used and complemented with further relevant studies. From the vast amount of mechanisms analyzed in research, a list of mechanisms was selected according to a range of criteria.

1) Theoretical relevance: The activators and mechanisms needed to be recurring and prominent in the literature about solutions to social dilemmas,
2) Practical relevance: The activators and mechanism needed to be present in more than three TMCNs in a first review of online material,
3) Contextual relevance: The activators and mechanism need to be relevant when considering the specific characteristics of TMCNs, as discussed above.

First, mechanisms were chosen that have been broadly confirmed as existing and recurring within research. The theoretical relevance has been grounded in the different theories that have most extensively analyzed solutions to social dilemma situations, RCT, NIE, and BE, leading to a selection that allows us to understand both potential mechanisms based on utility maximization but also others that relax the assumptions of RCT and explain cooperation through other perspectives such as social preferences, and therefore allow for a more complete picture of the analysis.

This has, secondly, been crossed with practical relevance, based on existing research around the activities of TMCNs as intermediaries and the services they provide to their members, as well as first reviews of the online material used to collect data in order to understand what to look for and which mechanisms might practically be most relevant. For example, a broadly researched RCT mechanism is positive incentives based on utility maximization. A review of online material indicated that those positive incentives TMCNs were using are co-benefits. Other mechanisms might also be used already, which might be uncovered by further research. It can be mentioned here that the analysis, as described in chapter 7, ultimately confirmed the presence of the selected mechanisms throughout the

cases of this research. This strengthens the understanding of the selection being relevant, although still leaving space for other mechanisms to be tested in further research, as will be indicated below.

Lastly, for contextual relevance, some of the chosen mechanisms work specifically well in networked environments (as opposed to markets and hierarchies) through a strong emphasis on prosocial behavior, trust building, or fast access to information, as discussed above. This approach ensures that the selected mechanisms and activators are theoretically grounded, practically observed in multiple TMCNs, and contextually adequate for networked organizations in the present governance structures. This serves as a basis for further discussion about how these mechanisms are implemented across different TMCNs, which will be further examined in the next part.

5.1 Discussion of solution mechanisms

In the following, different mechanisms will be presented and critically discussed. The discussion will then be summed up in an activator and a mechanism that TMCNs might use to increase the willingness for cooperation within their membership. To distinguish between activator and mechanisms, the above definition will be used to distinguish between mechanisms as a consequence of an activator, where the activator triggers the mechanism and the actual causal forces. Hence, *situation t_0* will be defined as a situation without cooperation, while *situation t_1* is characterized through a city's cooperation, which was caused by an activator triggering a mechanism.

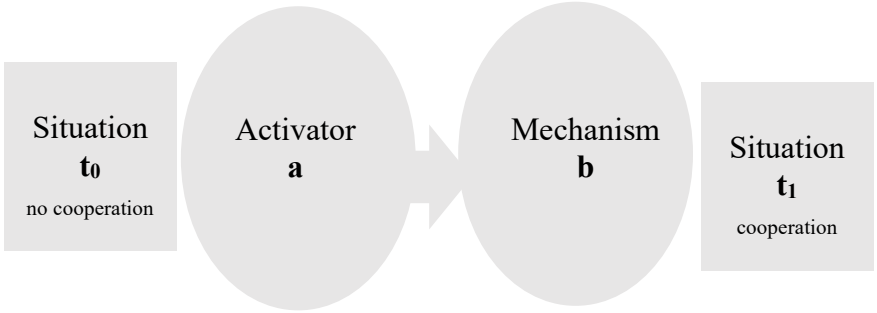


Figure 6: The mechanistic process of TMCNs activities

For each mechanism, the causal chain will be captured verbally to fit into the following logic: The TMCN initiates a causal chain by using activator a to trigger the mechanism b.

Positive selective incentives

Selective incentives can engage people in collective action, even when they are not that interested in the collective action itself (Oliver, 1980, p. 1372). This concept is mostly based on approaches from research within RCT, with a cost-benefit analysis for the provision of public goods at the center. The fundamental assumption is that "the rate of cooperation in a public goods game increases when the pro-capita marginal return increases" (Capraro, 2013, p. 6). In this sense, changing a dilemma's payoff structure can fundamentally transform an interaction. As Axelrod (1984, p. 132) observes, if the punishment for defection is so big that cooperation becomes the better option, there is no longer a dilemma. It does, he continues, however, not need to be so drastic, and even relatively small transformations of payoff can enable cooperation, even though the dilemma still exists. Changing the payoff can be done in different ways, such as by a central enforcer introducing a tax on emissions. However, we want to look at positive incentives first before looking into negative ones in the next part.

One specific opportunity here is so-called co-benefits: The actual payoff for each actor in the social dilemma depends on the decision of all other actors. However, there is also the option of a benefit for individual actors independent of the group decision. This has been brought into the economic discussion by Musgrave (1959, p. 13), stating, "Certain public wants may fall on the borderline between private and social wants, where the exclusion principle can be applied to part of the benefits gained but not to all", and can have a considerable impact on the level of cooperation. Olson (1965), furthermore, has found that giving a private good to an actor as an inducement to contribute towards a public good can encourage cooperation. He calls this a "selective incentive". Therefore, the total individual cost-benefit ratio can be improved for an actor by changing the ratio itself and creating additional benefits to the one that could be achieved in case of successful cooperation. If we look at the scenario as a public goods game, the game stays unchanged because these benefits are created independently from the decision of other players and occur on an

individual level when an actor decides to cooperate. This can make cooperation "attractive or at least acceptable" (Mueller, 2018, p. 10).

In the context of climate change, these benefits, also known as ancillary benefits, secondary benefits, spillover benefits, or, as mentioned above, co-benefits (see IPCC, 2001; Markandya and Rübbelke, 2004, p. 489), are generated by climate policy that is explicitly not derived from the slowing of climate change itself (Finus and Rübbelke, 2013), such as reducing extreme weather events and local damage. Rather, a co-benefit is a payoff received on an individual level and independent from the level of climate change itself. It can be seen as a private good, for example, though saving energy costs when a person installs solar panels on a house. It can also be seen as partially transforming the public good into an impure one. Ostrom (2010b) provided an example when she said that investments in better waste disposal facilities help decrease global emissions and generate local benefits. Another prominent example of a local co-benefit of greenhouse gas (GHG) mitigation with local public good characteristics is combating local air pollution (McCollum et al., 2013).

The rationale behind this mechanism is that the payoff is assumed to be included in an actor's cost-benefit analysis, and it has a positive impact on the optimal climate policy levels (Ekins 1996a, p. 163, 1996b, p. 14), as the individual benefit and therefore the utility increases. Finus and Rübbelke have looked into the effect and found that although these benefits do not increase the likelihood of a cooperation agreement per se, they can be an incentive to take action for raising abatement of emissions (Finus and Rübbelke 2013; emphasis in italic by the author of this dissertation). Therefore, it is an interesting mechanism, especially in a setting where a group acts without a binding global agreement within their own level of governance, which here are the cities or local governments.

	Cooperate	Defect
Cooperate	1+3, 3+1	1+1, 4
Defect	4, 1+1	2, 2

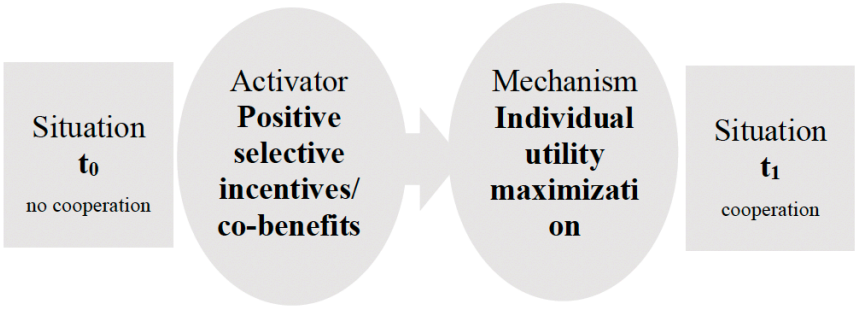
Figure 7: Example of an N-person person prisoner's dilemma with co-benefits (source: adapted from Hindmoore, 2006, p. 109).

The "by-product theory" goes one step further and argues that groups organizing to secure a common interest dissipate over time and that the persisting groups actually have one feature in common: Their membership, for example, in a labor union, actually builds on selective incentives, as in, private rather than collective goods, such as insurances, specialized journals and other benefits for their members as a continuous feature, creating the collective good such as higher wages for the group, as a by-product (Olson, 1965, pp. 132; Hardin, 1982, pp. 31). Unger and Thielges (2021) have also researched this perspective and found that groups or climate clubs that reduce emissions as a public good can create additional benefits or club goods, such as co-benefits or reputational or knowledge benefits.

Therefore, the dimension and nature of these benefits is a considerable aspect of decision-makers' cost-benefit analysis. However, obtaining information about benefits in general in situations of social dilemmas is difficult due to a range of factors, such as the actual number of participants or the size of a common good, and must be "[...] searched for, organized and analyzed" (Ostrom, E., 1990, p. 198). Benefits are also not always clearly measurable in numeric terms or only indirectly. For example, better waste disposal facilities might lead to less pollution of streets in a city and less flooding impact from clogged draining systems. This might be measured through the height of flooding. It might also lead to a range of other benefits, such as less odor pollution or less frequent garbage truck transit once garbage recipients and routes are improved, which will only be felt in specific neighborhoods. Summing up these smaller and broader benefits can have a very positive impact but requires communicating these co-benefits to the local population, which is often not easy due to missing data about the magnitude or quality of the benefits and how they can be factored into the cost-benefit analysis of a decision-maker.

TMCNs can support this mechanism by providing knowledge about these benefits and making them applicable to their members. An example of this is research into the concept and applying it to cities and climate action in general, or specifically for cases of cities, or providing tools or funding for cities to do this themselves. It can come in the form of

explicitly pointing to specific co-benefits, but also on a conceptual level of a narrative of through fighting climate change, creating more "livable" cities.



Following the causal logic established above, the TMCN uses the activator *positive selective incentives/ co-benefits* to trigger the mechanism of *individual utility maximization*, aiming at the causal chain of cities cooperating due to a benefit for the individual city. By helping cities recognize benefits, a city's wish to maximize its individual utility is triggered in a way that positively influences its decision to cooperate. An example of the causal chain is directly financing a co-benefits study of a project, such as a green corridor in a city, and showing the various advantages, such as lowering heat levels and, at the same time, increasing the value of a nearby real estate area. TMCN can help a city government recognize a benefit and more easily communicate it to different decision-makers or entities with political influence in a city. As a consequence, the city might decide to cooperate when recognizing that committing to lower GHG emissions also generates additional benefits locally.

Negative selective incentives

We are now moving on from positive to negative incentives, as Kollock (1998, p. 205) notes, "If carrots work, so do sticks". Fehr and Schurtenberger, for example, highlight that there is a widespread willingness to punish free-riders even in one-shot interactions, although it is costly for the punisher and can cause large cooperation increases up to near complete and stable cooperation (Fehr and Schurtenberger, 2018). Experimental research shows that the likelihood of cooperation increases if individuals can punish defectors (Caldwell, 1976; Komorita, 1987; Fehr and Gächter, 2000; Fehr and Gächter, 2002). Those

incentives target defectors rather than potential cooperators. Positive and negative incentives are, therefore, not mere opposites. There are further differences in their costs, the context in which they are most efficient, and the different effects on group processes and structures (Oliver, 1980). An important difference highlighted by Oliver is that positive selective incentives are effective for motivating small numbers of cooperators for more "elite" action. Negative ones, on the other hand, are effective for motivating unanimous cooperation in special cases where unanimity or near-unanimity of an entire group is required. However, this might also generate discord in a group, which can risk cooperation. Yamagishi (1986) highlights another effect based on the expectation of another individual's willingness to cooperate. His findings from experimental research suggest that a negative incentive in the form of a sanctioning system can fundamentally increase people's expectation of others' willingness to cooperate. This again influences their own decision in a positive way towards cooperation.

Fehr and Fischbacher highlight that the self-interest hypothesis predicts zero punishment since punishment is costly for the punisher (Fehr and Fischbacher, 2002). However, people do punish their peers. Fehr and Gächter (2002) present an explanation for this with the concept of altruistic punishment, which means that individuals punish, although it is costly for them and yields no material gain. In experimental research, Fehr and Gächter found that people were punished even though the punishment only provided a benefit in the future, not even for the punishers themselves, but for whoever would be dealing with the defector. It is, hence, a benefit to a more general population and not at all related to personal benefit, which is why the punishment is understood as altruistic.

Rustagi et al. refer to the mechanism of individuals willing to enforce cooperation even at a personal cost as costly norm enforcement (Rustagi et al., 2010), but with a different explanation. They also highlight that findings in their research indicate that enforcement mechanisms, such as costly monitoring and punishment, are needed to sustain cooperation, specifically looking at different types of cooperators. Due to a self-serving bias, where conditional cooperators do, increase their contributions according to the other actors' contributions, they eventually fall short of matching them (Kocher et al., 2007). This happens as cooperators bring in their contribution, but not to the degree they expect from

other contributors, so they do not match their contributions. Ostrom (2000) also pointed to this phenomenon by explaining it with conditional cooperators reducing their contributions if they notice free riding above their tolerance level. They then end up discouraging other conditional cooperators in a downward cascade, creating a need for other mechanisms to sustain cooperation, such as creating trust through communication. However, conditional cooperators also had a higher tendency to contribute to monitoring in Rustagi et al.'s research.

Notably, monitoring or sanctioning systems are themselves subject to freeriding and are considered a second-order public good (Oliver, 1980). Cooperation in the second-order dilemma is known as instrumental cooperation, as it aims to implement a structural change needed to solve the actual first-order dilemma, then known as elementary cooperation (Yamagishi, 1986). Interestingly, experimental research (Yamagishi, 1986) has shown that people do not make the same decision about cooperating or defecting for related primary and secondary public goods. High-trust individuals tend to cooperate in the first-order public good but are less inclined to contribute to a second-order one as a sanctioning system, while low-trust individuals act contrariwise. Yamagishi highlights that this is an important recognition because, if people acted the same way in both dilemmas, there would only be an extension from the first to the second-order dilemma and the same people that cooperated would cooperate, and the same defected would defect. An external authority would need to enforce a solution. However, if there is a difference in behavior and first-order dilemma defectors are willing to cooperate in the second-order dilemma, then it also becomes possible for actors themselves to implement an enforcement mechanism to the system and, with that, solve the overall dilemma. Furthermore, research also suggests that punishment is much more effective internally by the group concerned with the dilemma than by an external authority (Van Lange et al., 2013; Ostrom, 1990), further favoring self-implemented enforcement.

Negative incentives are, however, also dependent on other factors. For example, the effectiveness of punishment in promoting cooperation in a public goods experiment was found to be greater in societies with higher levels of general trust (Balliet and Van Lange, 2013). A challenge of implementing sanctioning systems is the potential costs that can

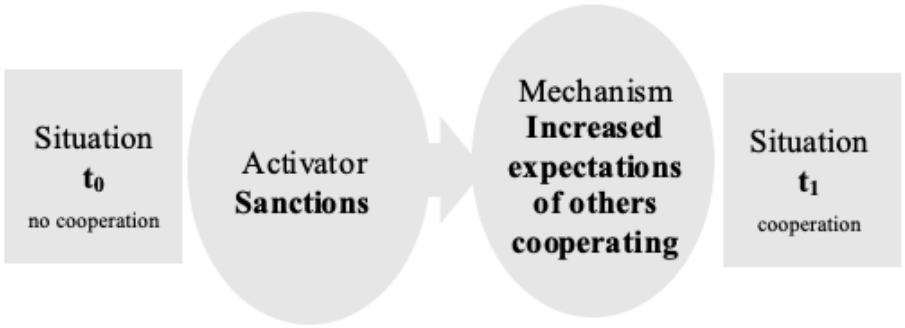
arise, for example, through monitoring (Hechter, 1984) and the administration of rewards and punishments (Kollock, 1998). However, these costs also depend on the institutional arrangements, as Ostom has shown (Ostrom, 1990), and tend to be smaller in small groups (Kollock, 1998). Additionally, negative incentives have a decreasing function, as they are cheaper to use the more successful they are, at the extreme, only generating the cost of threatening to use it if everyone cooperates (Oliver, 1989). Negative selective incentives are, therefore, often less costly than positive ones (Oliver, 1980).

Besides potential costs, another challenge of negative incentives is the above-mentioned discord and the associated consequence of risking cooperation. Oliver (1980) describes that the thread of punishment must be available to deter defection and make punishment efficient. Nevertheless, when used, the punished person might retaliate or even cooperate due to the lack of alternatives, but group members will probably doubt the conversion and become distant, weakening the former defector's ties to the group. This creates a tendency for defectors to be permanently ostracized, diminishing the ranks of a movement. These tensions, she proceeds, can, however, be minimized. An important mechanism for this is ideology, such as "law and order", "morality," or "class solidarity", to give positive reasons to people to conform to or legitimize punishment. In TMCNs, this ideology can, for example, be an appeal to climate justice.

More recent research has provided an additional caveat concerning negative and positive incentives that has shown an actual decrease in cooperation after sanctions or rewards. One explanation is, for example, that a person reinterprets his/ her situation according to the incentive and their internal motivation to cooperate. If the motivation is at first purely altruistic, it can be undermined by a monetary or other incentive (Gneezy and Rustichini, 2000). Gneezy and Rustichini ran an experiment where a fine was implemented for parents who picked their children up late from daycare, leading to a higher delay rate after the sanction. Their explanations, besides the possibility of the fine being too small, was that parents reinterpreted the situation as a commodification of the delay, which they ended up paying for. Furthermore, research also suggests that in the presence of a sanctioning system, people trusted fellow group members less (Mulder et al., 2006). This is due to people interpreting cooperative behavior as being induced not by internal motivation but by

sanctions, which makes them fear that cooperation will cease once there are no sanctions. This does, however, also mean that "If, on the other hand, they believe that others are contributing because of intrinsic factors, they will have stable expectations of the others' contributions [...]" (Xiao-Ping et al., 2009) which highlights the positive effect of an appeal to altruism and other intrinsic factors on the stability of level of cooperations. Overall, economic research indicates that incentives may sometimes decrease and sometimes increase intrinsic motivation, but that behavior is usually, besides in exceptional situations, in line with incentives (Pomberger and Marteau, 2013), and therefore, incentives generally do increase cooperation.

Sanctioning systems consist of some form of punishment provided by all group members, which are either tangible, for example, through restricting access to the good, or intangible, for example, through social stigmatization (Komorita and Parks, 1994). To keep Komorita and Parks' example of the latter, this could be a friend embarrassing another friend who watches public television but does not pay for it and eventually ends up paying. These intangible sanctions, such as peer pressure, social ostracism, or other forms of enforcement of social norms (Fehr and Fischbacher, 2002), which can also be considered to be institutions (Jann and Przepiorka, 2017, p. 4), can also play a vital part in influencing decision-making. Olson also sees social sanctions as a part of selective incentives, which can be used to mobilize a latent group (Olson, 1965, p. 61). He highlights that social incentives and social pressure only work in smaller groups, as members need to have face-to-face contact with one another for these mechanisms to have an effect. He, therefore also recommends using smaller groups in a federated system, which aims to achieve one collective goal, to materialize the effect of social (negative) incentives (Olson, 1965, p. 63). This can, again, explain why a polycentric system, which creates smaller sub-groups such as different TMCNs, can have enabling effects on cooperation.



Summing up, the TMCN initiates a causal chain by using the activator *sanctions* to trigger the mechanism and *increased expectations of others cooperating*. The threat of or actual implementation of sanctions, such as excluding cities from the organization, is a measure that impacts other members in their decision-making. According to the mechanism, there is a positive correlation between a decision maker's willingness to commit associated to the assumption that others who defect will be punished. As a consequence, the decision of individual cities to cooperate is influenced positively, increasing the overall number of cooperators. TMCNs can use this mechanism through their expectation towards their members to commit to reducing GHG emissions. For example, through a participation standard, they can define the level of ambition of their members and sanction those who do not comply. As targets for the reduction of GHG emissions have become increasingly ambitious throughout the last years along with growing scientific evidence, it can also be assumed that some networks might have started off with lower targets and increased those over time, adding sanctions such as the exclusion from the network in case of non-compliance.

Information and monitoring

As mentioned above, international organizations can facilitate cooperation efforts by providing information (Martin 1997, p. 51). It is, however, needed to understand what effect different types of information have. First, the information type we are looking at here is not the kind of information to increase capacity or opportunity, such as peer-to-peer sharing of know-how around implementing specific projects. What we are looking for here

is specifically related to actors' willingness and, therefore, information about other actors' strategies around the decision to cooperate (or to what degree). In this sense, one way to judge information is to see it as if it were removing or making transparent the walls separating prisoners in a PD (Martin 1997, p. 54). This means that by removing these barriers, individuals gain access to information about each other's actions and intentions, which can potentially influence their decisions and increase the likelihood of cooperation.

Furthermore, the impact of information also happens in an interplay with other factors, such as the following three: (1) Information is required for reciprocity. Reciprocity, again, as we will see below, plays an important role in decisions about cooperation regarding the effectiveness of commitments. It is a precondition for promises and commitments to be binding (Atiyah, 1981). (2) Personal ties are generally seen as a necessary additional factor for the entire effect of information to materialize. Granovetter (1973) uses the example of a mass media campaign, which will most likely not be taken seriously and neither change the way people act, if there is not a transmission through personal ties. (3) There is extensive research about how transparency, which can also be seen as access to information, can reduce uncertainty and, therefore, keep commitments more likely to be fulfilled, especially important for voluntary commitments as is mostly the case in climate governance (Aldy, 2018). Information can then alter the dynamics of a situation by reducing uncertainty. The uncertainty here refers to the amount of control one has over achieving the common goal - “the greater the control, the lower the uncertainty and so the greater the incentive to contribute” (Pavitt, 2018, p. 67). As we will also see below, this also relates to the size of a group: The bigger the group, the less individual control over the outcome, and the harder the monitoring process (Pavitt, 2018). This can, however, also be interpreted as an opportunity of developing monitoring, for example, by using a specific mechanism to continuously raise and track information about the commitments of actors to keep level of cooperations up even with groups getting larger.

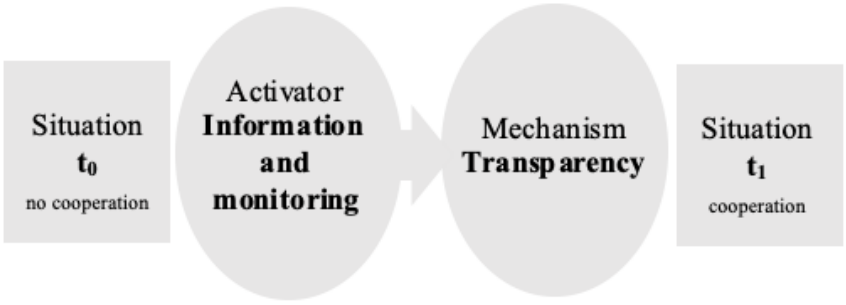
Climate policy surveillance is a specific way of monitoring, evaluating, and learning about mitigation performance (Aldy, 2018), which different organizations are using. Aldy also suggests that in polycentric systems, surveillance can have two (not mutually exclusive) forms of either a transparent polycentric system or multiple, independent transparency

efforts that may feed into a more centralized mitigation regime such as the United Nations Framework Convention on Climate Change (UNFCCC). Even though the negotiation process in TMCNs is not the same as the iterative nature of multilateral climate negotiations on a UN level, it is also an extensive process where commitments have continuously become more ambitious. In this sense, as Aldy highlights, this iterative character provides an opportunity for transparency to inform subsequent rounds of negotiations or, in the case of TMCNs, perhaps also subsequent calls for more ambitious commitments and action. An important effect is that publicly available information about commitments can influence future level of cooperations or sustain cooperation over time (Barrett and Dannenberg, 2016; Levy et al., 1993), which might incentivize conditional cooperators.

Olson (1965) also argues that people will be more inclined to cooperate the closer their personal gain is to their personal cost of the collective good. His understanding is based on a cost-benefit analysis, where an individual decides on cooperation by assessing the difference between individual cost and benefit. The smaller the difference, the more likely the individual will cooperate. In game theory, this is also known as the so-called Lindahl solution, where a public good is provided by every consumer paying an individual price according to the individual utility. Critics of the concepts point to a range of problems, of which one of the most common has been argued by Samuelson and Musgrave, which Roberts (1973, p. 40) sums up as "[...] if taxes are to be based on announced preferences, then each consumer would seem to have an incentive to understate his desire for public goods, while if tax rates are to be independent of preferences, there would appear to be every incentive to exaggerate one's interest in public goods." Monitoring can also be additional information that can help understand each person's actual commitment delivery to add a qualifying layer to signal an actor's willingness to commit.

When specifically applying this to TMCNs, Powell highlights a specific characteristic of networks as opposed to other organizational forms through their emphasis on lateral forms of communication and mutual obligation (Powell, 1990, p. 324). He sees information getting richer while passing through a network as new meanings are generated, debated, and evaluated, making it generally richer than in markets and, at the same time, freer than

in hierarchies (Powell, 1990, p. 425). In this sense, information sharing and monitoring are essential parts of communication that can contribute to increasing level of cooperations in networked environments. In relation to TMCN's work, a common way is asking their members to self-commit through different options like signing up for a specific target or pledges or publishing specific information about targets and even implementation plans. These commitments can, depending on the TMCN, be more or less detailed and accessible through websites and are monitored to different degrees.



By using the activator *information and monitoring*, the TMCNs can trigger the mechanism *transparency*. Participants of a social dilemma get the opportunity to inform themselves about the decision-making of other participants, which allows them to align their decisions accordingly. By making decisions about the commitments of others available to their members and facilitating the exchange of this information, TMCN can contribute considerably to increasing transparency. This can, for example, be done by publishing reports about each city's commitment through the communication channels of a TMCN.

Frequency of meetings

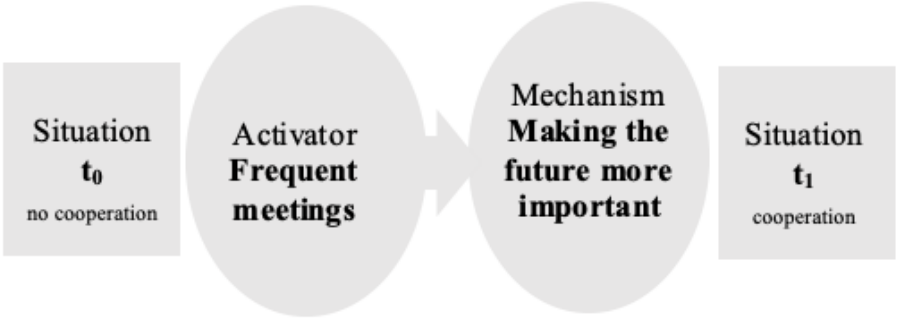
Coined by Axelrod as "enlarging the shadow of the future" (Axelrod, 1984, p. 126), this effect assumes that people defect because they do not project their strategy into the future and do not see a benefit of enabling future cooperation or being made accountable for defection - they give much more value to the present than they do to the future. This is, according to Axelrod, due to, first, the uncertainty about whether there will ever be a future - the other person or organization might walk away or cease to exist before any further

interaction. Second, individuals typically prefer a given benefit rather today than tomorrow, even if a benefit promised tomorrow is higher than the one achievable today.

Axelrod indicates two basic ways to make the future more important and enable cooperation: First, making interactions more durable, which he exemplifies through a wedding, or second, making interactions more frequent, which means that the next interaction occurs sooner. He highlights that a good way to achieve this is to "keep others away" (Axelrod, 1984, p. 130) in order to increase the frequency of interactions by using smaller groups, adding to the reasons for higher levels of cooperation in smaller groups, as we will see below. Axelrod sees organizations as especially effective in this sense, as organizational practice not only increases the frequency of interactions but also makes it easier for workers to build more stable relationships. Organizations, in his view, bind people together in a long-term and multilevel game "[...] increase the number and importance of future interactions, and thereby promote the emergence of cooperation among groups too large to interact individually" (Axelrod, 1984, p. 131). Additionally, the "identifiability" of the other person and how they behaved in the past (Axelrod, 1984) adds to this dynamic.

TMCNs can offer these features through their organizational structure where a stable relationship, celebrated through their official joining of the organization, is combined with the organizational practice of a common agenda, requiring all members to repeatedly and frequently participate in meetings. TMCNs provide a platform for ongoing dialogue. In the terminology of game theory, this would be a repetition of the game, which guarantees that players will meet again. Axelrod's first way of enlarging the shadow of the future is therefore given through the mere fact that a city has joined a TMCN (and at the same time keeping others away as membership is restricted in different degrees), while the second one can be expressed through the organizational practice of meetings between its members.

How often cities meet in the context of decision-making on their level of cooperations is therefore assumed to be positively related; however, with the restriction that this is not infinitely repeatable, there can also be too many meetings where they could become counterproductive.



The TMCN, in this case, used the activator's *frequent meetings* to trigger the mechanism, *making the future more important*. By meeting face-to-face more frequently within TMCNs, the highest level decision makers, such as mayors, increase their sense of the importance of the future, also due to the identifiability of other members in a given network. Therefore, being part of, and in fact, meeting other members as a core function of a TMCN can contribute to increasing level of cooperations.

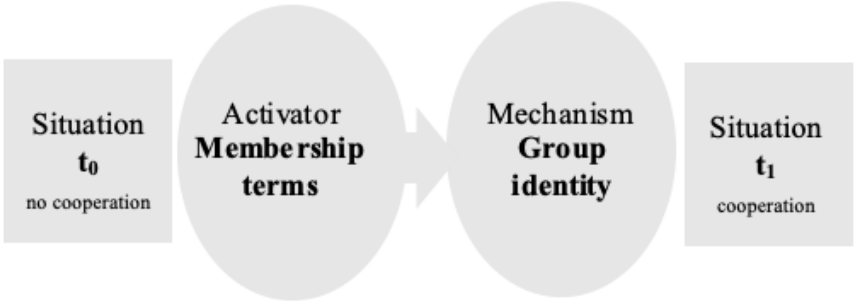
Membership terms

Another important mechanism is group identity. The understanding of identification in groups goes back to Campbell (1958), who introduced basic Gestaltist perceptual principles such as proximity (objects relatively close to one another are perceived as a unit), similarity (objects alike in some easily identifiable way are perceived as a unit) and common fate (objects sharing the same outcome are perceived as a unit) (Pavitt, 2018). The very fact of experiencing a social dilemma together could be sufficient for a preliminary perception of group identity to form among the participants (Pavitt, 2018). This effect could be strengthened additionally through the framing of the social dilemma as a situation in which actors are more likely to cooperate. For example, merely framing a simultaneously played prisoners' dilemma game differently by calling it a "community game" instead of a "stock

market game" typically causes substantial increases in cooperation rates (Fehr and Schurtenberger, 2018).

The reason why people seem to be more willing to cooperate in a group is not completely clear and might go along a rather blurry line of "apparent altruism" to "subtle long-term strategic considerations" (Kollock, 1998, p. 195). However, there are some explanations for the phenomenon. One explanation is that group identity can generate higher levels of trust through an expectation that membership in a group implies mutual reciprocity (Foddy and Yamagishi, 2009) or the existence of a social rule stating that trust and trustworthiness are required among group members (Messick and Kramer, 2001). Kollock highlights that group identity can have such a powerful effect that it can influence rates of cooperation even in the absence of communication, for example, by subjects being more willing to exhibit personal restraint in a common dilemma simply as a result of being identified as members of a common group (Kollock, 1998). In fact, as Dawes and Messick explain (2000), social psychologists have shown that people do not only identify with groups on the basis of strong characteristics, such as belonging to one country that is at war with another. Experiments, as well as observation, have even shown that people "[...] are capable of creating group identities and intergroup hostilities on totally silly bases" (Dawes and Messick, 2000, p. 113), such as telling one group they are over- and the other one that they are underestimators of dots after showing them a display - enough for people to act more favorably toward their in-group than toward the out-group and be more likely to cooperate than to defect, even when group membership is determined on a explicitly random basis.

Communication, however, also does play a role here again. Orbell et al. (1988) found out in a series of studies that cooperation between groups increased with communication. In an experimental game, students got 6 dollars as their stake, which would become 12 dollars if the participant gave the 6 dollars to the group. Only 38% gave their money away when it was not clearly determined if their group or the other group would get the bonus. With the determination of which group the bonus would go to and communication beforehand, 79% gave the money away to their group, but only about 30% gave the money away when it went to the other group.



The TMCN initiates a causal chain by using the activator *membership terms* to trigger the mechanism *group identity*. In this case, the activator is TMCNs defining the type of members they want to have, for example, through their membership terms, and also to define the level of heterogeneity of the membership. Participants in a social dilemma are confirmed to be more cooperative when levels of identity within their group are increased. Coming back to the Gestaltist principles, while the proximity principle might be more applicable in regional networks (including regional subunits of TMCNs), TMCNs are assumed to especially play into the common fate as special entities, cities, facing a common challenge by climate change, but in some cases also similarity principles. The former has been widely called upon when TMCNs highlight cities' important role in this context (for example, by stating something like "Cities are responsible for about 70% of global emissions") as their reason for existence. The latter breaks down the concept of the TMCNs and their different profiles to a closer level. Through their characteristics or city typologies as limiting criteria for membership, they also form different types of groups and group identities. For example, besides some exceptions, C40 only accepts megacities, while ICLEI accepts any city and provides a less pronounced identity.

Group size and composition

Besides a group identity, a second aspect is also the composition and size of a group. This has already been mentioned a few times above, as the group size also has an interdependent relation with other mechanisms. The learning about the effects of smaller groups is mainly attributed in its beginning to Olson (Olson, 1965), who argued that the tendency to free-ride increases with the size of groups. Throughout research, there continues to be a clear tendency towards the understanding that smaller groups tend to achieve cooperation more

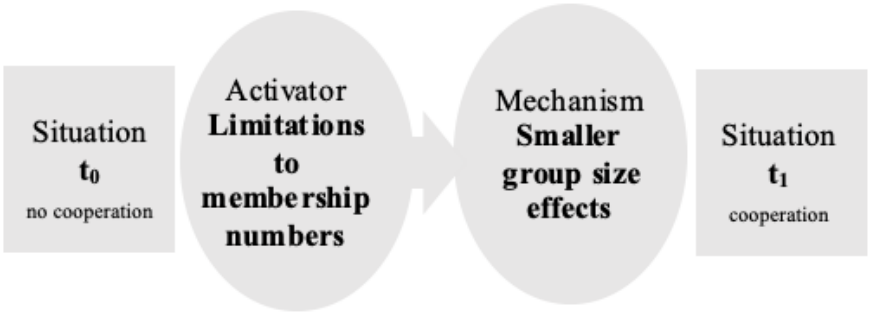
easily (Kollock, 1998; Yamagishi, 1986). This is because a range of factors can change with group size. First, members of large groups can conclude that their influences within the decision-making process are smaller and that responsibility is diffused (Darley and Latane, 1968), as each individual's decision and action is less identifiable (Olson, 1965). If a group is very big, for example, in national elections, the effect of each individual's participation becomes extremely small, and self-interested, rational individuals will choose to freeride unless if no constraints are in place.

This is also connected to the ease of monitoring the actions of other group members, which becomes more difficult with increasing group sizes (Pavitt, 2018). The sense of group solidarity might also be weaker (Edney, 1981). It is also assumed that the coordination of tasks and members increases with the size of an organization and, with that, its operational cost (Kerr, 1989, p. 304; Olson, 1965). Van Lange et al. also mention that people care about their image and reputation in their local communities, which is much harder to establish or keep in large groups as people are less recognized (Van Lange et al., 2013). Kollock (1998) refers to game theory and the difference between a PD based on two people and an N-person game with many participants, where increasing the group size might also have effects like spreading the harm of defection and making it less noticeable for each actor, making it generally harder to influence the behavior or players, as well as making it much easier to defect anonymously.

An additional factor to the size of the group is also related to its composition. Powell (1990, p. 326) highlights, "The more homogeneous the group, the greater the trust, hence the easier it is to sustain network-like arrangements". According to Powell, this also means that trust can recede with increased diversity, and with that, the willingness to enter into long-term collaborations, where calculative attitudes replace cooperative ones and formal agreements - either contractual or bureaucratic - supplant informal understandings (Powell, 1990). The same is true for the stability of a group's composition (in repeated games), with cooperation being higher when the groups' members stay the same (Fehr and Schurtenberger, 2018).

However, if groups are larger, higher heterogeneity in terms of the diversity of group members' interests and resources in large groups has also been discussed to favor

cooperation (Kollock, 1998). Glance and Huberman (1994) explain this with an example of a conservative person participating in a demonstration against the government with the risk of getting imprisoned only if thousands were already committed, decreasing the chance of getting caught, while a revolutionary might join at the slightest sign of unrest. However, this effect might be restricted to circumstances with a thread of individual persecution.



Summing up, there is strong evidence that a group's size substantially impacts the decision to cooperate or defect. *Limitations to membership numbers* in a TMCN as an activator could trigger *smaller group size effects*. Even though this mechanism happens in a setting with the peculiarity that a huge group is needed to solve the social dilemma at hand, dealing with smaller groups or arenas of negotiation as is possible in a polycentric system can bring beneficial effects and increase the number of cooperators. As discussed above, this can happen due to undiffused responsibility when each member of a TMCN is directly targeted to commit to it or through the ease of monitoring in smaller groups. Limiting the number of members can be seen as an example of using these mechanisms.

Efficacy

An aspect specifically related to efficacy is often related to a so-called critical mass. It is assumed that a minimum of people is needed to get a movement off the ground, such as a certain proportion of university students to stage a demonstration (Marwell and Oliver, 1993). Marwell and Oliver find that this is due to a higher likelihood of a large group containing a sufficient number of individuals whose interests are served by providing the public good, which again is easier, especially when a public good is highly non-rival, such as is the case for a climate-safe future. Mueller (2018), for example, in an analysis of how

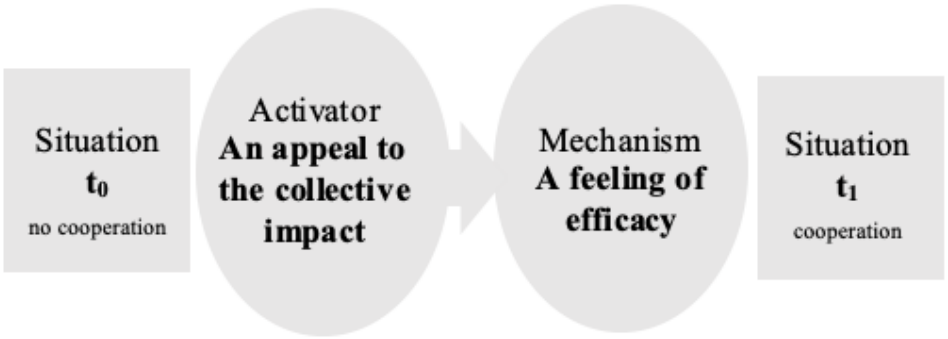
global governance can solve the provision of GPG, essentially concludes that for the case of climate stability, a critical mass from national governments, businesses, and cities could be sufficient. He also highlights that a polycentric system is most promising, as it overcomes the criticism of a multilateralism where states cooperating in small clubs are considered insufficient.

The willingness to cooperate can also be seen as a rational decision based on the expectation about the success or failure of the collective action - a perception of the reality that can be influenced, for example, through persuasion of campaigns (Klandermans, 1988) or also by highlighting the probability of getting to a critical mass (Marwell and Oliver, 1993). In other words, actors decide more often to cooperate if they believe there will be a benefit for them because they believe that the dilemma can be solved. Also, if people believe that they have a noticeable effect, for example, if an individual believes that a group is close to a threshold and that adding one's own contribution can be enough to put the group over the top, cooperation can increase (Kollock, 1998). This effect can be considered especially significant in step-level games, where more of these "tops" are to be achieved.

In this sense, it is important to distinguish between the collective efficacy of a group to provide a public good and self-efficacy as "the probability that one's contribution will make a difference in the group's chance for obtaining the public good" (Kerr, 1989, p. 290). The scope needs to be considered when applying this reasoning to TMCNs in a polycentric system. TMCNs cover only a fraction of the actors that must cooperate globally to provide the GPG. Self-efficacy might, therefore, not refer to one of the members but rather to one TMCN as an intermediate level for the members. In this sense, a city would assess its efficacy as a city and as a network member and its aggregate action towards providing a GPG. Many TMCNs state their weight on their websites, such as their economic power, by summing up all members' GDP. On the one hand, this might also be directed to potential funders who might want to bet on the highest-impact offering TMCN. However, TMCNs are primary networks that want to serve their members, and external actors are only relevant insofar as they assist their member cities (Bouteligier, 2013, p. 160). In this sense, the appeal to their weight, or potential impact, by networks is likely

directed to a TMCN's membership, highlighting its potential efficacy in meeting the common goal of the members.

In TMCNs, this can translate into two actions. First, based on the reciprocity assumption, cities' willingness to cooperate can be influenced by increasing their perception of reciprocate actors, such as other cities that are also willing to cooperate. This perception could be strengthened by making the commitments of each member explicit, as reflected in the mechanisms around information and transparency above. Second, implying that there is a sufficiently high number of cooperators, or also a critical mass, increasing the chance to help solve the dilemma can be used by pointing to a considerably high number of cooperators.



Therefore, The TMCN can appeal to its members' collective impact as an activator to trigger a *feeling of efficacy* throughout its membership as a mechanism. TMCNs can get active by establishing a narrative that creates an impression of being connected to a group that can have an actual impact. Consequently, cities might decide to cooperate based on their belief that the network, and potentially with other TMCNs they know, have considerable influence over the dilemma at hand and can contribute to its solution. An example is the appeal, as mentioned above, to the importance of a TMCN's own importance, such as pointing to the importance of its members in terms of GDP.

Altruism, fairness, or the greater good (Social preferences)

The self-interest hypothesis, assuming that all people are exclusively motivated by their material self-interest (Fehr and Fischbacher, 2002), as often assumed when using

incentives, will now be specifically relaxed. This will include the above-explained social preferences.

Fehr and Fischbacher (2002) explain the four quantitatively most important types of social preferences that the literature has uncovered as (1) reciprocal fairness, (2) inequity aversion, (3) pure altruism, and (4) spitefulness or envy. In that, they define reciprocal fairness as individuals responding kindly to the kind actions of others (positive reciprocity) and hostile to hostile ones (negative reciprocity), explicitly not driven by expectations of future benefit (as could be the case for a conditional cooperator mentioned above). Whether an action is considered kind depends on the judgment of fairness, which is determined by the equitability of the payoff distribution caused by the action. This goes as far as actors reciprocating unfair behavior by harming the person who treated them unfairly, even when causing a substantial, although smaller, cost for themselves (Camerer, 2003, p. 10). Inequity aversion (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000) is based on altruistic behavior and makes actors want to distribute material payoff equally among those involved. The key difference between these two preferences is that inequity aversion is driven by a preference for fairness and a desire to rectify inequalities. In contrast, reciprocity is motivated by the principle of reciprocating others' behaviors and can involve both positive and negative responses. As the third preference, pure altruism is a form of unconditional kindness and is not a response and, therefore, independent from the other actor's decision - an altruistic person never takes action that decreases the payoff of a reference agent. Lastly, they define spitefulness or envy as a person who is always and independent of the decisions of others willing to decrease the material payoff of others, even at a cost. Following Fehr and Fischbacher (2002), reciprocal fairness is the most prevalent of all preferences. The effectiveness of reciprocity varies with the conditions in which the strategy is applied. For example, group size and how many group members apply the strategy can have an impact (Komorita et al., 1992).

The ultimatum bargaining game is an example to demonstrate (negative) reciprocity used by Fehr and Gächter (2000b). There is a fixed sum of money, and one of the two agents gets to propose splitting the money between them. The responder can then accept or reject, in which case both receive nothing. Fehr and Gächter cite hundreds of trials in which the

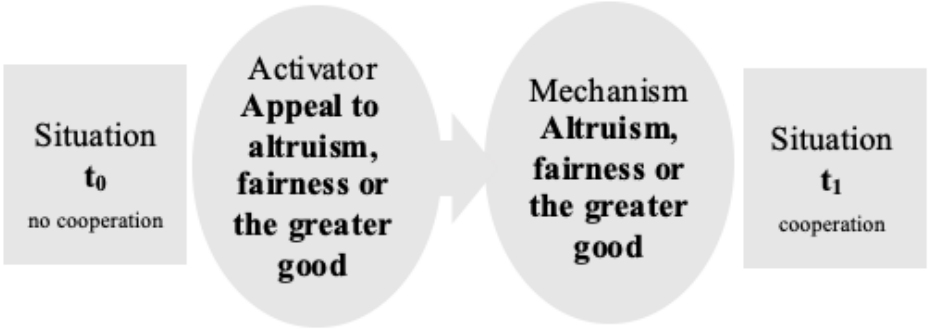
tendency was confirmed that offers under 30 percent are rejected with a high probability, with the responder arguing that the offer is unfair. Orbell et al. (1988) found in a similar experiment with students with a six-dollar stake that those who had given away their money without communication had justified their decision as being “the right thing to do”. Those students that gave away their stake after a discussion said they did it “to benefit the group”. Group identity and communication, therefore, also have an effect in this context.

Fehr and Gächter (2000b) summarize findings from different studies and estimate that between 40 and 66 percent of actors seem to react reciprocally, while another 20 to 30 percent behave selfishly. This finding is quite similar to the estimations mentioned above for conditional cooperators. Pavitt (2018) highlights that research is also distinguishing between broad categories of prosocial and proselfs and a more specific ordering of altruists (who cooperate no matter what), cooperatives (who cooperate if others do), individualists (who cooperate if it brings personal gain) and competitiveness (who do not cooperate).

To activate social preferences, actors can specifically appeal to the related activators, such as deciding on cooperation in a question of fairness or explicitly stating the greater good of the situation. For example, Chen et al. (2009) found in experimental research that level of cooperations increased with a moral appeal to their experiment participants. For this, they sent an email to the participants with an appeal addressing the nature of the dilemma situation of the experiment, the importance of group work, and the confidence they had in the non-egoistic behavior of the participants. As a result, cooperation did, in fact, increase when compared to a situation without email. They also found that the level of cooperations did not decrease in repetitions, in contrast to the same experiment they did for sanctions, where cooperation declined when sanctions were taken away. They explain this effect by the appeal to stay in the actors' minds sustainably.

Regarding the application to TMCNs, the appeal to the greater good can also potentially generate a tendency for cooperation beyond one's own TMCN. Increasing the total number of cooperators, not only in one's own TMCN, is possible, especially when a superordinate group identity can be achieved (Dawes and Messick, 2000). This group identity can be achieved by appealing to a common goal that all of the different TMCNs of other actors have in common, which in this case would be the provision of the GPG or the avoidance of

the public bad. TMCNs could, therefore, make sure that the common goal of providing the GPG stands above the identity of different TMCNs if they want to spread their impact beyond their membership to outside cities as well.



In the context of TMCNs, this would mean that cooperative behavior is not motivated by a city trying to improve its own situation but rather that of all other cities and the global community or by making sure they put in their fair share. TMCNs can, therefore, "moralize", or also call upon their members' sense of fairness, in an appeal to their members to be working towards a greater good. For this, they can use the activator *Appeal to altruism, fairness, or the greater good (social preferences)* to trigger the mechanisms *Altruism, fairness or the greater good (social preferences)*, in the sense of committing based on a moral feeling. By highlighting the greater good as the reason for cooperation, TMCNs should, therefore, be able to cause a reflection process throughout their memberships, where decision-makers can decide positively about cooperation based on their understanding of fairness. An example of this is using themes such as "climate justice" in the messaging of a TMCN.

Trust, reciprocity, and communication

In literature, especially about polycentric systems, trust is seen as a precondition for solving social dilemmas. Along with a perception of group identity, norms such as reciprocity and equity provide a preliminary reason for group members to trust one another (Pavitt, 2018).

Fehr and Fischbacher highlight that, based on their recognition of conditional cooperators, if people believe that others cooperate to a large extent, cooperation will be higher compared to a situation where they believe that others rarely cooperate (Fehr and Fischbacher, 2002). This translates to increased cooperation if cities believe that a large group of other cities also cooperate or reciprocate in a "social interaction effect" (Fehr and Fischbacher, 2002).

Dorsch and Flachsland (2017) also indicate "trust catalysts" that enable or contribute to an environment of trust, such as face-to-face communication, monitoring, or (graduated) sanctioning. Ring and Van de Ven (1994) point to two different definitions of trust: A more business-related view of trust is based on confidence in the predictability of one's expectations (Luhmann, 1979; Zucker, 1986). One hedge against uncertainty, adverse selection, or moral hazard through formal contractual means such as guarantees, insurance mechanisms, laws, and organizational hierarchy. In the second one, trust is confidence in another's goodwill (Dore, 1983; Ring and Van de Ven, 1992), and uncertainty is dealt with through interpersonal interactions that lead to social-psychological bonds of mutual norms, sentiments, and friendships.

This understanding has also been applied in the context of international cooperation. Cole (2015, p. 115), for example, describes that the global-level climate negotiations, with thousands of participants meeting in big delegations from around the world, might have underperformed due to the difficulty of developing trust. He highlights, "Trust is not the same as blind faith, where parties simply sit down and "do the right things" according to someone's moral compass. Rather, trust is earned by mutual commitments that are not overly costly to monitor." Ostrom (2009, p. 1) argues that policies adopted to reduce global warming only at a global scale are "[...] unlikely to generate sufficient trust among citizens and firms so that collective action can take place [...]". This is among other factors, related to a "lack of knowing that others located halfway around the globe are taking actions similar to those being taken "at home"(2009, p. 1). Furthermore, instruments implemented by a single government unit like the Carbon Development Mechanism (CDM), in her view, do not solve the free-riding problem as they can be "gamed". Ostrom (2009, p.13) adds to the perspective of trust in social dilemma situations with the understanding that the problem

does not disappear with the implementation of a policy. In her analysis, it also requires a willingness from citizens to comply, which is much higher and less costly to enforce when citizens approve of the policy and trust that the governmental policy is effectively and fairly enforced.

Trust is known to be able to improve the efficiency of society by facilitating coordinated action. Together with norms and networks, these three factors are also defined as "social capital" (Putnam, 1993). Putnam highlights that social capital can facilitate cooperation (Putnam, 1993, p. 167). He cites, for example, a group of farmers who need less physical capital by lending one another agricultural tools based on social capital. According to Putnam, volunteering and, therefore, cooperating is easier in a community that has inherited a substantial body of social capital in the form of norms, reciprocity, and civic engagement networks. Therefore, this could also provide an environment where frontrunners are more likely to make commitments before others commit. Components of social trust, such as norm reciprocity, develop because they lower transaction costs and facilitate cooperation (North, 1990, p. 36-45). Generalized reciprocity is, therefore, a highly productive component of social capital, which leads to a more efficient restraint of opportunism and the solution of problems of collective action (Putnam, 1993; Ostrom, 1990), and therefore also a norm that is highly relevant in the context of social dilemmas.

Trust is part of a self-reinforcing cycle in repeated social dilemmas, as shown in Figure 8, which is based on Ostom (Ostrom, E., 1997; 2003) and further adapted and described by Cole (2015). In this approach, cooperation happens if people invest in developing reputations for trustworthiness and adopt norms of reciprocity (such as tit-for-tat strategies). Then, initial cooperation can lead to higher levels of trust and new or stronger norms of reciprocity and trustworthiness between actors, leading to higher levels of cooperation.

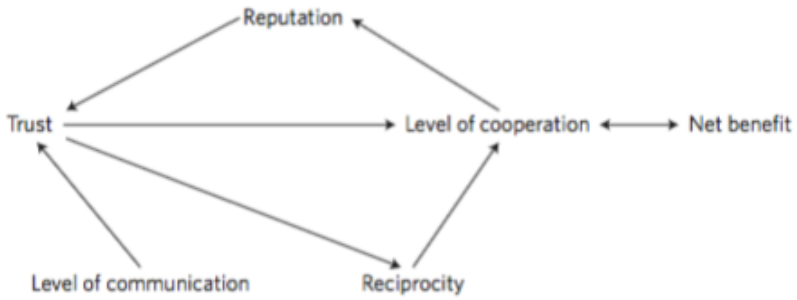


Figure 8: Core relations in repeated social dilemmas (Cole, 2015, p. 115).

As shown in the figure above, communication is an effective tool to increase cooperation, even when individual incentives conflict (Cole, 2015). Based on findings from experimental simulations, Bornstein (1992b) proposed a set of reasons why communication can engender cooperation in social dilemmas: it allows for the (1) clarification of available choices, (2) enhances trust among participants, (3) reinforces the activation of relevant social norms, (4) encourages a group identity, and (5) allows for the establishment of a collective strategy and member commitments to adhere to it.

Furthermore, Ostrom, Gardner, and Walker found in experimental research that especially low-cost face-to-face communication makes a strong impact by players (1) calculating coordinated yield-improving strategies, (2) making verbal agreements to implement these strategies and (3) dealing with non-conforming players (Ostrom et al., 1994). Although they highlight that the opportunity to communicate in field settings is rarely costless, this is exactly where TMCNs come in, providing infrastructure and facilitating communication among their members. Even though there are still costs for the members to participate in TMCNs, such as literal membership fees or also the time their officials dedicate to activities, it can be assumed that the costs for arranging communication with other cities on an ad hoc basis and without a third party facilitator would be substantially higher. Based on a literature review of public good and common-pool resource experiments, Ostrom (2003) gathers six potential reasons for communication increasing cooperation:

(1) facilitates the development of socially optimal strategies;
(2) allows for exchanges of promises;
(3) increases mutual trust and thus affects expectations of others' behavior;

(4) adds value to payoffs;
(5) reinforces norms; and
(6) promotes the development of "group identity"

This shows how much communication really allows the creation of basic conditions, such as understanding the respective dilemma at hand as a group, but also enables a whole range of mechanisms that can positively influence the level of cooperation.

Further research also analyzes communication characteristics and their impact, and Coles suggests the following two examples (Cole, 2015). Aumann and Hart (2003) show that "long cheap talk" (meaning plain conversation - unmediated, nonbinding, and payoff-irrelevant) leads to higher levels of cooperation and is better than "short cheap talk". Revelations about preferences or intentions of making a commitment that motivates agreement, which again motivates another revelation, motivating another agreement, and so on, can create a positive dynamic in a sequence. Additionally, quieter and more confidential conversations might be advantageous, as compromise is not so easy when it must be done in full public view (Barrett, 2003). Cole concludes, "Such assessments warrant the hypothesis that formal or informal, one-on-one or small-group communications might have a significant positive impact on climate negotiations" (Cole, 2015, p. 116). He later adds that this also implicitly endorses a polycentric approach to climate governance, citing an example with the US-China Climate Change Working Group. The group achieved considerable advances by establishing a new target for emission reductions between the two states within the first nine months after establishing the group in 2013. The first working group report also mentions that "[...] both sides appreciate that advancing concrete action on climate change can serve as a pillar of our bilateral relationship, build mutual trust and respect, and pave the way for a stronger overall collaboration" (Cole, 2003, p. 116).

From this perspective, the adequacy of polycentric systems can again be based on their smaller arenas where direct communication is possible between participants. Additionally, Granovetter (1973) explains that trust depends heavily on whether intermediary personal contacts exist that can assure the trustworthiness of third parties and can intercede if necessary. According to Granovetter, a fragmentation of networks, therefore, also leads to declining levels of trust by reducing the number of paths between actors or a (political)

leader and his followers. TMCNs, therefore, seem to be an adequate place to create smaller arenas through the TMCNs themselves.

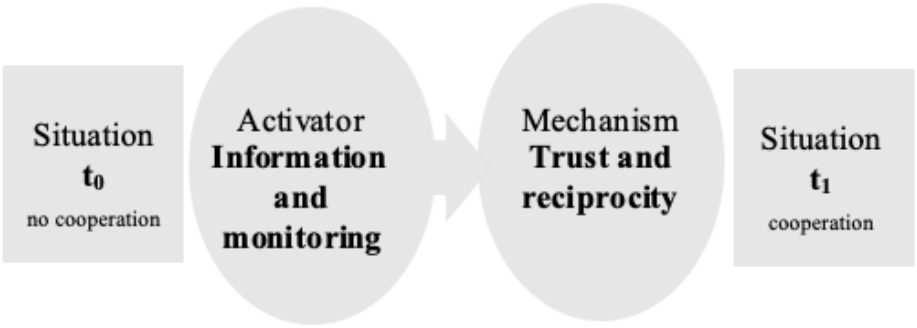
The long-term focus of TMCNs also allows for a "long talk" not only between decision-makers in local governments but also provides a frame to continually re-engage decision-makers after changes in the political leadership of those local governments, for example, after elections. Consequently, new city officials of a local government are automatically invited to engage as the new representatives of a city in TMCN activities, picking up the "talk" where their predecessors left it. Even though each city official might engage on their own and new terms in the cooperation negotiation, they do not start the negotiation process at zero, where a history of the process is already established through revelations and sometimes commitments. Formal commitments might already be in place and continued, while the same might be true for informal commitments even though in a weaker condition.

The recognition of other players, that is, in our case, city officials, from past interactions and the features of these interactions play an important role in developing cooperative relationships (Axelrod, 1984, p.139). TMCNs might be key providers that maintain mutual recognition between frequently changing representatives. As mentioned above, this might happen formally, for example, by TMCNs providing up-to-date information about each city's formal commitments through their climate action plans. Alternatively, TMCNs that facilitate relationships between city officials and support them in the recognition process can also act on a more personal level, for example, by passing along informal information on a city's reputation and general strategy or negotiation mode. The trust then depends on communication, which in intergovernmental relationships is done by traditional bureaucrats and specifically by working-level officials (Cole, 2015). TMCNs, therefore, generally also talk not only to one focal point in the city but also to a range of officials who are active in different sectors of the city.

Communication is not yet guaranteed cooperation, however. For example, Isaac and Walker (1988) also found that level of cooperations decreased when the complexity of the environment increased. When they did the same experiment with variations of endowments of individuals or a more complicated group payoff function, the participants' difficulties in understanding the situation and potential payoffs substantially decreased the impact of

communication and the level of cooperation. Furthermore, costs for communication might be prohibitive as well. One might consider the enormous expenditure of a platform providing active face-to-face communication for thousands of local governments globally. Furthermore, as included in Cole's framework, other factors, such as the development of norms for reciprocal action, are additional conditions to make communication effective.

The same can be assumed for trust. It is not a guarantee for cooperation, either. Nevertheless, and as mentioned at the beginning, different mechanisms can contribute to an enabling environment and play together to strengthen the conditions that make a decision for cooperation more likely. The abovementioned mechanisms, trust, and reciprocity, can also be seen as mechanisms that strongly impact cooperation-enabling contextual conditions and, therefore, lay the ground for other mechanisms to work out more efficiently.



A TMCN, therefore, can start a causal chain by using the activator *information and monitoring*, in the sense of making commitments transparently available, to trigger the mechanism of *trust and reciprocity*. As cities use this dynamic, it fosters an environment where mutual expectations of cooperation are not just anticipated but actively reinforced, increasing the chances of a decision-maker to cooperate. Participation in TMCNs not only facilitates direct communication but also builds a foundation of trust and relationships built on the idea of mutual support that can significantly reduce the transaction costs associated with the coordination and implementation of climate action strategies. An example here of how TMCNs can use this mechanism is to make the commitments of their members accessible in a transparent way.

5.2 Set of solution mechanisms in TMCNs

The author's intention in this section is not to provide a comprehensive list of mechanisms. There are already numerous approaches and a wide body of literature on overcoming dilemmas and the mechanisms at work. Despite this rich research, there is no final set of mechanisms that could be used as a silver bullet and applied to guarantee full cooperation. The discussed mechanisms contribute to increasing cooperation under certain conditions or "make cooperation possible" (Messner et al., 2013, p. 22), in many cases also only as combinations of mechanisms that either have interdependencies or work in an additive way throughout its target group. This is partially because these processes happen in very complex environments and under complex conditions. For example, Messick (1982) highlights the psychological complexity of social dilemma situations, where various motives can not only exist at the same time but also compete with each other. Furthermore, players in public goods games have different profiles, such as the above-mentioned conditional cooperators or players with a free-rider profile. Therefore, one mechanism might influence one actor to cooperate while it does not work for another. Prior research has shown that voluntary cooperation depends on multiple mechanisms, such as communication institutions that incentivize or punish free riders (Ostrom, 2000; Rustagi et al., 2007). The results are often packages of mechanisms, such as creating an atmosphere of trust through smaller group size while at the same time applying negative incentives to defectors.

Besides, boundaries are blurry, and the mechanisms will show certain overlaps and some influence each other. Mitchie et al. (2011, p. 4) also highlight that one intervention can very well change one or more of the three components in their model for behavior. This is true for the mechanism in general: For example, communication can engender cooperation in social dilemmas for a range of reasons, which are cited as mechanisms in literature, such as trust-enhancing effects among participants or the encouragement of group identity. Another example is from Van Lange et al. They point to the fact that authorities are often associated with structural solutions such as sanctioning free-riding and, at the same time, rewarding cooperative action. However, trust also plays into these mechanisms, and like (horizontal) trust among people, vertical trust between people and institutes (institutional trust) is

crucial for the acceptance of rewards and punishment (Van Lange et al., 2013, p. 137). They also highlight that it is "[...] the combination of measures, rather than their isolated effects, that effectively promote cooperation." Each mechanism can, therefore, play into a variety of other mechanisms. Although fully isolating the mechanisms might not be completely possible, it is useful to analytically separate them and understand differences in the conditions they require and the consequences they generate. After that, they can also be assessed as a package of mechanisms that might vary between TMCNs.

The discussion and application of the mechanism can then be brought together in a final list, as shown in Table 4. Two of the mechanisms have been dropped throughout the research process. The reduction was based both on a methodological and a practical reason. Regarding the methodology, fsQCA requires limiting the variables used so as not to get to an overly complex assessment that can create difficulties in interpretation. Furthermore, in practical terms, data availability was insufficient for the mechanisms "Making the future more important," and the frequency of face-to-face meetings between highest-level decision makers (e.g., mayors), which was assessed through the questionnaire. As data from the questionnaire is not available for all cases, and this specific data point can not be assessed through the alternative data collection method of the content analysis, the mechanism was excluded. The second mechanism that was excluded was the last one on trust, reciprocity, and communication. In the process of further reducing the total number of mechanisms, this one had been chosen as it had been built on an activator, "information and monitoring," that was already reflected in another mechanism.

Mechanism	**Activator**
Individual utility maximization	Positive selective incentives/ co-benefits
Increased expectations of others cooperating	Negative selective incentives/ sanctions
Transparency	Information and monitoring

Making the future more important	Frequent meetings
Group identity	Membership terms
Smaller groups size effects	Limitations to membership numbers
A feeling of Efficacy	An appeal to the collective impact
Altruism, fairness or the greater good (social preferences)	Appeal to altruism, fairness or the greater good (social preferences)
Trust and reciprocity	Information and monitoring

Table 4: Mechanisms and activators.

6. Research question and methodology

Research has already produced insights into a range of aspects around the role and impact of TMCNs in the context of climate change policy and, with that, on their engagement in a global social dilemma situation. They offer a set of services, which can have impacts such as increasing cities' capacity in specific areas, for example, through learning about projects of their peers. Recent research, however, indicates that TMCNs have a particular impact through their influence on the political decision-making process within municipalities and their willingness to commit. It is unclear how this influence is exerted, especially concerning decisions about commitments towards providing GPGs, such as a climate-safe future. The analysis will, therefore, specifically look at the influence on decision-makers' willingness to cooperate in order to analyze the political decision-making process in more detail. Other factors around the decision-making process, such as the above-explained *capacity* and *opportunity*, will be excluded for simplicity but should be subject to further research beyond what is already available.

Considering this research gap, the following research question is going to be addressed:

Research question:

"In what way do mechanisms within Transnational Municipal Climate Networks influence member cities' willingness to commit to the reduction of Greenhouse Gas emissions in a social dilemma to provide the Global Public Good "climate-safe future?"

The research question will be answered through three subordinate questions, as follows:

4. Which mechanisms are Transnational Municipal Climate Networks using to influence their member cities' willingness to commit to the reduction of Greenhouse Gas emissions?

5. How can the effect of Transnational Municipal Climate Networks on the provision of the Global Public Good "climate-safe future" by cities be explained through these mechanisms?

6. How can the relevant mechanisms be improved to increase cooperation and, therefore, the provision of the Global Public Good “climate-safe future”?

The research in the present thesis started with developing a conceptual framework around Transnational Municipal Climate Networks, presented in Chapter 4. The concept and its assumptions will now be reflected in a proposition. Proposition P assumes that TMCNs use mechanism H to influence cities’ “willingness” in the decision process in the social dilemma.

TMCNs trigger different mechanisms, such as increasing group identity, through activators, such as by only admitting cities with a certain typology into the TMCN as limiting criteria for membership. Each activator and mechanism presented in the previous chapter will constitute a hypothesis for this proposition. An example is Hypothesis H1: “The mechanisms "group identity" [independent variable] is used to increase cities' level of cooperation [dependent variable]”. This will serve as a basis to answer the research questions. All hypotheses are listed in the table below and numbered according to their application in the questionnaire.

Number	**Hypotheses**	**Mechanism**	**Activator**
H1	The mechanism "group identity" [independent variable] is used to increase cities' level of cooperation [dependent variable]	Group identity	Membership terms
H2	The mechanism "Smaller groups size effects" [independent variable] is used to increase cities' level of cooperation [dependent variable]	Smaller group's size effects	Limitations to membership numbers
H3	The mechanism "Increased expectations of others cooperating" [independent variable] is used to increase cities' level of cooperation [dependent variable]	Increased expectations of others cooperating	Negative selective incentives/ sanctions

H4	The mechanism "Transparency" [independent variable]is used to increase cities' level of cooperation [dependent variable]	Transparency	Information and monitoring
H5	The mechanism "Altruism, fairness or the greater good (social preferences) " [independent variable] is used to increase cities' level of cooperation [dependent variable]	Altruism, fairness or the greater good (social preferences)	Appeal to altruism, fairness, or the greater good (social preferences)
H6	The mechanism "Individual utility maximization" [independent variable] is used to increase cities' level of cooperation [dependent variable]	Individual utility maximization	Positive selective incentives/ co-benefits
H7	The mechanism "A feeling of Efficacy" [independent variable] is used to increase cities' level of cooperation [dependent variable]	A feeling of Efficacy	An appeal to the collective impact

Table 5: Hypotheses, mechanisms, and activators.

The research questions will be answered sequentially, each using varying methods. Research question 1 will be answered by collecting data about the work of TMCNs through a content analysis on websites and other sources, as well as a questionnaire. This will allow us to detect the different mechanisms used in TMCNs. A set of indicators is going to be developed for each one of the mechanisms in order to detect the mechanisms in the TMCNs. The data will then be combined with the data collected through the questionnaire for further confirmation.

In order to test and provide evidence for the hypotheses and answer research questions 2 and 3, a Qualitative Comparative Analysis (QCA) is going to be used as a method in the following steps in an iterative way after having already identified the outcome and conditions (mechanisms) in the previous chapters: Identify cases that produce the outcome in varying degrees. A mid-sized sample of 7 to 15 cases will be assessed with the indicators and results included in a fuzzy table to be then analyzed using the QCA method. In this

step, the indicators will also be calibrated according to scores. The results will be analyzed and interpreted, and the mechanisms at work in each TMCN and their potential interdependencies will be discussed.

6.1. Application of a Qualitative Comparative Analysis

QCA was introduced by Ragin in 1987 to provide a method to answer "how-questions" (as applied here to research questions 2 and 3) through comparative analysis of a small to mid-sized sample of cases, bridging qualitative and quantitative research that would allow for a context-specific notion of causality (Ragin, 1987). QCAs (Ragin, 1998; Blatter et al., 2007; Lauth et al., 2008; Rihoux and Ragin, 2009; Scheider and Wagemann, 2012) are applied by assessing each case's conditions and their relationship to a specific outcome. Conditions are the different aspects or features of cases or factors such as stimuli, causal variables, ingredients, determinants, etc. (Rihoux and Ragin, 2009, p. xix) and can have multiple memberships in sets of cases (Ragin, 1998). Each case is understood as a combination of these conditions and, therefore, seen as a configuration (Ragin, 1998, p. 108). By analyzing the combinations in each case, it is possible to get a sense of how the different aspects fit together and what distinguishes each case from the other (Ragin, 1998). The conditions are stated as being true or false and summed up in a so-called truth table, showing all combinations of conditions for the cases. The matrix can then be assessed in terms of sufficiency (condition A always leads to outcome X) and necessity (condition B has to occur for outcome X to occur) (Blatter et al., 2007; Sehring et al., 2013).

QCA aims to generalize the explanation of how the outcome combines with the conditions over a set of cases (Befani, 2013). The mid-sized sample of cases, which covers nine of eleven existing cases according to the present case definition, aims at a middle path between complexity and generality, allowing for moderatum generalization (Ragin, 1998; Lamnek, 2010). These generalizations are moderate in two senses (Payne and Williams, 2005, p. 297): First, in terms of the "scope", they do not attempt to hold over long periods or across ranges of cultures. Second, they are "moderately held, in the sense of a political or aesthetic view that is open to change." Also, compared to a case study with a small sample of three or four cases, using fsQCA will help uncover patterns across a bigger section of the phenomenon before case studies might be useful for doing more detailed assessments.

Blatter et al. (2007) highlight that a great advantage of the method concerning data representation is that QCA allows the cases to be broken down into their individual components and, thus, lets the actual units of investigation recede behind the combinations of these properties. An even more distinct advantage, as Blatter et al. however highlight, lies in the view of causality: The methodology allows and was therefore specially chosen due to its basis on equifinality, i.e., a scenario in which alternative factors can produce the same outcome, and conjunctural causation where single conditions do not display their effect on their own, but only together with other conditions (Scheider and Wagemann, 2012). With equifinality, described by Blatter et al. (2007, p. 201) also as "many roads can lead to Rome", the various conditions are alternatives to each other, potentially causing an outcome on their own or in a combination. The comparison to another method, regression, makes this difference even clearer (Blatter et al., 2007): In a regression equation, partial effects do not have a mutually alternative function and are added up, leading to only one unifinal way to produce the outcome. QCA will, therefore, allow us to understand how different TMCNs are applying varying combinations of conditions to get to a potentially similar outcome, as well as taking the option into account that none of the analyzed mechanisms might be able to bring about the outcome on their own, but only in combination with others as a package.

This dissertation will apply the more recent type of the method, a fuzzy-set QCA (fsQCA) (Ragin, 2000), which differs from the original, now called a crisp-set QCA. fsQCA overcomes one of QCAs main critics about its binary nature by allowing partial fulfillment of conditions, with gradual values between 0 (non-membership in the set/ completely false status) and 1 (full membership in the set/completely true status) and, therefore, offers more differentiation and more precise description (Sehring et al., 2013). Using fsQCA also reflects that the outcome, a climate-safe future, can be classified as a continuous GPG, which can exist in varying degrees and variations in the level of commitments that cities are making in TMCNs. In this dissertation, the conditions will be the mechanisms that enable cooperation as the outcome. An example of a mechanism is "group identity". The outcome is measured by the number of cooperators that a TMCN has achieved, defined as the average sum of (1) the percentage of cooperators in the TMCN and (2) the quality of the commitment used in the TMCN. A cooperator is defined as a member who has committed

to a target of reducing greenhouse gas emissions. The quality of the commitment was determined through the commitment being below, in line, or beyond the Paris Agreement, in the sense that a commitment in line requires at least compliance with the nationally determined contributions (NDCs) of the country in which the TMCN member is located.

It is highlighted here that even though QCA uses numeric symbols, it remains a qualitative method because each numeric symbol measures the conditions through the indicators, which represent a complex characteristic, and by no means is intended to quantify the qualitative data on which the study is built (Cortes et al., 2021; Blatter et al., 2007, p. 204). In that sense, to find the mechanisms, the theory of solution mechanisms was reviewed and discussed in order to introduce the most relevant mechanisms for this context in Chapter 5. In terms of the number of conditions, or here, the mechanisms, the selection needs to find the right balance between selecting enough conditions to provide a full account of the phenomenon and not selecting too many, avoiding complex results and difficult interpretation (Mello, 2021). The aim was to iteratively build a list of four to seven mechanisms. The richness of research around the topic and mechanisms that seemed adequate and potentially present in the work of TMCNs first led to a total of nine mechanisms. After the data collection, two mechanisms ended up being dropped. Mechanism eight was dropped as the data required for the mechanisms could not be raised without the questionnaire, as the data was internal to the TMCN operation. Specific cases would otherwise have been excluded, as four out of the 11 TMCNs had not answered the questionnaire. Mechanism nine was also dropped to keep the total number of mechanisms down, and this specific mechanism had been built on an activator, “information and monitoring,” already reflected in another mechanism. This then led to a total of seven mechanisms.

The mechanisms were measured through an indicator. The indicators will attempt to capture a prominent phenomenon of these mechanisms, depicted in scores that will reflect non-membership (0), full membership (1), or crossover points with partial membership (f.ex. 0.33) in a set ranging from 0 to 1. An example of an indicator for the mechanism “group identity” is “City typology as limiting criteria for membership”, based on basic

Gestaltist perceptual principles such as proximity, similarity, and common fate (Campbell, 1958).

Hypothesis	**Indicator**	**Values of the indicator (when applicable)**
H1 The mechanism "group identity" [independent variable] is used to increase cities' level of cooperation [dependent variable]	City typology as limiting criteria for membership	0 ≙ no requirement 0.33 ≙ local government can join 0.67 ≙ only cities can join 1 ≙ only cities with special characteristics can join
H2 The mechanism "Smaller groups size effects" [independent variable] is used to increase cities' level of cooperation [dependent variable]	Membership number	0 ≙ more than 300 0.33 ≙ 101 to 300 0.67 ≙ 21 to 100 1 ≙ less than 20
H3 The mechanism "Increased expectations of others cooperating" [independent variable] is used to increase cities' level of cooperation [dependent variable]	Level of expectation for members to commit, connected to sanctions	0 ≙ no requirement 0.33 ≙ commitment tool available 0.67 ≙ commitment expected along a journey 1 ≙ membership only possible with commitment
	Expected commitment	0 ≙ no commitment 0.33 ≙ any 0.67 ≙ substantial commitment 1 ≙ commitment in line with the Paris Agreement or beyond

H4 The mechanism "Transparency" [independent variable] is used to increase cities' level of cooperation [dependent variable]	Commitment of other members is publicly available	0 ≙ no information 0.33 ≙ individual cases showcased 0.67 ≙ only committers showcased 1 ≙ each city's commitment available
H5 The mechanism "Altruism, fairness or the greater good (social preferences) " [independent variable] is used to increase cities' level of cooperation [dependent variable]	TMCN appeals to cooperation based on altruism, the greater good or fairness	0 ≙ no mention 0.33 ≙ rudimentary mention 0.67 ≙ part of core messaging 1 ≙ core motivation based on the values
H6 The mechanism "Individual utility maximization" [independent variable] is used to increase cities' level of cooperation [dependent variable]	TMN supports information about co-benefits	0 ≙ no substantial mention of the topic 0.33 ≙ TMN pubished material stating the importance of co-benefits (e.g., blog) 0.67 ≙ TMN has published general case studies, research, and or tools to help cities identify co-benefits 1 ≙ TMN actively helps identify/ quantify/ qualify co-benefits
H7 The mechanism "A feeling of efficacy" [independent variable] is used to increase cities' level of cooperation [dependent variable]	TMCN appeals to the collective impact	0 ≙ no mention 0.33 ≙ TMN justifies being of little mass 0.67 ≙ TMN as part of a movement 1 ≙ TMN claims to have substantial mass to be critical
Outcome	Number or percentage of members that have signed the TMN main commitment	0 ≙ no or maximum 20% of members have made a commitment 0.33 ≙ 20% to 50% made a commitment 0.67 ≙ 50% to 95% made a commitment

		1 ≙ At least 95% made a commitment

Table 6: List of mechanisms and their indicators.

6.2. Case selection

Overall, the selection followed the definition of TMCNs established above. The full list of cases considered is available in attachment II, with 11 out of 74 TMCNs as the total number of cases selected. From this number, nine remained as actual cases after dropping two more due to insufficient data.

The cases were selected within the domain of investigation, where a certain homogeneity defines the scope of the sample and makes the cases comparable (Berg-Schlosser and De Meur, 2009). For this, the cases were initially selected according to the subject matter and the outcomes (Berg-Schlosser and De Meur, 2009), in the sense that the cases needed to have climate change as a key theme. Further criteria for homogeneity were the type of membership of those networks, which should primarily consist of local governments (as opposed to, for example, businesses).

Also, to keep the focus on the global aspect of public goods and avoid networks that primarily work as national government representatives, such as national associations of cities, an additional criterion is their transnational character. Heikkinen has developed an overview of the different benefits of different levels of networks (Heikkinen, 2022). National networks generally seem to engage less on a global level and often advocate for the demands of their members towards national governments or provide platforms for cooperation on common projects specific to the local context. In contrast, local networks focus more strongly on cooperation with the private sector. Heikkinen has also concluded that local networks focus more on a practical level, whereas international networks play a more important role on a political level, which is the focus of this dissertation. Lastly, as in

other studies about TMCNs, programs were also included to allow for important cases, such as the Green Climate Cities Program (GCC), a sub-chapter of ICLEI that works with its strategy.

In order to conduct a QCA analysis, cases should ideally also have a certain heterogeneity in terms of the success of the conditions that are being assessed and present differences in the outcome and in the factors presumed responsible for it so that the factors leading to "success" or "failure" can be compared and identified (Befani, 2015; Berg-Schlosser and De Meur, 2009). To gain heterogeneity, the sample will allow for variation of all other characteristics, such as different types of local governance, including regions or subtopics that the TMCN focuses on, such as "renewable energy". An intermediate approach between a "most similar" and "most different" system design (Przeworski and Teune, 1970; Berg-Schlosser and De Meur, 2009) is therefore used in the sense of a similar outcome, but in different degrees, with different cases that nevertheless fall into the same category. Therefore, the sample scope will be a sufficiently homogeneous universe of the cases considered with maximum heterogeneous cases within the universe (Berg-Schlosser and De Meur, 2009). Pragmatic considerations played an additional role (Berg-Schlosser and De Meur, 2009), such as the researcher's language skills, accessibility of sources, and availability of data. To justify the inclusion of each case into the sample on theoretical grounds (Ragin, 1994 as cited in Berg-Schlosser and De Meur, 2009, p. 23, 24), these considerations were summed up in four criteria with (a) Is it a network of primary cities/subnational governments?, (b) Is the network transnational?, (c) Is climate mitigation a key theme? and (d) Is there enough up to date information accessible in a language understood by the researcher?. Each criterion was necessary to be answered with "yes", excluding the potential case with any first "no". For example, when looking at the TMCN "Climate Mayors", the information about their exclusive geographic scope in the US led to a "no" of criteria (b), and was therefore excluded.

The number of cases is a mid-sized N, with the sample generated from existing research and online material. As a basis, an available selection of 64 potential networks was used that was published as "Supplementary material B. Full List of Climate City Networks Considered" by Cortes et al. in 2022 in the article "Unpacking the Heterogeneity of Climate

City Networks" (Cortes et al., 2022). Additional potential cases were then added through a further review of the above-cited literature and literature identified by a keyword search on the research platforms "Google Scholar", as well as the author's home university literature search engine. Secondly, a keyword search was also done on Google to identify further networks. The keywords for both were "transnational city network", "international city network," and "city network", as well as all three in combination with "climate change". Lastly, information about partnerships with other TMCNs on the websites and other information material of the identified TMCNs was also used to find more cases. A total of 74 potential cases were finally identified.

For a QCA, a recommended minimum number is to analyze at least five cases (Befani, 2015). The number and kind of cases were based on a tentative first sample and not fixed a priori, open to adding or dropping cases in an ongoing process when new hypotheses arise that can be confirmed with more similar or falsified with other contrary cases (Berg-Schlosser and De Meur, 2009). An additional factor was also the availability of data. Some 11 cases were analyzed in the first moment, while there were responses to the questionnaire from seven cases. The networks without a response were ICLEI - Local Governments for Sustainability/ GCC", "Global Covenant of Mayors for Climate and Energy" (GCoM), Energy Cities and City Net. One of these networks had, in fact, answered the questionnaire, but the interviewee asked to maintain anonymized results, as will be the name of that organization in this place. However, including the case under anonymity was not possible with the method applied in this research. Eventually, two of these four cases had to be completely excluded from the research, as the content analysis yielded insufficient data. For the two remaining cases, GCoM and Energy Cities, the data collected through the content analysis was sufficient to cover all mechanisms. However, the weaker data limitation, as the second perspective of a network representative is missing, needs to be considered. From those cases that were not included, especially the case of ICLEI's campaign Green Climate Cities (GCC), might add to the picture in future research, as ICLEI is one of the oldest and biggest networks globally. Barbi and Macedo (Barbi and Macedo, 2019) also highlight that it had a strong focus on implementation at its earlier stages, but later recognized that political commitment is crucial to projects' success and therefore changed the methodology

to commitment and mobilization more recently, which is in line with the assumption of this dissertation.

In terms of limiting the scope, the prior focus was set on cases that cover the most recognized TMCNs in terms of their presence in studies and their membership and are based on typical representatives of these cases in the sense of what is collectively shared (Lamnek, 2010). Examples of internationally active city networks in the field of climate change are “C40 Cities”, “GCC,” or GCoM. The TMCNs vary widely in their membership base from over 12000 members in GCoM to 96 members in C40 or only 22 in the “Carbon Neutral Cities Alliance” (CNCA), which is also reflected in their agendas and operations. While C40 and CNCA specifically identify themselves as TMCNs for leaders, networks like GcoM are accessible to a wider group of cities as big tents with less strict membership standards regarding the cities’ ambitions towards a climate-safe future. The “Climate Alliance of European Cities with Indigenous Rainforest Peoples” and “Energy Cities” have their membership base exclusively in Europe as a special characteristic. At the same time, the “Under2 Coalition”, with about 270 members internationally, is characterized by also including other regional governments besides municipalities. The selected cases are located in their majority, although not exclusively, in the Global North. This might be related to the topic of climate change mitigation, as opposed to adaptation, where Global North cities have had a much higher historical negative impact and responsibility, as well as more access to resources to develop initiatives and take mitigation action.

TMCN	**Number of Members**	**Geographical Scope**
Carbon Neutral Cities Alliance *https://carbonneutralcities.org*	22	International (Strong Global North focus)
C40 Cities *https://www.c40.org/*	96	International
Climate Alliance of European Cities with Indigenous Rainforest Peoples *https://www.climatealliance.org*	Nearly 2000	Europe (Including partnerships in the Global South)

Global Covenant of Mayors for Climate and Energy *https://www.globalcovenantofmayors.org*	12610	International
Eurocities *https://eurocities.eu*	Over 200	Europe
Under2 Coalition *https://www.theclimategroup.org/under2-coalition*	Over 270	International
Energy Cities *https://energy-cities.eu*	Several hundred	Europe
UrbanShift *https://www.shiftcities.org/*	23	International
Clean Air Asia *https://cleanairasia.org/*	Over 1000	Asia

Table 7: Overview of the sample of cases (Source: own, all data as per information on TMCN websites).

The profiles of the set of cases are now going to be presented. Special attention is given to unique features to understand the differences in their dynamics.

Carbon Neutral Cities Alliance

The Carbon Neutral Cities Alliance (CNCA) is a small-scale TMCN with only 22 members from 13 countries, which works specifically with a city's sustainability directors (CNCA, Our Cities, n.d.; Wang and Ma, 2021). CNCA was founded in Copenhagen in 2014 at an organizing meeting with 17 cities as original members (CNCA, 2015). It is distinct in that it aims to prove the feasibility of extremely ambitious targets around climate change and the implementation of policies, with "[...] the knowledge that carbon neutrality requires transformative, systemic changes" (CNCA, 2020, p. 3). CNCA's members aim to achieve carbon neutrality between 2030 and 2040, making it "the most aggressive GHG reduction targets undertaken anywhere by any city" (CNCA, About us, n.d.). They see their member cities as the "climate vanguard" that can show what it will take for leading international cities to achieve deep emissions reductions (CNCA, 2015, 2020). Their members want to take another step by achieving carbon neutrality through radical, transformative changes to core city systems (CNCA, About us, n.d.). These actions are called "game changers",

defined as “impactful actions that can accelerate and amplify decarbonization in cities” (CNCA, Game changers, n.d.), which the TMCN also supports through a specific fund for game-changing projects in their member cities (CNCA, CNCA Game changer fund, n.d.). Besides the fund, CNCA’s main activities are in the development of standards for carbon neutrality planning, supporting their members with the implementation of their projects, advocacy, giving a voice to their members through different communication initiatives, and reaching other cities beyond their members with their learnings and ambition (CNCA, Our work, n.d.; Wang and Ma, 2021).

C40 Cities Climate Leadership Group

C40 Cities Climate Leadership Group (C40) was founded in 2005 as the “C20” with its first 18 cities as members to cooperatively reduce GHG emissions, and grew to 96 members over the years. Following the idea of G20, C40 is a TMCN specifically for megacities (although with few exceptions) that highlights its potential impact through the number of 582 million residents (C40, Cities membership, 2022) and 20% of global GDP (C40, About C40, 2022) when summing up all of their member cities.

C40 is a high hurdle network (Lust and Gunkel, 2018) with exclusive access, however less so than the quite similar CNCA. Membership is based specifically on cities’ ambition to reduce emissions and the action to ensure its self-defined role as a network of climate leaders. The TMCN highlights this membership criteria as an alternative approach to fee-based TMCNs (C40, About C40, 2022). With the mayors of each city as the main contact (see attachment III), the network has direct contact with decision-making authorities in each city.

Climate Alliance of European Cities with Indigenous Rainforest Peoples

Climate Alliance (CA) was founded in 1990 by 33 institutions, of which 12 were municipalities from Germany, Austria, and Switzerland, as well as 6 indigenous organizations of the Amazon Basin. Today, it has over 2000 members from all over Europe. It continues to have a strong commitment to climate justice via a partnership with the umbrella organization for the indigenous of Amazonia, known as COICA

(Coordinadora de las Organizaciones Indígenas de la Cuenca Amazónica), which is also part of the Executive Board of CA. The organization's members also committed to abstaining from using tropical timber. All members must pass a municipal resolution committing itself to continually cut greenhouse gas emissions, aiming for a 95% reduction by 2050 (compared to 1990 levels), which aligns with IPCC recommendations (CA, About us, n.d.; CA, Climate Justice, n.d.).

Climate Alliance strongly focuses on the EU in its advocacy work but also does projects in cooperation with EU institutions. Besides maintaining a range of working groups, such as one on adaptation to climate change, and tools for its members, it also offers a range of ready-made campaigns and awareness-raising material. Their members can use these to get their municipal administrations and residents involved in their efforts, such as the "Energy Caravan", which helps municipalities motivate citizens for energy retrofits through free energy advice by consultants to specific neighborhoods (CA, Energy caravan, n.d.; CA, Activities, n.d.).

Global Covenant of Mayors for Climate and Energy

The Global Covenant of Mayors for Climate and Energy (GCoM) calls itself the largest global alliance for city climate leadership, with a membership base of more than 12.000 cities and other local governments, representing more than 1 billion people and a potential to reduce global emissions by 1.9 GtCO2e annually in 2030 compared to a business-as-usual (BAU) trajectory based on current targets and actions. It is a merger of the former European Union's Covenant of Mayors and the Compact of Mayors, which happened in 2016. The GCoM requires a commitment at least as high as the country's NDC (Nationally Determined Contribution) in which the city is located (GCoM, 2019). The GCoM offers extensive space and options to disclose commitments and developments of cities in detail. It offers its reporting system, MyCovenant, or alternatively, the also well-established reporting system CDP-ICLEI Track (GCoM, How to join, n.d.; GCoM, Who We Are, n.d.).

The GCoM offers some support programs and tools to its members; however, it also delegates members to national or regional chapters and partners, who oversee the development of technical assistance plans for cities and their reporting on the targets, as

well as recruitment of new members, and engage other levels of government, NGOs or regional alliances and parallel initiatives. The list of partners of GCoM also includes other TMCNs such as C40 or ICLEI (GCoM, Who we are, n.d.). The Climate Alliance, for example, also states that it has been involved in the shaping of the GCoM since it became a global initiative and has contributed elaborate the GCoM's so-called "Multilevel Climate Action Playbook for Local and Regional Governments" in cooperation with the EU Commission and the UNFCCC (CA, 2022). Other TMCNs, such as ICLEI's GCC or national networks, for example, the Brazilian Forum CB27, actively recruit their members to sign up for the commitment by GCoM (Barbi and Macedo, 2019; Forum CB27, n.d.).

Eurocities

Eurocities was founded in 1986 and is one of the longest-established TMCNs, uniting over 200 of Europe's largest cities (Eurocities, About us, n.d.). Eurocities understands itself as "the urban voice" in EU high-level groups on issues like cultural heritage, food policy, mobility, and better regulation, alongside member states and other stakeholder organizations (Eurocities, Why become a member, n.d.). Eurocities poses itself and its members as "[...] essential partners for turning EU policies and ambitions into reality", which as such need to be "[...] included directly in European decision-making and should be in direct receipt of European funds (Eurocities, Why become a member, n.d.). Despite the strong focus on the EU, Eurocities also has members beyond the EU in other European countries, for example, Istanbul in Turkey, giving it a membership base in 38 countries (Eurocities, Cities, n.d.).

In contrast to the other cases, Eurocities is not a TMCN that looks at climate change as the main topic, although an absolutely central one. Besides the advocacy efforts for its members on an EU level, both for legislation and funding, Eurocities also facilitates exchange between its members and direct support to cities by its staff (Eurocities, Why Become a member, n.d.).

Under2 Coalition

The Under2 Coalition was founded in 2003 and is the largest global network of states, regions, provinces, and other subnational governments. At the latest, it is also committed to achieving net zero emissions by 2050. Its membership base comprises over 270 governments, representing 1.75 billion people and 50% of the global economy. Their work consists of 5 workstreams, which are "pathways" providing support for their members to develop long-term emission reduction plans, "policy action" through mutual learning, "transparency" through the disclosure of their members' commitments and actions, "diplomacy", for their members and their climate targets as well as a "future fund" that specifically supports climate activities in developing and emerging economy regions (Under2 Coalition, Our work, 2023).

Their core goal is for members to keep global temperature rise well below 2°C with efforts to reach 1.5°C, while over 40 states and regions have committed to reaching net zero emissions by 2050 or earlier (Under2 Coalition, Under2 Coalition, 2022). For this, the Under2 Coalition works with a Memorandum of Understanding (MOU) as a climate agreement to achieve net zero emissions by 2050 as a Coalition and individual net zero emissions as soon as possible. Their members can either sign up for or endorse the MOU (Under2 Coalition, MOU, 2021). According to the Boston University Initiative on Cities (Lusk and Gunkel, 2018), the organization allows cities to engage directly with state and national government members. This might potentially be of advantage for cities, for example, when trying to influence policy on a regional instead of only their local level that ends up causing emissions in their city, compared to other networks that do not allow other members besides cities and therefore do not offer this direct access.

Energy Cities

Energy Cities sees itself as a "learning community for cities". It does not only focus on energy-related issues, as its name might suggest but instead aims at "future proofing" their members' economies through a "local and sustainable first" approach. After 30 years of operation, the TMCN has decided that its sectoral approach is too narrow to address climate change (Energy Cities, 2021). Therefore, besides focusing on energy issues, the TMCN also works with its members on food systems or fair economies (Energy Cities, Vision and Mission, 2022).

Energy Cities has hundreds of members in 30 European countries and nearby countries such as Algier in Algeria. It can be characterized as a big tent network (Lusk and Gunkel, 2018), bringing together diverse cities of any size and other actors such as regional governments, collective members such as associations of cities, or energy agencies. The only commitment expected is to be willing to share, and members can join in different stages of their development.

UrbanShift

UrbanShift was launched in 2021 as a follow-up to a pilot phase of the Global Environment Facility (GEF) Sustainable Cities program that started in 2017. GEF's director of programs, Gustavo Fonseca, explains in the first yearly report of the network from 2022 that the program had "[...] quickly evolved into a global partnership with several key initiatives operating simultaneously to create sustainable solutions for cities in developing regions and countries." This is also reflected in the structure of UrbanShift, which is built on the cooperation of a range of TMCNs such as C40 and ICLEI, as well as supranational implementing agencies such as the UNDP or the Word Bank (UrbanShift, Annual Report 2021-2022, n.d.).

It has 23 member cities in the Global South, including China. UrbanShift's strategy is based on a two-fold approach of planning and executing projects locally, combined with capacity building through a knowledge platform managed by some partners. The expected result is to mitigate 170 million tonnes of CO2e emissions.

Clean Air Asia

Clean Air Asia (formerly Clean Air Initiative for Asian Cities) was launched in 2001 by the Asian Development Bank, the World Bank, and USAID, originally responding to air pollution. Throughout its existence, its main theme evolved with the topic into one that also comprises sustainable development, specifically, climate change (Clean Air Asia, Clean Air Asia Strategy n.d.).

The network's membership is based on a partnership with over 250 organizations in Asia and internationally. It works through six country networks (Indonesia, Malaysia, Nepal, the

Philippines, Sri Lanka, and Vietnam) (Clean Air Asia, n.d., Who we are), which differs from other networks in the sense of maintaining a country-specific focus on such a prominent level of the organization. Cities, furthermore, do not need to become official members, while the organization claims to be addressing Asia's 1,000+ cities. The organization also works across its different country networks, for example, in its conference Better Air Quality (Clean Air Asia (n.d.) Better Air Quality), its flagship event.

Clean Air Asia is a particular case that has put the co-benefit of climate action at the core of its strategy when saying, "Our mission is to reduce air pollution and greenhouse gas emissions in Asia and contribute to the development of a more sustainable, equitable and healthier region." (Clean Air Asia, n.d., Who we are). With this, it follows Olson's (1965) "by-product theory" by building on clean air as a selective incentive and a private good, using the actual collective good of a climate-safe future as a by-product, although an absolutely central one to their overall strategy.

6.3. Description of the data collection process

The data collection took place from 2022 to 2023. It started with collecting data through an analysis of the content of online material of the cases. A questionnaire then followed to gather further data. In the following, the process will be described in more detail.

First, each selected case was assessed by gathering data online. The first source was always the official website of each TMCN, which provided a first-hand account of their strategy, values, tactics, and operations. Generally, the websites also contain links to reports that the TMCNs have launched. The most relevant ones for the present research are mostly self-descriptions of the TMCN, such as "about us" or "our vision" sections, or also reports about past activities and achievements, such as yearly reports or strategic papers with their planning for the future, their mission, core values, etc. Those sources have been scanned from the newest ones backward to get the most up-to-date picture. For example, a strategic report about activities that are dated for the current period was used before reports were launched prior to that one. Whenever information was still lacking or unconsolidated, the next source was existing research and grey literature, such as blogs or third-party reports.

The material was analyzed in two different ways. For most mechanisms, information could be found and consolidated mostly through the websites, as there was little need for interpretation or confirmation, such as the number of members in the network. However, the indicators for hypotheses H5 and H7 are more ambiguous. In these cases, a structural content analysis, according to Mayring, was used, the objective being to "filter out particular aspects of the material, to give a cross-section through the material according to predetermined ordering criteria, or to assess the material according to certain criteria" (Mayring, 2014, p. 64). Following the steps of a structural content analysis of (1) defining categories and (2) anchor examples, which means "concrete passages belonging in particular categories are cited as typical examples to illustrate the character of those categories"' (Mayring, 2014, p. 95) and (3) coding rules (Mayring, 2014), the (1) categories in this dissertation are the mechanisms, which have been developed in chapter 5. Following Mayring (2014), deductive category assignment is an adequate procedure if there is relevant previous research, as with solutions for social dilemmas. Mayring also states that structural content analysis is indeed deductive (as opposed to other forms of content analysis, such as "summarizing") because the categories are deduced from theory, from other studies, from previous research, and the category system is established before coding the text. This is also the approach that the researcher has taken for this dissertation.

For the second step, the (2) anchor examples, a first review of the material was done to get an idea of what to look for and consolidate an example wherever data was ambiguous. The anchor examples can be found in Attachment III. All anchor examples have been chosen for the indicator with the highest value encountered.

In step three, the (3) coding rules are developed, especially used in ambiguous situations. Mayring states: "Where there are problems of delineation between categories, rules are formulated for unambiguous assignment to a particular category" (Mayring, 2014, p. 95). This means that when the assignment of a text passage to a category is unclear, considerations from the foundational theory of the categories can be used to decide and formulate a coding rule for this and follow similar cases. However, in this study, the ambiguity did not materialize in the distinction between categories but rather in the decision about the indicator score. It was, therefore, necessary to establish some rules to

decide which information would constitute which level of the indicator. For example, for the indicator of H7 on the efficacy of TMCNs, the use of verbs or nouns that indicate having a leadership role in influencing the entire movement, such as “being at the centre” or “lead”, would qualify for value 1, while “help” or “contribute” to a movement would qualify for the 0.67. On a second hypothesis, H6, about the use of co-benefits of a TMCN, C40, for example, has provided direct assistance to a third of its members to evaluate co-benefits of climate action in their cities. This was a service provided by C40 after publishing research, case studies, and reports on the topic. The additional information about a TMCN taking further strategic action to operationalize their appeal to co-benefits was also turned into a coding rule, moving the TMCN into the highest value 1.

The analysis, in some instances, led to different pieces of evidence. For example, when assessing hypothesis H4, “The mechanisms "Transparency" [independent variable] is used to increase cities' level of cooperation [dependent variable]”, and its indicator “Commitment of other members is publicly available” in the case of the Under2 Coalition, different pieces of information can be found on their website. It offers a map of signatories and endorsers of their commitment (called a Memorandum of Understanding) without adding any further data about the strategy for implementation or other qualitative information about each signatory. Additionally, however, the website also contains a report based on their first analysis of data submitted in 2021 to the Under2 Ambition Tracker, which not only highlights the collective commitments and actions of 62 state and regional governments, including 52 members of the Under2 Coalition but also outlines the key findings from their assessment of state and regional net zero targets and showcases examples of best practice. The pieces of evidence were then consolidated and checked against the indicator's scores, always considering the evidence related to the highest score of the indicator. As the evidence for the highest score of an indicator has been collected, other evidence suggesting a lower level was not further analyzed. For example, if there was a general statement about a TMCN striving for a reduction of emissions, and later one that specified the ambition to the highest score of the indicator, the second example was used. Whenever there are several statements with the same meaning, one specific representative is chosen. For example, the statement by CNCA "[...] our role as a global agenda setter for ambitious urban climate action, innovation lab for urban carbon neutrality solutions,

accelerator of action and results, and catalyst for systemic change, CNCA can help mobilize the transformative climate action [...]".

Further evidence that might be available but have less significance is therefore not further integrated. For example, if there is another report on the website of the Under2 Coalition, only showcasing a small number of their signatories, this evidence will not further change the assessment and was therefore disregarded. The result was, therefore, the first score of the indicator connected to the hypothesis.

After this data collection, some data gaps remained for specific mechanisms, such as internal data about the frequency of meetings between members of the TMCNs. A questionnaire was applied to close this gap, which was also used for control questions to verify the data collected before. This also takes into account that many TMCNs also maintain internal platforms that are only accessible through a login, where further information might indeed be available to all members of a TNM beyond the public website. Additionally, some questions have also been added to allow for comments about mechanisms and other perspectives that the researcher might not have included but could be considered essential by the respondents of the questionnaire. The additional questions, therefore, aim to uncover further mechanisms or other aspects. The questionnaires are available in Attachment I.

The format of a questionnaire has been chosen for three reasons. First, much of the requested information was data about the strategy and operation of the TMCN, which does not require a personal view of an interviewee. The person might, however, need to look up information internally. A questionnaire is a useful tool for this process that allows one to stop at each question according to the time needed and potentially come back later. Second, the researcher was mindful of potential challenges to establishing contact and getting the availability of interviewees to participate. In order to make participation as easy as possible, the researcher decided against an interview, which generally is less flexible and takes more time for each interviewee to schedule the interview and execute it. In order to keep the questionnaires as short as possible, wherever a data point was absolutely clear through the content analysis, for example, the membership number, the question relating to that data point was not included. Furthermore, a questionnaire also offers the advantage of a ranking

as an answer, which was developed in accordance with the indicators of each mechanism. Lastly, the researcher was in a working relationship with one of the TMCNs (C40) during the data collection. This could potentially have created a stonger reservation during the execution of the interview from the side of the interviewees. The questionnaire was therefore used as a written form of a structured interview (Mayer, 2004), assumed to pass stronger control about what is shared to interviewees, and potentially increase their willingness to participate. Furthermore, to take the working relationship into account, a transparency statement has also been added to the questionnaire, where the researcher discloses the information and declares that the research is an independent project and that any data beyond what is going to be published is not going to be shared with the TMCN C40, with which the researcher has the working relationship.

The questionnaires were sent to members of the management team of each TMCN. Management team members were chosen as experts who not only have access to the strategic decisions of the TMCN but also influence and set strategy directly. Additionally, they are generally supposed to be in close contact with the highest-ranking primary contacts of their member cities, allowing them to develop a perspective about how the TMCNs strategy resonates with their members and their decision-makers. In some cases, the person who was first contacted indicated a colleague, who then responded to the questionnaire. The exact roles of each interviewee can also be found in Attachment I. It is important to highlight that only seven of the 11 cases were filled in the questionnaire. Two cases could be kept in the set after thorough consideration, as the data for all mechanisms but one (H8) was available through the online assessment. The data was considered sufficiently strong despite the limitations of the lack of confirmation by the network representatives and was therefore kept to maintain the strength of a more varied set of cases.

Once all data was collected, the different data types were consolidated into the fsQCA mentioned above. For this, the following process has been used: As each condition in the fsQCA is based on a hypothesis, the data raised for each hypothesis was used. To include the data into an fsQCA, the researcher took an intermediate step by assigning indicators to each mechanism, which attempted to capture a prominent phenomenon of these mechanisms, depicted in scores in four thresholds (0; 0.33; 0.67; 1). The four thresholds

aim at reflecting the membership of a condition as non-membership, full membership, or crossover points in between - in the present case, a situation of a mechanism being present within a TMCN in the dimension of:

0 - No significance

0.33 - Minor to medium significance

0.67 - Substantial significance

1 - Close to or maximum significance

The intervals are calibrated to ensure that the data does not only indicate relative relationships. Calibration in the context of fsQCA is the process of converting raw data into a fuzzy-set score, where values typically range between 0 and 1, representing the degree of membership in a set. Based on the researcher's theoretical knowledge, each value was assigned to a specific definition (see attachment III for definitions).

In the next step, different data points needed to be consolidated into one indicator score. However, consolidating qualitative data from two different sources or data points is challenging, especially as qualitative data is often context-dependent and subjective. The quantitative data, such as the number of members of a TMCN, was assessed using the value of the indicator that was built before. For the qualitative data, to distill meaningful insights while maintaining the integrity of the original data, content analysis was also used here and then checked against plausibility criteria such as consistency, coherence, and relevance. Wherever there were discrepancies between the data collected through the content analysis and the questionnaires, the rule to consolidate the data was to build the average of both data points. Wherever the average was not available in the original four scores of the indicator, an additional score was introduced with 0.8 and 0.2. There were also two cases, where the average of both scores resulted in a score of 0.5 (see attachment III, tab Climate Alliance R22 and tab Under2 Coalition R21), which is highly problematic in an fsQCA due to its ambiguity. To decide if the condition is in or out, the researcher has assessd both data points again to decide wether the value should be below the actual average (0.33) or above (0.67) and has set the result accordingly (see notes in the attachment for each case).

Additionally, in some cases, especially in the case of multiple-choice questions, the additional explanations the questionnaire respondents gave led to the conclusion that the multiple-choice response was not completely adequate or potentially contradictory. When the researcher understood that the interviewee might not have understood the question correctly or that data from the online assessment was more substantial, this was noted in the comment section of the datasheet for each case.

The outcome was calculated through the use of two joint indicators. The first indicator measuring (1) the percentage of cooperators in the TMCN measures how many members have signed up for the commitment that the TMCN provides. The higher the number of signatories of the total number of members, the higher the number of the indicator. For those TMCNs that do not commit, there is generally no tracking of any mitigation-related commitments that their members have made elsewhere. This leads to a situation where the TMCN can not actually evaluate its success in directly influencing its members' willingness. It does not mean that there is no influence, but it gets even harder to establish a clear causality between network membership and the willingness to commit, on top of the already existing difficulty of tracking causality in this multi-factorial setting. Therefore, in all cases where there was no tracking, the indicator was set to zero, as even though some members might have made mitigation commitments in some way or another, these commitments can not be related to the TMCN in question, which does not require any commitment or track it.

The second indicator, measuring (2) the quality of the commitment used in the TMCN, measures the quality of any expected commitment or target the TMCN strives towards. In most cases, the TMCNs had a specific commitment members could or needed to sign up for, such as becoming climate-neutral by 2050. In exceptional cases, however, there was no commitment, but still an objective that the organization communicated. For example, Energy Cities states in its vision: "Our vision is that, by 2050, we will all be living in decarbonized and resilient cities [...]". This was considered sufficient to assume that the TMCN strives towards this goal, even though individual members are not technically obliged to commit. It can, therefore, be assumed that the TMCN nevertheless wants its members to work towards this goal but uses mechanisms other than a mandatory

commitment or sanctions to achieve sufficient willingness of their members to do so. The goal a network strives towards was therefore used to measure the quality of the commitment even in the absence of a high expectation of making the commitment or sanctioning those that do not commit.

6.4 About measuring the impact of TMCNs and general limitations

Before beginning the analysis, a brief discussion of the dissertation's objectives and methodology will be provided here, especially of two challenges: The first one is about causality. Measuring impact is generally based on establishing causality between an exogenous and an endogenous factor, in the sense that the impact of the former on the latter is studied. It is important to highlight that the analysis is done in a setting where causality is hard to trace. This is, on the one hand, due to the complex context in which varied factors, such as the mechanisms discussed and the capacity and opportunity to act, play a role. Also, a city's decision can hardly always be tracked down to the influence of one organization, as numerous ones are trying to impact the decision-making process. This could be an influence to prevent the city from making a commitment or influence in the same direction as the TMCN, such as other environmental groups. In the latter case, in the end, it might be hard to distinguish between the pressure from local groups like "Fridays for Future" and the influence from a TMCN, as both might have had a role in a city committing. Additionally, the direction of the causality might be a challenge. There is a chicken and egg situation, as a city might become a member of a network and increase its willingness to cooperate, or it might already have had that willingness and joined the TMCN to then make use of the benefits that come with the membership, for example, reputational benefits through the networks campaigns of high-level political opportunities for mayors. Transferring learning from the lab to real life can also be challenging. Mazar and Soman (2022) explore a range of difficulties in this process, such as behavioral interventions indeed pointing citizens toward the right behavior. However, systems are sometimes so complex that a mere increase in the intention of individuals does not translate into actual action. As indicated below, for further research to strengthen the assumption of causality and confirm its direction, it will need to be assessed in every specific case for each mechanism and also in each TMCN, as these interventions are very context-dependent. Nevertheless, it can be

assumed that TMCNs have developed and continuously improved their mechanism over the years either in a trial and error approach or sometimes also in science-based and tailored interventions, and found those to be working due to a causal relation as a primary experience.

A specific challenge stems from the difficulty of assessing a city's willingness to participate in the outcome of the fsQCA. In this dissertation, committing has been used as a proxy, but not without leading to some caveats. Commitments to act cannot be determined a priori or by observation of behavior alone and must be accompanied by the observation of intentions (Hardin, 1982, p. 103). In other words, just committing does not guarantee that the content of the commitment will be delivered. Haarstad, for example, recognized that "[...] target-setting is a political-rhetorical practice, and therefore not necessarily representative of actual processes of transformation [...]" (Haarstad, 2020, p. 65). Furthermore, commitments might also be based on targets with different standards, such as an absolute or relative reduction or total or per capita emission reductions (Leal and Azevedo, 2016). Leal and Azevedo have reviewed the targets of cities in the context of local energy planning and shown a lack of standardization, leading to a difficult comparison between cities and preventing assessment of their global impact (Leal and Azevedo, 2016). Nevertheless, they recognize the need for targets as "[...] crucial to the successful outcome of any plan, as they guide and facilitate the monitoring process of its implementation and the desired goal(s)achievement" (Gupta et al., 2007 as cited in Leal and Azevedo, 2016, p. 421). Making a public commitment can also facilitate "naming and shaming" by other parties (Aldy, 2018, p. 211). The credibility of a commitment also depends on transparency, not only of the commitment but also of its ex-ante pledge and ex-post outcome (Schelling, 1956, p. 288). Additionally to this accountability aspect, Haarstad highlights that interventions need to be legitimized, which is where metrics and targets can play a role (Haarstad, 2020). This transparency or "publicity" can be provided through international institutions, including non-profit organizations, academics, business stakeholders, and other non-state actors (Keohane, 1998; Aldy, 2016). In this sense, the targets and commitments can be considered necessary but insufficient prerequisites for transformative action. This should also be considered when "sufficiency" is evaluated, where a restricted extent of sufficiency should be used due to the described caveats.

More recently, targets in cities have also started to be accompanied by implementation plans, where the target is linked to concrete action in different sectors. They contribute to institutionalizing climate trajectories, creating a lock-in effect that sets the frame for local climate governance (Busch, 2018). For example, C40 had been calling members to sign up for their initiative "Deadline 2020" (C40 Cities and Arup, 2017) in 2017, which developed a pathway for cities to prepare for a trajectory in line with the 1.5°C target of the Paris Agreement. Since then, it has moved further ahead and requires the publication of a so-called "Climate Action Plan" in line with the Paris Agreement. After committing, The GCoM requests members to move along their so-called "city journey", where one of the next steps is to provide a climate strategy to implement and measure success (GCoM, n.d.). These targets and plans are generally required to pass through local legislators, such as local councils, making them more binding. In fact, the Under2 Coalition has found that when compared with governments that do not have a regional net zero target or published net zero action plan, governments reporting both of these have, on average, most significantly reduced their GHG emissions since the base year 1999 (Under2 Coalition, Under2 Coalition Net Zero Progress Report 2022 (website summary), 2022). The tendency of a stronger command-and-control approach and giving more importance to the elaboration of membership terms within TMCNs is also in line with recent findings of research (Nielsen and Papin, 2020) and can be assumed to increase in the future, specifically for those TMCNs that understand themselves as frontrunners. In this sense, using commitments as the outcome is restricted in its reliability about future action but can be a valuable approximation to measure future intentions of cities, increasingly so with concrete plans and measurements being added to these commitments.

7. Analysis and findings

In this chapter, the results of the analysis are going to be presented. All three research questions will be answered, followed by a critical view of limitations. Afterward, the results are also translated into recommendations for future improvements toward a higher level of the GPG and options to transfer learnings to similar contexts in Chapter 8.

7.1 Analysis of the collected data

The collected data will allow us to start responding to the research question through the subordinate questions. Each of the questions will be responded one after the other. The methodology that will be used will vary for each subordinate question and also be presented one after the other, starting with the first one:

1) Which mechanisms are Transnational Municipal Climate Networks using to influence their member cities' willingness to commit to the reduction of Greenhouse Gas emissions?

After establishing seven mechanisms from theory, this set of mechanisms was used to assess the cases in terms of the presence of each mechanism. As a result, the presence of these mechanisms was confirmed in varying degrees throughout the cases. The data was collected and brought together in the data matrix below based on the indicator and process described above. The matrix shows the score for each case, mechanism, and outcome (for detailed data, see attachment III). As explained above, the outcome was calculated as an average of two different scores, which are also shown separately in Table 9 below.

CaseID	H1	H2	H3	H4	H5	H6	H7	**Out-come**
1 Climate Alliance	0.33	0	0.67	0.67	1	0.33	0.8	**0.8**
2 Eurocities	1	0.33	0.33	0	0	0.33	1	**0.67**
3 C40 Cities	1	0.67	0.8	0.8	1	1	1	**0.67**
4 Under2 Coalition	0.33	0.33	1	0.67	0.67	0.67	1	**0.67**
5 Clean Air Asia	0	0	0	0.33	0.8	1	0.33	**0.33**
6 Urban Shift	0.67	0.8	0	0.2	0.8	0.33	0.67	**0.33**
7 GCoM	0.33	0	0.67	1	0.67	0.33	0.67	**0.67**
8 CNCA	0.67	1	1	1	1	0.67	0.8	**1**
9 Energy Cities	0.33	0	0	1	0	0.33	0.67	**0.33**
Average	0.52	0.35	0.50	0.63	0.66	0.55	0.77	0.61

Table 8: Data matrix.

TMCNs	Quantity of the outcome	Quality of the outcome	Total
1 Climate Alliance	0.67	1	**0.8**
2 Eurocities	0.67	0.67	**0.67**
3 C40 Cities	0.67	0.67	**0.67**
4 Under2 Coalition	0.67	0.67	**0.67**
5 Clean Air Asia	0	0.67	**0.33**
6 Urban Shift	0	0.67	**0.33**
7 GCoM	0.67	0.67	**0.67**
8 CNCA	1	1	**1**
9 Energy Cities	0	0.67	**0.33**

Table 9: Separate scores of the outcome.

The matrix in Table 8 shows that the mechanisms are used throughout the TMCNs. A few mechanisms stand out regarding how intensely they are used throughout the networks. The bottom line of the table shows the average use of each mechanism. H7, “A feeling of efficacy”, stands out as the most used one, followed by H4, “Transparency”, H5, “Altruism, fairness or the greater good (social preferences),” and H6, “Individual utility maximization”. It can be noted that those are also the mechanisms with the lowest requirement level for making a commitment. H2 “Smaller groups size effects” scores lowest, as only CNCA, C40, and UrbanShift use this mechanism more expressively. H3, "Increased expectations of others cooperating," and H4, "Transparency", most related to direct commitments throughout the mechanisms, range in the middle regarding how much

they are applied, with some TMCNs using them quite intensely and others not using them at all.

To uncover additional mechanisms that the choice of theory might have left out, the questionnaire also asked the interviewees about their views on the most effective mechanism. When looking at the answers in Table 10 below, there is a mix between answers. On the one hand, the answers focus on activities that TMCNs had been doing traditionally, such as capacity building or creating opportunity, for example, by "mobilizing support for implementation". On the other hand, the answers also focus on TMCNs' activities that aim to influence the decision process and a city's willingness, as the focus of this dissertation, and an activity that has gained more weight throughout TMCNs, as discussed above.

Question: When you think about the process in a city to make the decision about committing to a greenhouse gas reduction target: Which measures do you think are the most effective ones that your organization can take/ is taking to influence this decision in a positive way? Do you have any anecdotes in that concern that you could share?	
Climate Alliance	A democratic agreement is needed (political commitment), to implement activities a systematic approach is important (not only individual actions), instruments for monitoring the success are key (Climate Alliance have developed own instruments), good communication and first projects to involve citizens. If there is no political willingness to act, all sorts of excuses are used, from the argument that it's too expensive or the one that they can do everything alone.
Eurocities	Sharing of best practices
C40	Resources to support them to produce climate action plans and deliver action - especially in the global south

	Peer pressure from the fact that other cities in their country have already committed, and hence can turn negative perception into a positive one
Under2 Coalition	Political leadership and stakeholder engagement
Clean Air Asia	Policy changes Institutional capacity strengthening Action planning and mobilizing support for implementation
UrbanShift	There are many ways to assist in the decision process. I would highlight two that seem particularly important. Assist with the definition of these targets through technical assistance (to understand emissions, define targets) and encourage the political will by creating spaces to showcase the commitment. We do both within our project through our Climate Workstream and Advocacy activities.

Table 10: Questionnaire answers to general questions about mechanisms.

Four out of the six networks indicated willingness, and therefore strengthening the research's theoretical background and hypothesis about the importance of TMCNs work in influencing their members'willingness. Climate Alliance has quite directly referred to it as a fundamental feature for action to occur while also highlighting the need for a collective approach instead of one based on the actions of individual cities. In the form of a mechanism, this can be interpreted as one close to H7, "A feeling of efficacy" in the sense of calling for a sufficiently comprehensive movement to achieve sufficient impact. Monitoring and communication both align well with mechanism H4, "Transparency". C40 references peer pressure from other cities. This aspect could also be used in further research and be analyzed as an additional mechanism. This could be especially interesting in the context of polycentric systems, as those also build a lot on competitive behavior to develop adequate institutions. The Under2 Coalition highlights the political aspect of the decision-making process, as also discussed above, as a complementary feature to technical and other support by TMCNs with political leadership. Lastly, UrbanShift highlights political will in

connection with the opportunity to showcase cities' commitments, which aligns with H4 "Transparency".

2) How can the effect of Transnational Municipal Climate Networks on the provision of the Global Public Good "climate-safe future" by cities be explained through these mechanisms?

The data matrix in Table 8 will serve as the basis for the subsequent analysis through the means of an fsQCA. A software was also used for the analysis. In conducting the fsQCA, utilizing specialized software was imperative due to the combinatorial complexity inherent to the analysis. With seven conditions, there are 2^7, or 128, possible combinations of conditions. This exponential increase in potential causal configurations presents a significant analytical challenge, which might not be adequately met with scans by the researcher and manual calculations. Additionally, with nine cases, the task of accurately assessing consistency and coverage scores for each combination becomes computationally demanding. The software facilitated a systematic and rigorous examination of these configurations, identifying which combinations of conditions are associated with the outcome of interest, for example, by assessing their empirical relevance through consistency and coverage metrics. Such computational efficiency and methodological rigor are necessary to derive robust and reliable conclusions from the fsQCA. The software used is fsQCA and has been made available by Charles Ragin, who has also developed the methodology (Ragin, 2022).

To understand the effect of TMCNs on the willingness of their members to contribute to a climate-safe future, the proposition will serve as a starting point and will be assessed through the hypothesis connected to it as follows:

> **Proposition**: TMCNs use mechanisms [independent variable] to influence cities' "willingness" [dependent variable] in the decision process in the social dilemma
>
> **Hypotheses**: H1-7 state a positive relationship between the mechanisms and cities' level of cooperation

→ **Sub-question 1**: How strongly are conditions related to an outcome: necessity and sufficiency analysis

→ **Sub-question 2**: Are specific configurations of conditions related to specific types of TMCNs or special features of TMCNs

Sub-question 1 will first be analyzed. The intensity of the relationship between the mechanisms and cities' level of cooperation can be assessed through an fsQCA. Two different approaches can be used to do this. The first one is analyzing the mechanisms (conditions) necessary for the outcome, generally used to determine whether a specific condition(s) is/ are necessary for an outcome to occur. A condition is considered necessary if it must be present for the outcome to occur. Consequently, whenever the outcome happens, the necessary condition is always present. However, there are also varying degrees to which this is true, and a condition can very well be partially necessary, being present (to varying degrees) in many cases where the outcome occurs, but not necessarily without any exception. This also concerns two concepts used in an fsQCA: consistency and coverage. These two measures provide insights into the strength and significance of the relationship between conditions and the outcome. The first concept, consistency, measures the degree to which the presence of the outcome corresponds with the presence of the condition.. A high consistency score suggests a strong relationship, indicating that whenever the outcome occurs, the condition is present. Scores closer to 1 (or 100%) indicate a stronger relationship.

The second concept, coverage, measures how much of the outcome is explained by each solution term (combination of conditions) and the solution as a whole (Ragin, 2017). High coverage scores mean that the condition(s) explain a large portion of the cases where the outcome occurs, signifying their empirical relevance. For example, if a coverage score for a specific configuration is 0.65, then this means that 65% of the outcome of all cases where the outcome is present can be explained by the presence of that configuration.

The researcher assessed the necessity of all conditions separately with the software fsQCA, where the data matrix was uploaded. The results for both consistency and coverage are displayed in the following table:

Condition	Consistency	Coverage
H1 - "group identity"	0.546053	0.533762
H2 - "Smaller groups size effects."	0.611842	0.865116
H3 - "Increased expectations of others cooperating"	0.825658	0.774691
H4 - "Transparency"	0.865132	0.629187
H5 - "Altruism, fairness or the greater good (social preferences)"	0.884868	0.607223
H6 - "Individual utility maximization."	0.431208	0.805643
H7 - "A feeling of efficacy"	0.825658	0.525105

Table 11: Results for testing the necessity of the conditions.

To analyze the data, consistency was specifically used to assess necessity and coverage to understand the empirical relevance of each condition. The conditions with the highest consistency are H3, H4, H5, and H7, all scoring higher than 0.8. This means that whenever one of these mechanisms is present, the outcome also tends to occur. As H3, "Increased expectations of others cooperating," and H4, "Transparency", are most directly required to commit and therefore the outcome, the high value of their necessity is consistent. H5, "Altruism, fairness or the greater good (social preferences)," together with H7 – “A feeling of efficacy,” are mechanisms that specifically use the power of appealing to the networks’ members without taking any other direct measures. This can be interpreted as a confirmation that the increased sense of being part of a bigger problem and a collective effort to solve it, coupled with a feeling of efficacy, encourages member cities to actively commit due to their belief that their contributions are impactful towards achieving the network's goals. This finding highlights the importance of this mechanism. It fosters a

strong sense of impact within TMCNs to enhance their effectiveness in promoting climate action, indicating that strategies to strengthen this feeling of efficacy could be important for TMCNs in achieving their members' commitments.

Looking at the coverage of these conditions, we can see that, out of these four conditions scoring high in consistency, the score is especially high for H3, making it empirically especially relevant. Interestingly, H1 is scoring lower in both scores of this analysis, suggesting a weaker relationship with the outcome. H6, a mechanism that is used in many of the cases and is based on co-benefits, is the one that most leverages individual benefits in this collective dilemma situation. The mechanisms appealing to a more collective thought, such as H7 and H5, are scoring higher and seemingly more closely related to the outcome.

We will now look at specific combinations of conditions to uncover relationships between mechanisms and which ones might be effective when used together. Given the large number of possible combinations, examining all combinations would be impractical and increase the risk of finding patterns that are statistically significant but not theoretically meaningful or generalizable. Instead of examining all possible combinations, we will start with a theory-guided approach to ensure the configurations have theoretical relevance and are causally plausible.

A first assessment based on the theory is that different types of TMCNs use different combinations of mechanisms. The differentiation between high hurdle and big tent networks has already hinted at the differing levels of commitment they ask from their members and the size of their membership. High hurdle networks should have higher requirements and be smaller in size, besides other potential factors such as being less flexible in their membership terms, while big tent networks have the opposite characteristics. Two mechanisms and the data collected for them were applied to test if the pattern of high hurdle and big tent networks can be found in the set of cases. The first one is H2, “Smaller group size effects”, which contains the data for the size of each network, combined with H3, "Increased expectations of others cooperating", containing data about each network’s expectation towards its members to make a commitment, which can be interpreted as the hurdle.

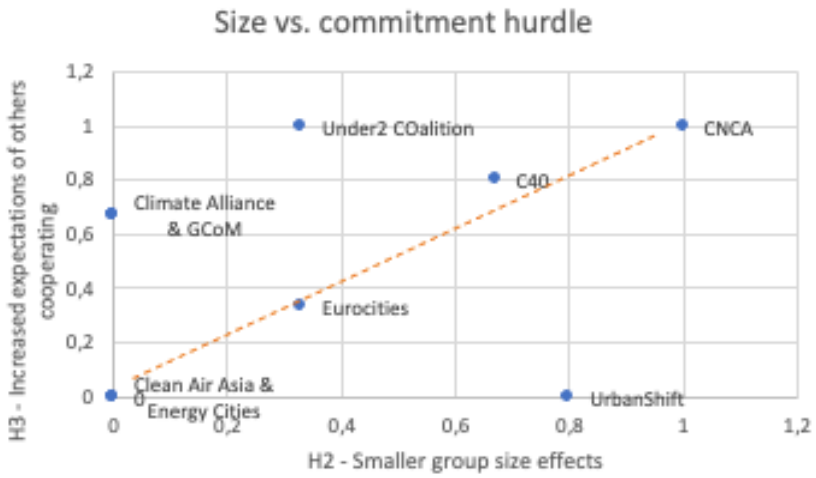


Figure 9: Size vs. commitment hurdle (Source: own creation by the author).

Figure 9, "Size vs. commitment hurdle," shows a clear pattern, where TMCNs lose in size and gain in the height of the hurdle, following the red line. The lower left-hand corner shows one side of the extreme with big tent cases, while the upper right-hand side shows the extreme for high hurdle cases. This confirms the dichotomy of big tents vs high hurdle networks, although two categories as a mix of both might still make sense in between.

Including this additional perspective, the quadrants in Figure 10 can help to find all four possible combinations of H2 and H3, resulting in a slightly extended version of the definition of high hurdle and big tent networks, which in this dissertation are going to be named: Q1 - High hurdle, Q2 - High hurdle tent, Q3 - Big tent and Q4 – Small low hurdle. Notably, the diagram scheme is, first of all, based on theory, while the cases are added through empirical data. All cases are included, while the outcome is absent in some cases (Clean Air Asia, Energy Cities, and Urban Shift).

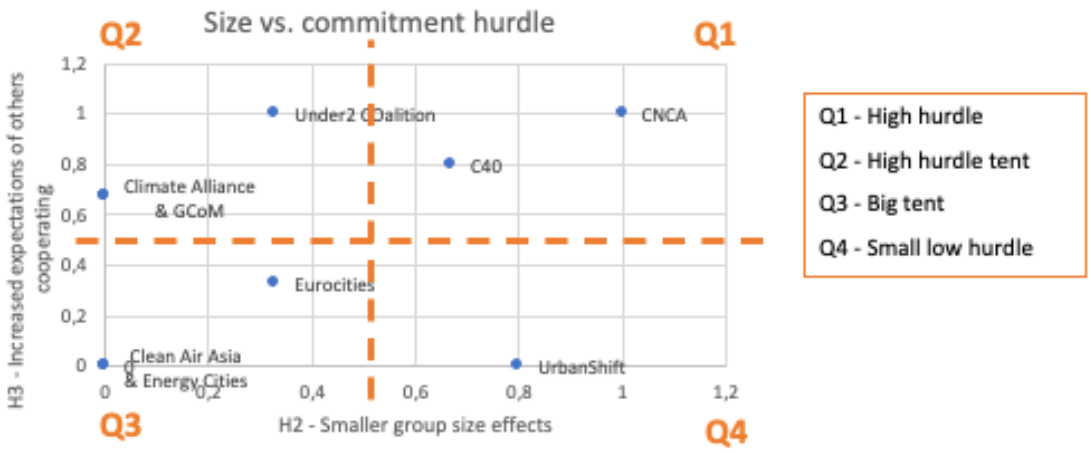


Figure 10: Size vs. commitment hurdle with quadrants (Source: own creation by the author).

To explain the two new typologies: Q2 is composed of networks with a mix of being of size and therefore a big tent, but at the same time also requiring strong commitments from their members and therefore having a high hurdle as well. These “high hurdle tents”, from the viewpoint of theory, could be built on H3, “Increased expectations of others cooperating" in terms of the requirement of a commitment, as well as H7, “A feeling of efficacy", to use their collective power. This is also going to be reflected in one of the solution paths, which is shown below.

Further on the graph, we now also have a situation where, empirically, there is a case in quadrant Q4. However, theoretically, the existence of at least the raison d’etre of such a case can be questioned, as it does not sound convincing to build small networks with low requirements for commitments. However, we still want to look at that option in the following sense: As Ragin (2017) points out, a counterfactual analysis can help to overcome the fact that naturally occurring social phenomena are limited in their diversity and rarely occur in all logically possible combinations. He highlights that one of QCA’s key strengths is to consider counterfactual cases systematically and explicitly, which can help to overcome the challenges presented by often small numbers of cases. However, counterfactual cases do not occur and are not part of the empirical data. In the present context, however, Q4 could be considered a counterfactual from the theory perspective, as the typology of a small-sized network with little or no requirements for commitments can be doubted. There is, however, the theoretical reason for such a type to exist, which is now

also found in the empirical data: A transition period that the network is in, as is the case of UrbanShift, which is a very recent organization and has already signaled to increase its requirements for its membership to commit in the future. This typology might, therefore, be a phenomenon with restricted relevance in the present but become a typical case like the other three types within a certain amount of time. The analysis will also be restricted to these three types in the following sections.

The typology is especially interesting to use in this section, as it allows us to differentiate between TMCNs in terms of their role in a polycentric ecosystem. As a climate-safe future is a common dilemma situation with one general goal, all networks that work to achieve that goal aim in the same direction. However, they might also recognize that there are different stages of committing, as well as different opportunities and capabilities as discussed above, and therefore, they should align their strategies with different types of cities and the situations they find themselves in at a certain time. For example, a city could start its journey to reduce emissions in a big tent network that does not require direct commitments and then move along to higher ambition and potentially higher hurdle networks. It becomes clear that there are variations between each network's role and the mechanisms they apply. This eventually also means that each network should be measured against its type's performance indicators to ensure that the performance is not misinterpreted, such as rating the performance of a big tent network very low if it shows a smaller score of the outcome.

We can now compare the network's application of mechanisms in this context. Clean Air Asia and Energy Cities, as big tent networks, achieved a rather low score for the outcome, with both scoring 0.33. They are also in line with each other regarding their use of mechanisms for H1 – H3 but differ quite strongly in using all other mechanisms. While Energy Cities uses H4, "transparency", and H7, "A feeling of efficacy", Clean Air Asia builds on a combination of H5, "Altruism, fairness or the greater good (social preferences)," and H6, "Individual utility maximization,", both mechanisms that either appeal to voluntarily cooperating or due to individual benefits. The specific characteristics of energy cities operating in Europe might explain why the network, although having generally low hurdles, nevertheless uses a mechanism directly linked to each member's

level of commitment by showing their individual commitment. In contrast, an Asian network might use a more anonymous approach according to the regional culture. Both networks do, however, refrain from using strong coercive measures and instead go for motivational ones. Overall, their low score in terms of the outcome can also be explained in two different ways. First, both networks use the seven mechanisms analyzed in this research to a smaller extent and might have room for additional application. Second, however, this might also be part of a broader strategy of the networks in order to keep barriers as low as possible and prioritize access to all kinds of members and their engagement over their inclusion and potentially less activity around emission reduction in cities without any membership at all.

Climate Alliance and GCoM, as the most typical cases for what has been named a high hurdle tent in this research, score high in terms of their outcome with 0.8 and 0.67, respectively. They also are very closely aligned in their use of mechanisms, with high values for H3, "Increased expectations of others cooperating", H4 "Transparency", H5 "Altruism, fairness or the greater good (social preferences)" and H7, "A feeling of efficacy". With this combination of mechanisms directly requiring a commitment, but in a slightly more flexible manner than CNCA uniting a vanguard connected to motivation, they might be balancing a mix of allowing participation for a bigger mass, but with sufficient substance to also create meaning and real impact to attract especially the broader mass of frontrunners and second movers that want to be seen as active for a climate-safe future, but are not able to make the highest possible commitment at that moment.

Lastly, CNCA and C40 are typical cases of a high hurdle network, scoring nearly as high as the others in all mechanisms. One slight but important difference is the application of H3, "Increased expectations of others cooperating", where CNCA uses the highest application, requiring the highest possible level of commitment and creating a group of only frontrunners. At the same time, C40 still allows for a development path, although on a very high level. Summing up, it can, therefore, be said that not only do different mechanisms seem to vary in how strongly they are connected to the outcome. The application of mechanisms and their combinations and intensity also depends on the network type that applies it.

A first configuration to be tested is, therefore, one that could be assumed to be used by a high hurdle network, consisting of a combination of H1 “group identity”, H2 “Smaller group size effects”, H3 “Increased expectations of others cooperating” and H4 “Transparency”. H1 sets higher requirements regarding membership type, while H2 aims in the same direction, specifically assuming that more exclusive and small networks can lead to higher commitments. H3 directly aims at a member committing and eventually sanctioning or excluding non-committers. H4 can be considered a slightly softer mechanism, as it does not directly sanction non-commitment but includes a form of naming and shaming.

High commitment 1		
Configuration	Consistency	Coverage
H1+H2+H3+H4	0.967105	0.447489

A consistency score close to 1 suggests that the configuration is almost always present when the outcome is present, indicating that the condition is necessary for the outcome to occur. To further narrow down necessary conditions in the context of high hurdle networks, the softest of the mechanisms, H4, was dropped, and only H1+H2+H3 was tested, however, with a lower result. This suggests that the configuration containing all four mechanisms is superior, although the level of coverage is lower, and therefore, the configuration is present in fewer cases where the outcome occurs.

High commitment 2		
Configuration	Consistency	Coverage
H1+H2+H3	0.940790	0.567460

A second approach is now to look at mechanisms that might be more common in big tent networks, with H4 “Transparency”, H5 “Altruism, fairness or the greater good (social preferences)”, H6 “Individual utility maximization” and H7 “A feeling of Efficacy”. These mechanisms can be applied without requiring strong commitments from the membership, even though H4 in this context does create some pressure for a commitment through the naming and shaming effect.

Low commitment 1		
Configuration	Consistency	Coverage
H4+H5+H6+H7	1.000000	0.379052

Again, the consistency is very high, and this time achieves the highest score of 1. H4, as the hardest mechanism in this setting in terms of requiring a commitment, was dropped to narrow down the most necessary conditions in the configuration. As a result, the consistency stayed the same, suggesting that H4 is unnecessary for the configuration, and the coverage rate is also slightly higher. Therefore, the necessity analysis for both configurations also indicates that the typology of big tent and high hurdle networks is reflected in the data collected, and the theory is supported empirically.

Low commitment 2		
Configuration	Consistency	Coverage
H5+H6+H7	1.000000	0.449704

While a condition might be necessary (in varying degrees) to create an outcome, it does not mean that it is also sufficient to bring about the outcome. This means that while the condition is critical for the outcome, it may not be enough to cause the outcome. Other conditions might also be required. Sufficiency in this context refers to the idea that a

configuration is enough, or sufficient, although at the same time not necessary, for the outcome to occur. A sufficient condition or configuration, when present, guarantees the outcome but is not always necessary for the outcome to occur. We will, therefore, also look at sufficiency as suggested in fsQCA in a second step.

A truth table was constructed based on the data matrix using fsQCA to assess sufficiency. The truth table groups similar cases based on their configurations of conditions. Each row in a truth table represents a unique combination of conditions. It is particularly useful for assessing sufficient conditions because it allows us to see which combinations of conditions consistently lead to the outcome. After running the "truth table analysis", the first version still requires setting cutoffs to indicate which configurations are considered relevant using the "Delete and code" function. The frequency cutoff was set to 1, requiring any configuration considered relevant to be represented through at least one case in the empirical data. The second cutoff was set for consistency, which reflects the degree to which a specific configuration reliably leads to the outcome across all cases. The consistency cutoff determines which configurations are considered sufficiently reliable, leading to the outcome. Setting the cutoff requires finding the right balance between a threshold that ensures reliability and one that allows for identifying patterns or solution paths that are still meaningfully related to the outcome. The cutoff was set to 0.95 and as a consequence, seven configurations continued in the truth table, which was then submitted to a standard analysis.

However, the results for the sufficiency analysis must be taken with care due to the limitation in variability and generalizability. This circumstance will still be discussed below and complemented with an additional qualitative approach. Nevertheless, the findings of the analysis with the consistency cutoff of 0.95 will be presented as follows, as they provide insights in terms of configurations that reflect scenarios under which an outcome can occur, although the very definition of "sufficiency" should be understood more flexibly.

H1	H2	H3	H4	H5	H6	H7	number	outcome	cases	Raw cons.	PRI cons.	SYM cons.
0	0	1	1	1	0	1	2	1	cases	1	1	1
1	1	1	1	1	1	1	2	1	cases	1	1	1
1	0	0	0	0	0	1	1	1	cases	1	1	1
0	0	1	1	1	1	1	1	1	cases	1	1	1
0	0	0	1	0	0	1	1	0	cases	0.716667	0	0
0	0	0	0	1	1	0	1	0	cases	0.662243	0	0
1	1	0	0	1	0	1	1	0	cases	0.492537	0	0

Figure 11: Reduced truth table.

While passing through the process of firstly reducing the truth table, the software is sometimes unable to fully reduce it, which leads to the need to choose prime implicants to be used. These are "[...] product terms that are produced using minimization rules (e.g., rules that combine rows that differ on only one cause if they have the same output value)" (Ragin, 2017, p. 57). The manual uses the example ABC combined with AbC to produce the prime implicant AC. The capital letters are used for the presence of a condition, while the lowercase letters are used for absence. The software uses a tilde before a condition in case of its absence. This was also the case in the present research, and all prime implicants were chosen to achieve the largest possible variation. The prime implicants were available for different configurations as shown below. Also, the red bar that the software uses (see Figure 12) indicates the extent to which each prime implicant covers the conditions in the row above, indicating that the configuration was fully covered.

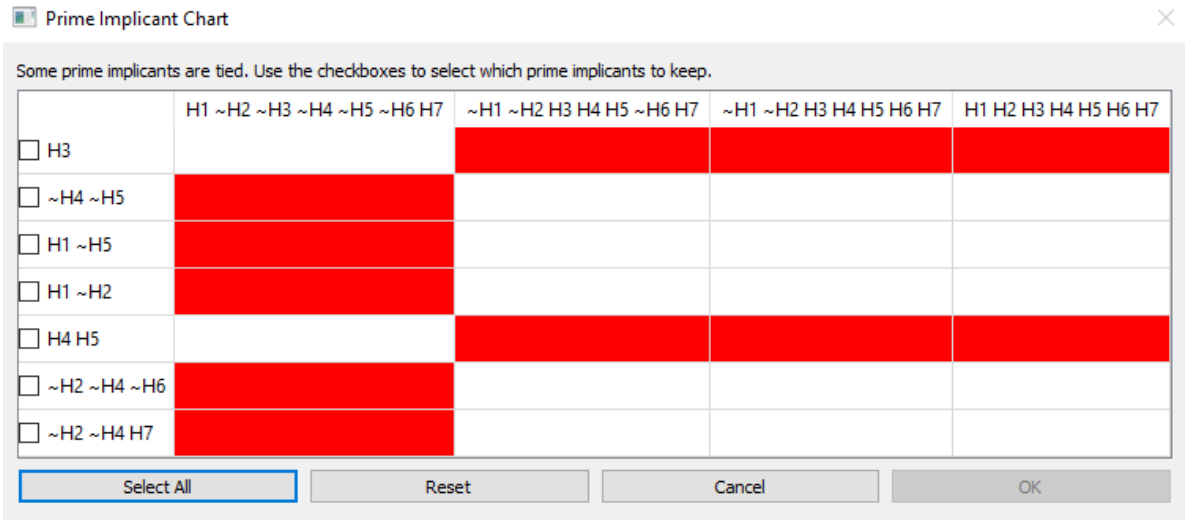


Figure 12: Prime implicant chart (Source: fsQCA).

In the next step, the researcher needs to choose how each causal condition should theoretically contribute to the outcome in an intermediate solution, with the options "present", "absent", or "present or absent". The researcher has chosen "present" for all conditions, as none of the conditions are assumed to have a specific impact when absent.

From the three possible solutions that the software then generates, parsimonious, intermediary and complex, the latter was chosen. This decision was based on the fact that the other two had substantially reduced the number of variables in the solution configurations to as few as one or two remaining ones. The parsimonious solution aiming for the highest level of simplicity can also lead to overly reductive explanations, especially if it reduces a complex set of variables to just a few. Based on the researcher's theoretical understanding, more variables are necessary to explain the outcome adequately, using the principle of conjunctural causation inherent in QCA. The complex solution offers a more detailed and potentially more accurate representation of the relationships between conditions and outcomes, providing a more differentiated understanding of a complex setting.

The complex solution leads to three different paths as a solution set, with a total solution coverage of 0.771481and solution consistency of 1. Both values are quite high, indicating that the model is quite consistent in explaining the outcome.

Solution paths	H1	H2	H3	H4	H5	H6	H7	Raw Cov.	Unique Cov.	Consist.
Solution coverage: 0.771481 Solution consistency: 1										
Path 1: high hurdle tent ~H1*~H2*H3*H4*H5*H7	0	0	1	1	1		1	0.367459	0.30713	1
Path 2: big tent networks: H1*~H2*~H3*~H4*~H5*~H6*H7	1	0	0	0	0	0	1	0.159049	0.159049	1
Path 3: high hurdle network H1*H2*H3*H4*H5*H6*H7	1	1	1	1	1	1	1	0.305302	0.244973	1

Table 12: Solution paths.

Each line represents a different configuration of conditions that leads to the outcome. Raw coverage indicates how much of the outcome is covered by each of these configurations or paths, while unique coverage indicates how much of the outcome is covered only by a specific path (Schneider and Wagemann, 2012). Consistency, again, measures how consistently the configuration leads to the outcome. A consistency of 1 means it always does, while lower values indicate less reliability. The asterisk symbol (*) in the paths represents a logical AND.

For all paths individually, the first two measures, raw coverage and unique coverage, are extremely low, which adds to the caution required when using the sufficiency analysis, as

mentioned. However, the paths also indicate the same pattern already seen in the truth table. Parts of the typology of networks introduced above can be identified throughout the four pathways.

When looking at the case membership, which is also calculated through the software, the membership again corresponds to the typology used above. The membership indicates whether a specific combination of conditions is associated with the presence of the outcome for that particular case and, therefore, whether the case supports the assumption that the configuration leads to the outcome. The membership for all three paths and cases is reasonable with scores that are neigther very low nor very high.

Path	Membership (conditions, outcome)
Path 1: ~H1*~H2*H3*H4*H5*H7	Climate Alliance (0.67,0.8) Under2 Coalition (0.67,0.67) GCoM (0.67,0.67)
Path 2: H1*~H2*~H3*~H4*~H5*~H6*H7	Eurocities (0.67,0.67)
Path3: H1*H2*H3*H4*H5*H6*H7	C40Cities (0.67,0.67) CNCA (0.67,1)

Table 13: Case membership of the different paths.

We will now look at each path and how they collectively contribute to understanding the outcome. We will also use descriptive names for each path to make the results more relatable and understandable, as a shorthand to encapsulate the essence of each path.

Path 1: The Collective Path - Together towards a common goal

~H1*~H2*H3*H4*H5*H7

This path includes a mix of presence and absence conditions. H3, H4, H5, and H7 are present, while H1 and H2 are absent, while H6 has become irrelevant and is excluded. The setting is, therefore, quite complex regarding the synergetic effects between the variables and the options for interpretation. However, what can be seen as a common theme is the focus on bringing the different actors together to a common goal based on shared values. The need for everyone to bring something to the table (H3), together with being transparent about it (H4), aligns well with an appeal to social preferences as a motivator (H5). Committing is combined here with reciprocity. As discussed above, research (Kramer and Brewer, 1986; Atiyah, 1981) also indicates that the degree to which commitments are fulfilled depends on the degree of solidarity between those who have made the commitment. “Promises and commitments are binding only in the presence of reciprocal promises and commitments”(Atiyah, 1981). Additionally, also appealing to the actual impact (H7) the collective can have beyond its good intentions can further strengthen the impact on the member’s willingness to commit and cooperate.

Path 1 can be seen as a high hurdle tent, as H7 tends to require tents (unless members are very big themselves like in C40); nevertheless, it also counts on members making commitments through H3, "Increased expectations of others cooperating". The three cases with membership, Climate Alliance, Under2 Coalition, and GCoM, align very well with the typology and the path. The path membership is reflected in only slightly lower scores for each member in each applied mechanism, so there is also very little space for additional improvement in following this path more closely.

Path 2: The Agency Path - While Nations talk, cities act

H1*~H2*~H3*~H4*~H5*~H6*H7

This path is characterized by the presence of only two conditions, H1 and H7, while all other conditions, H2, H3, H4, H5, and H6, are absent. In this configuration, TMCNs use higher exclusivity with the mechanisms H1 “Exclusivity of membership terms” to access the network in terms of the typology of a TMCN, mostly only allowing in cities, as

opposed to regions or other levels of government, or also organizations such as NGOs or businesses. In some cases, such as C40, the cities also need to fulfill specific characteristics, such as a minimum number of inhabitants, to be counted as a megacity. This can lead to an even higher level of conformity among the members, increasing the level of group identity in the network. Second, the mechanism H7, “A feeling of efficacy,” is also used, appealing to the actual impact the cities can have as a collective organized in a TMCN when committing to reducing GHG emissions. The combination of these two mechanisms very much reflects the narrative that not only TMCNs themselves have used throughout the years when saying that cities can really make a difference but also advocate for the agency of cities and their organizations. A strong group identity and a clear label of the group's character, such as only cities or local governments, can claim much more powerful efficacy. For example, stating the number of inhabitants covered by the network is a data point that is very relatable for outsiders, but it is only possible if no other organization can be a member. This configuration can also help activate those decision-makers who are holding back action because they feel like taking action would not change anything, even if it might be morally right. Therefore, this configuration strongly builds on the collective impact and the idea of a critical mass of TMCNs.

Path 2 can , therefore, be seen as a solution for big tent networks, although with the caveat that H1 can impose a certain restriction on the size while still getting to huge numbers, for example, if only accepting cities but in a very large quantity. This again strengthens H7, "A feeling of efficacy" as the second mechanism. Other mechanisms that raise requirements for a commitment are absent, which aligns very well with the definition of a big tent network. Eurocities aligns well in this definition both in terms of the typology as well as the path membership, although it is located in the middle of the quadrant Q3 in Figure 14: Size vs. commitment hurdle with quadrants, as opposed to the margin close to 0/0, and could therefore be interpreted as something like a small tent network.

Path 3: The Comprehensive Condition Path - A Mosaic of Change

H1*H2*H3*H4*H5*H6*H7

In this path, all conditions are present, implying that the combined effect of all conditions is required to produce the outcome. This is not only in line with the assumption of conjunctural causation, where single conditions do not display their effect on their own but only with other conditions (Scheider and Wagemann, 2012). Indicating a positive role for all conditions also aligns with the abovementioned theory regarding the interaction of different mechanisms and knowledge about the different cases. In terms of the latter, the data collected also shows that each applies the mechanisms at a different intensity, and not all use the entire set. Finally, though, this path suggests that no mechanism excludes another one and that using all of them together is a safe path to achieving the outcome – or also, that it is not enough to only use the stronger mechanisms on their own. This again, could be further analysed in the context of the assumption that only cities that are already committed become members of TMCNs and might be a case against this assumption.

Independent of this, some mechanisms might have higher synergies than others in practical terms. For example, not all TMCNs will be able to work with megacities as C40 is doing, and therefore will not use H2 “Smaller groups size effects” together with H7 “A feeling of Efficacy” in such an impactful way, but might strengthen H7 through a different mechanism such as the combination indicated through path 1.

Lastly, path 3 can be seen as a high hurdle network type, located in Q1. Typical representatives here are C40 Cities and CNCA, appearing in Q1 and the path. Both networks also have high scores in the outcome, specifically CNCA with a 1, and therefore, they seem to apply the mechanisms of the path very adequately. In general, there is little room for improvement in these cases, as the scores of each of the mechanisms applied in the paths are nearly as high in each case. For each path, the mechanisms that could still be slightly intensified are highlighted below.

Regarding case membership in the configurations and the outcome of each case, six of the original nine cases show membership in one of the paths, however with no city showing an expressive membership. In terms of the outcome, the highest scores can be found for CNCA (0.67,1) in Path 3. It is important to note that even though a score in the original

data for the mechanisms is the same as in the path, for example, a 1 in the outcome as is the case for CNCA, the membership can be lower as it depends on other cases and the complexity within the analysis to define the final membership score. In this sense, the sufficiency analysis has provided additional value through the case membership that it calculates for each path.

It is important to highlight that the coverage rate is quite high for the solution as a total, taking all paths together. This underscores the aspect of equifinality as a strength of QCA as a method to handle causal complexity in the sense that all paths are considered together to understand the outcome of interest. It also shows that there might not be a single dominant path leading to an outcome but multiple equally important pathways. However, the coverage rates of the different paths are quite low, which can be influenced by different aspects. If the number of cases is rather low, each case carries much weight in the analysis. If the cases are quite diverse or unique, this can lead to lower coverage rates, as each configuration might only apply to one or a few cases. Furthermore, a high number of conditions, as is the case, can also generate a large number of possible configurations. Again, this and the number of cases make it less likely for any single configuration to cover many cases. contains only one solution path. Additionally, This path is fully consistent with CNCA as the one case, or configuration, that shows full membership in the outcome.

In this sense, the fact that CNCA stands out as one case that shows the highest membership in any of the two solution paths, especially the outcome, indicates that cases might be so unique that they are not infinitely replicable. Considering that CNCA claims to be the network based on "[…] the most aggressive GHG reduction targets undertaken anywhere by any city" and their member cities being the "climate vanguard" (CNCA, About us, n.d.; CNCA 2015, 2020), their specific model is built on the very idea that it cannot be replicated, as it would make the TMCN mainstream instead of the vanguard. It, therefore, also seems intuitive for the network to use mechanisms that more strongly require direct commitments by their members, giving their members the benefit of calling themselves part of a global vanguard. However, this could also be a mechanism that could be further analyzed, with the caveat that it is equally little replicable as is the model of CNCA. It might, however, also work for different regions, highlighting frontrunners, for example, in

Europe or Africa, or even in smaller regions within countries, using peer pressure as suggested by the representative of C40 in the questionnaire.

Due to the limitations of the sufficiency analysis, combining the analysis with a more qualitative approach can be useful to further the understanding of the causal mechanisms at play and answer the research question in a complementary way. This will also help to further address both sub-question 1, “How strongly are conditions related to an outcome?” and sub-question 2, “Are specific configurations of conditions related to specific types of TMCNs or special features of TMCNs?“. To do this, the pattern of the big tent, high hurdle tent, and high hurdle networks that have already been uncovered in the data, pointing to different typologies of TMCNs and, in addition to related differences in their use of mechanisms, will be used. Based on the theory already gathered, typical combinations of mechanisms for each network type will be developed and discussed, and then, the combinations will be compared to the actual cases and the empirical data about which combinations they apply in practice. They will also be further analyzed regarding their role from a systemic perspective on the social dilemma.

Big tent networks per se have a high number of members as their requirements for access are low. In a polycentric system, they can, therefore, specifically fulfill two roles: First, being low access, they can try to attract bigger numbers of cities that have not been well connected to the ecosystem of TMCNs yet and bring them into an area of influence through the mechanisms used in these networks. Eventually, if these mechanisms have effects, they will also increase the chances of new members increasing their ambitions around reducing GHG emissions. Secondly, they can have an active but very soft approach to influencing their members’ will to make more ambitious commitments. Typical mechanisms that are in line with the low access model of networks are those that appeal to motivation or offer individual benefits, such as H5, "Altruism, fairness or the greater good (social preferences)", and H6, "Individual utility maximization", as well as potentially also H7 "A feeling of efficacy". This last one, however, might be limited in its impact, as big tent networks, on the one hand, can build their narrative on having mass, for example, in terms of inhabitants, but on the other hand, due to the low access, can be assumed to have overall smaller ambitions and therefore less impact.

High hurdle tents, conversely, can first and foremost focus on increasing their members' ambition and commitment to cooperate. On the contrary to big tent networks, they do not need to attract additional cities into the ecosystem that might not have developed serious ambition yet but can rather aim at being a big platform for all cities with substantial commitments. They also do not need to be the most ambitious and can, therefore, allow their members some flexibility through pathways to increase ambition over time. Their influence is therefore strongly internal, while not excluding their positive signaling to other cities and networks, where they might, for example, also increase indirectly H7 "A feeling of efficacy" for other networks and their members with their mass and potential impact. Typical mechanisms are, therefore, to use the more coercive ones H3, "Increased expectations of others cooperating," and H4, "Transparency", although to a softer degree. For example, GCoM uses the following development path: "Local governments shall submit their city-wide greenhouse gas emissions reduction target(s) to GCoM within two years upon joining GCoM. Once the city has reached the monitoring phase, a more recent GHG emissions inventory shall be submitted every two years to GCoM." Furthermore, H7, "A feeling of efficacy," might be especially impactful, as tents can naturally score with high membership numbers, which is substantially more powerful when combined with high ambition, as should be the case for high hurdle tents. Big tents can also be assumed to have quite diverse membership, which also makes the use of H5 "Altruism, fairness or the greater good (social preferences)" and H6 "Individual utility maximization" useful additional mechanisms to both increase motivation throughout their membership but also offer direct incentives to those responding more to individual benefits of their cities, achieving different profiles of decision makers.

Lastly, high hurdle networks are small groups with extremely committed members. Their prime mechanisms could, therefore, be H1 "group identity", H2" Smaller group size effects", H3 "Increased expectations of others cooperating," and H4 "Transparency". The result will be a group of frontrunners that might not focus that much anymore on increasing ambition at some point if a global best mark has already been reached. In this case, further influencing their members can also be assumed to be of lesser importance, and proofing the delivery of the commitments and the concepts suggested by their members for implementation might become more important. This, again, can then serve to influence not

only internally but also externally towards other cities in the ecosystem by showcasing success. Other mechanisms such as H5, "Altruism, fairness or the greater good (social preferences)," and H7, "A feeling of efficacy", might still aim at their membership, for example, to also help specific decision-makers to make the case in their home cities, but might also aim at external cities that accompany the network and their members' activities and development. H6 "Individual utility maximization" can also be assumed to be used as part of the frontrunner's narrative about why committing is also a benefit to the city.

Network type	**Role in a polycentric system**	**Direction of influence**	**Typical mechanisms**
Big tent	- Include isolated cities into the system - Slightly increase member's ambitions	Strongly external (low barrier and and soft influence)	H5, H6, H7
High hurdle tent	- Increase ambition internally	Strongly internal	H3, H4, H7, H5, H6
High hurdle	- Proof of concept - Increase ambition externally	Strongly external (Strong example setting) Internal: Full compliance	H1, H2, H3, H4, H5, H6, H7

Table 14: Network types, their role in a polycentric system and their typical use of mechanisms (Source: own creation by the author).

The causal mechanisms based on the combination of mechanisms can, therefore, vary and are very specific to each type of TMCN, as each network can play a different role as part of a polycentric system. In the next step, we can also look at typical cases within these different typologies and compare the typical mechanisms to the empirical data of each one of the cases.

	H1	H2	H3	H4	H5	H6	H7	Outcome
Big tent	0	0	0	0	1	1	1	
Eurocities	1	0.33	0.33	0	0	0.33	1	0.67
Clean Air Asia	0	0	0	0.33	0.8	1	0.33	0.33
Energy Cities	0.33	0	0	1	0	0.33	0.67	0.33
High hurdle tent	0	0	1	1	1	1	1	
Climate Alliance	0.33	0	0.67	0.67	1	0.33	0.8	0.8
Under2 Coalition	0.33	0.33	1	0.67	0.67	0.67	1	0.67
GCoM	0.33	0	0.67	1	0.67	0.33	0.67	0.67
High hurdle	1	1	1	1	1	1	1	
C40 Cities	1	0.67	0.8	0.8	1	1	1	0.67
CNCA	0.67	1	1	1	1	0.67	0.8	1

Table 15: Comparison of each case with the typical mechanism.

Table 15 shows that the theoretically developed sets of mechanisms that different typologies are likely to use can be confirmed when each score does not differ more than 0.33 from the score set as being typical. For example, if H1 is theorized to typically be 0, then networks scoring 0 or a maximum of 0.33 can be seen as in line with the assumption.

3) How can the relevant mechanisms be improved to increase cooperation and, therefore, the provision of the Global Public Good "climate-safe future"?

The analysis now allows us to draw some conclusions in terms of improvements. As a first step, the solution paths can provide some orientation, comparing each network to the mechanisms suggested in each path.

	H1	H2	H3	H4	H5	H6	H7	Outcome
Path 1	0	0	1	1	1		1	
Climate Alliance	0.33	0	0.67	0.67	1	0.33	0.8	0.8
Under2 Coalition	0.33	0.33	1	0.67	0.67	0.67	1	0.67
GCoM	0.33	0	0.67	1	0.67	0.33	0.67	0.67
Path 2	1	0	0	0	0	0	1	
Eurocities	1	0.33	0.33	0	0	0.33	1	0.67
Path 3	1	1	1	1	1	1	1	
C40 Cities	1	0.67	0.8	0.8	1	1	1	0.67
CNCA	0.67	1	1	1	1	0.67	0.8	1

Table 16: Detailed membership of each case in the solution paths.

Cases that can be seen as already using mechanisms successfully show membership in both the configuration of the mechanisms of the solution path and, more importantly, the successful outcome, as described above. To further improve and increase their outcome scores, these cases could strengthen the mechanisms of each of their respective solution paths. All of the cases, except for CNCA, which already achieves the highest outcome score of 1, might also increase their outcome level. Each mechanisms that is below the

score of the mechanisms indicated in each path is therefore highlighted as these are the areas of potential improvments according to this comparation.

Cases that do not follow the solution paths at all are Clean Air Asia, UrbanShift and Energy Cities. Especially the first two of these cases also score quite low in terms of the outcome. Consequently, these cases could still improve their outcome score by adapting the mechanisms they are applying. The networks could choose one of the solution paths to focus on specifically. However, each one of the paths might be a better or worse fit, depending on a range of factors, such as the profile and the history, the available funding, or the secondary goals of the network. Path 2, for example, requires setting an exclusive identity, which might interfere with the broad flexibility that Clean Air Asia is applying in terms of their membership and the wide reach they achieve in addition to that. It might, however, invest more heavily in H7, in line with the large number of cities the network cooperates with, and with the necessity test, rating this mechanism the highest. UrbanShift, on the other hand, might be an exception, as it is a fairly new network, and the interviewee added the information in the questionnaire that they might be increasing the requirements for their members soon. The network might then progress toward becoming a high hurdle network, becoming more exclusive and collectively more ambitious. UrbanShift's profile is closer to that of a high hurdle network in terms of the membership number and its claim of leadership, and it might be successful in following path 3. In line with this, increasing H3 will bring the network closer to the path, accompanied by increasing H4 and H3 in agreement with the most important necessary conditions. Eurocities on the other hand is already quite well aligned with the path its typology corresponds to most, but there might still be opportunities for improvement.

In this sense, we want to, in addition to the paths, use the combination of mechanisms that each of the network typologies could typically use, as pictured in Table 14: "Network types, their role in a polycentric system and their use of mechanisms". Table 15 now makes the same comparison for each network typology with the scores for the mechanisms the networks use, but highlighting opportunities for improvement. This shows different opportunities for each case and which of their mechanisms could be improved compared to typical mechanisms of a network typology, as discussed above. For example, Clean Air

Asia could still make stronger use of H7, and the fact that they convene a very high number of cities offers much potential to make a real difference towards the mobilization and actual impact of the network's cities.

	H1	H2	H3	H4	H5	H6	H7	Outcome
Big tent	0	0	0	0	1	1	1	
Eurocities	1	0.33	0.33	0	0	0.33	1	0.67
Clean Air Asia	0	0	0	0.33	0.8	1	0.33	0.33
Energy Cities	0.33	0	0	1	0	0.33	0.67	0.33
High hurdle tent	0	0	1	1	1	1	1	
Climate Alliance	0.33	0	0.67	0.67	1	0.33	0.8	0.8
Under2Coalition	0.33	0.33	1	0.67	0.67	0.67	1	0.67
GCoM	0.33	0	0.67	1	0.67	0.33	0.67	0.67
High hurdle	1	1	1	1	1	1	1	
C40 Cities	1	0.67	0.8	0.8	1	1	1	0.67
CNCA	0.67	1	1	1	1	0.67	0.8	1

Table 17: Options for improvments through the comparison of each case with the typical mechanism

An important aspect for assessing improvements is, therefore, also what each type of network strives for. A high hurdle network, for example, might not aim at increasing its membership to a maximum and should, therefore, be assessed against standards different from those of a big tent network. Therefore, analyzing the best practice cases of TMCNs within the paths and the ones with generally high outcome scores should be done according to the typology to consider how other networks can adopt or adapt these practices. Overall,

the assessment should be done with the overall outcome in mind in the sense of reducing the emissions globally throughout all cities as a final goal, where each network is only part of a bigger ecosystem.

In this sense, there are also opportunities for improvement when looking at the TMCNs systemically in the sense of a polycentric system. As Aligica and Tarko highlight, the stake of polycentricity from a research perspective is discovering how to improve different configurations of complex social systems (Aligica and Tarko, 2012, p. 260). A typical feature of such systems is the development of a certain institutional diversity, which is also happening with TMCNs. We have seen that the different types also cater to different potential members and complement each other. This complementariness can be shown through specific features that could be improved. High hurdle networks could, for example, develop programs with their frontrunners to appeal to "Altruism, fairness or the greater good (social preferences)" with H5 in big tent networks, working as ambassadors or change makers. Networks could also include incentives or appeals to social preferences to encourage the members to take on more proactive roles in increasing the willingness of cities beyond their network. An example related to H7 is the “Cities Race to Zero”, a subchapter of the global campaign “Race to Zero” to convince businesses, cities, regions, and investors to sign up for the Paris Agreement. C40 Cities actively supports the campaign to be “the largest-ever alliance” and uses appeals such as “cities are ready and willing”.

Another example is based on H4 "Transparency", where some TMCNs cooperate with other TMCNs or entities for the monitoring process of a commitment, such as GCoM, which is specially engaged in displaying individual commitments, or the NGO CDP, which also monitors commitments and emissions for other entities. As Aldy (2018) highlights, delegating the monitoring to external experts, especially when working with established international organizations, can also mitigate concerns about politicizing the transparency mechanism. Additionally, some mechanisms could also work across networks through multiple memberships of cities. For example, a city could be a member of a small high hurdle network, but at the same time also of a big tent like GCoM, so the same city might be affected by an effect of being in a small trusting group on the one side with H2, and on

the other side also be associated with a bigger movement through H7. Networks need, therefore, to be able to aggregate effects across the system.

Furthermore, from the questionnaire (see Table 18), a picture is reflected of interviewees seeing other TMCNs as both a positive factor through the opportunities to cover the huge amount and spectrum of cities, as well as a source of confusion for cities. Regarding the former, it could also be added that these different networks within a polycentric system have some synergies before any active coordination efforts are made. For example, through multiple memberships or changing memberships, cities can evolve their engagement depending on their own development and the development of the network. Also, if one network increases their reuqirements around a commitment or a city that signed up to deliver a commitment within a certain amount of time after joining a network and does not comply, it can migrate its engagement to a TMCN with less strict requirements and stay within the networked part of this system, and with this also maintaining a continuous pressure to make a commitment through a TMCN even on a reduced level. The same can, of course, also happen in the other direction, such as a city moving from a big tent network to a high hurdle one or maintaining multiple memberships and changing active engagement over time according to the cities' needs.

Question: Considering that there is a number of organizations whose goals and work are similar to yours: Would you say that this creates any advantage/ disadvantage for cities and other local governments on their journey to reducing greenhouse gas emissions?	
Climate Alliance	It´s important to cooperate and create synergies but the amount of new actors coming also because of financial opportunities with similar names are often confusing to the public.
Eurocities	It may create some confusion for cities
C40	It is an advantage if all organizations can consolidate around a single target and commitment. That is the rationale for "Cities Race to Zero", which has over 1200 cities committed to reducing emissions in line with 1.5 degrees.

	We are working with the Global Covenant of Mayors, UCLG and ICLEI. This collaboration ensures that cities are aligned on the science-based targets required to achieve a net-zero future and provides support to cities signing onto the campaign. This partnership also ensures that the Cities Race to Zero commitment is consistent with existing reporting metrics and does not require additional reporting burdens.For more information see this link https://www.c40.org/what-we-do/building-a-movement/cities-race-to-zero.
Under2 Coalition	Merits and demerits to having multiple Coalitions, could offer differing perspectives, opportunities and support. But, equally, can sometimes place conflicting demands on the same team's time.
Clean Air Asia	More of advantage since the air pollution and climate change sphere is complex, so collaboration among many actors is needed.
UrbanShift	There are so many cities globally that not a single organization can support them, so I would consider this is good.

Table 18: Questionnaire answers to general questions about other TMCNs.

Regarding the confusion and conflicting demands mentioned by the interviewees, there seems to be room for systemic improvements. While there might already be a certain level of mutual adjustment and competition, coordination might be lacking. In line with the discussion about polycentric systems above, a certain level of coordination might be needed, as is already the case in some instances, as mentioned by C40. A closer look at potentially existing coordination mechanisms and how to strengthen or supplement them further might be needed and could be the subject of further research.

7.2 Limitations of the research and critical reflection of the method

A critical reflection of the methodology can be made in the sense that conditions and cutoff must be carefully decided to produce meaningful results. While generalizability is lower with a lower consistency cutoff, it can also decrease with lower robustness if increasing the cutoff does not produce meaningful results. Furthermore, conjunctural causation and equifinality as core principles of fsQCA can, although helpful in capturing complexities, have limitations. For example, a high number of conditions, which is the case for the

phenomenon at hand, combined with a limited number of cases due to their restricted actual occurrence, can lead to a picture that is at the same time oversimplified with a reduced number of solutions paths as results, as well as over specific, highlighting singular solutions in a more complex situation and context.

Variables, or mechanisms, in this research have been limited to seven due to methodology limitations, even though there are further potential mechanisms to be assessed. Therefore, there is a need for comprehensive analysis that includes not only the seven selected but also other potential variables to align with the theoretical framework and fulfill the requirements of conjunctural causation to a higher degree. As Schneider and Rohlfing state: "Qualitative Comparative Analysis (QCA) is a method for cross-case analyses that works best when complemented with follow-up case studies focusing on the causal quality of the solution and its constitutive terms, the underlying causal mechanisms, and potentially omitted conditions" (Schneider and Rohlfing, 2016, p.526). However, this could also involve re-running the QCA with different parameters without necessarily increasing the total number of variables for each analysis or using additional analytical methods like process tracing, contribution analysis, or case studies to evaluate the causality and interdependence of different variables and find other potential configurations to test and keep the number of variables within a manageable quantity. Although one of QCA's strengths as a method is especially in capturing complex, conjunctural causation, there are still limits to how complex of a phenomenon the method can capture and analyze. This became especially obvious in the sufficiency analysis, which had to be complemented with additional qualitative assessment. As mentioned above, in fsQCA, conditions and cutoff must be carefully decided to produce meaningful results. Lastly, on the point of follow-up case studies, the present dissertation has already delved further into some cases along the lines of the typologies of high hurdle and big tent networks, but specifically analyzing the individual cases could add to further cross-validate findings and gain a deeper understanding of how the different mechanisms are applied in different TMCNs.

One example of an additional variable or mechanism besides the one dropped in this research is "norm nudges". These are special mechanisms built on social norms by reframing an individual's choice architecture to redirect behavior without forbidding any

option or changing economic incentives (Bicchieri and Dimat, 2022; Thaler and Sunstein, 2008). To apply norm nudges, the mechanisms of action rely on eliciting social expectations (empirical and normative) by providing social information about what others do or approve/ disapprove of, such as, for example, that the majority of people also pay taxes (Bicchieri and Dimat, 2022). This mechanism could also be extremely relevant in the context of TMCNs, as reference networks (Hogg and Turner, 1987) are the strongest influence on behavior in this concept.

8. Discussion of the results and conclusions

In this chapter, results will be discussed, and conclusions will be drawn from the research. The discussion begins with analyzing the key findings and their meaning and implications. Then, the transferability of these findings will be addressed, providing indications for further research. Finally, recommendations to improve the provision of the Global Public Goods will be presented.

8.1 Discussion of the key findings

This section will summarize key findings from the study and discuss their implications, as well as how findings contribute to the existing body of knowledge. First, the answers to the research question are going to be summed up:

“In what way do mechanisms within Transnational Municipal Climate Networks influence member cities' willingness to commit to the reduction of Greenhouse Gas emissions in a social dilemma to provide the Global Public Good “climate-safe future?”

1) Which mechanisms are Transnational Municipal Climate Networks using to influence their member cities’ willingness to commit to the reduction of Greenhouse Gas emissions?

A set of mechanisms was confirmed in varying degrees throughout the cases. A few mechanisms stand out in terms of how intensely they are used throughout the networks, especially those with the lowest level of requirement of making a commitment are more intensely used, such as H7, “A feeling of efficacy”.

The research has also uncovered an additional mechanism to the ones based on theory by assessing TMCNs representatives directly through a questionnaire. While this assessment has confirmed some of the mechanisms derived from theory, it also pointed to the aspect of peer pressure between cities as an additional mechanism. This could be especially interesting in the context of polycentric systems, as those also build a lot on competitive behavior to develop adequate institutions and be assessed in further research.

2) How can the effect of Transnational Municipal Climate Networks on the provision of the Global Public Good "climate-safe future" by cities be explained through these mechanisms?

This question was answered through two further sub-questions. The necessity analysis with fsQCA answered sub-question 1: "How strongly are conditions related to an outcome: necessity and sufficiency analysis?" and revealed that the relationship with the outcome varies across mechanisms. In terms of individual mechanisms, especially the two conditions that are directly related to making a commitment, H3, "Increased expectations of others cooperating", and H4 ", Transparency", are more closely related to the outcome and also show high coverage rates (also making them empirically more relevant). Softer mechanisms scored lower, with H5, "Altruism, fairness or the greater good (social preferences)," together with H7 "A feeling of efficacy" as the highest scoring ones.

Combinations of different mechanisms pointed to the understanding that applying H1 to H4 together, a combination typical for a high hurdle network, is highly related to the outcome. Furthermore, applying H5 to H7, a combination more typical for a big tent network, also scored very high, making it critical for the outcome to occur (although insufficient).

The sufficiency analysis yielded limited insights through a pattern of three solution paths. The discussion of the different configurations in each path has shown that each of the three paths broadly corresponds to one of the network types introduced before. This finding has, in this sense, confirmed sub-question 2, "Are specific configurations of conditions related to specific types of TMCNs or special features of TMCNs?" To further confirm this understanding, typical mechanisms that each network type would use were developed from theory and discussed. A comparison with the empirical data showing which mechanisms each TMCN uses confirmed that these typical sets of mechanisms are indeed used and also showed potential for improvement, giving way to answering question 3.

3) How can the relevant mechanisms be improved to increase cooperation and, therefore, the provision of the Global Public Good "climate-safe future"?

The comparison with the empirical data showing which mechanisms each TMCN uses confirmed that the typical sets of mechanisms are indeed used and also showed potential for improvement, giving way to answering question 3.

The question was first assessed by comparing each network to the mechanisms suggested in each of the three solution paths. In the second step, the same comparison was made to the typical sets of mechanisms for the network typologies developed above. This allowed pointing out which mechanisms each network could still apply more intensely to improve their outcome, resulting in tables showing opportunities for improvement for each TMCN.

Additionally, opportunities for improvement were discussed when looking at the TMCNs as parts of a polycentric system. The typology of TMCNs has also allowed us to understand differences in their abilities and limitations. Strengthening specific abilities of each typology, such as, for example, big tent networks attracting more cities into the ecosystem of TMCNs, can open opportunities to improve cooperation and the provision of the GPG "climate-safe future" systemically. The questionnaire also produced data that allowed considering that there might be a lack of coordination between the TMCNs for mutual adjustment as an important feature of polycentric systems. A certain level of coordination might be needed to improve the overall systemic performance, as is already the case in some instances, as mentioned by C40.

To analyze the performance of TMCNs, it is also important to define the expectations for their performance. This dissertation has focused on TMCNs influence on their members' decision-making about their contribution to a climate-safe future and highlights differences in how networks excerpt this influence depending on the type of membership they strive for. In what way do the mechanisms they use actually influence member cities' willingness to make a commitment? This depends very much on different network types, each using different sets of mechanisms to achieve impact. TMCN should, therefore, be understood as diverse actors in a polycentric system, where good performance also depends on the role they aim to play and manage to successfully coordinate within the interdependencies of this ecosystem. Eventually, it might, therefore, be more useful to evaluate performance against indicators for each role, such as assessing big tent networks against the number of new cities making more humble commitments, instead of judging

them based on fully committed members - which is rather the role of high hurdle networks. Therefore, assessing performance should focus on determining how well each type of network delivers on its specific role within a system that peruses one common goal, providing a climate-safe future with different responsibilities. The learnings of this research, therefore, add to prior research in that the political sphere of TMCN as intermediaries can be seen as a crucial area of action and provide a more detailed understanding of how these networks try to leverage their influence on their members to increase the provision of a GPG.

8.2 Transferability, indications for further research and learnings

When it comes to the transferability of the research results, in the first part, this dissertation integrates insights from Rational Choice Theory, New Institutionalism, and Behavioral Economics to develop a theoretical concept that clarifies and discusses the interplay of individual choices, institutional constraints, and cognitive behaviors in decision-making in social dilemmas. By integrating these theories, the governance structures can be designed more robustly and effectively: RCT can aim at aligning economic incentives with individual utility maximization of individual cities, making it economically rational for cities to cooperate. NIE can improve the institutional framework, for example, by reducing the costs of cooperation and enforcing compliance through formal rules and informal norms. Lastly, Behavioral Economics can align strategies to actual psychological patterns and increase the likelihood of adoption and adherence through real-world decision-making processes. This integrative approach enables TMCNs to improve their systemic governance structures that are both theoretically sound and practical and adequate for the complexities of global and local challenges in climate governance. This concept can serve as a blueprint for future research, enabling a deeper understanding and broader application of solution mechanisms across various disciplines.

Concerning the empirical analysis, as mentioned above, QCA aims to generalize the explanation of how the outcome combines with the conditions over a set of cases (Befani, 2013). The mid-sized sample of cases aims at a middle path between complexity and generality, allowing for moderate generalization (Ragin, 1998; Payne and Williams, 2005; Lamnek, 2010). Also, the assessment was based on a specific conceptual framework,

which makes transferability higher the closer a problem is to this framework. In this sense, the results of the empirical analysis are transferable first and foremost to other social dilemma situations on a global scale, where governance structures are highly decentralized and networked organizations like TMCNs are active. In that way, findings apply to contexts similar to the studied cases and can be relevant and useful in comparable scenarios. A similar context is, for example, given in structurally similar settings of networks or other intermediaries in polycentric areas around a GPG. Research on other transnational municipal networks that also work on increasing the willingness of their members to commit to another GPG, such as the management of natural resources or biodiversity, should be able to be informed by the findings of this research. Therefore, factors such as a problem connected to a GPG or a CPR are also important. Applicability then decreases with each characteristic further away from the present concept. For example, national instead of transnational municipal climate networks are likely to attempt to influence their members' willingness to commit but show other characteristics that need to be considered, such as a strong focus on influencing national policy. At the same time, learning still applies to a certain degree. The results can, therefore, also be used by TMCNs directly to inform policy development and improve network governance in other sectors. Application, therefore, requires one to be aware of the specific context of the findings and adapt parts of the analysis as necessary.

A closer look at potentially existing coordination mechanisms and how to strengthen or supplement them further might be needed and could be the subject of further research. Mapping out cooperation between TMCNs and the division of tasks to coordinate could be a first step in that direction and provide insights to systemically improve the impact of TMCNs.

A different aspect also concerns big tent networks, as one of their key features is also to bring along cities that are just starting their transition to reducing GHG emissions and might not see themselves able to attend to standards in line with the Paris Agreement for various reasons such as missing funding or weaknesses in the local institutional setting. With this, big tent networks will inherently achieve a smaller score for the outcome but, at the same time, would score higher if the increasing ambition of starters was also measured.

In this sense, including such measures in further research could yield interesting results to further understanding of how to raise cities' commitment beyond the global frontrunners and second movers. It will also be important to further understand how the Global South context, which is underrepresented in this research due to a lack of cases, can further be analyzed and understood, given that the capacity angle additional to political willingness probably has much more weight in the decision process.

Lastly, two questions also remain open. The first one is how to influence those cities that are not members of any TMCN or how to improve systemically, in the sense of aligning improvements within the polycentric system. More networks are needed to provide an adequate profile for underserved regions, mainly in the Global South. As discussed above, the second-order social dilemma of creating a network could be a challenge in this sense, and solutions such as political entrepreneurs might not always be available to a sufficient extent.

Another question refers to timing and how these networks and their mechanisms should evolve in the future. Where high hurdle networks have already achieved the full commitment of their frontrunners, it is not completely clear how their strategy will evolve. They might leverage their influence from a systemic point of view through a proof of concept of implementing the commitments and signaling to others that this is possible or beneficial to each city. Their role might, therefore, change from activating their members to activating the members of other networks. Clues might be found when looking at the stages that critical mass theory works with, as discussed above. Broadly determining at which stage the level of commitment is right now might help refine strategies and the most indicated mechanisms.

Regarding learning throughout the research process, the researcher suggests reconsidering the use of questionnaires. The researcher had opted for this form due to her working relationship with one of the cases, C40 Cities, and to avoid a potential conflict of interest. A questionnaire was therefore used to increase the level of impersonality during the data collection process, as compared to doing interviews. However, it could be beneficial in other circumstances to use interviews, especially to attract the remaining networks to participate and get additional information beyond the standardized questions.

8.3 Recommendations to improve the provision of the GPG

Based on the results above, a few recommendations can be made to further strengthen the impact of TMCNs on the willingness of cities to commit, and therefore also the provision of the GPG "climate-safe future". It is important to note that different network types have different roles in a polycentric system. While high hurdle networks like CNCA might be better equipped to organize frontrunners or zealots as in critical mass theory, big tent networks might bring in a bigger mass required to get to an active movement with sufficient impact. How those roles can be lived might also slightly change in the future, as high hurdle networks achieve high outcomes, posing new challenges in terms of what the networks want and opportunities in what they can achieve. In general, TMCNs could benefit from evaluating which mechanism they have been consciously or even unconsciously using and trying to track the impact on their members to understand options for individual improvement for each TMCN. The following recommendations can be made, restricted to the findings based on the present research:

- High hurdle networks: Those with a high score in the outcome could improve to getting as close to 1 as possible, using further potential throughout the available mechanisms. TMCNs that have already achieved a full commitment throughout their membership might want to proceed to help cities prove their concepts, such as climate action plans. This can further help to influence cities beyond their network once a very high rate of cities have committed their own TMCN already.

- Big tent networks: Per definition, the requirement for strong commitments is lower. Big tent networks might want to ensure that all other mechanisms are used in their best combinations and, to the most extent, to help increase both their outcome and their membership to increase the total number of committers globally.

- High hurdle tents: These networks are already quite successful in both convening bigger numbers of members and achieving high ambition levels. Capacities might

still need to increase to potentially receive even more members who can become part of the committed cities globally. Additionally, a stronger appeal to co-benefits with H6 might help further increase internal commitments.

- Enhance inter-network cooperation: As also clearly wished for in the questionnaire, TMCNs, as well as their orchestrators, should leverage the complementing strengths of the different networks, such as through campaigns like the "Cities Race to Zero" which themselves might make use of the mechanisms discussed in this research. A closer look at potentially existing coordination mechanisms between TMCNs and how to further strengthen or supplement them might be needed.

- Active entrepreneurship to extend the system: Existing TMCNs might take a more active role in helping to create new networks in underserved regions. Their highly specialized know-how could be useful as a first step to understanding what might and might not work in terms of mechanisms, besides all other know-how about starting and running a network. This might also support overcoming the second-order social dilemma to create new TMCNs in places still lacking, ideally by supporting local political entrepreneurs.

8.4 Conclusions

The research highlights the significance of a more political perspective beyond the broadly researched technical one by showing a series of mechanisms that TMCNs use to influence their members "willingness" to commit to collective action. A set of mechanisms has been developed, and evidence has been found for network use. The analysis also suggests that specific configurations are strongly related to the outcome, meaning there are relations between specific sets of mechanisms and cities to commit.

In conclusion, this dissertation demonstrates that TMCNs largely influence their members' willingness to commit to the social dilemma of providing the GPG with a "climate-safe future". The research contributes to our understanding of TMCNs within polycentric governance systems by explaining how these networks leverage mechanisms to positively influence the decision of cities to commit to climate change mitigation. We have also

learned that these mechanisms are used according to the different profiles of TMCNs. From a systemic perspective, this also shows that TMCNs consider different profiles of cities and have together developed into a diverse ecosystem of organizations that can cover a range of these different profiles, however, with the potential to create further access for cities that are not integrated into this ecosystem yet.

Literature and software

Literature

Abbott, K. W. (2012) 'The transnational regime complex for climate change', *Environment and Planning C: Government and Policy*, Vol. 30(4), pp. 571–590.

Abbott, K.W. (2018) 'Orchestration. Strategic ordering in polycentric governance' in *Governing Climate Change. Polycentricity in Action?* Jordan, A.; Huitema, D.; van Asselt, H.; Forster, J. (Eds.), Cambridge: Cambridge University Press, pp. 118-209.

Abbott, K.W.; Hale, T. (2014) 'Orchestrating global solutions networks. A guide for organizational entrepreneurs', *Innovations: Technology, Governance, Globalization*, Vol. 9(1-2), pp. 195-212.

Abbott, K., Genschel, P., Snidal, D. and Zangl, B. (Eds.) (2015*) International Organisations as Orchestrators*. Cambridge: Cambridge University Press.

Ackermann, A.A.; Murphy, R.O. (2019) 'Beliefs and Decision Rules in Public Good Games: How Preferences and Beliefs Affect Contribution Levels', *Games*, Vol. 10(15).

Acuto, M.; Rayner, S. (2016) 'City networks. Breaking gridlocks or forging (new) lock-ins?', *International Affairs*, Vol. 92(5), pp. 1147-116.

Acuto, M.; Leffel B. (2021) 'Understanding the global ecosystem of city networks', *Urban Studies*, Vol. 58(9), pp. 1758–1774.

Aldy, J. E. (2016) 'Living mitigation plans. The co-evolution of mitigation pledge and review', *Harvard Project on Climate Agreements Discussion Paper ES*, Vol. 05.

Aldy, J. E. (2018) 'Policy surveillance. Its role in monitoring, reporting, evaluating and learning' in Jordan, A.; Huitema, D.; van Asselt, H.; Forster, J. (Eds.) *Governing climate change. Polycentricity in action?* Cambridge: Cambridge University Press, pp. 210-228.

Aligica, P.D.; Tarko, V. (2012) 'Polycentricity: From Polanyi to Ostrom, and beyond', *Governance*, Vol. 25(2), pp. 237-262.

Amadae, S.M. (2015) *Prisoners of Reason. Game Theory and the Neoliberal Political Economy*. New York: Cambridge University Press.

Anand, P.B. (2004) 'Financing the Provision of Global Public Goods', *WIDER Discussion Paper*, Vol. 2002(110), Helsinki: The United Nations University World Institute for Development Economics Research (UNU-WIDER).

Andonova, L.B.; Bestill, M.M.; Bulkeley, H. (2009) 'Transnational Climate Governance', *Global Environmental Politics*, Vol. 9(2), pp. 52-73.

Andreoni, J. (1989) 'Giving with impure altruism. Applications to charity and ricardian equivalence', *The Journal of Political Economy*, Vol. 97(6), pp. 1447-1458.

Arrow, K. J. (1969) *The organization of economic activity. Issues pertinent to the choice of market versus non-market allocation*. Washington DC: Joint Economic Committee of Congress.

Arrow, K. J. (1994) 'Methodological individualism and social knowledge', *The American Economic Review*, Vol. 84(2), pp. 1-9.

Atiyah, P. (1981) *Promises, morals and law.* New York: Oxford University Press.

Aumann, R. A.; Hart, S. (2003) 'Long cheap talk', *Econometrica*, Vol. 71, pp. 1619–1660.

Axelrod, R.M. (2006) [1984]: *The evolution of cooperation.* Revised edition. Basic Books.
Balliet, D.; Van Lange, P. A. M. (2013) 'Trust, conflict, and cooperation. A meta-analysis', *Psychological Bulletin*, Vol. 139(5), pp. 1090–1112.
Bansard, J.; Pattberg, P., Widerberg, O. (2017) 'Cities to the rescue? Assessing the performance of transnational municipal networks', *International Environmental Agreements: Politics, Law and Economics*, Vol. 17, pp. 229–246.
Barbie, F.; Macedo, L. V. de (2019) 'Transnational Municipal Networks and Cities in Climate Governance Experiments in Brazil' in Van der Heijden, J.; Bulkeley, H.; Certomà, C. (Eds.) *Urban climate politics. Agency and empowerment*. Cambridge/ New York/ Port Melbourne/ New Delhi/ Singapore: Cambridge University Press.
Barrett, S. (2003) *Environment and Statecraft. The strategy of environmental treaty-making*. Oxford University Press.
Barrett, S.; Dannenberg, A. (2016) 'An experimental investigation into 'pledge and review' in climate negotiations', *Climatic Change*, Vol. 138(1–2), pp. 339–351.
Bates, R. H. (1988) 'Contra contractarianism. Some reflections on the new institutionalism', *Politics and Society*, Vol. 16(2-3), pp. 387-401.
Baumeister, R.F. (2016) 'Toward a general theory of motivation. Problems, challenges, opportunities, and the big picture', *Motivation and Emotion*, Vol. 40(1), pp. 1–10.
Befani, B. (2013) 'Between complexity and generalization. Addressing evaluation challenges with QCA', *Evaluation*, Vol. 19(3), pp. 269–283.
Berg-Schlosser, D; De Meur, G. (2009) 'Comparative research design. Case and variable selection' in Rihoux, B.; Ragin, C.C. (Eds.) Configurational comparative methods. Qualitative Comparative Analysis (QCA) and related techniques. Los Angeles/ London/ New Delhi/ Singapore: Sage, pp. 19-32.
Bernstein, S.; Hoffmann, M. (2018) 'Decarbonisation. The Politics of Transformation' in Jordan, A.; Huitema, D.; van Asselt, H.; Forster, J. (Eds.) *Governing climate change: Polycentricity in action?* Cambridge: Cambridge University Press, pp. 248-265.
Betsill, M.M.; Bulkeley, H. (2004) 'Transnational networks and global environmental governance. The Cities for Climate Protection Program', *International Studies Quarterly*, Vol. 48, pp. 471-493.
Betsill, M.M.; Bulkeley, H. (2006) 'Cities and the multilevel governance of global climate change', *Global Governance: A Review of Multilateralism and International Organizations*, Vol. 12(2), pp. 141-159.
Bicchieri, C. (2006) *The grammar of society. The nature and dynamics of social norms*. Cambridge: Cambridge University Press.
Bicchieri, C. (2016) *Norms in the wild. How to diagnose, measure, and change social norms*. Oxford: Oxford University Press.
Bicchieri, C.; Dimat, E. (2022) Nudging with care. The risks and benefits of social information, *Public Choice*, Vol. 191, pp. 443-464.
Blatter, J., Janning, F., Wagemann C. (2007) *Qualitative Politikanalyse. Eine Einführung in Forschungsansätze und Methoden*. Wiesbaden: VS Verlag.
Bloomberg Philanthropies (2022) *World's Best Climate Projects Recognised at 2022 C40 Cities Bloomberg Philanthropies Awards* [Online] Available at: https://www.bloomberg.org/press/worlds-best-climate-projects-recognised-at-2022-c40-cities-bloomberg-philanthropies-awards/ (Accessed: 26.08.22)

Bolton, G. E.; Ockenfels, A. (2000) 'ERC: A theory of equity, reciprocity, and competition', *American Economic Review*, Vol. 90(1), pp. 166–193.
Bornstein, G. (1992) 'The free-rider problem in intergroup conflicts over step-level and continuous public goods', *Journal of Personality and Social Psychology*, Vol. 62, pp. 597-606.
Bosetti, V., Heugues, M.; Tavoni, A. (2017) 'Luring others into climate action. Coalition formation games with threshold and spillover effects', *Oxford Economic Papers*, Vol. 69(2), pp. 410-431.
Bouteligier, P. (2013) *Cities, networks, and global environmental governance. Spaces of innovation, places of leadership*. New York/ London: Routledge.
Bremer, S.; Glavovic, B.; Meisch, S.; Schneider, P.; Wardekker, A. (2021) 'Beyond rules. How institutional cultures and climate governance interact', *Wiley Interdisciplinary Reviews: Climate Change*, Vol. 12(6), e739.
Bulkeley, H.; Betsill, M. (2003) *Cities and Climate Change. Urban Sustainability and Global Environmental Governance*. London: Routledge.
Bulkeley, H.; Davies, A.; Evans, B. et al. (2003) 'Environmental governance and transnational municipal networks in Europe', *Journal of Environmental Policy and Planning*, Vol. 5(3), pp. 235–254.
Bulkeley, H., Andonova, L. and Betsill, M.; Compagnon, D.; Hale, T.; Hoffmann, M.J.; Newell, P.; Paterson, M.; Roger, C.; VanDeveer, S.D. (2014) *Transnational climate change governance*. Cambridge: Cambridge University Press.
Bulkeley, H., Betsill, M., Compagnon, D., Hale, T., Hoffmann, M., Newell, P., and Paterson, M. (2018) 'Transnational governance: Charting new directions post-Paris' in Jordan, A.; Huitema, D.; van Asselt, H.; Forster, J. (Eds.) *Governing climate change: Polycentricity in action?* Cambridge: Cambridge University Press, pp. 63-80.
Busch, H. (2015) 'Linked for action? An analysis of transnational municipal climate networks in Germany', *International Journal of Urban Sustainable Development*, Vol. 7(2), pp. 213-231.
Busch, H.; Bendlin, L.; Fenton, P. (2018) 'Shaping local response. The influence of transnational municipal climate networks on urban climate governance', *Urban Climate*, Vol. 24, pp. 221-230.
Cahenzli, M. (2020) 'Guiding the institutionalization of behaviour. Designing a nudging-inspired solution', *Working Paper*, Institute of Information Management, University of St.Gallen.
Cairney, P. (2020) [2012] *Understanding public policy: theories and issues*. 2nd Ed. Houndmills/ Basingstoke/ Hampshire: Palgrave Macmillan.
Caldwell, M.D. (1976) 'Communication and sex effects in a five-person prisoner's dilemma game', *Journal of Personality and Social Psychology*, Vol. 33., pp. 273–80.
Camerer, C.F. (2003) *Behavioral Game Theory. Experiments on Strategic Interaction*. Princeton: Princeton University Press.
Campbell, D. T. (1958) 'Common fate, similarity, and other indices of the status of aggregates of persons as social entities', *Behavioral Science*, Vol. 3(1), pp. 14-25.
Capano, G.; Howlett, M.; Ramesh, M. (2019) 'Disentangling the mechanistic chain for better policy design', in Capano, G.; Howlett, M.; Ramesh, M.; Virani, A. (Eds.) *Making policies work. First- and second-order mechanisms in policy design*. Cheltenham, UK/ Northampton, MA, USA: Edward Elgar Publishing, pp. 2-13.

Capraro, V.; Jordan, J.J.; Rand, D.G. (2014) 'Heuristics guide the implementation of social preferences in one-shot Prisoner's Dilemma experiments', *Scientific Reports*.
Capraro, V. (2013) 'A Model of Human Cooperation in Social Dilemmas',. PLOS ONE, Vol. 8(8), e72427.
Carlisle, K.; Gruby, R.L. (2017) 'Polycentric systems of governance: A theoretical model for the commons', *Policy Studies Journal*, Vol. 00, no. 00.
Charness, G.; Rabin, M. (2002) 'Understanding social preferences with simple tests', *Quarterly Journal of Economics*, Vol. 117(3), pp. 817-869.
Chen, X.P.; Pillutla, M.; Yao, X. (2009) 'Unintended consequences of cooperation inducing and maintaining mechanisms in public goods dilemmas. sanctions and moral appeals', *Group Processes & Intergroup Relations*, Vol. 12 (2). pp. 241-255.
Chen, G.; Wiedmann, T.; Hadjikakou, M.; Rowley, H. (2016) 'City carbon footprint networks', *Energies*, Vol. 9, pp. 1-16.
Choshen-Hillel, S.; Yaniv, I. (2012) 'Social preferences shaped by conflicting motives. When enhancing social welfare creates unfavorable comparisons for the self', *Judgment and Decision Making*, Cambridge University Press, Vol. 7(5), pp. 618-627.
Coakley, S.; Nowak, M. (2013) 'Introduction. Why Cooperation Makes a Difference', in Martin Nowak, M.; Coakley, S. (Eds.) *Evolution, Games, and God: The Principle of Cooperation*. Cambridge, MA: Harvard University Press, pp. 1-34.
Cole, D. H. (2015) 'Advantages of a Polycentric Approach to Climate Change Policy', *Nature Climate Change*, Vol. 5(2), pp. 114–118.
Coleman, J. (1990) *Foundations of Social Theory*. Cambridge, MA: Harvard University Press.
Cortes, S.; van der Heijden, J.; Bush, S. (2022) 'Unpacking the heterogeneity of climate city networks', *Cities*, Vol. 212.
Czarniawska, B. (2002): *A tale of three cities. Or the glocalization of city management*. Oxford: Oxford University Press.
C40 Cities; Arup (2017) *Deadline 2020* [Online] Available at https://www.c40.org/wp-content/uploads/2021/07/Deadline_2020.pdf (Accessed: 26.08.22)
Darley, J.M.; Latané, B. (1968) 'Bystander intervention in emergencies. Diffusion of responsibility', *Journal of Personality and Social Psychology*, Vol. 8, pp. 377-383.
Dawes, R.M. (1973) 'The commons dilemma game. A n-person mixed-motive game with a dominant strategy for defection', *Oregon Research Institute Research Bulletin*, Vol. 13(2).
Dawes, R.M. (1975) 'Formal models of dilemmas in social decision-making' in Kaplan, M.F.; Schwarz, S. (Eds.) *Human Judgment and Decision Processes*. New York: Academic Press, pp. 88 - 107.
Dawes, R.M.; Messick, D.M. (2000) 'Social Dilemmas', *International Journal of Psychology*, Vol. 35(2), pp. 111-116.
Derudder, B.; Hoyler, M.; Taylor, P.J.; Witlox, F. (Eds.)(2012) *International Handbook of Globalization and World Cities*. Northampton: Edward Elgar Publishing, Inc.
DiMaggio, P.J.; Powell, W.A. (1983) 'The iron cage revisited. Institutional isomorphism and collective rationality in organizational fields', *American Sociological Review*, Vol. 48(2), pp. 147-160.

Dold, M. (2023) 'Methodological Individualism in Behavioral Economics' in Bulle, N.; Di Iorio, F. (Eds.) *Palgrave Handbook of Methodological Individualism*, Vol. 1. London: Palgrave MacMillan, pp. 655-680.
Dore, R. (1983) 'Goodwill and the spirit of market capitalism', *British Journal of Sociology*, Vol. 34, pp. 459-482.
Dorsch, M.J,; Flachsland, C. (2017) 'A polycentric approach to global climate governance', *Global Environmental Change*, Vol. 17(2), pp. 45–64.
Dorsch, M.J. (2023) *Polycentric Sustainability Governance in the 21st Century as a Transformative Task* [Ph.D. dissertation]. Technischen Universität Berlin.
Dovers, S.R.; Hezri, A.A. (2010) 'Institutions and policy processes. The means to the ends of adaptation', *Wiley Interdisciplinary Reviews: Climate Change*, Vol. 1(2), pp. 212-231.
Edney, J.J. (1981) 'Paradoxes on the commons. Scarcity and the problem of equality', *Journal of Community Psychology*, Vol. 9, pp. 3-34.
Ekins, P. (1996a), 'How large a carbon tax is justified by the secondary benefits of CO2 abatement?', *Resource and Energy Economics*, Vol. 18, pp. 161-187.
Ekins, P. (1996b) 'The secondary benefits of CO2 abatement. How much emission reduction do they justify?', *Ecological Economics*, Vol. 16, pp. 13-24.
Ernst, A.M. (1997) *Ecological-social dilemmas. Psychological mechanisms of action of environmental behavior*. Weinheim: Beltz Verlag.
Falk, A., Fehr, E.,; Zehnder, C. (2006) 'Fairness perceptions and reservation wages. The behavioral effects of minimum wage laws', *The Quarterly Journal of Economics*, Vol. 121(4), pp. 1347- 1381.
Fay, C. (2007) 'Think locally, act globally. Lessons to learn from the Cities for Climate Protection Campaign', *Innovations. A Journal of Politics*, Vol. 7, pp. 1-12.
Fehr, E.; Fischbacher, U. (2002) 'Why social preferences matter. The impact of non-selfish motives on competition, cooperation and incentives', *The Economic Journal*, Vol. 112(478), C1-C33.
Fehr, E.; Gächter, S. (2000a) 'Cooperation and punishment in public goods experiments', *American Economic Review*, Vol. 90, pp. 980-994.
Fehr, E.; Gächter, S. (2000a) 'Fairness and retaliation. The Economics of Reciprocity', *Journal of Economic Perspectives*, Vol. 14(3), pp. 159-181.
Fehr, E.; Gächter, S. (2002) 'Altruistic punishment in humans', *Nature*, Vol. 415, pp. 137-140.
Fehr, E.; Schmidt, M. (1999) 'A Theory of Fairness, Competition, and Cooperation', *The Quarterly Journal of Economics*, Vol. 114(3), pp. 817-868.
Fehr, E., Schurtenberger, I. (2018) 'Normative foundations of human cooperation', *Nature Human Behaviour*, Vol. 2, pp. 458–468 .
Finus, M.; Rübbelke, D.T.G. (2013) 'Public good provision and ancillary benefits. The case of climate agreements', *Environmental and Resource Economics*, Vol. 56(2), pp. 211-226.
Fischbacher, U. Gächter, S.; Fehr, E. (2001) 'Are people conditionally cooperative? Evidence from a public goods experiment', *Economics Letters*, Vol. 71, pp. 397–404.
Foddy, M.; Yamagishi, T. (2009) 'Group based trust' in Cook, K. S.; Levin, M.; Hardin, R. (Eds.) *Whom can we trust?* New York, NY: Russell Sage Foundation.
Forum CB27 (n.d.) *7 years in perspective. Forum CB27 activities report 2012-2019* [Online] Available

at_ https://cb27.s3.amazonaws.com/20190502_ICLEI_relatorio_ingles_dupla.pdf (Accessed: 27.12.22).
Foster, S.R.; Swiney, C. (2021) 'City networks and the glocalization of urban governance' in Aust, H.P.; Nijman, J.E. (Eds.) *Research Handbook on International Law and Cities*. Cheltenham, UK/ Northampton, MA, USA: Edward Elgar Publishing, pp. 368-380.
Fox, D.R. (1985) 'Psychology, Ideology, Utopia, and the Commons', *American Psychologist*, Vol. 40, pp. 48-58.
Friedman, M. (1953) 'The methodology of positive economics', *Essays in Positive Economics*, Chicago: University of Chicago Press, pp. 3-43.
GCoM (n.d.) *City journey* [Online] Available at https://www.globalcovenantofmayors.org/journey/] (Accessed: 26.08.22).
Friel, D. (2017) 'Understanding institutions: different paradigms, different conclusions', *Revista De Administração*, Vol. 52(2), pp. 212-214.
Gilligan, M.J. (2009) 'The transaction costs approach to international institutions' in Milner, H.V.; Moravcsik, A. (Eds.) *Power, Interdependence, and Nonstate Actors in World Politics*. Princeton, New Jersey: Princeton University Press, pp. 50-65.
Glance, N.S.; Huberman, B.A. (1994) 'The dynamics of social dilemmas', *Scientific American*, pp. 76–81.
Gordon, D.J. (2016) 'Lament for a network? Cities and networked climate governance in Canada', *Environment and Planning C: Government and Policy 2015*, Vol. 34(3), pp. 1-17.
Gordon D.J.; Johnson, C.A. (2017) 'The orchestration of global urban climate governance: conducting power in the post-Paris climate regime', *Environmental Politics*, Vol. 26(4), pp. 694–714.
Gordon, D.; Johnson, C. (2018) 'City-networks, global climate governance, and the road to 1.5 C.', *Current Opinion in Environmental Sustainability*, Vol. 30, pp. 35–41.
Grad, E. (2021) *Nudges, prosocial, preferences & behavior. Essays in behavioral economics*. [Ph.D. dissertation]. Södertörn University, Huddinge.
Granovetter, M.S. (1973) 'The strength of weak ties', *American Journal of Sociology*, Vol. 78(6), pp. 1360-1380.
Green, D.; Shapiro, I. (1994) *Pathologies of Rational Choice Theorie*. New Harvey: Yale University Press.
Grønnestad, S.; Bach Nielsen, A. (2022) 'Institutionalising city networking. Discursive and rational choice institutional perspectives on membership of transnational municipal networks', *Urban Studies*, Vol. 59(4), pp. 2951–2967.
Grüne-Yanoff, T. (2010) 'Rational Choice Theory and Bounded Rationality' in Pyysiäinen, I. (Ed.) *Religion, economy, and cooperation*. Berlin/ New York: De Gruyter, pp. 61-82.
Guillermo, C.; Gobet, F. (2010) 'Herbert Simon's decision-making approach. Investigation of cognitive processes in experts', *Review of General Psychology*, Vol. 14 (4), pp. 354 - 364.
Gupta,S.; Tirpak, D.A.; Burger, N.; Gupta, J.; Höhne, N.; Boncheva, A.I. (2007) 'Policies, instruments and co-operative arrangements' in Metz, B.; Davidson, O.R.; Bosch, P.R.; Dave, R. and Meyer, L.A. (Eds.) *Climate change 2007: Mitigation. Contribution of working group III to the fourth assessment report of the*

intergovernmental panel on climate change. Cambridge/ NewYork: Cambridge University Press, pp. 745–807.
Haarstad, H. (2020) 'Do climate targets matter? The accountability of target-setting in urban climate and energy policy' in Sareen, S. (Ed.) *Enabling sustainable energy transitions. Practices of legitimation and accountable governance*. Cham: Palgrave Pivot, pp. 63-72.
Hanna, S. (1995) 'Efficiencies of user participation in natural resource management' in Hanna, S.; Munasinghe, M. (Eds.) *Property rights and the environment. Social and ecological issues*. Washington, D.C.: Beijer International Institute of Ecological Economics and the World Bank, pp. 59-67.
Hardin, R. (1982) *The logic of collective action*. 3rd. Ed. Baltimore, Maryland: Resources for the Future.
Hargreaves Heap, S.P.; Ramalingam, A.; Stoddard, B. (2016) 'Endowment inequality in public goods games: A re-examination', *Economics Letters*, Vol. 146, pp. 4-7.
Hauert, C.; Wakano, J.Y.; Doebeli, M. (2008) 'Ecological public goods games. Cooperation and bifurcation', *Theoretical Population Biology*, Vol. 73(2), pp. 257-63.
Hechter M. (1984) 'When actors comply: monitoring costs and the production of social order', *Acta Sociologica*, Vol. 27(3), pp. 161-183.
Heikkinen, M. (2022) 'The role of network participation in climate change mitigation: a city-level analysis', *International Journal of Urban Sustainable Development*, Vol. 14(1), pp. 1-14.
Hindmoor, A.; Taylor, B. (2006) *Rational choice*. 2nd Ed. London: Red Globe Press.
Hobbes, T. [1668] (1982) *Leviathan*. London: Penguin Classics.
Hoff, K.; Stiglitz, J. E. (2016) 'Striving for balance in economics. Towards a theory of the social determination of behavior', *Journal of Economic Behavior & Organization*, Vol. 126, pp. 25-57.
Hogg, M.,; Turner, J. (1987) 'Social identity and conformity' in Doise, W.; Moscovici, S. (Eds.) *Current issues in European social psychology*, Vol. 2, Cambridge: Cambridge University Press.
Holm, P. (1995) 'The dynamics of institutionalization. transformation processes in Norwegian fisheries', *Administrative Science Quarterly*, Vol. 40(3), pp. 398-422.
Hume, David (1739) *A Treatise of Human Nature*. Oxford: Clarendon Press.
IPCC (2001) 'Climate change 2001. The scientific basis. Contribution of Working Group I to the third assessment report of the Intergovernmental Panel on Climate Change [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K.Maskell, and C.A. Johnson (Eds.)]. Cambridge, United Kingdom/ New York, NY, USA: Cambridge University Press.
Isaac, R.M.; Walker, J.M. (1988) 'Communication and free-riding behavior. The voluntary contribution mechanism', *Economic Enquiry*, Vol. 26(4), pp. 585-608.
Jann, B.; Przepiorka, W. (2017) 'Introduction', in Jann, B.; Przepiorka, W. (Eds.) *Social dilemmas, institutions, and the evolution of cooperation*. Oldenbourg: De Gruyter, pp. 3-10.
Johnson, E.J.; Shu, S.; Dellaert, B.G. C.; Fox, C.R.; Goldstein, D.G.; Haeubl, G.; Larrick, R.P.; Payne, J.W.; Peters, E.; Schkade, D.; Wansink, B.; Weber, E.U., (2012) 'Beyond nudges. Tools of a choice architecture', *Marketing Letters*, Vol. 23, pp. 487–504.

Jonge, J.de (2012) *Rethinking Rational Choice Theory. A companion on rational and moral action*. New York: Palgrave Macmillan.
Jordan, A.; Huitema, D.; Schoenfeld, J.; van Asselt, H.; Forster, J. (2018) 'Governing climate change. The promise and limits of polycentric governance' in Jordan, A.; Huitema, D.; van Asselt, H.; Forster, J. (Eds.) *Governing climate change. Polycentricity in action?* Cambridge: Cambridge University Press.
Kahneman, D.; Tversky, A. (1979) 'Prospect Theory. An analysis of decision under risk', *Econometrica*, Vol. 47(2), pp. 263-292.
Kallhoff, A. (2014) 'Why societies need public goods', *Critical Review of International Social and Political Philosophy*, Vol. 17(6), pp. 635–651.
Kaul, I. (2001) 'Global Public Goods. What Role for Civil Society?', *Nonprofit and Voluntary Sector Quarterly*, Vol. 30(3), pp. 588-602.
Kaul, I.; Grunberg, I.; Stern M.A. (1999) 'Defining global public goods' in Kaul, I.; Grunberg, I.; Stern, M.A. (Eds.) *Global public goods. International cooperation in the 21st Century*. New York/ Oxford: Oxford University Press.
Keck, M.E.; Sikkink, K. (1998) *Activists beyond borders: advocacy networks in international politics*. Ithaca, NY: Cornell University Press.
Keohane, R.O. (1984) *After Hegemony. Cooperation and Discord in the World Political Economy*. Princeton University Press: New Jersey.
Keohane, R.O. (1989) *International Institutions and State Power: Essays in International Relations Theory*. Boulder: Westview.
Keohane, R. (1998) 'International institutions. Can interdependence work?' *Foreign Policy*, Vol. 110, pp. 82–96.
Keohane, R. O.; Ostrom, E. (Eds.) (1995) *Local Commons and Global Interdependence*, London/ Thousand Oaks/ New Delhi: Sage.
Kern, K., Bulkeley, H. (2009) 'Cities, Europeanization and multi-level governance: Governing climate change through transnational municipal networks', *Journal of Common Market Studies*, Vol. 47(2), pp. 309–332.
Kherallah, M.; Kirsten, K.J. (2002) 'The New Institutional Economics. Applications for agricultural policy research in developing countries'*, Agricultural Economics Association of South Africa* (AEASA), Vol. 41(2), pp. 110-133
Klandermans, B. (1984) 'Mobilization and participation: Social-psychological expansions of resource mobilization theory', *American Sociological Review*, Vol. 49(5), pp. 583-600.
Knoepfel, P.; Larrue, C.; Varone, F.; Hill, M. (2007) *Public Policy Analysis. The Policy Press*. University of Bristol: Bristol.
Kocher, M.G.; Cherry, T.; Kroll, S.; Netzer, R.J.; Sutter, M. (2008) 'Conditional cooperation on three continents', *Economics Letters*, Vol. 101(3), pp. 175-178.
Kollock, P. (1998) 'Social dilemmas: The anatomy of cooperation', *Annual Review of Sociology*, Vol. 24, pp. 183-214.
Komorita SS. (1987) 'Cooperative choice in decomposed social dilemmas', *Personality and Social Psychology Bulletin*, Vol. 13, pp. 53–63.
Komorita, S.S.; Parks, C.P. (1994) *Social Dilemmas*. Boulder, CO: Westview Press.
Komorita, S.S.; Parks, C.D.; Hulbert, L.G. (1992) 'Reciprocity and the induction of cooperation in social dilemmas', *Journal of Personality and Social Psychology*, Vol. 62, pp. 607-617.

Kramer, R.M.; Brewer, M.B. (1984) ‘Effects of group identity on resource use in a simulated commons dilemma’, *Journal of Personality and Social Psychology*, Vol. 46(10), pp. 44–56.
Kramer, R.M.; Brewer, M.B. (1986) ‘Social group identity and the emergence of cooperation in resource conservation dilemmas’ in Wilke, H.; Messick, D.M.; Rutte, C. (Eds.) *Experimental social dilemmas*. Frankfurt: Verlag Peter Lang, pp. 205–34.
Kuhn, Steven (Winter 2019 Edition) *Prisoner’s Dilemma*, The Stanford Encyclopedia of Philosophy , Edward N. Zalta (Ed.), [Online] Available at <https://plato.stanford.edu/archives/win2019/entries/prisoner-dilemma/>. (Accessed: 23.09.2022)
Labaeye, A.; Sauer, T. (2013) ‘City Networks and the socio-ecological transition. A European inventory’, *WWWforEurope Working Paper*, Vol.27, Vienna.
Lamnek, S. (2010) *Qualitative Sozialforschung*. 5th Ed. Weinheim/ Basel: Beltz Verlag.
Lange, P. A. M. V., Joireman, J., Parks, C. D.; Dijk, E. V. (2013) ‘The psychology of social dilemmas: A review’, *Organizational Behavior and Human Decision Processes*, Vol. 120(2), pp. 125–141.
Lara, A. (2015) ‘Rationality and complexity in the work of Elinor Ostrom’, *International Journal of the Commons*, Vol. 9, pp. 573–594.
Lauth, H-J.; Pickel, G.; Pickel, S. (2008) *Methoden der Vergleichenden Politikwissenschaft. Eine Einführung*. Wiesbaden: VS Verlag.
Leal, V., Azevedo, I. (2016) ‘Setting targets for local energy planning: Critical assessment and a new approach’, *Sustainable Cities and Society*, Vol. 26, pp. 421–428.
Ledyard, J.O. (1995) ’Public goods. A survey of experimental research’ in Kagel, J.H.; Roth, A.E. (Eds*.) The Handbook of Experimental Economics*. Princeton/ New Jersey: Princeton University Press, pp. 111-194.
Levi, M. (1988) *Of rule and revenue*. Berkeley:University California Press.
Levy, M., Keohane, R. and Haas, P. (1993) ‘Improving the effectiveness of international environmental institutions’ in Haas, P. R.; Keohane, R. O.; Levy, M.A. (Eds.) *Institutions for the earth. Sources of effective international environmental protection*. Cambridge, MA: MIT Press.
Lindblom, C.E. (1965) *The intelligence of democracy*. New York: The Free Press.
Luhmann, N. (1979) *Trust and Power*. Chichester, England: Wiley.
Lusk, K.; Gunkel, N. (2018) *Cities joining ranks. Policy networks on the rise.* United States: Boston University Initiative on Cities.
Mackie, J.L. (1967) ‘Fallacies’ in Edwards, P. (Ed.) *The Encyclopedia of Philosophy*, Vol. 3. New York: Macmillan, pp. 169-179.
March, J.G. (1987) ‘Bounded rationality, ambiguity, and the engineering of choice’, *The Bell Journal of Economics*, Vol. 9(2), pp. 587-608.
Markandya, A.; Rübbelke, D.T.G. (2003) ‘Ancillary benefits of climate policy’, *Nota di Lavoro*, No. 105.2003, Fondazione Eni Enrico Mattei (FEEM), Milano.
Marshall, G. (2015) ‘Polycentricity and Adaptive Governance’, *Working Paper presented at the 15th Biannual International Conference of the International Association for the Study of the Commons*, Edmonton, Canada.
Marwell, G.; Oliver, P. (1993) *The critical mass in collective action*. New York, NY: Cambridge University Press.

Mayer, H. O. (2004) *Interview und schriftliche Befragung. Entwicklung, Durchführung und Auswertung.* 2nd Ed. Oldenbourg Wissenschaftsverlag: München.
Mayring, P. (2014) *Qualitative content analysis: theoretical foundation, basic procedures and software solution*. Klagenfurt.
Mayring, P. (2015) *QualitativeInhaltsanalyse. Grundlagen und Techniken*. 13th Ed. Weinheim/ Basel: Beltz Verlag.
Mazar, N.; Soman, D. (2022) *Behavioral science in the wild*. Toronto: University of Toronto Press.
McCann, L.; Colby, B.; Easter, W.K.; Kasterine, A.; Kuperan, K.V. (2005) 'Transaction cost measurement for evaluating environmental policies', *Ecological Economics*, Vol. 52(4), pp. 527-542.
McCann, L., Easter, K.W., (2000) 'Estimates of public sector transaction costs in NRCS programs'*, Journal of Agricultural and Applied Economics*, Vol. 32 (3), pp. 555–563.
McGinnis, M. D.; Ostrom, E. (2011) 'Reflections on Vincent Ostrom, public administration, and polycentricity', *Public Administration Review*, Vol. 72(1), pp. 15–25.
Melis, A. P.; Semmann, D. (2010) 'How Is Human Cooperation Different?', *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 365(1553), pp. 2663–74.
Ménard, C.; Shirley, M.M. (Ed.) (2008) 'Introduction', in Ménard, C.; Shirley, M.M. (Eds.), *Handbook of New Institutional Economics*. Berlin/ Heidelberg: Springer-Verlag.
Mello, P. A. (2021) *Qualitative comparative analysis. An introduction to research design and application*. Washington, DC: Georgetown University Press.
Messick, D. M. (1982) 'Solving social dilemmas. Individual and collective approaches', *Paper presented at the Social Psychology Alumni and Friends Conference*, August, 19-21, Chapel Hill, NC.
Messick, D. M.; Kramer, R. M. (2001) 'Trust as a form of shallow morality', in Cook, K.S. (Ed.), *Trust in society*. New York, NY: Russell Sage Foundation.
Messner, D.; Guarín, A.; Haun, D. (2013) 'The behavioral dimensions of international cooperation', *Global Cooperation Research Papers*, No. 1, Duisburg: University of Duisburg-Essen, Käte Hamburger Kolleg, Centre for Global Cooperation Research (KHK/GCR21).
Michie, S.; van Stralen, M.M.; West, R. (2011) 'The behaviour change wheel. A new method for characterising and designing behaviour change interventions', *Implementation Science*, Vol. 6 (42).
Milgram, S. (1967) 'The small world problem', *Psychology Today*, Vol. 2, pp. 60-7.
Morner, M.; Wälder, N. (2013) 'Auf dem Weg zu einem kooperativen Menschenbild. Überlegungen zur Organisation der Kooperation (Towards a Cooperative Idea of Man in Organizations)', *Zeitschrift für Wirtschafts- und Unternehmensethik (Journal for Business, Economics & Ethics)*, Vol. 14(2), pp. 178-194.
Morrissey, O.; Te Velde, D.W.; Hewitt, A. (2002) 'Defining international public goods. Conceptual issues', in Ferroni, M.; Mody, A. (Eds*.) International Public Goods. Incentives, Measurement, and Financing*. Dordrecht: Kluwer Academic Publishers.
Mulder, L.B.; Van Dijk, E.; De Cremer, E.; Wilke, A.M.W. (2006) 'Undermining trust and cooperation. The paradox of sanctioning systems in social dilemmas', *Journal of Experimental Social Psychology*, Vol. 42 (2), pp. 147-162.

Mueller, M. (2018) 'Making the World Great Again. Using Global Public Goods to Enhance Global Governance Outcomes', *UCL Global Governance Institute Working Paper Series*, No. 5.
Musgrave, R.A. (1959) *The theory of public finance*. New York: McGraw Hill.
Nabli, M. K.; Nugent, J.B. (1989a) 'Collective action, institutions and development', in Nabli, M. K.; Nugent, J.B. (Eds.) *The new institutional economics and development. Theory and applications to Tunisia*. Amsterdam: Elsevier Science Publishers B.V., pp. 80-137.
Nabli, M. K.; Nugent, J.B. (1989b): 'The New Institutional Economics and its applicability to development', *World Development*, Vol. 17(9), pp. 1333-1347.
Ngah, K.; Zakaria, Z.; Noordin, N.; Mustaffa, J. (2015) 'Decision-making model at local government level. A new proposed for Majlis Perbandaran Kuantan', *Journal of Economics and Sustainable Development*, Vol. 6 (1).
Nguyen, T.M.P.; Davidson, K.; Coenen, L. (2020) 'Understanding how city networks are leveraging climate action. Experimentation through C40', *Urban Transform*, Vol. 2(12).
Nielsen, A.B, Papin, M. (2020) 'The hybrid governance of environmental transnational municipal networks: Lessons from 100 Resilient Cities', *Environment and Planning C: Politics and Space*, Vol. 39(4), pp. 667-685.
Oliver, P. (1980) 'Rewards and punishments as selective incentives for collective action. Theoretical investigations', *American Journal of Sociology*, Vol. 85, pp. 1356-1375.
Oliver, P. E.; Marwell, G.; Teixeira, R. (1985) 'A theory of the critical mass. I. Interdependence, group heterogeneity, and the production of collective action', *American Journal of Sociology*, Vol. 91, pp. 522-56.
Olson, M., Jr. (1965) *The logic of collective action*. Cambridge, MA: Harvard University Press.
Ophuls, W. (1973) 'Leviathan or oblivion', in Daly, H.E. (Ed.) *Toward a steady state economy*, San Francisco: Freeman, pp. 215-230.
Orbell, J.M.; van de Kragt, A.J.C.; Dawes, R.M. (1988) 'Explaining discussion-induced cooperation', *Journal of Personality and Social Psychology*, Vol. 54, pp. 811-819.
Ostrom, E. (1972) 'Metropolitan reform. Propositions derived from two traditions', *Indiana University Social Science Quarterly*, Vol. 53(3), pp. 474-493.
Ostrom, E. (1990) *Governing the commons. The evolution of institutions for collective action.* Cambridge University Press: Cambridge.
Ostrom, E. (1997) 'A behavioral approach to the rational choice theory of collective action', *American Political Science Review*, Vol. 92(1), pp. 1-22.
Ostrom, E. (1999) 'Coping with tragedies of the commons', *Annual Review of Political Science*, Vol. 2, pp. 493–535.
Ostrom, E. (2000) 'Collective action and the evolution of social norms', *Journal of Economic Perspectives*, Vol. 14(3), pp. 137–158.
Ostrom, E. (2003) 'Toward a behavioral theory linking trust, reciprocity, and reputation' in Ostrom, E.; Walker, J. (Eds.) *Trust and reciprocity. Interdisciplinary lessons from experimental research*. New York: Russell Sage Foundation, pp. 19–79.
Ostrom, E. (2009) 'A Polycentric approach for coping with climate change', *Background Paper to the 2010 World Development Report*, Washington, D.C.: The World Bank.

Ostrom, E. (2010a) 'A long polycentric journey', *Annual Review of Political Science*, Vol. 13, pp. 1-23.
Ostrom, E. (2010b) 'Polycentric systems for coping with collective action and global environmental change', *Global Environmental Change*, Vol. 20(4), pp. 550-557.
Ostrom. E. (2015) [1990] *Governing the commons*. Cambridge: Cambridge University Press.
Ostrom, E.; Gardner, R.; Walker, J. (1994) *Rules, Games, and Common-Pool Resources*. University of Michigan Press.
Ostrom, V. (1991) *The Meaning of American Federalism*. San Francisco: Institute for Contemporary Studies Press.
Ostrom, V. (1999) 'Polycentricity (Part 1)', in McGinnis, M.D. (Ed.) *Polycentricity and Local Public Economies. Readings from the Workshop in Political Theory and Policy Analysis*. Michigan: The University of Michigan Press.
Parianen, F. (2012) *Teilen und Haben. Warum wir zusammenhalten müssen, aber nicht wollen*. Berlin: Bibliographisches Institut, Dudenverlag.
Pavitt, C. (2018) 'The path to cooperative action during group social dilemmas. A literature review, set of propositions, and model describing. How the opportunity to communicate encourages cooperation', *Review of Communication Research*, Vol. 6, pp. 54-83.
Payne, G.; Williams, M. (2005) 'Generalization in qualitative research', *Sociology*, Vol. 39(2), pp. 295-314.
Pittel, K; Rübbelke, D.T.G. (2012) 'Transitions in the negotiations on climate change. From prisoner's dilemma to chicken and beyond', *International Environmental Agreements: Politics, Law and Economics*, Vol. 12(1), pp. 23-39.
Polanyi, M. (1951*) The logic of liberty*. Chicago, IL: University of Chicago Press.
Pomberger, M.; Marteau, T.M. (2013) 'When do financial incentives reduce intrinsic motivation? Comparing behaviors studied in psychological and economic literatures', *Health Psychology*, Vol. 32(9), pp. 950-957.
Pomery, E. A.; Gibbons, F.X. ; Reis-Bergan, M.; Gerrard, M. (2009) 'From willingness to intention. Experience moderates the shift from reactive to reasoned behavior', *Personality and Social Psychology Bulletin*, 35(7), pp. 894-908.
Pruitt, D. G.; Kimmel, M. J. (1977) 'Twenty years of experimental gaming. Critique, synthesis, and suggestions for the future', *Annual Review of Psychology*, Vol. 28, pp. 363-392.
Przeworski, A.; Teune, H. (1970) *The Logic of comparative social inquiry*. New York: John Wiley and Sons, Inc.
Ragin C.C. (1987) *The comparative method. Moving beyond qualitative and quantitative strategies*. Berkeley: University of California Press.
Ragin, C.C. (1998) 'The logic of qualitative comparative analysis', *International Review of Social History*, Cambridge University Press, Vol. 43(S6), pp. 105-124.
Ragin, C.C. (2000) *Fuzzy-set social science*. Chicago: The University of Chicago Press.
Ragin C.C. (2017) *User's guide to Fuzzy-Set / Qualitative Comparative Analysis*, Department of Sociology University of California, Irvine Irvine, CA. [Online] Available at https://sites.socsci.uci.edu/~cragin/fsQCA/download/fsQCAManual.pdf (Accessed: 26.12.23)
Richter, R. (2005) 'The New Institutional Economics. Its start, its meaning, its prospects', *European Business Organization Law Review*, Vol. 6(2), pp. 161 - 200.

Rihoux, B.; Ragin, C.C. (2009) 'Introduction' in Rihoux, B. Ragin, C.C. (Eds.) *Configurational comparative methods. Qualitative Comparative Analysis (QCA) and related techniques*. Los Angeles, London, New Delhi, Singapore: Sage, pp. xvii-xxv.
Ring, P.S.; Van de Ven, A.H. (1994) 'Developmental processes of cooperative interorganizational relationships', *Academy of Management Review*, Vol. 19(1), pp. 90-118.
Ring, P.S.; Van de Ven, A.H. (1992) 'Structuring cooperative relationships between organizations, *Strategic Management Journal*, Vol. 13, pp. 483-498.
Roberts, D.J. (1974) 'The Lindahl solution for economies with public goods', *Journal of Public Economics*, Vol. 3(1), pp. 23-42.
Rousseau, J.-J. (2004)[1754] *Discourse on the origin of inequality*. Mineola, New York: Dover Publications.
Rubinstein, A. (1998) *Modeling Bounded Rationality*. Cambridge, Massachusetts: MIT Press.
Rustagi, D.; Engel, S.; Kosfeld, M. (2010) 'Conditional cooperation and costly monitoring explain success in forest commons management, *Science*, Vol. 330, pp. 961-965.
Samuelson, P.A. (1954) 'The pure theory of public expenditure', *Review of Economics and Statistics*, Vol. 36(4), pp. 387-389.
Scharpf, F.W. (2000) *Interaktionsformen. Akteurzentrierter Institutionalismus in der Politikforschung*. Opladen: Leske+Budrich.
Schneider, C.Q. ; Rohlfing, I. (2016) 'Case studies nested in fuzzy-set QCA on sufficiency. Formalizing case selection and causal inference', *Sociological Methods & Research*, Vol. 45 (3), p.526-568.
Schneider, C.Q.; Wagemann, C. (2012) *Set-theoretic methods for the social sciences. A guide to qualitative comparative analysis*. Cambridge: Cambridge University Press.
Schelling, T. C. (1956) 'An essay on bargaining', *American Economic Review*, Vol. 46(3), pp. 281–306.
Schelling, T.C. (1960) *The strategy of conflict*. Cambridge: Harvard University Press.
Schelling, T. C. (1956) 'An Essay on Bargaining', *The American Economic Review*, Vol. 46(3), pp. 281-306.
Sehring, J.; Korhonen-Kurki, K.; Brockhaus, M. (2013) 'Qualitative comparative analysis (QCA): An application to compare national REDD+ policy processes', *Working Paper,* No.121, Bogor, Indonesia: CIFOR.
Selten, R. (2001) 'What is bounded rationality?', in Gigerenzer, G.; Selten, R., (Eds.), *Bounded rationality. The adaptive toolbox*. Cambridge, MA: MIT Press, pp. 13–36.
Shapira, Z. (Ed.) (1997) *Organizational decision making*. Cambridge: Cambridge University Press.
Simon, H.A. (1953) *A behavioral model of rational choice.* Santa Monica, California: The Rand Corporation.
Simon, H. A. (1955) 'A behavioral model of rational choice', *The Quarterly Journal of Economics*, Vol. 69(1), pp. 99–118.
Simon, H.A. (1957) *Models of man. Social and rational*. New York: Wiley.
Simon, H. A. (1964) 'Theories of bounded rationality', *CIP Working Paper*, Vol. 66.
Simon, H.A. (1969) *The Sciences of the Artificial*. Cambridge, MA.: The MIT Press.

Simon, H.A. (1976) 'From substantive to procedural rationality' in Latsis, S.J. (Ed.), *Method and appraisal in economics*. Cambridge, MA: Cambridge University Press, pp. 129-148.
Simon, H.A. (1985) 'Human nature in politics. The dialogue of psychology with political science', *American Political Science Review*, Vol. 79, pp. 293-304.
Simon, H.A.; Dantzig, G.B.; Hogarth, R.; Plott, C.R.; Raiffa, H.; Schelling, T.C.; Shepsle, K.A.; Thaler, R.; Tversky, A.; Winter, S. (1987) 'Decision Making and Problem Solving', *Interfaces*, Vol. 17(5), pp. 11-31.
Simon, H.A. (1997) *Models of Bounded Rationality. Empirically grounded economic reason*. Cambridge, MA: The MIT Press.
Skelcher, C. (2005) 'Jurisdictional integrity, polycentrism, and the design of democratic governance', *Governance*, Vol. 18, pp. 89–110.
Smith, A. (1909) *An inquiry into the nature and causes of the wealth of nations*. New York: P.F. Collier.
Smith, R.J. (1981) 'Resolving the tragedy of the commons by creating private property rights in wildlife', *CATO Journal*, Vol. 1, pp. 439-468.
Smith, K. G.; Carroll, S. J.; Ashford, S. J. (1995) 'Intra- and interorganizational cooperation. Toward a research agenda', *Academy of Management Journal*, Vol. 38, pp. 7-23.
Teraji, S. (2018) *The cognitive basis of institutions. A synthesis of behavioral and institutional economics*. London/ San Diego/ Cambridge/ Oxford: Academic Press (Elsevier).
Thaler, R.; Sunstein, C. (2008) *Nudge. Improving decisions about health, wealth, and happiness*. New Haven: Yale University Press.
Thompson, J.D. (2003) *Organizations in action. Social Science Bases of Administrative Theory*. New York: Routledge.
Truc, A. (2021) 'Forty years of behavioral economics', *The European Journal of the History of Economic Thought*.
Tversky, A. and Kahneman, D. (1974) 'Judgment under uncertainty. Heuristics and biases', *Science*, Vol. 185 (4157), pp. 1124–1131.
Tversky, A.; Kahneman, D. (1981) 'The framing of decisions and the psychology of choice', *Science*, New Series, Vol. 211(4481), pp. 453-458.
UN/ DESA (2018) *World urbanization prospects 2018* [Online] Available at https://esa.un.org/unpd/wup/ (Accessed: 01.08.2018)
UN/Framework Convention on Climate Change (2015*) Adoption of the Paris Agreement* [Online], 21st Conference of the Parties, Paris:United Nations, Available at https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement (Accessed: 01.08.2018)
UN Habitat (2011) *Cities and climate change. Global report on human settlements*, Washington DC; London: United Nations Human Settlements Programme. (Accessed: 01.08.2018)
UNEP/ UN Habitat (2005) *Coastal Area Pollution. The Role of Cities*, http://www.unep.org/urban_environment/PDFs/Coastal_Pollution_Role_of_Cities.pdf (Accessed: 01.08.2018)
Unger, C.; Thielges, S. (2021) 'Preparing the playing field. Climate club governance of the G20 Climate and Clean Air Coalition and Under2 Coalition', *Climatic Change*, Vol. 167(3), pp. 1-21.

UN Habitat (2011) *Cities and climate change. Global report on human settlements*, Washington DC; London: United Nations Human Settlements Programme.
van der Heijden, J. (2018) 'City and subnational governance. High ambitions, innovative instruments and polycentric collaborations?' in Jordan, A.; Huitema, D.; van Asselt, H.; Forster, J. (Eds.) *Governing Climate Change. Polycentricity in Action?* Cambridge: Cambridge University Press.
van der Heijden, J.; Bulkeley, H.; Certomà, C. (2019) 'Promises and concerns of the urban century. Increasing agency and contested empowerment' in Van der Heijden, J.; Bulkeley, H.; Certomà, C. (Eds.) *Urban climate politics. Agency and empowerment*. Cambridge/ New York/ Port Melbourne/ New Delhi/ Singapore: Cambridge University Press.
van Dijk, J. (2012) *The Network Society*. 3rd Ed. Thousand Oaks: Sage Publications.
von Neumann, J.; Morgenstern, O. (1944) *Theory of games and economic behavior*. Princeton, NJ: Princeton University Press.
Williamson, O. (1975) *Markets and hierarchies. Analysis and antitrust implications*. New York: Free Press.
Williamson, O. (1996) *The mechanisms of governance*. New York/ Oxford: Oxford University Press.
Chen, X., Pillutla, M.M., Yao, X. (2009) 'Unintended consequences of cooperation inducing and maintaining mechanisms in public goods dilemmas. Sanctions and moral appeals', *Group Processes & Intergroup Relations*, Vol. 12, pp. 241 - 255.
Yamagishi T. (1986) 'The provision of a sanctioning system as a public good', *Journal of Personality and Social Psychology*, Vol. 51, pp. 110–16.
Zeng, M.; Chen, X.-P. (2003) 'Achieving cooperation in multiparty alliances. A social dilemma approach to partnership management', *The Academy of Management Review*, Vol. 28(4), pp. 587–605.
Zucker, L.G. (1986) 'Production of trust. Institutional sources of economic structure' in Staw, B.M.; Cummings, L.L. (Eds.) *Research in organizational behavior*, Vol. 8, pp. 53-112.

Case study literature

Cities Race to Zero

CRTZ (n.d.) *About* [Online] Available at
CRTZ https://www.c40knowledgehub.org/s/cities-race-to-zero-about?language=en_US (Accessed: 14.12.2022)

Clean Air Asia

Clean Air Asia (n.d.) *Better Air Quality* [Online] Available at https://cleanairasia.org/baq (Accessed: 02.10.2023)
Clean Air Asia (2023) *Our work* [Online] Available at https://cleanairasia.org/our-work (Accessed: 02.10.2023)
Clean Air Asia (n.d.) *Clean Air Asia Strategy* [Online] Available at https://cleanairasia.org/sites/default/files/2021-08/CAA-strategy-2020-2030.pdf (Accessed: 02.10.2023)
Clean Air Asia (2023) *Who we are* [Online] Available at https://cleanairasia.org/who-we-are (Accessed: 02.10.2023)

Climate Alliance

Climate Alliance (n.d.) *About us* [Online] Available at https://www.climatealliance.org/about-us.html (Accessed: 22.11.2022)

Climate Alliance (n.d.) *Activities* [Online] Available at https://www.climatealliance.org/activities.html (Accessed: 22.11.2022)

Climate Alliance (n.d.) *Climate justice* [Online] Available at https://www.climatealliance.org/about-us/climate-justice.html (Accessed: 22.11.2022)

Climate Alliance (n.d.) *Energy caravan* [Online] Available at https://www.climatealliance.org/activities/campaigns/energy-caravan.html (Accessed: 22.11.2022)

CA (2022) *Review and Outlook 2021|2022* [Online] Available at https://www.climatealliance.org/fileadmin/Inhalte/7_Downloads/2021_Climate_Alliance_Annual_Report.pdf (Accessed: 22.11.2022)

CNCA

Carbon Neutral Cities Alliance (CNCA) (n.d.) *About us* [Online] Available at https://carbonneutralcities.org/about/ (Accessed: 17.11.2022)

Carbon Neutral Cities Alliance (CNCA) (n.d.) *CNCA Game changer fund* [Online] Available at https://carbonneutralcities.org/cnca-game-changer-fund/ (Accessed: 17.11.2022)

Carbon Neutral Cities Alliance (CNCA) (n.d.) *Our cities* [Online] Available at https://carbonneutralcities.org/cities/ Accessed: 17.11.2022)

Carbon Neutral Cities Alliance (CNCA) (2015) *Framework for Long-Term Deep Carbon Reduction Planning* [Online] Available at https://carbonneutralcities.org/wp-content/uploads/2018/04/CNCA-Framework-for-Long-Term-Deep-Carbon-Reduction-Planning.pdf (Accessed: 17.11.2022)

Carbon Neutral Cities Alliance (CNCA) (2020) *Strategic Plan 2021 - 2023* [Online] Available at http://carbonneutralcities.org/wp-content/uploads/2020/11/2021-2023-CNCA-Strategic-Plan_November-2020.pdf (Accessed: 17.11.2022)

C40

C40 Cities Climate Leadership Group (C40) (2022) *About C40* [Online] Available at https://www.c40.org/about-c40/ (Accessed: 17.11.2022)

C40 Cities Climate Leadership Group (C40) (2021) *Leadership Standards* [Online] Available at https://www.c40.org/news/statement-by-the-c40-cities-steering-committee/ (Accessed: 17.11.2022)

C40 Cities Climate Leadership Group (C40) (2022) *Cities Membership* [Online] Available at https://www.c40.org/wp-content/uploads/2022/04/C40-Cities-Membership_6-Oct-2022.pdf (Accessed: 17.11.2022)

Energy Cities

Energy Cities (2022) *Vision and mission* [Online] Available at https://energy-cities.eu/vision-mission/ (Accessed: 27.11.2022)

Energy Cities (2021) *Agenda for a transformative decade* [Online] Available at https://energy-cities.eu/wp-content/uploads/2021/05/RZ_EnergyCities_2021_Agenda_EN_SinglePage.pdf (Accessed: 27.11.2022)

Eurocities

Eurocities (n.d.) *About us* [Online] Available at https://eurocities.eu/about-us/ (Accessed: 22.11.2022)
Eurocities (n.d.) *Cities* [Online] Available at https://eurocities.eu/cities/ (Accessed: 22.11.2022)
Eurocities (n.d.) *Goals* [Online] Available at https://eurocities.eu/goals/ (Accessed: 22.11.2022)
Eurocities (n.d.) *Why become a member* [Online] Available at https://eurocities.eu/why-become-a-member/ (Accessed: 22.11.2022)

GCoM

GCoM (n.d.) *How to join* [Online] Available at https://www.globalcovenantofmayors.org/how-to-join/ (Accessed: 22.11.2022)
GCoM (n.d.) *Who we are* [Online] Available at https://www.globalcovenantofmayors.org/who-we-are/ (Accessed: 22.11.2022)
GCoM (2019) *Guidance note. Explanatory Note accompanying the Global Covenant of Mayors Common Reporting Framework* [Online] Available at https://www.globalcovenantofmayors.org/wp-content/uploads/2019/08/Data-TWG_Reporting-Framework_GUIDENCE-NOTE_FINAL.pdf (Accessed: 22.11.2022)

ICLEI/ CCP (GCC)

ICLEI South Asia (n.d.) *Cities for Climate Protection (CCP) Campaign* [Online] Available at https://southasia.iclei.org/project/cities-for-climate-protection-ccp-campaign/ (Accessed: 27.11.2022)
ICLEI (2016) *Green Climate Cities Program. A pathway to low-emission, low-risk city development* [Online] Available at https://iclei.org/wp-content/uploads/2022/05/GCC-4pager-update_web-version-v2.pdf (Accessed: 27.11.2022)
ICLEI (2022) *ICLEI World Congress 2021-2022* [Online] Available at https://worldcongress.iclei.org/wp-content/uploads/2022/09/ICLEI_World_Congress_2021-2022_Report.pdf (Accessed: 27.11.2022)

Under2 Coalition

Lusk, K./ Gunkel, N. (2018) *Cities Joining Ranks. Policy Networks on the Rise*, Boston University, Initiative on Cities [Online] Available at https://hdl.handle.net/2144/28865 (Accessed: 29.09.2023)
Under2 Coalition (2022) *Our work* [Online] Available at https://www.theclimategroup.org/our-work (Accessed: 29.09.2023)
Under2 Coalition (2022) *Under2 Coalition* [Online] Available at https://www.theclimategroup.org/under2-coalition (Accessed: 27.11.2022)
Under2 Coalition (2022) *Under2 Coalition Net Zero Progress Report 2022* (website summary) [Online] Available at https://www.theclimategroup.org/our-work/resources/under2-coalition-net-zero-progress-report-2022 (Accessed: 27.11.2022)
Under2 Coalition (2022) *Under2 Memorandum of Understanding (MoU)* [Online] Available at https://www.theclimategroup.org/sites/default/files/2021-10/Under2%20MOU_English_2021.pdf (Accessed: 27.11.2022)

UrbanShift

Urban Shift (n.d.) *Transforming cities for people and planet. Annual report 2021-2022* [Online] Available at https://www.shiftcities.org/sites/default/files/2022-11/UrbanShift%20Annual%20Report%202021-2022_Web_0.pdf (Accessed: 22.12.2022)

Software

Ragin, Charles C.; Davey, S. (2022) *Fuzzy-Set/Qualitative Comparative Analysis 4.0*. Irvine, California: Department of Sociology, University of California. [Online], Available at https://sites.socsci.uci.edu/~cragin/fsQCA/software.shtml (Accessed throughout November 2023)