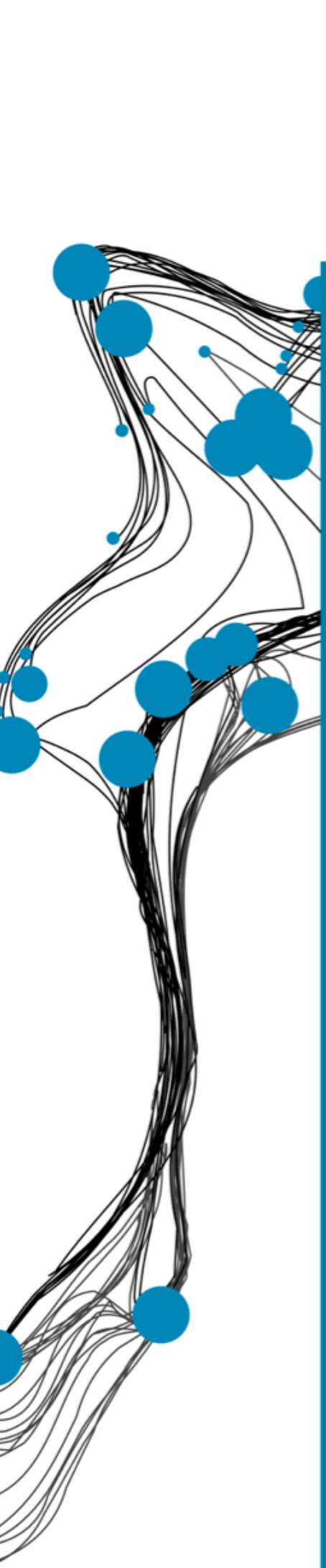

GOVERNING SUSTAINABLE MOBILITY:

MODES OF GOVERNANCE IN INFRASTRUCTURE DEVELOPMENT FOR ELECTRIC VEHICLES

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Summary

The climate crisis has increased the need to develop sustainable mobility infrastructure, such as public AC-charging stations for electric vehicles. German municipalities approach this task in many different ways, involving different actor roles and responsibilities. The objectives of this research are to examine the 'polity' and 'politics' structure in the three Germany cities and classify their governance modes all the while leveraging Elinor Ostrom's IAD-framework as a guide for conducting this examination. Within a descriptive case study design the mechanisms and the role of each actor within the arena will be identified by systematically analyzing formal municipal documents, which are collected via desk research. It became evident that the mode of governance is determined by the rules in place. Comparing the three cities 'polity' and 'politics' dimensions via the IAD-framework enabled academic important insights about how the dimensions influence each other and together determine the mode of governance. Moreover, it provides proof for polycentricity and argues against the idea that there is one best way to govern sustainability. It challenges the arguments of participatory governance, as it accounts for the key position that local government has in the action arena.

List of Abbreviations

Abbreviation	
AC	Alternating Current
CPO	Charging Point Operator
DC	Direct Current
EGO	Electrictiy Grid Operator
EU	European Union
EV	Electric Vehicle
GHG	Greenhouse Gas
IAD	Institutional Analysis and Development Framework
PPP	Public Private Partnerhsip

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1. Introduction

There is overwhelming scientific consensus that we are in the midst of a global climate crisis, that is induced by human actions (e.g. Steffen et al., 2018). National governments have until now failed to meet their self-set objectives and commitments (cf. Rosen, 2015; Brandt, Svendsen 2002). In the resulting policy vacuum, climate change is increasingly tackled by local governments who have emerged as active forces in climate policy-making (Nguyen-Long & Krause, 2020; Mayer and Nguyen Long forthcoming). One area in which cities are taking action is the transportation sector. The transportation sector is responsible for 27% of total EU greenhouse gas emissions and is therefore an important action field in the fight against global warming (EEA, 2019). Cities are actively trying to reduce emissions by investing in sustainable transportation infrastructure, such as charging stations for electric vehicles (EVs). Electric mobility can raise compliance with emission reduction targets by emitting only natural by-products rather than exhaust fumes. The technology of electric mobility therefore becomes a solution to climate change.

Sustainable transportation infrastructure encourages people to invest in electric mobility. Indeed, an insufficient charging station provision ranks amongst the three most serious barriers to EV adoption (Engel, Hensley, Knupfer, & Sahdev, 2018) because people fear of running out of battery or being unable to satisfy their individual mobility needs, an issue often described as ‘range anxiety‘. It is argued that a dense and comprehensive *public* charging infrastructure is useful to reduce this fear and increase EV attractiveness (Halbey, Kowalewski, & Ziefle, 2015). Planning and implementation measures of such public infrastructure should therefore be part of public policy.

As early as 2007, the German government declared e-mobility as a key element in climate protection. Aiming for the goal to develop Germany into the lead market and leading provider of electric mobility, the government and the responsible ministries have intensified their efforts to support e-mobility and are funding a large number of pilot and research projects (Bundesministerium für Umwelt, 2018). Accordingly, almost 3 out of 4 German cities have already started to build EV charging stations (NOW, 2019). However, there is no federal guideline on how to design the provision process. Thus, German municipalities approach the task of providing charging stations in many different ways, involving different actor roles and responsibilities.

These different approaches may be examined through the lens offered by the growing scholarship on governance modes. A working definition of governance modes is

proposed as ways of realizing collective goals through the collective action of state and society (cf. Lange, Driessen, 2013; Treib, Bähr, & Falkner, 2007). The different modes through which these public goods can be provided are still poorly understood, as few to no studies targeted the topic so far, it seems. The literature on governance modes acknowledges that different policy issues may be addressed by myriad mixes of actors and organizational set-ups. So, the different ways to interact can be described by the constituted rules (‚polity') and actors (‚politics'). Thus, this thesis answers the following research question: 'How do polity and politics influence the modes of governance in the development of public AC-charging infrastructure for electric vehicles in German cities?'

To answer these questions, the thesis consults theory by Nobel laureate Elinor Ostrom (2007, 2010, 2011) on the Institutional Analysis and Development Framework (IAD). The IAD-framework is leveraged to examine the polity structures and actor's roles in the three german cities Hamburg, Stuttgart and Berlin and eventually determine their mode of governance. These cities all employ different strategies to build public charging infrastructure, especially concerning the roles of public administration and private companies. Thereby this thesis also answers the question how helpful Elinor Ostrom's IAD-framework is to identify governance modes.

This research makes some important theoretical contributions to governance scholarship. First, it integrates the IAD's building blocks into governance literature to provide scholars with a 'tool-kit' to empirically analyze governance modes, as they have been poorly studied due to the vagueness of the term. Second, it provides proof about the interrelatedness of the political triad's pillars and about the importance of the triad to understand governance, as it becomes evident that the polity dimension essentially determines the governance mode. Third, this paper also challenges claims that sustainability governance must be participatory. The idea that government is taking a step back in favor of bottom-up governance (Bingham, Nabatchi, & O'Leary, 2005) is not backed up by empirical findings (cf. e.g. Adger, Jordan 2009; Hysing 2009; Van Kersbergen, Van Waarden 2004 in Lange, Driessen, Sauer, Bornemann, & Burger, 2013). This analysis shows that the government is still the key player but the way of governing has shifted from delegation to diverse ways of steering. The important position of governments needs to be accounted for and the different rule settings in this new dynamic must be studied. Lastly, the description of three successful and highly diverse governance modes to provide the same outcome addresses the scientific debate of whether there is a best way (or mode) to govern sustainability (cf. Meadowcroft 2007; Lafferty 2004 in Lange et al., 2013). By showing that there are in fact many ways to arrive

at the same destination and thereby providing proof for polycentricity (Ostrom, 2010), the idea of ‚one best way of governance' is challenged and invalidated.

The empirical question takes place within an applied context. The descriptive and comparative research is not of explanatory nature, as the factors leading to different design choices are not under investigation. It is rather the variation of the designs, roles and modes themselves, that is the center of this analysis.

1.1. Structure of the Thesis

The first chapter introduced the topic, clarified the research questions and argued for the theoretical of this research. Chapter 2 discusses the theoretical background of EV charging infrastructure and the theoretical underpinnings of this paper, that is the 'modes of governance' theory and the use of the IAD-framework. In chapter 3 the research design will be described, including case selection and the techniques of data collection and analysis. Chapter 4 provides a description of how the cases were selected and introduces the three cities Hamburg, Stuttgart and Berlin. Chapter 5 analyzes the 'polity' and 'politics' dimensions of the three cities, concludes about each city's mode of governance and selects on the expectations that have been made based on the theoretical background. Chapter 6 discusses the limitations of this study and recommendations of issues that future research should address. Moreover, a brief section discusses policy implications of this study's findings by referring to experts' and authorities' recommendations for the design of EV infrastructure provision. The last chapter (7) concludes on the findings and reflects about the general lessons to be drawn from the study.

2. Theory / Concepts

This section discusses models, concepts and theories relevant to the research topic. First, electric vehicle (EV) charging infrastructure is defined along its' energy provision capacity and type of good. Moreover, relevant literature further introduces the topic (2.1.). The second part (2.2.) discusses (modes of) governance theory and thereby builds the theoretical frame of this paper. An essential part of this is the connection to the polity-politics-polity triad of governance.

2.1. EV Infrastructure Development

Action arenas are described by Elinor Ostrom (2007) as the "the social space where individuals interact, exchange goods and services, solve problems, dominate one

another, or fight" (p.28). Usually applied in the study of collective action around common pool resources, this thesis applies this concept to the case of urban public goods provision (cf. Klok & Denters, 2018). The development and systematic expansion of a sustainable charging infrastructure, that is need-based comprehensive and user-friendly, is an action arena upon which the success of electric mobility hinges and thereby a more climate-friendly transportation sector. EV charging infrastructure can therefore be understood as a technological solution to climate change. In this context, charging infrastructure refers to the aggregation of charging stations or charging points within an area[1].

This thesis focuses on the provision of AC- (Alternating Current) charging infrastructure, which is one of two common technical charging possibilities. AC charging points ("normal charging") charge vehicles with a charging capacity of up to 22 kilowatts compared to Direct Current (DC) charging points ("fast charging"), which provide a capacity of more than 22 kilowatts[2]. Charging infrastructure can be further categorized based on the type of access and the ownership of the ground property (see table 1). Public charging infrastructure therefore is accessible to everyone and located on publicly owned land.

Typology of Charging Infrastructure		*Access to Infrastructure*	
		Public (Potentially everyone)	*Private (Access limited)*
Ownership of Ground Property	*Public*	Public Charging Infrastructure e.g. in public streets	Semi-Public Charging Infrastructure for certain user groups e.g. police
	Private	Semi-Public Charging Infrastructure e.g. in parking lots of supermarkets	Private Charging Infrastructure e.g. Corporate parking Spaces or wallboxes in private garages

Table 1. Types of charging infrastructure for EVs. Source: (ISI, 2017 p.7)

In Germany, the practical development of public charging station largely falls under the responsibility of the local municipalities, as they are the owners and administrators of the public space (Monopolkommission, 2019). Therefore a prerequisite for the development is cooperation with the municipality, as the owner and administrator of the

[1] One charging Stations usually hold 2 charging points ("Stecker"). By definition of the regulation LSV (Ladesäulenverordnung), a charging point is the device intended to supply electricity to one electric vehicle.

[2] These types are formally defined within the German legal framework, as part of the Ladesäulenverordnung (Charging Station Regulation). The definitions can differ in other countries.

public space. In the absence of a unified national guideline on how to design the development process, the policies of the local public bodies are highly diverse.

Few to no studies have targeted the topic of governance modes in this specific research area of public AC-charging infrastructure so far, it seems. However, there are some studies with valuable insights for this study's components. Helmus and Hoed (2016) have identified the common actors ('politics') involved in public charging infrastructure roll-out, which include the municipality, EV users, residents, (semi-)commercial parties like charge point operators (CPOs) and the electricity grid operators (EGOs). They state that the objective of municipalities is to 'facilitate' infrastructure by 'adding' charging points, however these vague terms understate the complex processes and more importantly the different ways to ‚add' charging points.

Looking beyond Germany's borders, research on EVs reveals a wide heterogeneity in approaches to infrastructure provision. Helmus et al. (2018) determined two EV infrastructure development approaches used in the Netherlands: 'demand-driven' referring to installation upon request by citizens and 'strategic' development referring to local or regional government placing infrastructure near strategic locations (e.g public facilities or other expected hot spots of usage). Similarly, Bakker and Trip (2013) observed different approaches of municipal behavior possibilities including public-private partnerships with one or more private corporations involved, financial support for local businesses or individuals to build infrastructure on their private property, installation upon request of individuals, or general strategic development as a public service of the municipality. Also, there are national-level-led approaches, including "federal mandate (Estonia) to auto-manufacturer led (Japan) to local government initiative (Belgium) to public-private partnerships (Norway)" (Sierzchula, Bakker, Maat, & van Wee, 2014 p.189). While this body of work indicates that there are multiple approaches to provide infrastructure, neither describe these approaches in detail nor include the roles and responsibilities of the involved stakeholders.

2.2. Modes of Governance Theory

The term governance is increasingly used to describe policy making scenarios that do not easily fit within conventional top-down government centered schema. In research about the governance of sustainable mobility Tschoerner (2016) refers to Farrell et al. (2005) and Meadowcroft (2007) who define governance along structures and processes developed in order to shape societal progress. She defines "structures (…) as institutions, rules, and norms shaping not only policy-making but society and the economy, whereas processes

describe how actors come together, engage in defining goals, and implement their visions of sustainable mobility in practice“ (Tschoerner, 2016, p.20). Governance can thus be understood as a new form of societal steering in which new multi-actor arrangements engage in policy formulation and implementation (cf. Treib et al., 2007). This definition of governance implies a shift in traditional actor roles, especially governments' role. The extent to which there is a new role in steering for governments will be explored in this research.

The above mentioned aspects of the governance definition implicitly relate to all three realms of the politics-polity-policy triad. The triad has long been established in political science and refers to the multidimensional nature of governing.

- 'Politics' refers to the procedural aspects of governing (e.g. elections, debates, lobbying, negotiations) but also concerns the actor constellations
- 'Policy' defines the content or material dimension of governance, defining the outcomes
- 'Polity' refers to the institutional structure of norms (‘rules of the game‘) and the resulting orders, (inter-)actions, actor responsibilities and political procedures

These dimensions are key to understanding governance and its results. Different pieces of research often focus on single dimensions when investigating governance (cf. Rosenau 1995; Rhodes 1997; Héritier 2002 in Lange et al., 2013). Treib et al. (2007) argue that the understanding of governance is further specified and distinct according to the realm it primarily belongs to, so it is reasonable to approach research about the governance modes through the triad's dimensions.

Scholars studying governance modes examine alternative ways to govern that may arise (e.g. markets and networks as ideal types) and try to reveal the ‘logics' which may underlie various modes (e.g. Lascoumes & LeGales, 2007). Their efforts have yielded various typologies of governance schemata or modes. However, the specific meaning of ‘modes of governance‘ is as ambiguously defined as ‘governance‘ itself. Lange et al. (2013) propose to define governance modes as “forms of realizing collective goals by means of collective action“ (p.407). Taking into account that ‚governance‘ can be associated with a changed nature of the state and with this the actor constellation (Treib et al., 2007), the definition of governance modes should include the relationship between the hierarchical state and the market or social autonomy, in other words the role of the state in society (cf. Bandelow, Lindloff, & Sikatzki, 2014; Pierre 2000 in Treib et al. 2007; Lange et al. 2013). The reference to the three dimensions of governance compromises key features along which modes of governance can be classified and enable a

comparison of the different pathways through which the public sector may achieve policy goals or or evaluate performance (Treib et al., 2007).

The interaction of public and/or private entities takes place in an institutionalized rule system ultimately aims to realize collective purposes (Lange et al., 2013). How groups find solutions and solve problems can be analyzed through the lens of the IAD-framework (Ostrom, 2007, 2010, 2011) because the framework essentially serves as a tool-kit to analyze the three pillars upon which collective action stands, the dimensions politics, polity and polity. The differences between several ways to interact can be described by the constituted rules. Van Heffen and Klok (2000) also use the IAD's rules-in-use to describe "a typology of pure types of state models" (p.2), concentrating on three state models that are 'market', 'hierarchy' and 'networks' - or in other words 'modes of governance'. Again, these three modes of governance have raised extensive academic discussions about their definitions (cf. Robichau, 2011) but working definitions are proposed as follows:

'Networks' governance refer to self-organizing, inter-organizational frameworks within which actors negotiate interaction, coordinate actions, struggle upon collective decision and form alliances (cf. e.g. Rhodes, 1996; Sørensen & Torfing, 2007 in Robichau, 2011). 'Hierarchy' is a governance mechanism referring to the state's or government's authority to regulate policy issues top-down (cf. Bell & Hindmoor, 2009; Lynn, 2011 in Robichau, 2011). Lastly ‚Market' governance refers to the privatization of fulfilling public purposes or conversely the governmentalization of the private sector (Kettl, 1993, p. 14 in Robichau, 2011) which is claimed to benefit efficiency, economic purposes and effectiveness.

2.3 Institutional Analysis and Development Framework

This case study leverages the 'rules-in-use' of Elinor Ostrom's IAD-framework (Ostrom, 2007, 2010, 2011) as its categories to organize the data and structure the comparison of different local settings and governance structures.

The framework is generally suitable for conducting comparative institutional analyses, that is, how different governance rules, within varying socio-legal contexts, impact policy choices and outcomes (Grossmann, 2019). Moreover, the application of an institutional framework should "identify the major types of structural variables that are present to some extent in all institutional arrangements, but whose values differ from one type of institutional arrangement to another" (Ostrom, 2011 p.9). The rules-in-use designate the action arena's structure and affect the actions taken in the situation at

hand. Rules are “generally agreed upon and enforced prescriptions that require, forbid, or permit specific actions for more than a single individual” (Schlager and Ostrom 1992 in Cole, 2014 p.11). Ostrom defines seven different set of rules - Position, Boundary, Authority, Aggregation, Scope, Information and Payoff rules - that shape the work within the action arena and eventually the outcomes. With a different configuration of rules applied, noticeable differences in incentives and likely patterns of behavior can be anticipated (Grossmann, 2019). The rules are defined in Table 3 based on Klok and Denters (2018).

Rules-in-Use	**Definition**
Position	- identify the different positions (or roles) of the participants - position holders are enabled or obliged to do something as a consequence of the other rules
Boundary (Entry & Exit rules)	- the attributes / conditions and actor must fulfill in order to entry the position or how a position can be left - refer to the ‚openness‘ of the arena; mechanism of include - also contain rules on the process of how actually entering positions is organized (e.g. election)
Choice / Authority	- specify courses of action that are allowed or obliged given the presence (or absence) of certain conditions - crucial in providing actors with options to influence the interaction with other position holders
Information	- prescribe which information is available to the various position holders and how actors should relate to one another in providing and granting access to informatio - might indicate types of information but also information channels
Aggregation	- how are (collective) decisions made on the basis of the contributions of all actors
Scope	- define the possible (and impossible) outcomes of the interaction; the range of allowed outcomes of combined actor action, - characteristic of the entire arena, rather than of one actor
Payoff	- assign rewards or sanctions to particular actions or to outcomes - prescriptions for the cost and benefits generated in the arena itself

Table 2. Definition of the rules-in-use of the IAD-framework. Source: (Klok & Denters, 2018)

2.4. Theoretical Propositions

Based on this theoretical background this thesis outlines the following three theoretical propositions. By understanding charging station development as a topic of local governance, *Proposition 1 expects that public provision of EV infrastructure is not designed as a conventional top-down government policy issue or government-centered design* (Lascoumes & LeGales, 2007*).* This implies engagement of multiple actors in

policymaking and implementation and possibly a background role of governments. Whether governments are really taking a step back in favor of other societal steering forms, like participatory governance, is a topic of discussion in current research (cf. e.g. Adger & Jordan, 2009; Hysing, 2009 in Lange et al., 2013), as it is indicated that this claim is not backed up by empirical findings. Finding elements of participatory governance elements in EV infrastructure provision would therefore support this claim, or vice versa falsify it and thereby strengthen the idea that governments are still in the driving seat.

These assumptions about governance lead to *Proposition 2: that different sets of actors will be involved in different designs and that these carry different responsibilities and levels of authority.* Nevertheless the cities manage to provide high levels of public charging stations, as all investigated cases being the the top 5 german cities in terms of number of public charging stations (cf. chapter 4), so it is reasonable to argue that there is not one best way to govern sustainability.

The essence of the IAD-framework is, that an arena is consist of rules (polity) and actors (politics). Scholars of governance have discussed the interlinkages between the triad's dimensions. According to Lange et al. (2013, p.409) polity and politics build the political playing field, and while political actor alterations can provoke rule change, the institutional rule setting can determine access to the arena and power division within it. Therefore, *Proposition 3 expects that the pillars influence each other, while the effects are assumed to diverge based on the political and rule settings.*

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3. Research Design

This thesis employs a contextual inquiry to gain insights and understanding of social phenomena and capture their inherent nature. The accurate description of social interactions gives value to the discipline. Case study research is suitable to research a real-life contemporary issue within a bounded system (Creswell, Hanson, Clark Plano, & Morales, 2016). Through the intensive study of one or more cases extensive understanding about the larger societal phenomenon at hand that reflects the complexity of reality can be gained (Turner, Ireland, Krenus, & Pointon, 2011). The type of case study conducted in this research is descriptive, as it is aimed as generating a complete description of a phenomenon within its context (Baxter & Jack, 2010) without necessarily aiming at generalization. Because of this selection bias is not a problematic as the selection of cases in this study does neither intend to be representative nor complete.

The descriptive study uses a comparative approach to describe EV infrastructure development. Traditionally, comparative analyses have an explanatory feature, however this is beyond the scope of this study as it investigates “how“ rather than “why“ municipalities build charging stations. By employing multiple cases, comparison of similarities and differences between the cases is facilitated, which is beneficial for theoretical development (Yin 1994 Creswell et al., 2016).

3.1. Data & Documents

This study employs qualitative secondary data, including documents and websites. The sources consist of the municipal strategy papers published by the respective local government and may come in various form of administrative publications (cf. Appendix 3: List of Consulted Documents). These formal regulations give the best picture of who the relevant actors are and what procedures are followed and are far less intrusive than for example interviews. The latter would presumably provide insights on the motivations of the policy-makers or provide a basis for evaluation, but this is not the concern of this research.

The documents were collected via desk research. This choice of data and data collection method is advantageous in terms of accessibility and resource considerations of time and finance management (Turner et al., 2011). However a possible danger of this is heterogeneity in data availability because some cities publish more detailed reports compared to others. A commonality of Berlin and Stuttgart is that both cities published a step-by-step guide to the development: Stuttgart made a detailed description of how CPOs can make the necessary requests and applications (focus on CPO perspective); Berlin’s working aid covers the whole process for all actors who take part in the development. The document published by the Hamburg government differs as it only contains the general concept and therefore lacks the level of detail that the other two cities provide. Still, it is possible to describe and understand the Hamburg development arena because the general concept gives at least an indication, if not a good understanding of the development process, what actors are involved and what role they play within the arena.

The methodology of case studies generally allows flexibility to adapt design and data collection procedures in such a way that they fit the research question. Moreover, an openness for “the use of theory or conceptual categories that guide the research and analysis of data“ is inherent in case studies (Meyer 2001 p.331 in Hill, 2017). This case study leverages the 'rules-in-use' of Ostrom’s IAD-framework as its categories to organize

the data and structure the comparison of different local settings and governance structures.

3.2. Data Analysis Technique

The objective of this research is to conduct a qualitative content analysis of the cities' strategies for charging infrastructure. Content analysis, as a distinctive technique of data analysis, draws its conclusions from inferences of the available documents, through processes of reading, interpreting, analyzing and concluding (Salkind, 2010). Williamson et al. (2018 p.461) describe the process as "classifying and organizing the content (…) systematically into categories that describe the topics, themes and context of that message". This is achieved by employing Elinor Ostrom's 'rules-in-use' of the IAD-framework as the categories for analysis. Within these categories several codes are established based on existing academic literature and insight from initial readings of the documents, which attempt to grasp the full nature of the rules in this applied setting. The codebook can be found in the appendix (Appendix 1). The analysis is conducted via the software package ATLAS.ti and the analyzed an example of a code report can also be found in the appendix (Appendix 2).

4. Cases: Hamburg, Berlin and Stuttgart

This fourth chapter revolves around the three cases under analysis. It explains how and why the three cities were selected (4.1.). Then, provides an overview of each city and its mobility governance in the city (4.2.).

4.1. Case Selection

More than 80% of German municipalities have already implemented policies to support e-mobility, and the probability of a city being active grows with the respective size of the city (NOW, 2019). The development of charging infrastructure is one of the most frequent action field within cities, as 72% of surveyed cities have already installed infrastructure and 23% are pursuing a strategy to do so (NOW, 2019). According to the BDEW (2019), the top 5 German cities with the highest numbers of installed publicly accessible charging points are Munich (1103), Hamburg (1070), Berlin (974), Stuttgart (405) and Düsseldorf (225). Each of these cities has more than 600,000 inhabitants. Out of these five a selection of three cities has been made given the online availability of data of municipal strategy papers as only three cities publicly provide the documents on the internet that

were necessary for the analysis. The three selected cases for this analysis are Hamburg, Berlin and Stuttgart.

4.2. Introduction of the Cases

Hamburg, Berlin and Stuttgart are the cases under analysis for this study. These cities have several commonalities, including being categorized as a ‘Großstadt‘ (metropolis), have had problems with air pollution for several years and surpassed the pollution thresholds in 2019 (Umweltbundesamt, 2020), are amongst the top 6 cities for amount of traffic jams (Zippmann, 2020) and have included the topic of e-mobility on the agenda for a long time, at least since they became part of the Federal Government’s 2009 e-mobility development program ‚model regions e-mobility in Germany’. There are however some differences between the cities, which are outlined below.

Stuttgart is the state capital of Baden-Württemberg, located in the southwest of Germany (see Map 1) and has a population size of around 635,000. In 2016, the per capita GDP was 82,397€. Since 2009, the city has been governed by a Green-party mayor. The Stuttgart modal split, that is the proportion of journeys travelled depending on means of transport, reports a percentage of 45% by car. Stuttgart is perceived as the home base of the (German) car industry while also having severe air pollution problems within the city basin. Cities with high nitrogen dioxide (NOx) levels show an increased perceived potential of e-mobility to reduce air pollution (NOW, 2019), as Stuttgart mayor Kuhn recalls: „There is no better solution [than e-mobility] to sustainably reduce the level of pollutants“ (Stuttgart, 2017). The municipality promotes e-mobility by, inter alia, supporting private investors in the development and operation of public charging points (Stuttgart, 2019). In 2019 347,839 cars were registered in the city, including more than 1,600 fully electric cars (SWR, 2019). The city has installed 405 publicly accessible charging points (BDEW, 2019).

Map 1. Suttgart in a map of Germany. Source: (KartePlan n.d.)

Hamburg is one of the three city states of Germany. Located in northern Germany (see map 2), its population size is around 1.84 million. In 2016, the per capita GDP was 62,793€. Hamburg has a tradition of electing a strong social-democratic senate. The modal split shows a 42% share for travelled journeys by car. 783,255 cars were registered in

Map 2. Hamburg in a map of Germany. Source: (KartePlan n.d.)

Hamburg in 2018 including about 2,300 electric vehicles (EVs) (SWR, 2019). The city has installed 1,070 publicly accessible charging points (BDEW, 2019) and was praised as a model city in climate protection by the Federal Environment Minister Schulze: “Hamburg is the city with the most charging points for electric mobility. The city […] recognized that things are changing and that it is necessary to redirect the course“ (Schulze on NDR, 2020). Hamburg sees e-mobility as a way to implement a new culture of mobility with the potential to facilitate a climate-friendly, clean and quiet urban mobility (Hamburg, 2014), as the former mayor Scholz recalls that „future-oriented solutions for urban mobility must rely on innovation and new technologies“ (Scholz in Kipp, 2017).

Berlin is also a city state (and the federal capital), and hosts 3.64 million inhabitants. Located in Eastern Germany (see Map 3). Berlin’s per capita GPD in 2016 was 36,798€. The Berlin senate is also led by Social-Democrats. In Berlin, 32% of all journeys are made by the 1.2 million cars registered in the city. About 2,700 of all registered cars were fully electrified (SWR, 2019), they can access circa 970 public charging points (BDEW, 2019). Berlin’s Environment and Transport Senator Günther aims to make cars with climate-damaging combustion engines avoidable within ten years. "It is a matter of creating the conditions for e-mobility to be the sole mode of propulsion (…) by 2030“ (Günther on RBB, 2019). Therefore, Berlin needs a comprehensive charging grid that extends over the city and is not concentrated on the inner city area. Aspects of climate protection go hand in hand with health protection, as more e-mobility results in less emissions and air pollution.

Map 3. Berlin in a map of Germany. Source: (KartePlan n.d.)

5. Analysis

This chapter provides a ‘polity‘ description of how the cities’ action arenas are structured along the IAD’s rules-in-use (5.1.) and a ‘politics‘ description of the involved actors and what roles or positions they take on in the respective arenas, building upon the previously gained understanding of the arena’s design (5.2.). After having understood these two dimensions a conclusion can be made about what mode of governance each city has and how they compare and the cases align with the expectations that were made based on the theoretical background (5.3.).

5.1. Polity: Descriptions of the Rules-In-Use in each Case

Polity dimension refers to the institutional structure of governance (‘rules of the game‘) and the resulting orders, (inter-)actions, actor responsibilities and political procedures. These structures can be illuminated through the use of the IAD-framework, which identifies “the major types of structural variables that are present to some extent in all institutional arrangements, but whose values differ from one type of institutional arrangement to another“ (Ostrom, 2011 p.9).

The theoretical assumptions about the interrelatedness of the ’polity’ and ’politics’ dimensions leads to the expectation that the rules (the strategy papers of each municipality) influence the actor constellation (see proposition 3, above). Vice versa, the local actors (e.g. political parties) might have influenced the design of the strategy.

The following sections include detailed descriptions of the institutional structure of each municipal arena. Six out of seven of Ostrom’s rules are discussed in this section on the ‘polity‘ dimension of governance, while the seventh rule, the position rule, is discussed in section 5.2. as part of the discussion about the actors and the roles that each actor has within the arena. Table 3 presents an initial comparison of the three cities scope and boundary exit rules, which indicate the general outlines of the development.

Rules-in-use	Hamburg	Stuttgart	Berlin
Scope Rules			
Total Number of Charging Stations	227	300	550
Time Frame for the Development	2,5 years (2014-2016)	3 years (2019-2021)	5 years (2015-2020)
Location Frame of the Charging Stations	(no information in strategy)	spread proportionally throughout the 152 city districts	municipality defined 200 search areas + EV users can request locations
Boundary Rule			
Exit	CPOs exit the arena when the time-limited special use permit expires. In this case the CPO has to dismantle the charging station.	The contract is set for a period of 8 years. Any specifications about the remaining charging infrastructure after the end of the contract are subject to the specific contract.	The contract is set for a duration of five years, with the possibility to extend it for two more years. When the contract has ended the municipality becomes the owner of all charging stations.

Table 3: Scope and Boundary exit Rules of Hamburg, Stuttgart and Berlin

5.1.1. Hamburg

Rules-in-use
Boundary: Selection

Through in-house allocation the municipality commissioned the municipality-owned electricity grid operator (EGO) 'Stromnetz Hamburg GmbH' to install and operate Hamburg's charging infrastructure at least until the end of the initial start-up phase (a two-year time span). Although not explicitly said, it can be assumed that the municipality covers the arising costs of the development (purchase, installation, operation and others) which level at about 2.5 million euros.

Choice: Installation & Operation

Choice: Finance

Payoff: Installation

Third charging point operators (CPO) can enter the arena in two ways (both upon request/initiation of the CPO): First, they can take over the charging stations that the EGO build (for a fee) and operate them in their own name. Second, they can request a special use permit, install and operate the charging stations on their own. However, at least 50% of all charging infrastructure is to be run by public entities (in other words the EGO) to "ensure that the further development process can be controlled to a significant extent and is not completely dependent on investment and disposition decisions by third parties" (Hamburg, 2014, p.24).

Choice: Initiation

Choice: Operation

Choice: Installation & Operation

The market access for third CPOs is bound to the condition that the CPO fulfills the criteria that the municipality has set for the operation of all charging stations. These criteria are content of a non-public guideline but it is indicated that the requirements show a strong user-oriented perspective, as opposed to being beneficial to the CPO. One condition for the infrastructure's operation (for EGO and CPO) is that the energy provision is organized as a 'Durchleitungsmodell' (transit model of energy provision). This means that EV users charge and pay their energy according to the conditions of their individually chosen and contracted energy provider and not necessarily to the provider that the CPO contracted. The CPOs are required to provide access to any customer in a non-discriminatory manner. This model is oriented towards the consumers' interest and independency, as EV users can charge the electricity of their self-chosen electricity provider but it results in a business model that is not profitable to the CPO. A

Boundary: Entry Barriers

Choice: Contract

Payoff: Profits

profitable charging station is for one part dependent upon a steady occupancy rate of the charging stations, which depends upon EV users' behavior. Considering the currently still low electricity sales volumes and the lack of supplier exclusivity due to the 'Durchleitungsmodell' the operating business is not expected to be financially attractive for the CPOs.

Choice: Permits

To install a charging station it is necessary to receive a special use permit from the municipality, which dedicates the public ground to a special interest or purpose. The permit is issued for a single charging station and requires prior approval of the specific location. The selection of suitable locations is an important preparatory measure for the development. The municipality has defined a matrix of criteria that which takes into account both the user's and the CPO's perspective. Only if the proposed location fulfills all criteria to a reasonable extent is it permissible to request a special use permit for a location. Multiple actors are involved in the evaluation process, including the municipality (district departments, topic-related departments), hySOLUTIONS as the coordinator and third actors (if the location has special stakeholders e.g. location in the city centre requires consultation of the municipal office for city development and the environment). It is not clearly indicated within the strategy how the decision is made.

Choice: Preparation

Aggregation: Final Location

Choice: Coordination

The private company hySOLUTIONS coordinates the strategy's implementation as part of a public-private-partnership. A detailed description of its' tasks is not included in the strategy - it is only indicated that hySOLUTIONS is the project's 'Leitstelle' (translation: central office / control center) and that the company takes part in finding and evaluating the locations for the charging stations.

Information: other

EV users are also provided with a virtual map which shows information about all charging stations on public ground e.g. their status (whether they are currently occupied or free), the address or the station-ID. To ensure that the users have easy access to every charging station the EGO was instructed to implement a parent IT-platform for all charging stations and it is mandatory for all of Hamburg's CPOs (third CPOs and the EGO) to submit information to this platform. Moreover, it can be

assumed that the CPOs deliver information about their charging stations' capacity utilization because that is one factor of assessing the next development period's need of charging infrastructure.

Information: Usage of Infrastructure

5.1.2. Stuttgart

Rules-in-use

The underlying goal of the municipality's strategy is to create a free market for the provision of charging stations in Stuttgart, which is typically characterized by a range of different providers. Therefore, a public call for tenders has been organized through which interested companies can make initial requests to build charging stations. The municipality set up a virtual map as a planning-tool for interested CPOs to examine the available and prospective sites for charging stations in Stuttgart. The map also informs the general public about where the new charging stations will be built.

Choice: Initiation

Information: other

Companies can submit up to 200 requests, each for a single charging station within a specific district (as opposed to e.g. one CPO operating all stations, or all in one district), while the desired location to build the charging station is indicated as precisely as possible. There is no limit on the number of companies that can make requests to become CPOs. The municipality, to be specific the 'Koordinierungsstelle Elektromobilität' receives and processes the requests. There is one minimal requirement which a requestor (=CPO) must fulfil to make a valid request and that is to provide proof of other projects of operating charging infrastructure. Thereby the municipality makes sure that the applicant complies with the pertinent regulations (e.g. Eichrecht, Ladesäuenverodnung) without having to check it on its own.

Choice: Initiation

Choice: Coordination

Boundary: Entry Barriers

If more requests are made for a specific district than there are available charging stations, a selection procedure is installed to determine which applicant becomes the CPO of each individual charging station. The applicants are ranked on how many of the following criteria they fulfil: roaming ability; whether there is a maximal access fee; permanent attainability in case of malfunction and remote-ability; reaction to malfunction in under 8 hours. For each fulfilled criterion the applicant receives one point. The applicant with the most points is then elected to be the CPO. In the event of an equal score, there is a lottery process

Boundary: Selection

which makes the final selection by chance. The municipality informs the applicants about the results of the process.

Information: Other

The process is deliberately designed in such a way that it has to be determined which company shall become the CPO for each individual charging station because this way it is more likely that EV users can eventually choose between charging stations operated by different CPOs in their area. After having selected the individual CPOs for the charging stations, the desired locations are evaluated for general availability (e.g. street owned by the municipality, no road reconstruction or redesign planned) by multiple municipal departments.

Choice: Preparation

Then, the municipality invites the CPO to a joint inspection of the site to evaluate the location based on a set of criteria or make an alternative proposal. Next to representatives of the municipality and the CPO there might also be extern actors present, such as the EGO or members of resident initiatives. When the location is accepted, the CPO requests a special use permit makes a formal proposal to build the charging station, which is again processed by the coordination office. To receive the permit, the municipality (licenser) and the CPO (licensee) have to enter into a contract about the use of public space. After the CPO has received said permit the CPO is responsible for the installation of the object and painting a pictogram of an EV on the ground). Simultaneously, the municipality installs the signage. Finally, the EGO installs the power supply and notifies the municipality on the installation's completion. The installation costs and administrative fees are fully paid by the investor. The administrative fees generates income for the municipality but the amount is negligible. The municipality provides the CPO with the public ground on which charging stations can be built and abstains from collecting a usage fee.

Aggregation: Final Location

Choice: Permits

Choice: Coordination

Choice: Contract

Choice: Installation

Information: Installation complete

Payoff: Installation Cost, Administrative Fee

Payoff: Usage Fee for Public Ground

The CPO operates the charging station and is responsible for the maintenance. The municipality makes no specifications on the pricing model of the charged electricity other than referring to relevant legal regulations. The municipality receives a yearly report from the CPO about how well each charging station is accepted. This could be valuable information for further development of charging infrastructure in the future.

Choice: Operation & Maintenance

Information: Usage of Infrastructure

5.1.3. Berlin

Rules-in-use

In 2015, Berlin's former department for urban development and the environment conducted a EU-wide competitive tendering procedure for the construction and operation of charging infrastructure. The contract was awarded to the bidding consortium Alliander / The New Motion GmbH / Allego GmbH, which therefore became the CPO. This private consortium is the only CPO that is allowed to install and operate infrastructure, so the arena is closed for any other interested CPOs. Details of how the selection was carried out or what criteria were decisive are not included in the strategy paper. The private consortium is responsible for the operation, energy provision, billing and maintenance of the charging stations. The contract between the CPO and the municipality defines necessary technical features, obligatory operation and maintenance requirements and specification about the billing system.

Boundary: Selection

Choice: Contract

Choice: Installation & Operation

Boundary: Entry Barriers

Choice: Operation & Maintenance

Choice: Contract

The harmonized is strategically coordinated by the municipality's bureau for charging infrastructure. The CPO initiates the development by requesting a preliminary review ('Vorprüfung') of a possible location by the municipality. The location has to lie within the 200 search areas that the municipality has defined within its location frame and fulfil a set of criteria (e.g. availability of parking space, findability, no one-way street). A precondition for making the request to the municipality is that the CPO has checked with the EGO whether the respective location is fitted with sufficient electricity supply. The bureau for charging infrastructure registers all requests and forwards them to the respective district department, which approves or disapproves the proposed location based on the established criteria and informs the bureau about their decision. If the location is approved the necessary permits and contracts need to be issued, including a contract with the EGO over electricity connection, a special use permit for the use of public space and the respective order to install signages. Then the CPO can make one further request for construction work and start the installation afterwards. Berlin has established design specifications to be applied at all charging stations, including the size, color and mandatory

Choice: Coordination

Choice: Initiation

Scope: Location Frame

Choice: Preparation

Choice: Coordination

Aggregation: Final Location

Choice: Permits & Contracts

Choice: Installation

application of the ‘be-emobil‘ logo. After completing the construction work, a final inspection is to be agreed upon with the district, during which the rule conformity of the charging station is verified. The CPO must immediately notify the municipality's bureau for infrastructure when the charging station starts operation and proof this by providing a protocol from the electrical specialist company.

Information: Installation complete

The municipality provides the CPO with a standardized financial compensation for the installation of the charging station. This includes the costs for the electricity grid connection. The municipality also pays an ‚operation compensation‘ for the operation of each charging point.

Payoff: Installation Cost

Payoff: other

The CPO is charged the administrative fee (56.24 €) for processing the application for a special use permit. Additionally, a fee of 15€ per month for each square metre of public space the charging station covers. The contract is set for a duration of five years, with the possibility to extend it for two more years. After the contract has ended the infrastructure becomes municipal property, due to the extensive financial resources that the municipality has paid the CPO over the contract period. At this time, the charging station has to be in a proper and technically updated condition. The CPO gives all the necessary documentation to the municipality, so it can close a new contract with a future CPO about the operation of these charging stations.

Payoff: Administrative Fee

Payoff: Usage Fee for Public Ground

Boundary: Exit

Payoff: Owner of Infrastructure
Choice: Finance

5.2 Politics: The Actor’s Roles

The politics dimension of governance refers to the procedural aspects of governing (e.g. elections, debates, lobbying, negotiations) but also concerns the actor constellations. The politics description will spotlight the actors and the roles they take over in the development process. Common actors within public charging station development are the municipality, EV users, residents, (semi-)commercial parties like charge point operators (CPOs) and the electricity grid operators (EGOs) (Helmus, Hoed, 2016). The description of their roles is based on previous insights of the described polity processes (cf. 5.1.). This section also includes a ‘reality-check‘, an inclusion of information that go beyond the theoretical strategies and tell how the development is actually going and what actors are participating (via e.g. newspaper articles, press releases).

Understanding EV infrastructure development as a governance topic raises the expectations that the traditional top-down role of government has shifted and that new

actors are involved in processes of societal steering (proposition 1). It is especially interesting how the regulatory structure in place influences the involved actors, as it can be theoretically expected that the politics dimension is shaped by the arena's rules (cf. Lange et al., 2013).

5.2.1. Hamburg

The 'Freie und Hansestadt Hamburg' is the 100%-shareholder of the local electricity grid operator (EGO) 'Stromnetz Hamburg GmbH'. Via in-house allocation, the public company is commissioned by the municipality to install and run the charging stations in the start-up phase of the strategy. Therefore the local EGO is a CPO within the Hamburg arena. So, the first layer of Hamburg's strategy is an almost pure public-good-provision-model, in which the government exercises most of the power and decision-making. This is beneficial if it is assumed that private CPOs will never supply the EV infrastructure at needed rates, if their profitability is not given (cf. the pure public goods problem). After the start-up phase there is free market access for third (private) companies to become CPOs by installing and/or operating charging stations. Therefore, a mixture of private and public actors may operate charging infrastructure in Hamburg. However, at least until three years after the strategy was passed no other CPOs have been interested in building charging stations in Hamburg. In the municipal budget plan (2017) it says that engagement of third CPOs was far less than assumed in the master plan of early 2014, as it was anticipated that CPOs and the municipality each operate a share of about 50% of the infrastructure. As of 2017, the all of the approximately planned 600 charging points were all installed and operated by the local EGO ‚Stromnetze Hamburg GmbH'.

As part of a public-private partnership, the company hySOLUTIONS is the coordination office of the development process. The company belongs to the private sector but its shares are predominantly owned by other publicly-owned companies. Its mission is to support the municipality of Hamburg to achieve its climate objectives with expertise in e-mobility and other alternative fuels. HySOLUTIONS is the coordination office for all e-mobility-related issues for Hamburg's administration.

EV users play an important but indirect role in the development strategy. Important parts of the strategy are oriented towards benefiting the user (as opposed to mainly the CPO), but the user does not take an active part in the development process itself. Again, this strengthens the top-down mode of provision that Hamburg chose for its infrastructure development. Residents and local utility providers do not play a role in the development.

5.2.2. Stuttgart

The administration of the ‘Landeshauptstadt Stuttgart‘ is an important actor in the Stuttgart’ arena of infrastructure development. While several different offices have a role to play, the most important office is the ‘Koordinierungsstelle Elektromobilität‘ (coordination office for e-mobility) which is situated directly within the mayor’s office and is responsible for the coordination of the development process. The municipality designed a call for tenders of interested companies to apply to become a CPO. In the strategy these companies are referred to as private investors, interested CPOs, requestors, applicants and operators and while these terms all refer to the same actor, they are specified along the actions that the actor takes in each step of the procedure. This design can be described as a public-private partnership, in which the municipality is the client and therefore controls the interaction. The municipality is dependent upon the CPO to provide the public good, because no infrastructure will be provided if there is no interest of private companies. The municipality expects multiple requests by multiple CPOs so that eventually the public charging infrastructure will be operated by a range of different providers. In this sense, private sector provision has advantages for the provision of goods, as consumers have a choice which service to use. The 300 tendered charging points attracted five CPOs (Stadtwerke Stuttgart GmbH, eze.network GmbH, EnBW Energie Baden-Württemberg AG, Allego GmbH, Comfortcharge GmbH), each of which build and operate an unequal share of the charging points due to the lottery nature of the process and the diverging number of requests the companies submitted in the first place (Stuttgart, n.d.). Interestingly, the local utility provider ‚Stadtwerke Stuttgart GmbH‘ became one of Stuttgart’s five CPOs, although not explicitly mentioned in the strategy. The company is municipality-owned but applied to be an independent CPO just like the rest of the applicants, with no advantages in the process due to its’ relations to the municipality.

The local electricity grid operator ‘Stuttgart Netze GmbH‘ is contacted and contracted by the CPOs for the one-time job to install the power connection of the charging stations. 74.9% of this company are owned by the municipality-owned local utility provider ‘Stadtwerke Stuttgart GmbH‘. Local utility providers are not mentioned in the strategy but interestingly, the ‘Stadtwerke Stuttgart‘ became one of the five Stuttgart’ CPOs.

The users of EVs and ultimately the charging infrastructure play a minor, rather indirect role in the development. How many EVs were registered in Stuttgart and how this number was expected to grow were two factors that were considered when calculating the demand for charging infrastructure. Residents, organized as a resident initiative, can appear as a

stakeholder in the decision about charging station location, as they can be invited by the municipality to participate in the site inspection of the proposed location. It is not indicated how much weight is attributed to their interest but the invitation to the inspection shows that the municipality is concerned with the residents' opinions.

5.2.3. Berlin

Berlin's administrative departments mainly responsible for EV infrastructure development are the Senatsverwaltung for Stadtentwicklung und Umwelt, its bureau for charging infrastructure and the district offices. In 2015, the municipality issued an EU-wide public competitive tendering procedure to find the company to be commissioned with the construction and operation of charging infrastructure. In a press release of the respective administrative department (2015) it says that 28 companies or consortia of bidders applied to become Berlin's CPO, seven of which took part in a dialogue procedure to work out all technical and contractual details together. In comparison to all offers, the offer of the bidding consortium 'Alliander AG / The New Motion GmbH / Allego GmbH' was awarded the tender. Due to extensive financial compensation the municipality's administration provides for the installation and operation of the charging stations the municipality becomes the owner of all charging stations when the contract between the consortium and the municipality has ended.

EV users play an important role in the second phase of the development, as they can request the installation of a public charging station if they can demonstrate the need for it. The individual sends an application form to the municipality's bureau for charging infrastructure, which is generally reviewed and then forwarded to the CPO. From there on, the above mentioned procedure applies (Berlin, 2019). Between 2016 and 2019 Berlin's EV users have submitted 170 requests to have a charging station build near their home or workplace (Berlin, 2019, p.6).

The local electricity grid operator 'Stromnetz Berlin GmbH' is contracted by the CPO to install the electricity connection of the charging station. The private company belongs to the 'Vattenfall' Group. Residents are not included in the development of public charging infrastructure.

5.3. Modes of Governance Comparison

This section takes into account both the 'polity' and 'politics' dimension of EV infrastructure development to make a statement about the mode of governance in each city. The previous section on the 'politics' dimension included details on the actual actor

composition, thereby going beyond the theoretical regulations and enhancing the analysis with a reality check of how the cities's strategic considerations turned out. These insight provide valuable information to make conclusions about the mode of governance in each city because it is possible to see how the 'polity' is actually practiced.

It has been established that public authorities always have to be involved because official permits have to be granted for each charging station, on top of closing a contract with a CPO. Moreover, the municipality's interest to have the charging stations spread over the whole city (not just the inner city area) requires some planning of the location frame beforehand. It became evident that governments are still substantially governing EV infrastructure development, contrary to the expectation that governance is characterized by non-conventional designs which do not center around governments. The municipalities designed the policies, regulate access to the arena and although the actual installation and operation is performed by the CPOs, the municipalities remain important partners in the development (e.g. permits, contracts, defining the scope). Therefore, proposition 1 is not supported, as governments are still in the driving seat in the governance of EV infrastructure development.

While governments are key governance players in EV infrastructure planning and regulating, the task of installing and operating the charging stations is left completely to the CPOs. Taking the concurrent performance of tasks into consideration, the development of public charging infrastructure can generally be characterized as a partnership of public entities and the CPOs. Since the CPOs in the three cities are all registered as private enterprises ('GmbH'), the partnership can be considered a public-private-partnership (PPP) but the three cities show substantial differences in how the partnerships are designed.

Participation of private actors in the provision of public goods can come in several different forms. In line with proposition 2, this analysis has described the diverse variations in terms of which actor is the key player in the arena and who is allocated what authority in the cities' designs.

The first form of private participation in public good provision is "a quasi-free market basis" (Grosse, 2005, p.7) with different competitive enterprises providing similar services (competition), after a given task has been delegated to more than one actor. This design can be observed in Stuttgart. Its' polity is oriented towards a market of service provision, where different CPOs provide infrastructure in Stuttgart's districts and the EV user is able to choose between these providers. The two-step selection procedure installed as entry rules mandatorily requires relatively little from the applicants but gives the more consumer-

friendly ones a greater chance of becoming the CPO, and it attracted five different CPOs in Stuttgart. Thereby it becomes apparent that the entry rules play an important role in attracting actors from the private sector, which supports proposition 3 (the 'polity' and 'politics' pillars influence each other).

Another way to organize PPP's is for public tasks to be delegated and commissioned to a single specialized private company. The company is selected e.g. through a public call for tender and the contract is limited in time. This form of a PPP is coinciding with Berlin's strategy of EV infrastructure development as the municipality commissioned a single private consortium for the installation and operation of the charging stations. It does not qualify as a 'market' because access to the arena is solely granted to a single private company. However, the partnership between the Berlin's local governments and the private CPO does not qualify as a pure 'network' because of the fixed nature of the interaction which does not involve negotiation and interests to maximize their influence on the outcome (cf. Rhodes, 1996). Interestingly Berlin's payoff rules are designed in such a way that the municipality covers the financial burden of installation and operation for the CPO, so that eventually the infrastructure hardware is owned by the municipality. Due to the complete reimbursement that the government pays the CPO for installation and operation of all charging stations, the important role of the public administration is highlighted in the arena. But design also shows the specialty of a participatory element as EV users are able to request specific locations for charging stations. This creates synergy effects for both the EV users and the CPO, as the users get a charging station installed in a favorable location and the CPO can therefore expect high usage rates from this specific charging station. Thus, the participation of citizens enhances the process, so some support for proposition 1 - the expectation of identifying non-government-centered governance - can be observed. However, the role of bottom-up governance is limited to this single element. Over all, Berlin's mode of governance is a hybrid model of the ideal modes because the public good is provided by a single private company but characterized by substantial hierarchical control.

Just like in Berlin, Hamburg commissions a single company for the start-up phase of the development but with the important difference that the elected company 'Stromnetze Hamburg GmbH' is 100% municipality-owned. Although technically being registered as private, the CPO can be assumed public in this case. This assumption is strengthened by the fact that the company was commissioned via in-house allocation. By remembering that Hamburg is traditionally governed by a social-democratic party (SPD) it can easily be understood why the city wishes a substantial share of the infrastructure to be publicly

controlled. Government provision of essential services is a classic socialist element, as it can not be assumed that private companies will provide the services to a full extent for all citizens due to restraints of e.g. profitability in some city areas. After the start-up phase of hierarchical development via a public company, the municipality has planned to give free-market access to other interested companies, which resembles the 'market' design of Stuttgart. The mixture of a publicly installed and controlled infrastructure ('hierarchy') and free market access for private companies ('market') results in an intended 'network' of infrastructure provision. However, there was little to no engagement of third CPOs after the start-up phase so Hamburg's governance mode is almost purely centered around public provision by the municipality-owned EGO ‚Stromnetze Hamburg GmbH'.

Why did Hamburg's intended network turn out to be a pure hierarchy? The possibility to access the free market to install and/or operate Hamburg's public charging stations has not been opted for by third CPOs as it was in fact in Stuttgart, where five different private actors are active. It has been theorized that the adoption of different rule configurations results in noticeable differences in incentives and likely patterns of behavior (Grossmann, 2019). A difference between Stuttgart's and Hamburg's free market access are the entry rules, the requirements that a CPO has to fulfill and agree to in order to gain access to the arena. It can be assumed that Hamburg's highly consumer-oriented entry requirements, which avert profitable business for the CPO, have deterred possible actors of the private sector. Even though the goal was the same - to create a market for EV infrastructure provision - the different ‚rules-in-use' altered the mode of provision. So, the rules shape the actors within an arena which fully supports proposition 3, that the pillars of governance influence each other and that the effects depend on the different kind of rules installed. The actors, in various positions determined by the rules, then shape the mode of governance. Therefore, it is essentially the polity dimension that determines the mode of governance.

6. Discussion

This chapter discusses the limitations of this study that arose due to time and resource constraints (6.1.) which is helpful to grasp what the research can and cannot be used for academically and it indicates topics that future research should consider. Moreover, a brief section discusses policy implications of this study's findings by referring to experts' and authorities' recommendations for the design of EV infrastructure provision (6.2.).

6.1. Limitations

A limitation of this descriptive case study is that while it enables the observation and description of governance phenomena it remains unclear what is causing them. Tschoerner (2016) for example recognized the policy field of mobility is shaped by ongoing processes of definition, redefinition and conflict. Actors in transportation governance are in an unsettled dispute about whether the state is responsible to provide their citizen with mobility services because it is a basic need of all people (‚öffentliche Daseinsvorsorge') or if the market economy should provide the goods, and about the distribution of costs and benefits between (…) stakeholders (Bandelow et al., 2014). These conflicts imply that the governance of this field requires constant (re-)negotiation of roles, tasks and benefits at every governmental level, which is likely to lead to different modes of governance in action. There are some indications that these conflicts are mirrored in the cities' development strategies. Future research should investigate whether these conflicts were influential in the establishment of the strategies.

Second, the study indicated that there are many ways to arrive at the same destination as the three cities various governance modes all lead to a high level of EV infrastructure provision. The idea that there is one best way to govern sustainability (cf. Lange et al., 2013; Meadowcroft 2007; Lafferty 2004 in Lange, Driessen 2013) is thereby invalidated. Further research could investigate what benefits this polycentric design of infrastructure provision has (cf. Ostrom, 2010).

6.2. Policy Implications and Expert Recommendations

After having described the three cities' strategy of EV infrastructure provision and having concluded about the respective governance mode, this brief section discusses the policy implications of the study. As previously stated, it is not the goal of this research to make recommendations about what governance mode suits the development of EV infrastructure or sustainability in general best because the evaluation of the three cities' approaches goes beyond the scope of this research.

However, a general lesson of this study is that the different designs of public EV infrastructure provision has high influence on how EV users can use them. Whether approach involves one or multiple CPOs providing the infrastructure has an effect on whether consumers are provided with a choice between different providers. The german monopoly commission alerts municipalities to prevent regional concentration of single CPOs as the largest regional operators already controls an average of more than 50% of

all charging stations (Monopolkomission, 2019). The lack of competition can lead to high prices for charged electricity but leave EV users with no choice between different offers. Municipalities should pay more attention to considerations of competition in the selection of their CPOs and "in order to prevent monopolization (…) the municipalities would have to divide the right to install and operate the charging points into lots - as small as possible - instead of awarding it exclusively to one company“ (Monopolkomission, 2019, p.113).

Additionally, It is the German federal government’s opinion that in the long-term the development of charging infrastructure is a task for the market economy (Bundesregierung, 2019) but for now the public sector has to invest in infrastructure to solve the chicken-egg-dilemma of e-mobility: EVs are not bought to the extend that is necessary to reach climate objectives if there is no comprehensive charging infrastructure available but on the other hand the private sector doesn’t invest in infrastructure if there are no customers (EV users) for their product.

Together these opinions of experts and authorities hint to future evolvement of the approaches to EV infrastructure development. Most strongly aligned with these recommendations is Stuttgart’s strategy, as the municipality successfully created a market of five competitive CPOs and installed a system where it has to be decided independently for each individual charging station which CPO operates it.

7. Conclusion

Local governments have become active forces to reach climate objectives by implementing strategies to develop public AC-charging infrastructure for electric vehicles (EV). This important role of cities in tackling the climate crisis features creativity in deciding how to design the development, as there is no federal guideline the process of building infrastructure. German municipalities approach the task in many different ways of governing, involving different rule structures and actors. Scholars emphasized that governance modes can be assessed based on the three pillars politics, polity and policy (cf. Treib et al., 2007) and it has been the goal of this research to determine how the ’polity‘ and ’politics‘ dimensions influence the governance mode of sustainable infrastructure provision. In an attempt to describe and understand the local regulatory structures, Nobel laureate Elinor Ostrom’s IAD-framework (Ostrom, 2007, 2010, 2011) has been utilized as a tool-kit to identify the mode of governance of three german cities - Berlin, Hamburg and Stuttgart. By applying the IAD-framework it becomes apparent who

interacts and how, under what conditions and what is required of them, so the interaction of the governance' triad's pillars can be clearly seen.

The term governance is increasingly used to describe policy making scenarios that do not easily fit within conventional top-down government centered schema which implies a new role for governance in organizing society. It has been proposed by Bingham et al. (2005) that government are taking a step back in favor of bottom-up governance (proposition 1) but this study provides evidence that governments are still a key governance player. This finding aligns with findings of other scholars, who questioned Bingham et al.'s claim because it is not backed up by empirical findings (cf. e.g. Adger, Jordan 2009; Hysing 2009; Van Kersbergen, Van Waarden 2004 in Lange et al., 2013). It can be observed in the three cities that the municipality establishes the overall strategy and thereby decides upon the regulatory structure, while it also being responsible for planning and coordinating the strategy's implementation. So the way of governing has shifted from delegation to diverse ways of steering (cf. Treib et al., 2007). The important position of governments in governance needs to be accounted (cf. 'state-centered governance' in Robichau, 2011).

The development process requires concurrent performance of tasks by both the municipal government and one or more charging point operators (CPO), as these two showed to be the central actors of the development. While governments are key governance players in EV infrastructure planning and regulating, the task of installing and operating the charging stations is left to the private CPO(s). So, the provision of public EV infrastructure can generally be described as a public-private-partnership. The three local governments show substantial differences in how this partnership is approached.

Stuttgart's governance mode is a 'market'. The municipality organized a public call for tenders with relatively low entry barriers and attracted five CPOs which thereby act within a competitive market. Via in-house allocation Hamburg commissioned the municipality-owned electricity grid operator with the installation and operation of public charging stations. Additionally it was planned that third CPOs can gain free market access to operate charging infrastructure on their own but due to the high entry barriers and operation requirements that were formulated by the municipality, no third CPOs were interested to enter the arena (at least until 2017). Therefore Hamburg's intended 'network' of EV infrastructure provision turned out to be a pure public provision of goods, in other words as a 'hierarchy'. Berlin's model wasn't easily classifiable into the three classic modes of governance. The provision of public goods by a single CPO is characterized by substantial hierarchical control, thereby showing that hybrid models of the classic

governance modes exist. Besides this one participatory element in Berlin the local governments show no societal self-governance or substantial participatory governance, which falsifies the claim that sustainable governance is participatory (cf. proposition 1).

Full support has been provided for the expectation that the three cities employ different designs, with different sets actors involved which carry different responsibilities and levels of authority (cf. proposition 2). The CPO, for example, can be a single municipality-owned utility provider, a private consortium of companies or a set of competing companies. Moreover, evidence has been provided that the interaction of actors in the politics pillar is shaped by the respective polity (cf. proposition 3). To understand the modes of governance of EV infrastructure provision means to understand the rules that are in place. Stuttgart and Hamburg show the importance of entry rules because they shape what actors are willing or able to take on positions. The higher the entry rules are, the lower the action in the arena, it seems. Another rule influencing the mode of governance is the payoff rule because it essentially determines the ownership of the charging stations. Both Hamburg's and Berlin's governments financially reimburse their CPO for the development while the Stuttgart government is not financially involved at all, as the CPOs are fully responsible for all costs. The ownership of infrastructure determines whether the provision of EV infrastructure is public or private and thereby determining the mode of governance. In turn, it became evident that the resulting governance modes have effects

This analysis of three German cities' design of public AC infrastructure provision for electric vehicles has shown that the mode of governance is determined by the rules in place. The IAD-framework has been very helpful to examine these rules in detail but also to generally gain an understanding of each cities arena. Comparing the three cities 'polity' and 'politics' dimensions via the IAD-framework enabled academic important insights about how the dimensions influence each other and together determine the mode of governance. Additionally, it became evident that the different modes of governance in public EV infrastructure provision have different effects back onto the actors in the arena, as for example EV users are dependent upon a single CPO or can choose between multiple competing CPOs. Therefore, a general lesson from this study is that the mode go governance is influenc*ed* by the 'polity' and 'politics' of the action arena - but also influenc*es* the arena likewise.

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Appendices

Appendix 1: Code Book

Codebook for Bachelor Thesis of Lise Dotzer („Governing Sustainable Mobility: Modes of Governance in Infrastructure Development for Electric Vehicles“)

Actors

Code	When to Use
Actor (Municipality)	When the municipality is involved in the development (e.g. an administrative office, a representative of the municipality)
Actor (EV users)	When EV users are involved in the development
Actor (Residents)	When residents are involved in the development
Actor (CPO)	When charging point operators (CPOs) are involved in the development
Actor (Electricity Grid Operator)	When Electricity Grid Operators (EGOs) are involved in the development
Actor (Utility Provider)	When local utility providers are involved in the development
Actor (other)	When other actors are involved in the development, that have not been indicated by existing literature about common actors of EV infrastructure development.

Boundary Rule: specify how participants enter or leave the positions. The boundary rules only concern the CPOs or the actors that want to build infrastructure in a city.

Code	When to Use
Boundary (Entry Barriers)	When there are mandatory requirements to enter the arena / to get involved in the development (to even submit an application)
Boundary (Selection)	When multiple actors want to enter a position, if the position is only availably for one actor, and there is some sort of selection
Boundary (Exit)	When there is information about how actors exit their position.

Choice / Authority Rule: specify the tasks/actions that each actor may or may not do, tasks assigned to position

Code	When to Use
Authority (Initiation)	When an actor is authorized to initiate the development in any kind

Authority (Coordination)	When an actor is authorized to coordinate the infrastructure development in any kind
Authority (Preparations)	When actors perform preparations before formal permits/contracts can be issued
Authority (Permits & Contracts)	When an actor is involved in receiving or issuing official permits to build infrastructure (e.g. ‚Sondernutzungserlaubnis‘ for the use of public space)
Authority (Installation)	When an actor is authorized to physically install the charging station on site
Authority (Finance)	When an actor is authorized to pay for any costs that come with the development of charging infrastructure
Authority (Operation & Maintenance)	When an actor is authorized to operate the charging station on a daily basis and ins responsible for its’ maintenance

Information Rule: describe which information is available to the various position holders and how actors should relate to one another in providing and granting access to information

Code	When to Use
Information (Installation complete)	When an actor need to inform other actors about the complete installation of the charging station.
Information (Usage of Infrastructure)	When the CPO informs about the usage of the operated charging infrastructure in a specific period of time.
Information (other)	When the development includes other types of information besides the above mentioned

Aggregation Rule: describe how (collective) decisions are made on the basis of the contributions of all actors

Code	When to Use
Aggregation (Final Location Charging Station)	When there is information about how actors decide upon the location of the future charging station
Aggregation (Which CPOs?)	(cf. Boundary (Selection))

Scope Rule

Code	When to Use
Scope (Total Number of Stations)	When there is information about how many charging stations / charging points are to be build within the development period mentioned in the strategy
Scope (Location Frame)	When there is information about how the charging stations are spread within the city (e.g. along the number of inhabitants in a district)
Scope (Time Frame)	When there is information about how long the development period is set be last.

Payoff Rule

Code	When to Use
Payoff (Administrative Fee)	When the financial impact of administrative fees is discussed and assigned to an actor.
Payoff (Usage Fee for Public Space)	When the financial impact of the usage of public ground is discussed and assigned to an actor.
Payoff (Installation Costs)	When the financial impact of the charging station's installation costs are discussed and assigned to an actor.
Payoff (Owner of the Infrastructure)	When there is information about who is the owner of the infrastructure.
Payoff (Profit)	When there is information about the profit that generates from the operation of the charging stations.
Payoff (Other)	When there is information about any other issues of payoff of the development.

Appendix 2: Example Code Report

Example of ATLAS.ti-Report - Bachelor Thesis of Lise Dotzer

Bachelor Thesis „Governing Sustainable Mobility: Modes of Governance in Infrastructure Development for Electric Vehicles“

Citations

Filter:
Coded with Code „Scope (Total Number of Stations)“

Report drawn from Atlas.ti by Lise Dotzer (Date: 24.06.2020)

1:94 Die Landeshauptstadt Stuttgart weist insgesamt 500 mögliche Standorte für Normalladeinfrastruktur…

Code: Scope (Total Number of Stations)

Content:
Die Landeshauptstadt Stuttgart weist insgesamt 500 mögliche Standorte für Normalladeinfrastruktur im öffentlichen Raum aus. Rund 200 dieser Standorte sind bereits aus früheren Projekten belegt. Rund 300 dieser Standorte sind zum Inkrafttreten dieser Richtlinie noch verfügbar.

2:27 Um die Planzahl von 500 AC-Ladesäulen in Stuttgart zu erreichen, müssten zusätzlich zu den schon…

Code: Scope (Total Number of Stations)

Content:
Um die Planzahl von 500 AC-Ladesäulen in Stuttgart zu erreichen, müssten zusätzlich zu den schon bestehenden 200 Ladesäulen in Zukunft noch 300 Ladesäulen neu auf- gebaut und betrieben werden. Diese Zahl wird dem Genehmigungsverfahren zu Grunde gelegt.

2:39 Die Verwaltung wird ermächtigt, auf der Basis dieser Richtlinie maximal 300 zusätzliche Standort…

Code: Scope (Total Number of Stations)

Content:
Die Verwaltung wird ermächtigt, auf der Basis dieser Richtlinie maximal 300 zusätzliche Standorte im öffentlichen Straßenraum für Normalladestationen mit je 2 Ladepunkten zu genehmigen.

2:40 as in der Studie entworfene mittlere Hochlaufszenario prognostiziert, dass im Jahr 2020 ca. 500 AC…

Code: Scope (Total Number of Stations)

Content:
as in der Studie entworfene mittlere Hochlaufszenario prognostiziert, dass im Jahr 2020 ca. 500 AC-Ladesäulen (mit je zwei Ladenpunkten) im öffentlichen Raum benötigt werden

---

3:2 1. Errichtungszeiträume, Anzahl der Ladepunkte und deren Verortung v Errichtungszeit 1 (15.01.2015…

Code: Scope (Time), Scope (Total Number of Stations)

Content:

Errichtungszeiträume, Anzahl der Ladepunkte und deren Verortung
Errichtungszeit 1 (15.01.2015 - 30.09.2016): Ø 20 DC-Ladepunkte und 400 AC-Ladepunkte im öffentlichen und halböffentlichen Raum (siehe unten)
Errichtungszeit 2 (01.01.2016 – 30.06.2020): Ø Bei nachgewiesenem Bedarf weitere Ladeeinrichtungen aus einem Gesamtkontingent von max. 20 DC-Ladepunkten und max. 700 AC-Ladepunkten

---

4:10 Grundlage der Planung ist eine von der Senatsverwaltung für Stadtentwicklung und Umwelt beauftragte…

Code: Scope (Total Number of Stations)

Content:
Grundlage der Planung ist eine von der Senatsverwaltung für Stadtentwicklung und Umwelt beauftragte Bedarfsanalyse für den Ladebedarf von Elektrofahrzeugen in Carsharing-Flotten. Die Analyse wurde vom Deutschen Zentrum für Luft- und Raumfahrt (DLR) und der Verkehrs managementzentrale Berlin Betreibergesellschaft mbH (VMZ) erstellt. Im Ergebnis wurde für die Startphase ein Bedarf von rd. 340 Ladepunkten mit einem räumlichen Schwerpunkt inner halb des S-Bahnrings, in daran angrenzenden Bereichen sowie in einigen bezirklichen Zentren ermittelt.

4:11 Aufbauend auf dem planerischen Ansatz in Phase 1 der geförderten Ladeinfrastrukturerweite rung erf…

Code: Scope (Total Number of Stations)

Content:
Aufbauend auf dem planerischen Ansatz in Phase 1 der geförderten Ladeinfrastrukturerweiterung erfolgt dann in Phase 2 eine Nachjustierung der in Phase 1 errichteten Ladepunkte. Im Sinne eines nachfrageorientierten Ansatzes muss für die Errichtung zusätzlicher Ladepunkte ein entsprechender Bedarf nachgewiesen werden.

4:14 Innerhalb der Such- räume sollen insgesamt 340 Lademöglichkeiten, z. B. 170 Ladesäulen, entsprech…

Code: Scope (Location Frame), Scope (Total Number of Stations)

Content:
Innerhalb der Such- räume sollen insgesamt 340 Lademöglichkeiten, z. B. 170 Ladesäulen, entsprechend der Bedarfsanalyse (DLR/VMZ) aufgebaut werden, 30 weitere Suchräume stehen als Ersatz- und Pla- nungsoption zur Verfügung (siehe Abbildung Seiten 4 und 5).

5:15 Bis Mitte 2016 sollen insgesamt 592 Ladepunkte im öffentlich zugänglichen Raum für ca. 4.900 er…

Code: Scope (Total Number of Stations)

Content:
Bis Mitte 2016 sollen insgesamt 592 Ladepunkte im öffentlich zugänglichen Raum für ca. 4.900 erwartete E-Fahrzeuge errichtet werden, d.h. zu den bereits be- stehenden 138 Ladepunkten sind 454 Ladepunkte an 227 Standorten neu aufzubauen.

5:50 Als Ergebnis aus dem ermittelten Fahrzeughoch- lauf und dem antizipierten Gesamtstromabsatz (s. unte…

Code: Scope (Total Number of Stations)

Content:
Als Ergebnis aus dem ermittelten Fahrzeughoch- lauf und dem antizipierten Gesamtstromabsatz (s. unten Kapitel 4.4) resultiert bis Mitte 2016 ein Hamburg-weiter Bedarf von insgesamt 592 Lade- punkten (341 AC-Ladepunkte, 181 AC-Schnellladepunkte, 70 DC-Ladepunkte).

5:51 Die quantitative Ermittlung dieser Werte ist mit einer Vielzahl qualitativer Annahmen unterlegt word…

Code: Information (Usage of Infrastructure), Scope (Total Number of Stations)

Content:
Die quantitative Ermittlung dieser Werte ist mit einer Vielzahl qualitativer Annahmen unterlegt worden, die trotz der mit Detailtiefe und Sorgfalt vorgenommenen Abschätzungen ein weiterhin beträchtliches Maß an Prognoserisiken und kalkulatorischer Schwankungsbreite beinhaltet. Um die Ladeinfrastruktur entsprechend dem tatsächlichen Bedarf aufbauen zu können, ist eine prozess- begleitende Evaluierung und Aktualisierung der Szenarien zu Fahrzeughochlauf und Ladeinfrastrukturbedarf mit Hilfe der entwickelten Methodik notwendig und vorgesehen.

5:63 Für die nachfrageorientierte Bedarfsermittlung wurden Nutzergruppen identifiziert, deren jeweilig…

Code: Actor (EV users), Scope (Total Number of Stations)

Content:
Für die nachfrageorientierte Bedarfsermittlung wurden Nutzergruppen identifiziert, deren jeweilige Relevanz und Verteilung auf die Folgejahre projiziert und hierzu für die jeweiligen Nutzergruppen einheitliche Grundannahmen aufgestellt, die die konkrete zukünftige Inanspruchnahme und damit verbundene Auslastung der Ladesäulen prognostizieren sollen

Appendix 3: List of Collected Documents

This section includes a complete list of consulted documents. The thesis analyzed three German cities strategy documents for the development of public AC infrastructure provision for electric vehicles. The documents were analyzed via the software Atlas.ti. The analyzed documents were enclosed in a zipped file when submitting the thesis and are now held by the University of Twente, Enschede.

Berlin

- Berlin, Senatsverwaltung für Umwelt, Verkehr und Klimaschutz. (2017). Eckpunkte des Vertrags für die Erweiterung und den Betrieb der Ladeinfrastruktur in Berlin. Retrieved from: https://www.stuttgart.de/elektromobilitaet/richtlinie-ladesaeulen (last access: 24.06.2020)
- Berlin, Senatsverwaltung für Stadtentwicklung und Umwelt. (2014). Elektromobilität in Berlin - Arbeitshilfe für die Ladeinfrastrukturerweiterung. Retrieved from: https://www.berlin.de/senuvk/verkehr/planung/e_mobilitaet/de/lib.shtml (last access: 24.06.2020)

Hamburg

- Bürgerschaft der Freien und Hansestadt Hamburg. (2014). Masterplan zur Weiterentwicklung der öffentlich zugänglichen Ladeinfrastruktur für Elektrofahrzeuge in Hamburg. Als Anlage zur Mitteilung des Senats an die Bürgerschaft ‚Masterplan Ladeinfrastruktur und Stellungnahme des Senats zu dem Ersuchen der Bürgerschaft vom 11. Dezember 2013 'An Erfolge anknüpfen und Elektromobilität weiterentwickeln“ (Drucksache 20/10267)’. Retrieved from: http://suche.transparenz.hamburg.de/dataset/masterplan-ladeinfrastruktur-und-stellungnahme-des-senats-zu-dem-ersuchen-der-buergerschaft-vom?forceWeb=true (last access: 24.06.2020)

Stuttgart

- Gemeinderat der Landeshauptstadt Stuttgart, der Oberbürgermeister. (2019). Beschlussvorlage: Rahmenkonzeption Ladeinfrastruktur für E-Mobilität im öffentlichen Raum. Retrieved from: https://www.stuttgart.de/elektromobilitaet/richtlinie-ladesaeulen (last access: 24.06.2020)
- Stuttgarter Amtsblatt der Landeshauptstadt Stuttgart. (2019). Richtlinie für Ladepunktbetreiber und Investoren - Anlage 1 der Rahmenkonzeption „Ladeinfrastruktur für E-Mobilität“ im öffentlichen Raum vom 24. Juli 2019. Retrieved from: https://www.stuttgart.de/elektromobilitaet/richtlinie-ladesaeulen (last access: 24.06.2020)

Appendix 4: Plagiarism Statement

PLAGIARISM STATEMENT

I certify that this assignment/report is my own work, based on my personal study and/or research and that I have acknowledged all material and sources used in its preparation, whether they be books, articles, reports, lecture notes, and any other kind of document, electronic or personal communication. I also certify that this assignment/report has not previously been submitted for assessment in any other unit, except where specific permission has been granted from all unit coordinators involved, or at any other time in this unit, and that I have not copied in part or whole or otherwise plagiarised the work of other students and/or persons.

Lise Josephine Dotzer

Name

29.06.2020

Date

Signature