To spark the roll out of EV

Research on the parts of municipal strategies that slow down the placement of chargers for electric vehicles

Universiteit Utrecht

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Research on the parts of municipal strategies that slow down the placement of chargers for electric vehicles

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Summary

The exhaustive nature of fossil fuels and environmental concerns associated with greenhouse gases are the major causes of the paradigm shift from conventional vehicles to electric vehicles (EVs). Dutch cities embrace electric mobility as a way to reduce CO_2 emissions and additional pollutions from road traffic (such as hydrocarbons and nitrogen oxides), lowering noise levels within their city limits, thereby increasing the quality of life for their inhabitants. This type of new mobility requires changes in the current infrastructure, especially public chargers, as not every EV owner has an own driveway to place one. The lead time of implementation of this public charging infrastructure varies per municipality, creating differences between them in realizing their individual and national sustainability goals. This research explores the factors that are of influence on the lead time for charger placement, seeks to explain their existence and provides recommendations for policymakers to set up an effective charger placement strategy, which is required by all Dutch municipalities by the end of 2020. It has done so by (i) data analysis on lead time data for charger placement in a frontrunning e-mobility concession in the Netherlands, (ii) expert interviews in the field of e-mobility and (iii) multiple case studies at Dutch municipalities at which the found variables were identified and their existence analyzed along the Multiple Streams Framework. Experts came from frontrunning e-mobility interest groups such as Stichting ElaadNL and NKL. Participating municipalities in the case studies were selected on their lead time for charger implementation, their view on e-mobility and their approaches taken to reduce this lead time. Results of this research showed that political support from the municipal board is the most influencing variable on the lead time for charger placement. This support leads to additional resources such as funding, manpower and knowledge which can be used to create an optimal placement strategy for a municipality, although this support provides no guarantee for a short lead time when used incorrectly. Additionally, the use of projection data to create a so-called ‘planning map’ approach can cause a reduction in lead time when used in the right way. The legal process (incl. traffic ordinance and objections) are causing the biggest delays in the implementation process. Finally, while parking pressure is often an argument from residents to object against a charger, municipalities often do not consider this in their decision for charger placement, reducing lead time in the process.

Samenvatting

Het gebruik van fossiele brandstoffen en de milieuschade veroorzaakt door broeikasgassen zijn de belangrijkste oorzaken van een verschuiving van conventionele voertuigen naar elektrische voertuigen (EV's). Nederlandse steden omarmen elektrische mobiliteit als een manier om de CO_2-uitstoot en andere bijkomende vervuiling door wegverkeer (zoals koolwaterstoffen en stikstofoxiden) te verminderen, het geluidsniveau binnen hun stadsgrenzen te verlagen en zo de kwaliteit van leven voor hun inwoners te verbeteren. Dit nieuwe type mobiliteit vereist veranderingen in de huidige infrastructuur en dan met name openbare laadpalen, omdat niet elke EV-eigenaar een eigen oprit heeft om een dergelijk apparaat te plaatsen. De doorlooptijd van deze openbare laadinfrastructuur varieert per gemeente, waardoor er verschillen ontstaan bij het realiseren van hun individuele en nationale duurzaamheidsdoelstellingen. Dit onderzoek richt zich op de factoren die van invloed zijn op de doorlooptijd van het plaatsen van openbare laadpalen, probeert hun bestaan te verklaren en biedt aanbevelingen voor het opzetten van een effectieve strategie voor het plaatsen van laadpalen. Dit is een vereiste voor alle Nederlandse gemeenten vanaf 2020. De resultaten van dit onderzoek zijn behaald door: (i) data-analyse van doorlooptijd van laadpalen in een vooruitstrevende e-mobiliteitsconcessie in Nederland, (ii) expertinterviews op het gebied van e-mobiliteit en (iii) meerdere casestudies bij Nederlandse gemeenten, waarin de gevonden variabelen zijn geïdentificeerd en hun bestaan is geanalyseerd met behulp van het Multiple Streams Framework. Experts vertegenwoordigen vooruitstrevende e-mobiliteit belangengroepen zoals Stichting ElaadNL en NKL. Deelnemende gemeenten in de casestudies werden geselecteerd op basis van hun doorlooptijd van laadpalen, hun visie op e-mobiliteit en hun aanpak om deze doorlooptijd te verkorten. De resultaten van dit onderzoek laten zien dat politieke steun van het gemeentebestuur de meest invloedrijke variabele is op de doorlooptijd voor het plaatsen van laadpalen. Deze steun leidt tot aanvullende middelen zoals financiering, mankracht en kennis die kunnen worden gebruikt om een optimale plaatsingsstrategie voor een gemeente te creëren, echter deze steun biedt geen garantie voor een korte doorlooptijd wanneer deze verkeerd wordt gebruikt. Bovendien kan het gebruik van voorspellende data, om een zogenaamde 'plankaart' te creëren, de doorlooptijd verkorten wanneer deze op de juiste manier wordt ingezet. Het juridische proces (waaronder het verkeersbesluit en bezwaren) veroorzaken de grootste vertragingen in het implementatieproces. Ten slotte, de parkeerdruk is vaak een argument van de bewoners om

bezwaar te maken tegen een laadpaal, maar gemeenten nemen dit vaak niet mee in hun beslissing voor plaatsing, waardoor de doorlooptijd in het proces wordt beperkt.

Key concepts

Electric mobility, Electric Vehicles, Public charging infrastructure, Municipal strategies, Multiple Streams Framework

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I hope you will enjoy the content of this thesis.

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Abbreviations and acronyms

BUCH	Bergen, Uitgeest, Castricum, Heiloo
CPO	Charge Point Operator
EV	Electric Vehicle
MRA-e	Metropolian Region Amsterdam - electric
MSF	Multiple Streams Framework
NAL	Nationale Agenda Laadinfrastructuur
NKL	Nationaal Kennisinstituur voor Laadinfrastructuur
PHEV	Plug-in Hybrid Electric Vehicle
RVO	Rijksdient voor Ondernemend Nederland

1. Introduction

Mobility has served as the lifeblood of human civilization. Over the course of the twentieth century, often called the century of the automobile, cars have moved drivers and riders with a combination of utility, efficiency, and complexity, unrivalled in the industrial age. Currently, as new cars are welcomed by the millions, the world appears on the edge of a new horizon for mobility, one that promises to be faster, smarter and greener. One route to this new horizon is electric mobility through the use of electric vehicles (EVs).

The exhaustive nature of fossil fuels and environmental concerns associated with greenhouse gases are the major causes of the paradigm shift from conventional vehicles to EVs. Countries and cities all over the world embrace electric mobility as a way to reduce CO_2 emissions and lowering noise levels, thereby increasing the quality of life for its inhabitants. In 2017 several EU member states, such as the Netherlands, Norway and France have vouched to ban the sale of fossil fuel powered cars from 2030 onward, indicating that the transition towards EVs is coming and is here to stay for the future (Volkskrant, 2017) .

1.1. E-mobility in the Netherlands

In response to concerns about air quality and to meet European targets set for 2015, several cities and regions in the Netherlands started developing an e-mobility program for their regions from 2009 onwards (Hull & Linnenkamp, 2015). The latest example is Amsterdam, which plans to ban fossil fuel powered cars in large parts of the city by 2030 (NOS, 2019). The measures taken by these cities and regions inspired the Dutch Ministry of Economic Affairs to publish its plans in its *Electric Mobility Gets Up To Speed 2011–2015 Action Plan* in 2011. One of its targets related to the number of EVs on Dutch roads: 20,000 by 2015, increasing to 200,000 by 2020.

1.2. Limitations of EVs

Currently, the use of EVs has three common limitations: (i) price, (ii) range and (iii) charging infrastructure (Biresselioglu, Demirbag Kaplan, & Yilmaz, 2018 ; Lu, Han, Hua & Qouang, 2013; Muratori et al 2019). Right now, the price of EVs is declining but in general an EV is still more expensive than a regular fossil fuel powered car (Canepa, Hardman & Tal, 2019; NKL, 2019). In addition, the largest limitation for EVs is the range it can travel on a fully charged battery. As both of these limitations are well documented and addressed, knowledge on how to design an efficient public infrastructure of chargers is still in its infancy (Rietmann & Lieven, 2019). Current research done on public charging infrastructure focusses on general prediction models to be used in every situation, with little to no attention to the specifics of the municipalities where chargers are placed and the policy these cities enforce (Pagany, Camargo, & Dorner, 2018).

1.3. EVs and charging infrastructure in the Netherlands

Since the introduction of plug-in hybrid vehicles a few years ago, the amount of electric vehicles dependent on (public) chargers in the Netherlands is increasing on an annual basis (see table 1).

Table 1: Number of vehicles per type vehicle for the period 2014 - 2018

Total number of vehicles per type of vehicle	31-12-2014	31-12-2015	31-12-2016	31-12-2017	31-12-2018	%growth, (baseline 31-12-2014)
EV	6825	9368	13105	21115	44984	559%
PHEV	36997	78163	98903	98217	97702	164%
EV + PHEV	43762	87531	112008	119332	142686	226%

EV stands for Electric Vehicle, PHEV stands for Plug-in Hybrid Electric Vehicle. Both types of cars need electric chargers to recharge their batteries (source: RVO, 2019).

As of April 2019 there are over 55.000 fully EVs and nearly 100.000 PHEVs in the Netherlands and that number increases daily (RVO, 2019). As 70% of Dutch e-riders are depending on public parking space, this increase in EVs and PHEVs means that municipalities receive a growing number of requests for public chargers (Over Morgen, 2018; NKL, 2019).

This increasing number of EVs on Dutch roads has been paralleled with an increasing number of charge points. As of April 2019 there are around 42.000 public chargers (so excluding private chargers) to provide charging possibilities for the current EV fleet in the Netherlands (see figure 1). To keep up with the demand, this number is expected to grow to 1,8 million chargers in 2030, as stated in the Nationale Agenda Laadinfrastructuur (NAL) (NAL, 2019).

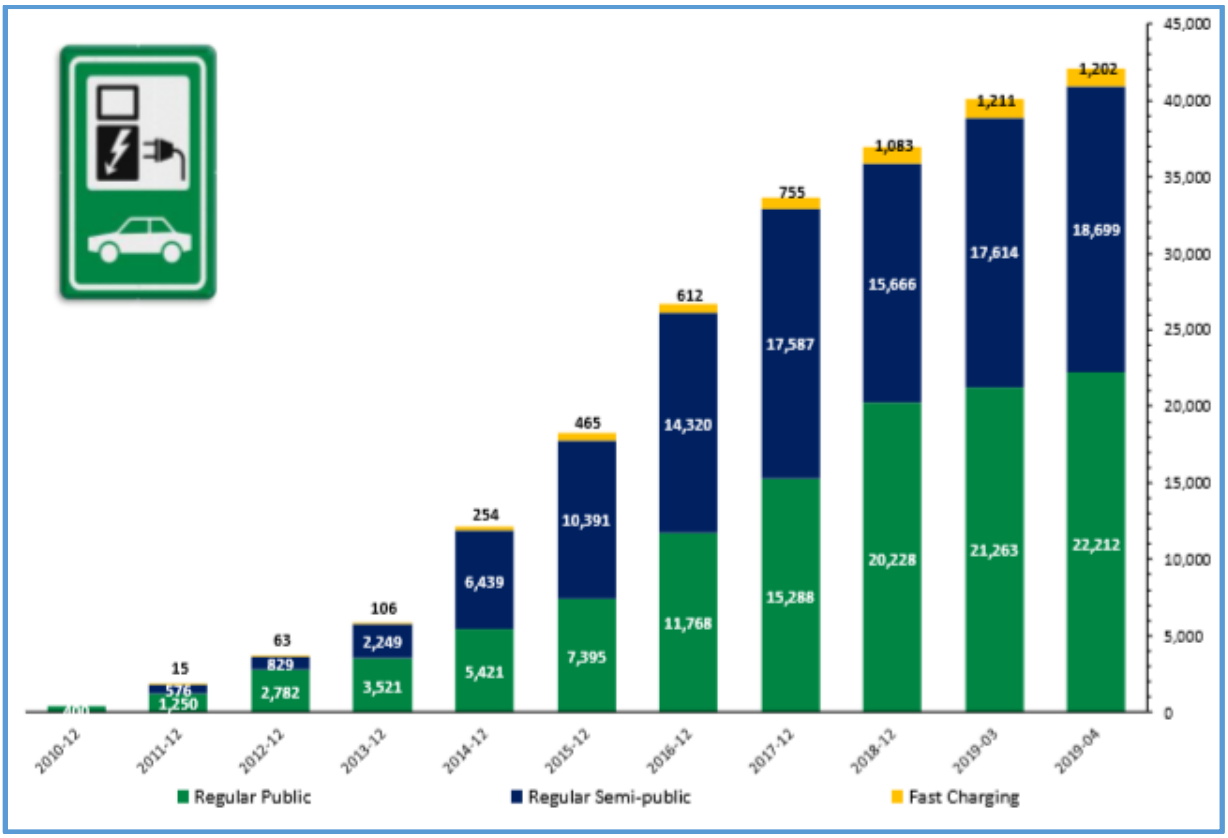


Figure 1: Number of chargers, divided by regular public, regular semi-public and fast charging in the period December 2010 till April 2019. *Private charge points are excluded from these numbers. Regular chargers are placed in the streets and are available for everyone. Regular semi-public chargers can be found in parking garages or businesses. Fast chargers are common along highways, often near petrol stations (RVO, 2019)*

1.4. Municipalities and electric mobility

For the majority of local councils, implementing a charging infrastructure themselves is not an option. It is a relatively new technology, and the finances required to purchase the chargers are rarely included in council budgets. However, local councils remain responsible for public space and do want to prevent the unchecked proliferation of charging poles (Hull & Linnenkamp, 2015). In order to overcome this, several regional initiatives in the Netherlands were set up. In January 2013, the MRA-e project (a project organization for the Amsterdam Metropolitan Region) is an example of such initiative which was created as a solution for introducing more public charging points in cities: it joins forces and issue calls for tenders for public chargers for all the local councils on whose behalf it operates. Such initiatives are also done in the provinces of Brabant and Limburg, and Gelderland and Overijssel. A call for tenders allows the market to operate freely and produces the economically most favorable bids. Councils are allocated chargers from the concession according to their requirements and become the owners of the chargers. They select the location for the chargers and facilitate its installation with a traffic ordinance. The role of local councils ends with organizing the parking places and the installation of the charger: the supplier retains responsibility for their management, maintenance and eventual removal (Hull & Linnenkamp, 2015).

1.5. Bottleneck to be assessed

While these constructions through upscaling projects are effective in creating public charging infrastructure in a larger region, participating municipalities have different views on electric mobility, thus

they use different implementation strategies and so there are expected differences in the implementation speed of public chargers between municipalities which participate in such projects.

This difference in lead time between municipalities can have effects on their respective sustainability goals as well as on the Dutch national EV target (NAL, 2019) (see figure 2a and 2b below). These figures show the expected charging needs for EVs in 2020 and 2025 respectively. Municipalities get a score between 0 and 1 (red to green), indicating to what extent they are prepared for the future growth of electric mobility when analyzing their current policy. For example, meaning that a score of 0.30 implies that the current public infrastructure is able to provide 30% of the expected demand for EV in 2020 (or 2025 respectively). As the red sections in figure 2a and 2b show; the majority of Dutch municipalities will have an insufficient public charging infrastructure in 2020 and 2025, indicating that their current policies are not effective in implementing chargers at a rate sufficient to match expected future demand.

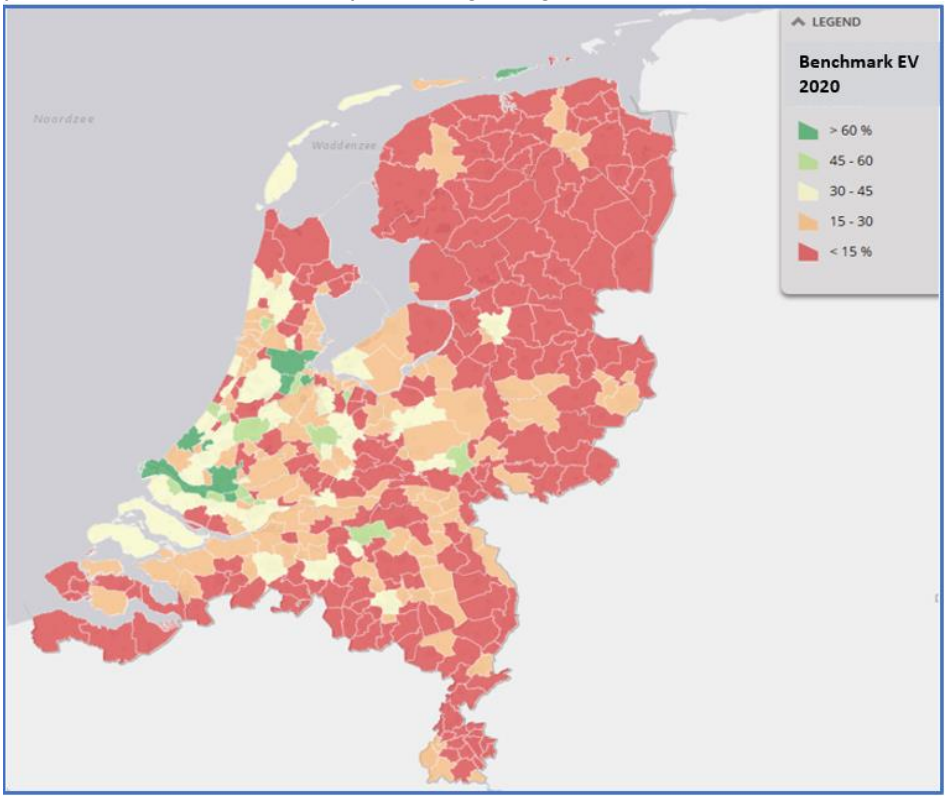


Figure 2a: Electric charging prognoses for 2020. *Map shows the expected need for public charging infrastructure per municipality for the year 2020. It shows that the majority of municipalities are incapable of providing the expected infrastructure with its current policies (Over Morgen, 2019). An interactive version of this map is available here.*

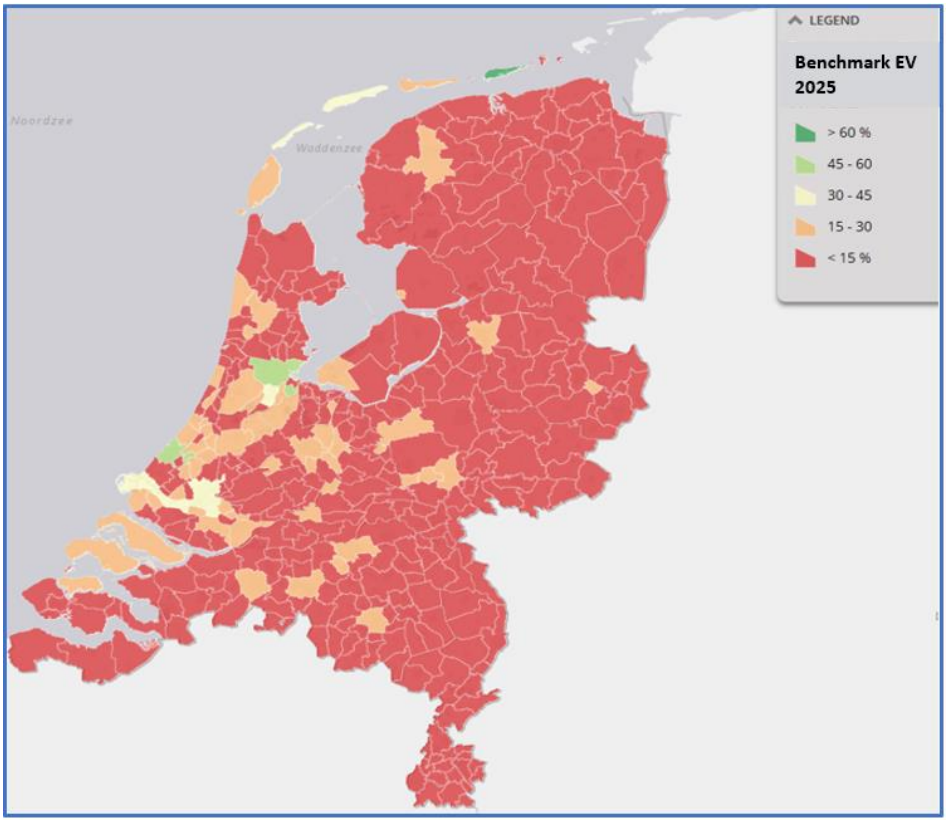


Figure 2b: Electric charging prognoses for 2025. *Map shows the expected need for public charging infrastructure per municipality for the year 2025. It shows that the majority of municipalities are incapable of providing the expected infrastructure with its current policies (Over Morgen, 2019). An interactive version of this map is available here.*

This finding is corroborated by calculations undertaken by APPM in its charging infrastructure analysis 2018, included in the NAL. Data shows that by 2024 almost 300 chargers need to be placed on a daily basis to keep up with the expected demand and this increases to more than 700 chargers a day by 2030 (see figure 3) (NAL, 2019).

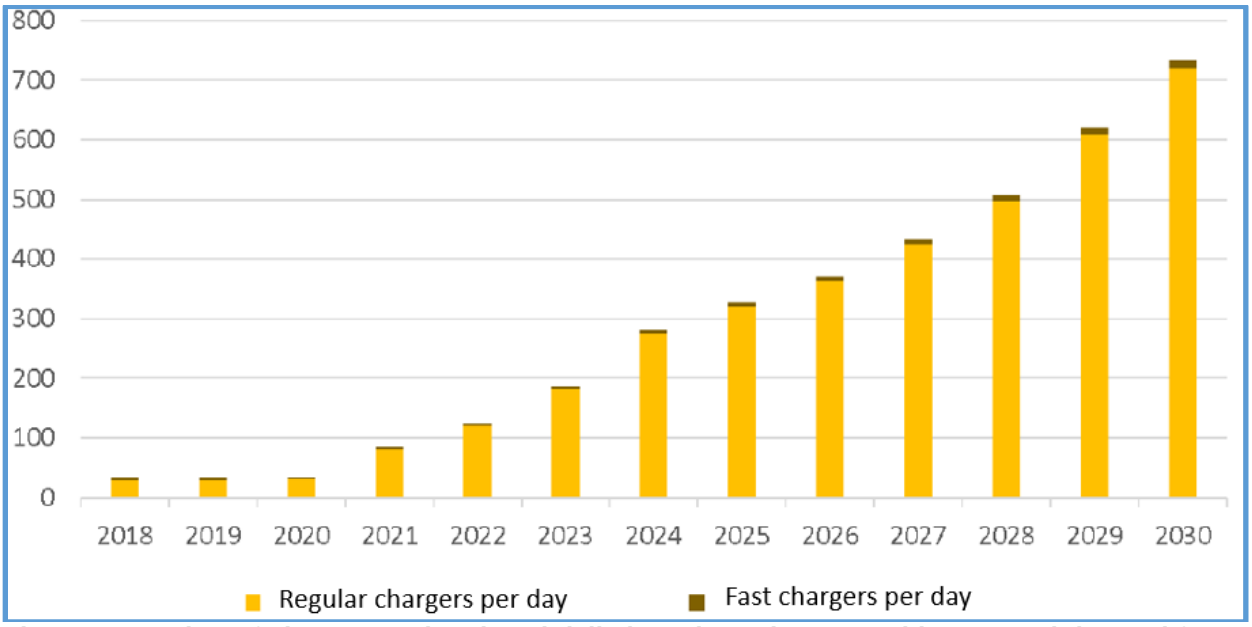


Figure 3: Number of chargers to be placed daily in order to keep up with expected demand for EV in the Netherlands. *Yellow bars show regular chargers, brown bars show fast chargers (NAL, 2019).*

The growing number of EVs, the increasing demand for chargers, the current rate of charger implementation and the expected demand for chargers in the near future, shows that Dutch municipalities are incapable to keep up with the pace of the growth of e-mobility and to provide a sufficient number of chargers in the public domain. Therefore, research on the factors that are responsible for this lack of pace on implementation at municipalities is needed. This research aims to fill in this knowledge gap and providing municipal policymakers with recommendations to being able to realize the municipal and in the end national goals on e-mobility in the future.

1.6. Research questions

Considering the situation described above, this research aims to answer the following main research question:

How can the observed variation between municipalities in the time it takes to develop a public charging infrastructure for EVs be explained?

This main research question will be answered along the following sub questions:

Sub question 1: How are municipal public charging infrastructures for EVs being developed so far?

- Sub question 1.1: How do planning and installation lead times differ per municipalities?
- Sub question 1.2: Who is involved in the process of planning and implementation of municipal public charging infrastructure and what are their respective roles and responsibilities?

Sub question 2: What factors can be expected to either help or hinder the development of municipal public charging infrastructure?

Sub question 3: How can the variety of existence or nonexistence of these variable within municipalities be explained?

Sub question 4: How can the roll out of municipal public charging infrastructure for EV be improved?

1.7. Research framework

In order to answer these research questions the following research framework was developed (see figure 4).

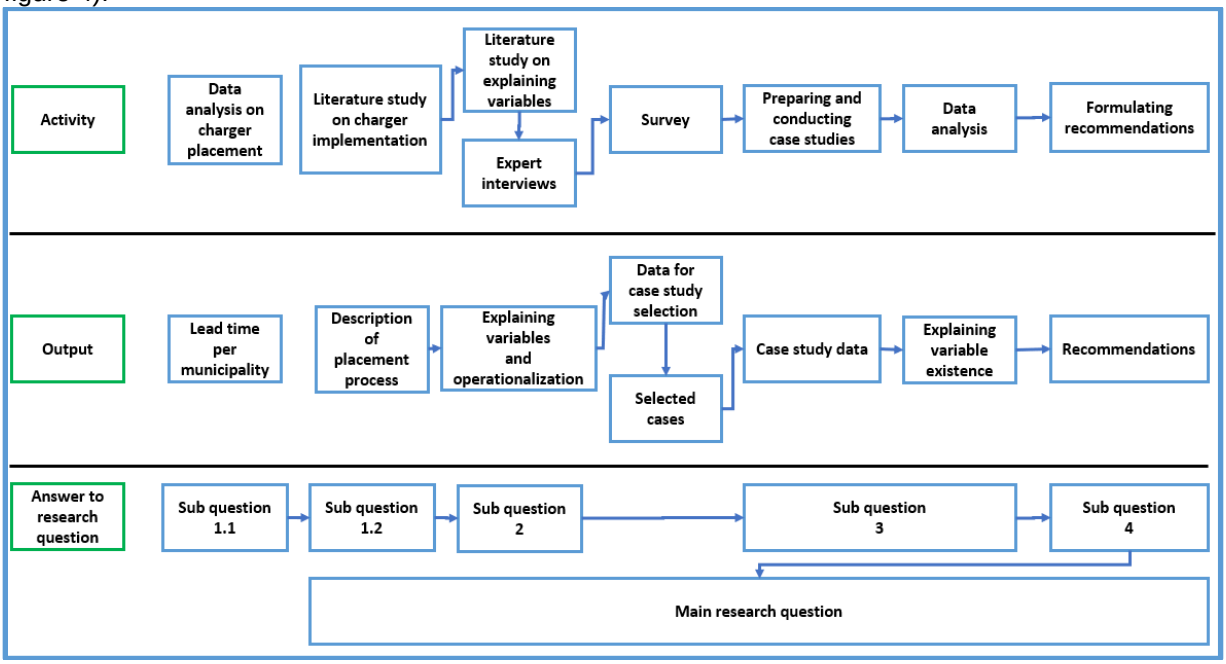


Figure 4: Research framework for this thesis project. *Top row shows the activities performed in this research in chronological order from left to right. The middle row shows the output from these activities and the bottom row shows which research questions were answered with each activity and output.*

Figure 4 shows the research framework for this research project. The steps taken in this figure are derived from the research questions described in section 1.6. First, preliminary research was done on the lead time for charger implementation per municipality in a selected population of municipalities through data analysis. Second, the steps of this implementation process were described in further detail trough a literature study. Third, a literature study on variables explaining the lead time differences was conducted. Because academic literature on this topic proved to be in its infancy, experts interviews were held to bridge this gap. This resulted in nine variables which are expecting to influence the lead time for charger implementation. Additionally, literature study on the Multiple Streams Framework (MSF) was done in order to get insights in how the existence or nonexistence of these variables can be explained. Fourth, based on the found lead time data, literature study and expert interviews, the variables were operationalized. A survey was developed and conducted among a selected group of municipalities. This survey attempted to collect data on the found variables for each municipality which was used for case study selection. Fifth, these case studies were prepared and performed to explore the factors that create the differences between the different municipalities. In the sixth and penultimate step the existence of these factors are explained along MSF theory and in the final seventh step recommendations are given to municipalities to spark their current and future e-mobility policies.

1.8. Document outline

This document outlines the research in further detail. In chapter 2 background information on public charging infrastructure is given based on a literature study. Chapter 3 will go into the theory of Multiple Streams Framework, which is used to explain the existence of the found variables in the case studies. Chapter 4 will explain the methods used during the research and chapter 5 follows with the results. Chapter 6 will provide a reflection on the results and goes into the limitations of this research in the discussion. Finally, chapter 7 will give the main conclusions of the research and ends with recommendations for municipal policymakers.

2. Background

The following chapter provides a background on the implementation of public chargers for EVs. It will describe the stances municipalities can have on implementing charging infrastructure and the general process of charger implementation.

2.1. Public charging infrastructure

As aforementioned, the growing number of EVs is coupled with a growing number of requests for chargers in public space. A public charger for electric cars is available for everyone who owns a car with a battery that needs to be charged, so either a plug-in hybrid (PHEV) or electric vehicle (EV). The charger is placed in the street, is connected to the existing electricity grid, has two sockets which can provide electricity for two cars and has two designated parking spots (in rare instances one spot) for electric cars (see figure 5).

Figure 5: Example of a charger. *A charger is placed in public space with two reserved parking spots and enables two electric cars to recharge their batteries simultaneously (PitPoint image bank, 2018).*

Because municipalities are responsible for changes in public space, every Dutch municipalities will have to address challenges related to the growing popularity of electric mobility (VNG, 2018). This topic is also of future relevance because all Dutch municipalities are obliged to have an e-mobility policy by 2020 (NAL, 2019).

EV owners will contact their municipality to place a public charger if they do not have the possibility to place a charger on private terrain. EV users are expecting clarity from their municipality on its policy for EVs. Does the municipality place the chargers themselves, or does she facilitates Charge Point Operators (CPO's) *(companies which place, exploit and maintain the chargers*) to do this? And what are the rules for parking EVs? With a clear EV policy a municipality can help existing and future e-riders. Research showed that municipalities with a clear EV policy have significant more EVs than municipalities which have no policy (NKL, 2019). The sections below explore the different options for charging solutions, the different stances a municipality can take on the placement of chargers and the different contract forms municipalities can take on.

2.1.1. Charging solutions

In order to charge an EV, three components need to align: the location at which the car can be charged, the location of the grid connection and the location of the charger. The following combinations are possible, based on the 'Charging ladder' ('*Ladder van laden')* (AgentschapNL, 2013).

Tier 1: Charging on private terrain at a dwelling or company.
Current national EV policy states that wherever possible an e-rider needs to be self-sufficient. An e-rider can be self-sufficient when he owns a private driveway to place a charger on or when he has the possibility to charge at private terrain at work (figure 6). Placement of chargers in these cases are often cheaper than public chargers and are sometimes even included by the dealer when buying an electric car. The municipal role for this tier can be, for instance to provide a subsidy for the e-rider to place a charger at home. The municipality of Rotterdam is such a municipality with a stimulating role for this tier of charging (Municipality of Rotterdam, 2019).

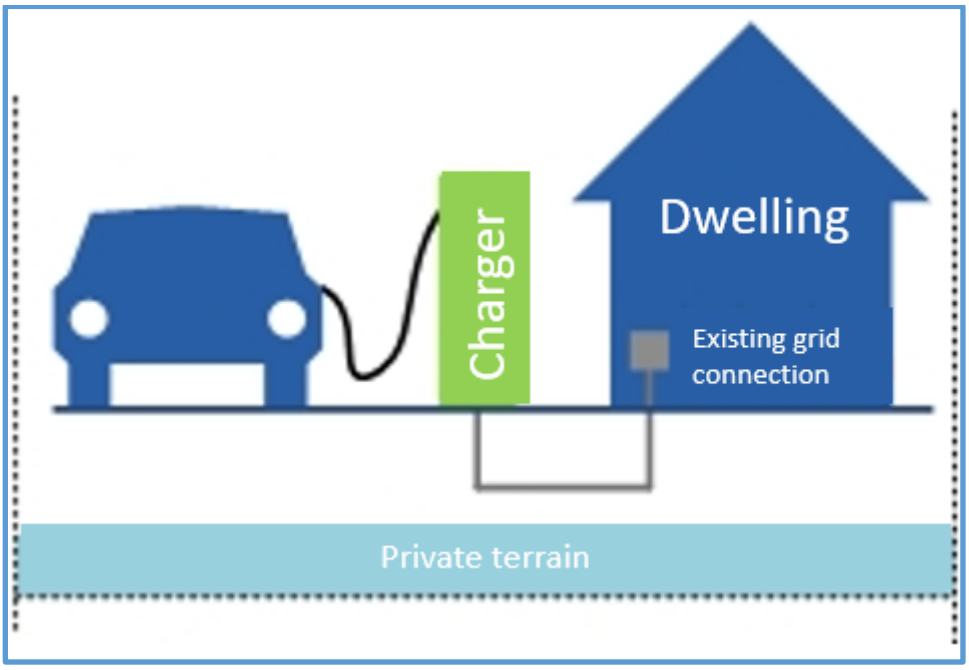


Figure 6: Tier 1 of charging possibilities. *The e-rider has the possibility to park his car on private terrain and to install a charger on private terrain as well.*

Tier 2a: Parking in public space and charger on private terrain
At times an e-rider is able to park in a public space and has the ability to charge his car by a charger on private terrain, for example when an e-rider has a parking spot in front of his house. This way of charging means that an electricity cable can potentially be laid down on the pavement across cycling lanes, parking spots and other types of roads (figure 7). In practice this type of charging occurs only if the distance between the car and the charger is small and most of the time only involves a cable to be put down on the sidewalk. Municipalities can choose not to allow this form of charging, for example on safety grounds. These municipalities often provide an alternative to overcome the charging need. An example of such municipality is Heemskerk, which states that the municipality is not investing in public chargers. Potential extra chargers will only be placed when investors are willing to do this. E-riders can charge their cars at the existing public chargers and at chargers on private terrain. E-riders who are not able to charge on own terrain are allowed to put down a cable on the sidewalk. The EV owner is then liable for any potential damages or injuries to others (Municipality of Heemskerk, 2019).

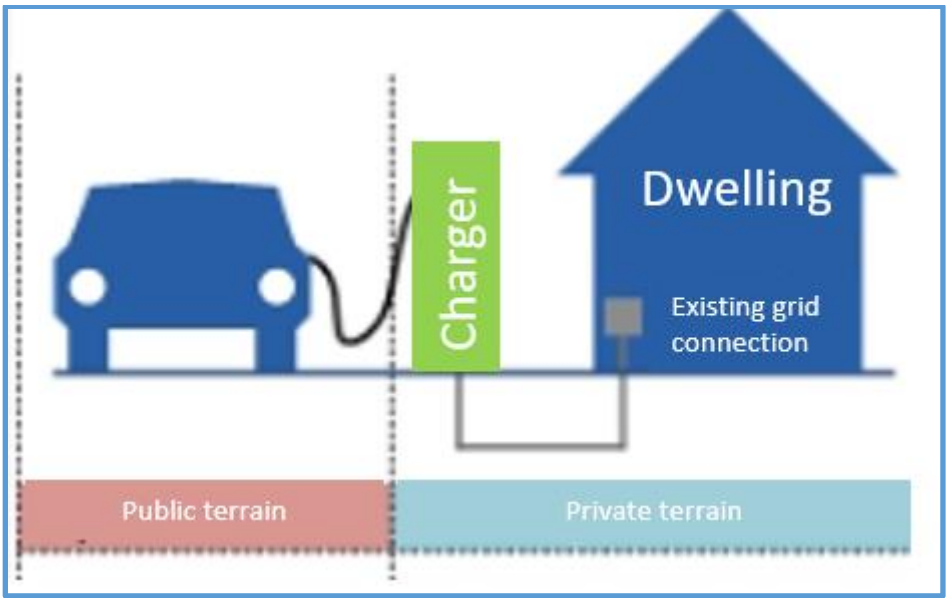


Figure 7: Tier 2a of charging possibilities. *The e-rider has the possibility to park his car on a public spot and to charger it from a private charger on private terrain.*

Tier 2b: Parking on a public space with private charger in public space
When it impossible to place a charger on private terrain, the e-rider can request the municipality to install a private charger on public terrain. Private chargers in public terrain can be an extended home connection as well as a regular private charger (figure 8). For this option, it is important for the municipality to make agreements with the e-rider and the CPO of the usage of the charger. The costs for the charger in this example are for the e-rider and the CPO. The municipality can choose to provide additional financial support. In practice this type of charging is rare, due to the complexity of required arrangements.

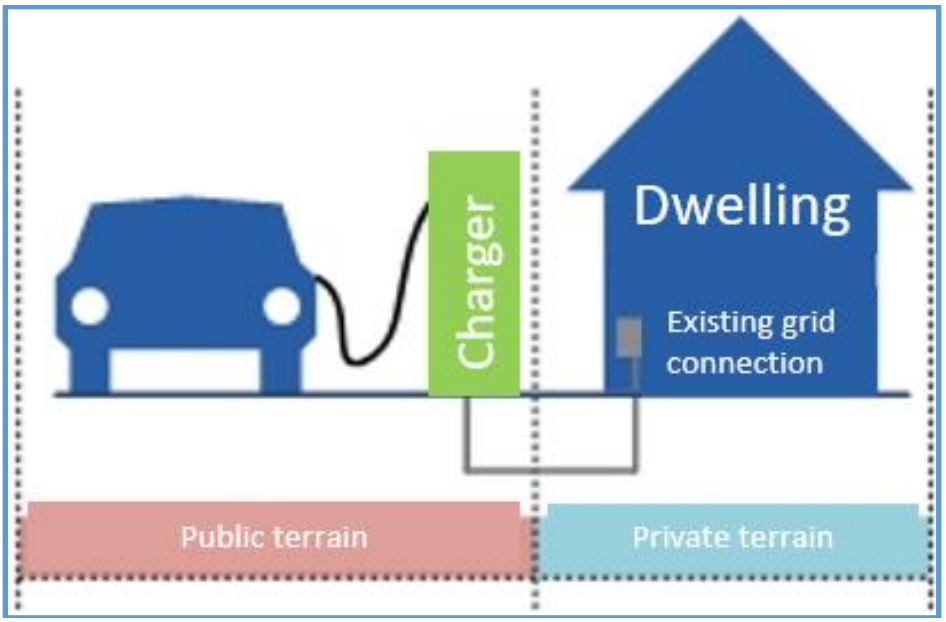


Figure 8: Tier 2b of charging possibilities*. The e-rider has the possibility to park his car on a public spot and to place a private charger on public terrain.*

Tier 3a: Public accessible parking spot on private terrain with charger
Owners and administrators of parking garages and industrial areas can place chargers on their own, publicly accessible grounds (figure 9). The placement of these chargers is generally cheaper than those in public space because of the existing grid connection. The owner of the charger can determine who is able to use the charger and who is not as well as the costs for using the charger. When a municipality wants to prevent an abundance of charger in public space, it can choose to promote semi-public

chargers. This can be done by informing citizens or even subsidy schemes. For instance, the municipality of Utrecht stimulates electric driving for providing subsidy for semi-public chargers in parking garages, at malls or industrial areas (Municipality of Utrecht, 2019).

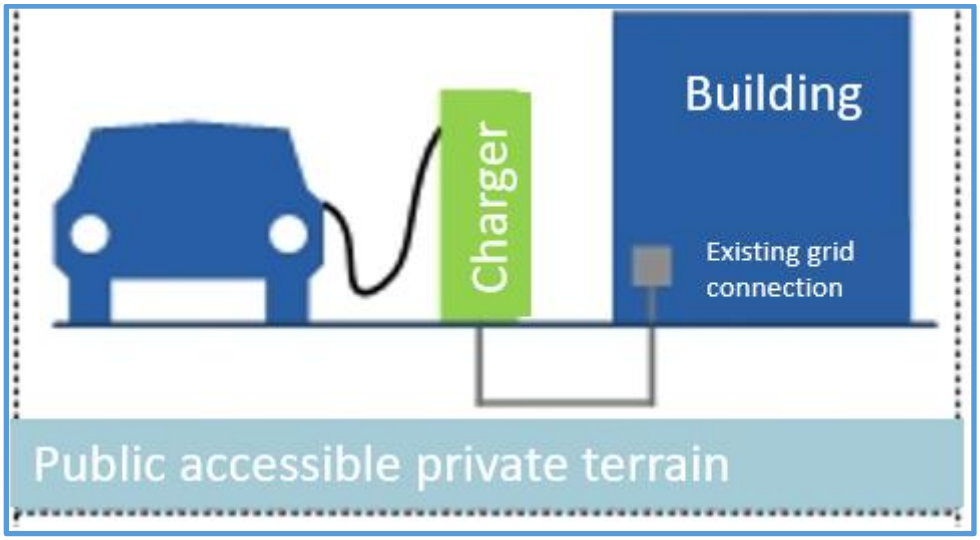


Figure 9: Tier 3a of charging possibilities. *The charger is placed on private terrain which is publicly accessible for everyone.*

Tier 3b: A public parking space and publicly accessible charger in public space
EV owners who cannot charge their electric car by one of the previously introduced methods, are depending on publicly accessible chargers in public space. This means the charger is not privately owned and everyone with an EV can use this charger to recharge their battery (figure 10). This is the case for 70% of the EV owners in the Netherlands. Municipalities are responsible for the implementation of these chargers because they involve changes being made in the public domain.

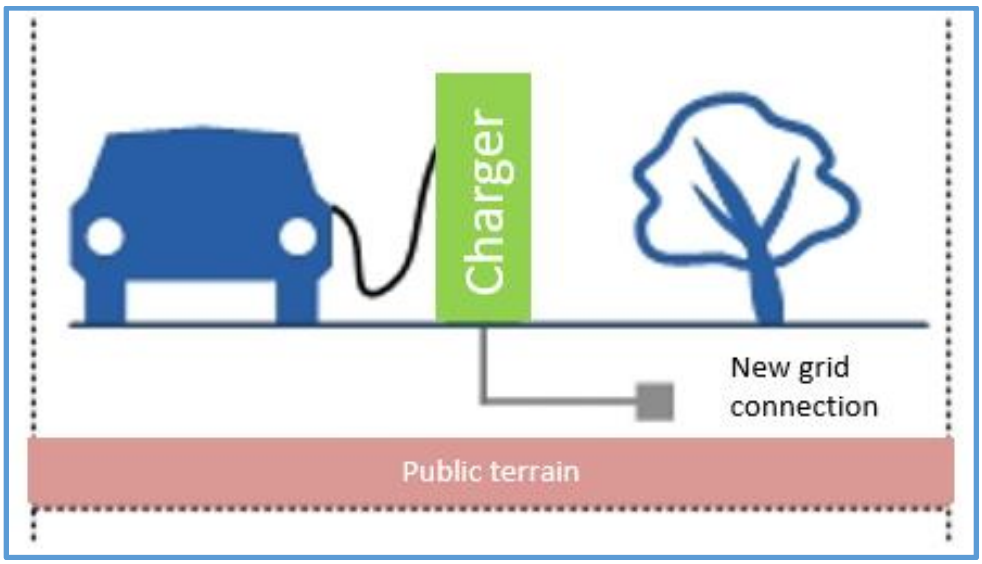


Figure 10: Tier 3b of charging possibilities. *A public charger available on public parking space in public space.*

2.1.2. Municipal roles for public charger infrastructure
When setting up a policy for EVs, a municipality has the option for four roles: (i) stimulate, (ii) facilitate, (iii) react and (iv) contain (NKL, 2019). The individual roles are explained below.

Stimulate
A municipality that stimulates EV has the goal of making e-mobility a success. For public charger infrastructure, this means that a municipality is pro-active in the placement of chargers and/or ensures the costs for implementation is low. This often means that the municipality conducts several projects for

EV simultaneously. For example, organizing meetings with local companies to promote EVs or providing subsidies for chargers on own terrain or when buying EVs. This is done by multiple municipalities in the provinces of Brabant and Limburg (Slim Laden Brabant, 2016).

Facilitate
A facilitating municipality works together with CPO's to place chargers or makes CPO's responsible for public charger placement. The municipality can choose to do this directly or via a regional cooperation. Most of the facilitating municipalities often provide a limited or no financial incentive for the placement of public chargers. For example, the municipality of Dordrecht is a facilitating municipality. Residents file a request at the CPO, which in turn is responsible for the placement of the charger. The CPO also makes a traffic ordinance and arranges the needed permits (Municipality of Dordrecht, 2019).

React
Municipalities with a low number of requests can choose for a reactive approach. These municipalities have no EV policy yet, which may be deliberate and deal with charger requests one at the time. Example of this kind of approach is the municipality of Zeist (Municipality of Zeist, 2019).

Contain
Municipalities can choose not to allow public chargers. In such case, this preference then has to be stated in the respective policy documents of the municipality. The number of municipalities choosing for this role are limited.

Contract forms
When municipalities have decided their stance on public chargers, they are able to choose one of three contract forms to roll out public charging infrastructure. (i) The *permit model* means that every CPO which complies to the rules set by the municipality is allowed to place chargers in the public domain. Municipalities such as Nieuwegein, Dordrecht and Gorinchem use this approach. (ii) *The concession model* gives one or multiple CPO's the rights to place and exploit chargers in the public domain. Selection of the CPO('s) is done through a tender process. Municipalities such as Houten, Haarlem and Alkmaar use this type of contract. (iii) The *project model* means that a municipality gives a CPO the right to place chargers in the public domain for a specific amount of time. The CPO in turn gets the rights for exploitation. The G4 municipalities (The Hague, Amsterdam, Rotterdam and Utrecht) used this model to initiate their individual charging infrastructure.

2.2. The implementation process for public chargers

The implementation process for public charging infrastructure is a collaboration between a number of actors. Because this research is focused on the role of the municipality within this process, it is important to understand how this process is set up, who is involved and what the responsibilities are of each actor.

2.2.1. Actors

EV owner
This group composed of owners of EVs, initiates the requests for a public charger and is the end user of the final product. The request for a public charger is made because the e-driver does not own a private driveway to place a charger as described in section 2.1.1.

Municipalities
Municipalities will receive the requests for public chargers by citizens through a project organization or directly from the e-rider (depending on their contract form), provide a location proposal for these chargers and will be the one who makes the final decision on implementation.

Project organization (if applicable)
A project organization makes upscaling possible for the municipalities in a larger region. For example, a collaboration between two or more provinces. The project organization will process all requests for public chargers done by citizens in its own digital environment and makes sure the respective municipality gets a notification of this request. It also serves as a guide for municipalities to help them through the implementation process and to answer any questions municipalities have on implementing an EV policy.

Grid operator
The grid operators are responsible for creating the physical connection from the electricity grid to the public charger. They have the legal obligation to create this connection within 18 weeks. By law, the grid operators in the Netherlands are not allowed to be a contractor of public chargers.

Energy supplier
A public charger in the Netherlands has its own energy contract, due to the fact it has its own unique connection to the electricity grid. In practice, this will be a contract between the energy supplier and the charge point operator.

Charge point operator (CPO)
These are commercial parties. They are responsible for requesting the connection at the grid operator, setting up the planning to place the public charger at the agreed location and service and maintenance of the final product. They also benefit from the exploitation (sold kWh's) once the charger is installed.

Contractor
The contractor is hired by the CPO to physically place the charger at the agreed location and to make this operational for EV users.

2.2.2. Steps and responsibilities
The actors described above interact with each other in the implementation process. This process is visually presented in figure 11. The following section will describe each step of this process and the respective roles of all actors.

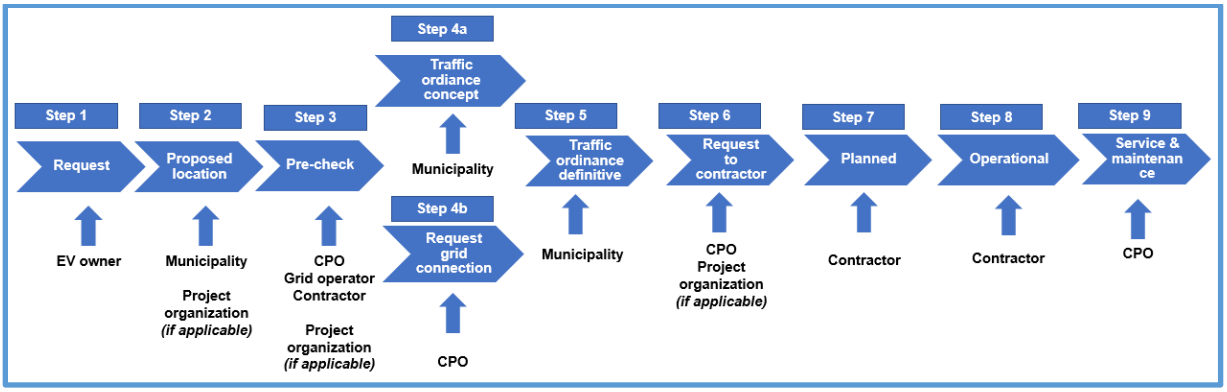


Figure 11: Implementation process of public chargers. *The arrows from left to right show the different steps that are taken in the process, with the respective actor responsible for these steps stated below.*

Step 1: Request
The process starts when an EV owner requests a public charger. The request is done at the project organization (if applicable) through a special website or at the website of the respective municipality. In order for the request to be handled effectively, municipalities with a concession model or project model often have an internal department that specifically deals with charger requests. This department handles submitted requests and has the responsibility for internal and external communication.

Step 2: Proposed location
The project organization provides the respective municipality with a notification that a request has been made or the requests arrives at the respective municipality directly. Based on this information provided by the requestee and the current traffic situation at the proposed location, the municipality proposes a location for the public charger close to the address of the e-rider. Detailed information about this proposed location is then send to the CPO, the grid operator and contractor for review.

Step 3: Pre-check
In this phase multiple actors will check if it is possible to physically place a public charger at the proposed location along a set of formulated requirements and if any additional permits are needed. For example, the CPO will check if the new charger it not to close to an existing one, or near trees. The grid operator in turn will provide detailed drawings (called a 'grid check') of the current situation of underground cables and the contractor will assess if any additional measures will be necessary when installing the charger.

For example, providing extra protection to the charger or the need to remove any bushes of trees. When all actors agree with the proposed location the charger is ready to go to the next phase of the process. However, not all proposed locations will pass this check due to multiple reasons. For example, the charger can be placed but there will not be enough room to physically perform maintenance on afterwards. These proposed locations will be cancelled or put on hold until a solution has been found. It then depends on the municipality if another suitable location will be found or if the request is abandoned altogether.

Step 4a: Conceptual traffic ordinance
The next step in the process is the sole responsibility of the municipality. Due to the fact that the placement of a public charger involves a physical change in the current traffic situation, the municipality has the legal responsibility to compose a traffic ordinance (Wegenverkeerswet 1994). A traffic ordinance states what change will be made, where and how this will possibly affect the current traffic situation. The municipality is then legally obliged to present the traffic ordinance to local citizens by publishing it in the Staatscourant, so they are informed about these changes. In turn, this will give right to citizens to object to these changes. Legally a six week period after publication.
If the traffic ordinance is not met with any resistance, it will proceed to the next step. If there is protest from citizens, the municipality will look for consensus or, cancel the proposed location. In this case an alternative location will be found.

Step 4b: Request grid connection
When a proposed location has a conceptual traffic ordinance (so simultaneously during step 4a), the CPO will request a grid connection at the local grid operator. This connection is needed because the charger will be connected to the existing electricity network. The grid operator has a legal obligation to create this connection within 18 weeks from the day of the request.
As mentioned in step 4a, some proposed locations will be cancelled or put on hold during this step. In these instances, the connection requests will be withdrawn and any potential costs will be refunded to the CPO.

Step 5: Definitive traffic ordinance
During this step the traffic ordinance for the proposed location will be made definitive and thus official. This means that the public charger can be installed. The municipality will inform the CPO (and project organization if applicable) to plan a date for placement. Some municipalities will also provide a neighborhood message to inform local citizens that the proposed changes will be definitive.

Step 6 and 7: Request to contractor and planned
In this step the CPO will inform its contractor that a charger can be installed at the proposed location. The contractor will then set a date for installation. The CPO orders a charger and arranges a contract with the energy supplier. Next the CPO is responsible for the placement of the charger, connecting it to the grid and adding additional protection to the charger if needed. Additionally, the following actions are taken by the municipality in this step as well:

- Informing requestee on placement progress;
- Providing permits for digging at the selected site;
- Informing parking law enforces on the new state of the parking spots;
- Placement of road signs and potential road markings to specifically show the spots are reserved for electric cars only.

Step 8: Operational
The final step in the installation process is the physical installation of the charger. During this step the municipality is responsible for clearing the respective parking spaces in advance, so the operator is able to work without interruptions. For this step, municipalities can choose if they want to place the needed traffic signs themselves or if they pay the contractor to do this. When installed, the charger is immediately operational and can be used by owners of EVs.
Also, municipalities will be able to monitor charger usage from this step. This will provide them data that will justify the placement of potentially additional chargers. For example, the municipality of Alkmaar uses its own called ‘rule of 6’: When a charger has at least six unique users who use at least 600 kWh for a six month period at the same charger, an additional charger would be installed (Municipality of Alkmaar, 2019).

Step 9: Service and maintenance
The CPO is now the owner of the charger and is responsible for the service and maintenance.

3. Theory

This chapter elaborates on the theories for public charger placement and the variables that are of expected influence on the differences in lead time between municipalities. Furthermore, it explores the Multiple Streams Framework theory, which is used in this research to explain the existence or non-existence of these variables.

3.1. Former research on implementing public charging infrastructure

As stated before in the introduction, contemporary research on EVs has a focus on the price of EVs and the challenges to improve battery quality to achieve a larger action radius. Although research on the barriers for implementing public infrastructure is a niche topic, a couple of attempts have been made in recent years. Biresselioglu et al (2018) for instance, looked at barriers at EU level that led to the lack of (public) charging infastructure. Their research showed that costs, technical problems, lack of trust in environmental benefits by potential EV owners, information and knowlegde and a limited supply of electricity within the EU hampered the creation of a solid charging infrastructure. Unfortunaly, this research did not zoom in on a city level approach. Additionally, Lopez-Behar et al (2018) zoomed in on the lack of public charging infrstructure on a city level. They did so by exploring the barriers a city faces when implementing a such technology. Their research, which only focused on one city in Canada and only specific type of residential building, came up with the following barriers: (i) charging infrastructure installation, (ii) building limitations, (iii) governance issues and (iv) parking availability.
The findings from the researches described above, together with the working experience in the e-mobiliy sector will be used to find variables that are of influence on the lead time for charger implementation.

3.2. Literature gap

Literature review on implementing charging infrastructure showed that the topic is still in its academic infancy. There is only limited research into e-mobility governance and more specifically on the implementation of public chargers and its potential variables. In order to bridge this literature gap, expert interviews were held. These interviews resulted in additional variables which were expected to have an influence on the lead time for charger implementation. The methods and results from these experts interviews are further discussed in chapter 4 and 5 respectively.

3.3. Multiple Streams Framework

Besides aiming to find the variables responsible for the lead time differences, the second part of this research project was aimed at trying to explain the existence or nonexistence of these variables within municipalities. This meant looking at agenda setting within municipalities and how this agenda came about. A tool developed for this approach is the Multiple Streams Framework (MSF). The aim of MSF and the reasons for choosing this framework in this research are described below.

3.3.1. Overview of MSF

MSF is a tool developed by Kingdon (1995) to explain how policies are made by governments. It is inspired from organizational theory and seeks to provide insights into the dynamics of how policies are created. This means it looks at agenda setting, decision making and implementation of new policies. The framework consists of three streams going through the policy process: problems, policy and politics. Each of these streams has its own rules and dynamics, each behaving separate from the other. At certain moments in time the streams are coupled. These are called ‘policy windows’. The coupling of these streams is done by policy entrepreneurs, which can be either a person or a group of people vouching for their own interest to be made into policies. The coupling of the three streams into one policy window increases the chances that policymakers will implement a specific policy or government agenda, which is the output of the model (see figure 12).

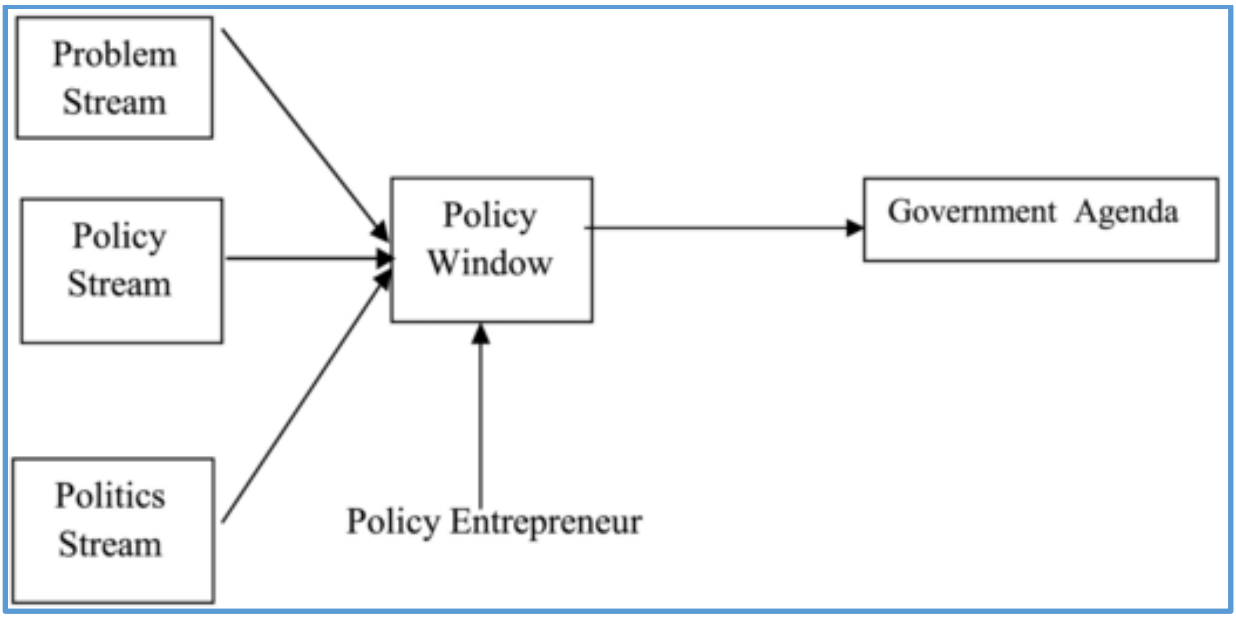


Figure 12: Multiple streams framework. *Three individual streams, problem, policy and politics are responsible for the creation of a new government agenda. When these streams are coupled by a policy entrepreneur during a moment in time (policy window), new governmental agendas can be created.*

Ambiguity
One important factor of MSF is its view in ambiguity in policy making. Ambiguity refers to ‘’a state of having many ways of thinking about the same circumstances or phenomena’’ (Feldman, 1989, p5). Due to the fact that these ways are not always reconcilable, they create confusion, stress and vagueness to those responsible for making policy decisions. Central in this view is the ‘garbage can model’ of choice (Cohen, March, Olsen 1972). In this metaphor, choice is seen as a garbage can into which stakeholders (like citizens, interest groups, businesses etc.) can dump their problems and solutions, hoping these get picked up by policymakers. No one is in control of this process and participation of actors fluctuate highly within it, showing the complex and chaotic nature of political life (Zahariadis, 2014). MSF thus is developed to explain policy creation in a more real world situation, instead of assumed conditions compared to other frameworks.

Time constraints
The problem created by ambiguity is that policymakers often do not know what the problem exactly is; it’s definition is changing constantly and is often made vague by those who put into the garbage can. The important process of distinguishing between relevant and irrelevant information causes problems for policymakers. In turn this can lead to false or misleading interpretations. So, choosing the right solution to a problem becomes less an exercise in solving actual problems and more an attempt to make sense of partially comprehensible descriptions of problems (Weick, 1995). Additionally, is it important for a policymaker to know who pays attention to what and when. Because policymakers are primarily concerned with using their time effectively rather than to manage tasks, it is reasonable that time is of a more important factor in policy making, than rationality (Zahariadis, 2014).

3.3.2. Assumptions in the model
Because no framework can represent reality in full, some assumptions are included. The following assumptions are part of the MSF.

Assumption 1: Individual attention or processing is serial, systematic attention or processing is parallel
Individuals can only attend to one problem at a time, meaning that the amount of issues actively handled by policymakers is limited (Zahariadis, 2014). This is also true for the policy entrepreneur, who can only have a few projects of self-interest active at a given time. This problem is often overcome by the division of labor in larger organizations by the creation of departments. For example at governments or municipalities This way more issues can be attended simultaneously (March and Simon 1958; Jones, 2001). This capacity is of course not unlimited, but this enables municipalities to deal with for instance e-mobility, unemployment and rising crime numbers at the same time.

Assumption 2: Policymakers operate under significant time constraints
It is quite common for policymakers to take decisions under significant time constraints and under pressure from the public. This does not mean that every decision is made within a time of crisis, but it does suggests that each problem has a sense of urgency in being addressed. Because multiple issues are in conflict for attention, policymakers need to act quickly when an opportunity presents itself (Zahariadis, 2014). Time constraint limits the range and number of potential alternatives for the problem that can be brought in by policy entrepreneurs as well.

Assumption 3: The streams flowing through the system are independent
Looking at the first assumption, implying that systems can do things in parallel, this means that each stream can be considered as having a way of its own. The problem stream includes the concerns from individuals from inside and outside of the policy system. The policy stream, or solutions for the problems, come from the small policy community working on policies on a daily basis, and the politics stream is referring to the broader political discourse in which the policy is made (it includes legislators, parties, the national mood on a topic etc.).

Manipulation of policymakers
Manipulation can be seen as the effort to manage ambiguity and is the main tool for policy entrepreneurs to create a policy window. Ambiguity entails many interpretations, so it is used by policy entrepreneurs to manipulate the policymakers to aim for the entrepreneurs' pet project. This logic of manipulation is what makes MSF different from other frameworks that use rationality and constructivism. Rationalists assume individuals are maximizing utility at every opportunity (Williamson, 1985). Constructivists see policymaking as a process in which different groups with different views try to convince the other group of their own argument (Majone, 1989). Despite having similarities, MSF differs from rationality and constructivism. For instance, MSF does not reject the concept of rationality, but aims to complement it. MSF believes that individuals sometimes behave rationally, but that the process of systematic decision making not always show rational components (Zahariadis, 2014). MSF distinguishes two groups of people: those who manipulate and those who are manipulated. Policy entrepreneurs are those who manipulate policymakers in making decisions in favor of their pet projects. Policymakers are under the effect of manipulation, because they are dealing with multiple problems at the same time. Rationalists believe that the best options are chosen under certain conditions, MSF believes that whether a solution is 'good enough' is determined by policymakers, not policy entrepreneurs (Zahariadis, 2014)

3.3.3. Problem Stream
The problem stream is made up out of multiple conditions which policymakers and citizens want addressed. For instance environmental problems, traffic jams, crime etc. Policymakers are being made aware of these conditions by indicators, focusing events and feedback (Zahariadis, 2014).
Indicators are used to assess the scope of the problem and amount of change that is needed to solve this. For example, the costs of a program, amount of traffic jams and crime rates. These indicators are either monitored on a regular basis or measured through special studies. However, not all conditions become problems. Kingdon states that problems contain a ''perceptual, interpretive element'' (1995, p110). Meaning they look like problems, while in reality they are not. Some conditions are made into problems and sequentially get more attention than others (Rochefort and Cobb 1994).
Focusing events are another way at which a problematic conditions can get attention (Birkland 1997). Focusing events are sudden occasions at which the evaluation of some conditions get questioned, often by media attention or policy entrepreneurs (Jones 1994). For instance a heavy traffic accident which could be related to the wrong placement of traffic signs, raising the question if the municipality has acted in the right way when designing the road.
Feedback from other programs can be found in the problem stream as well. It implies which measures work well and which do not. This input can be used to create solutions for contemporary problems.
Problem load, meaning the number of problems aiming for attention for policymakers at a given time, has a negative effect on information usage by policymakers and a strong effect to predict which issue is going to be placed on the political agenda (Zahariadis 2003). Problem load is most often relevant in times of crises, when many difficult issues are on the policymaker agenda. When facing an problem overload, policymakers tend to focus on the problems they can actually solve, rather than those that should be solved (Hood 2011).

3.3.4. Policy Stream
The policy stream is made up out of numerous ideas which compete to win acceptance in policy networks (this is also called the ''primeval soup of ideas'' by Kingdon, 1995). These ideas come from

policy specialists, such as bureaucrats, staff members, academics and researchers who all act in their own policy community. A policy community has a shared view on a certain topic, for instance health care or environmental issues. In the policy stream, these ideas are assessed in multiple ways, such as hearings, papers and conversations. Some ideas pass through these initial tests, some get changed afterwards and others disappear from the policy stream. While a large amount of ideas tend to float around in the policy stream at the same time, only a few tend to get attention. This is because of the technical feasibility of the idea, the value acceptability and the amount of resources that ae needed to execute the idea (Zahariadis, 2014). Ideas that seem too difficult to implement have less change to survive this process. Alternatives who do not conform to existing norms or values of policymakers are also less likely destined to be adopted. Also, proposals which involve high costs have a higher rate of failure.

3.3.5. Politics Stream

The politics stream includes three elements: the national mood, pressure group campaigns and administrative or legislative turnover.
The national mood refers to the general opinion of a majority of the population on a topic. This mood tends to swing back and forth over time. Policymakers can see this change through monitoring instruments such as opinion polls and can act on these polls to promote certain topic to the political agenda.
Additionally, policymakers often look at the stance of interest groups on certain topics. If an interest group is supporting a topic of the policymaker, the latter will make sure that this topic will be on the political agenda as soon as possible. When an interest group is voicing its concerns on a topic, policymakers often create the sense that the interest group is in support of the opposition and that this is unfair to the existing political balance, basically counter manipulating the policy entrepreneurs. This would cause the idea to have a greater chance of falling into obscurity.
Lastly, legislative turnover can also have a significant effect. An influx of new administrators which have a contrasting view compared to the previous legislators, can cause for existing policies to be abandoned and new ones to be implemented in a short period of time. Of the three components in the politics stream, the national mood and legislative turnover tend to have the most powerful effect of agenda setting (Zahariadis, 2014).

3.3.6. Policy Window

Choices in the framework are made when the problem, policy and politics streams are coupled together. Kingdon named these ‘policy windows’ and describes them as ‘’opportunities for advocates of proposals to push their pet solutions, or to push attention to their special problems’’ (Kingdon 1995, p165). Policy windows are the circumstances in which a policy is being made. They can even act as a catalyst for the creation of new policies that are irrelevant for the problem which policymakers are dealing with, for instance the policy reactions after the terrorist attack of September 11th 2001 (Birkland, 2004). This happens when policy entrepreneurs use the wrong window to push their own projects (Avery, 2004).
A policy window is opened by problems which create national attention or in the politics stream when political events, such as legislative turnover, occur.
MSF theory states that policy windows are of short duration and unpredictable, while Sharp (1994) and Howlett (1998) believe that these windows can last for years if the right problem occurs, or be as predictable as annual budget allocations. Copeland and James (2014) even believe that multiple policy windows can overlap. Additionally, research done by Pot et al. (2018) on Dutch municipalities making forward looking decisions (meaning a decision by policymakers that goes beyond their elected term of 4 to 8 years). showed that for a policy to be implemented successfully, not all three streams have to be combined into a policy window.

3.3.7. Policy entrepreneur

The policy entrepreneur is the actor who tries to couple the streams into a policy window. This can be individuals, but in reality this is most often done by particular organizations (Zahariadis, 2014). If a policy window opens, policy entrepreneurs should take their chances immediately, before the possibility is lost and the window is closed. This requires entrepreneurs to be persistent, but also to have skills that enables them to couple the streams together. An entrepreneur should be able to connect existing problems to their solutions and to find politicians who are open to their idea. Additionally, they can use manipulation strategies towards policymakers in order to couple the streams together. The changes for a policy being adopted are greatly enhanced when the three streams, problems, policies and politics, are coupled into one.

3.3.8. Decision making process according to MSF

Attention

Because policymakers cannot pay attention to all problems they are confronted with, they need to divide their attention. This limits policymakers in creating solutions for all problems they are confronted with. MSF states that this limitation can be overcome through institutional structure, the type of policy window that opens and the symbols used to attract the attention of policymakers (Zahariadis, 2014). Policy entrepreneurs have a crucial role in getting attention from policymakers and manipulating them to their advantage.

Institutional structure has a strong effect on attention. Policymakers at top levels are often overwhelmed by the amount of problems they need to address. Institutions are designed to ease this overload. The institutional system has policy communities and subsystems in place who act as filters. These subsystems take on the problems and make them manageable for the policymakers at the top levels, meaning institutional structure acts as a first step in sorting out available solutions.

The arguments for policymakers to choose for a certain problem depends on the opportunities they have to choose these problems. Choice is often a consequence of a problem-solution sequence. MSF states that opportunities ration attention. When a problems opens in the problem stream, the process will be consequential: solutions will be developed in response to a problem. If a policy window opens in the politics stream, the sequence in different: policymakers focus on solutions first before any problems are defined. This means the process is ideological based. In this case it is more important for the policy to be adopted than a problem to be solved (Zahariadis, 2003).

Lastly, attention to a problem by policymakers is also decided by the symbols policy entrepreneurs use to attract them. Policy entrepreneurs are more successful in coupling the problem, policy and politics streams when they use well known symbols for their pet projects. By using these symbols, policy entrepreneurs reach more people, can get a stronger emotional reaction from these people and spend less time explaining their pet projects, because the symbol explains this already.

Search

The process of searching for solutions is linked to the concept of slack (Cyert and March, 1963). Meaning organizations put aside extra time and resources in the search for new ideas. Aim of this strategy is to anticipate rather than to predetermine the next change in rapidly changing environments. The same goes for policy creation. Governmental institutions have a range of instruments which they can decompose and reconstruct in order to attend the problems at hand. For example, governmental programs which stay idle for a certain time for ideological reasons, before emerging again when the stance is relevant again. This slack provides governments with a batch of solutions which can be used at any time.

Next, search is influenced by the way the policy networks are constructed. The time for an idea to stay in the policy stream varies from limited to constant. Also, the content of the problem in the stream can range from new to an minor extension of the old. This means there can be four types of problems in existence: (i) quick emergence of new ideas, also called ‘quantum’, (ii) gradual incoming problems, also called ‘emergent’, (iii) quick emergence of old ideas, also called ‘convergent’ and (iv) slow emergence of old ideas or additions to old ideas, also called ‘gradualists’ (Durant and Diehl, 1989). Less integration policy networks tend to support quantum and gradualist ideas while more integrated policy networks are more likely to go for emergent and convergent ideas.

Selection

Problem selection by policymakers is biased by the efforts of the policy entrepreneur who coupled the three streams into a policy window. A successful tactic by policy entrepreneurs for their projects to be selected are the symbols they use, but also how the frame their projects. Research from Elder and Cobb (1983) showed that problems who are presented as a loss from the current policy status quo are more likely to be adopted, than those that maintain the status quo.

In summary: the reasons for policymakers to adopt certain policies and not others depends on the policy window that opens up, the persistence of the policy entrepreneur which is in constant search for solutions to problems by coupling the problems, politics and policies streams. An implementation of a new policy is more likely when all three of the streams are coupled during the right policy window that is open and the skills of the policy entrepreneur to affect the attention of the policymaker to choose their own pet project.

3.3.9. Role of MSF in this research

This research aims to provide explanations on why certain variables exists within a municipality and why others are not. MSF will be used to analyse the current e-mobility policy for a number of Dutch municipalities. This analysis will consists of the following parts per case study: (i) giving a description of the problem, politics and policy stream, (ii) providing a description of any potential policy entrepreneurs, (iii) check if any coupling of streams resulted in a policy window, (iv) see if this policy window let to a new or change in the policy for e-mobility and (v) which variables are included or not in this new or changed policy and why these were present or not.

4. Methods

This chapter addresses the methodology used to conduct this research. It starts with describing the sample selection and the argumentation for this selection. Next, the activities done and argumentation for the steps provides in the research framework (see figure 4) are described are explained. Additionally, this chapter explains the variables that resulted from the literature study and expert interviews and explains how these variables are operationalized.

4.1. Sample selection

The data for the lead time analysis comes from municipalities participating in the Metropolitan Region Amsterdam- Electric (MRA-e) project. This project is a collaboration between municipalities (*N*=80) in the provinces of North Holland, Flevoland and Utrecht (see figure 13).

Figure 13: Overview of the MRA-e project in the Netherlands. *The project entails a collaboration between 80 municipalities in the provinces of North Holland, Flevoland and Utrecht. The two major cities in the region, Amsterdam and Utrecht, have their own e-mobility programs but they coordinate their activities through the MRA-e project. (MRA-e, 2019)*

The eponymous MRA-e organization facilitates participating municipalities with a workflow for installing chargers. The project was set up to achieve efficiency in the roll out of public charging infrastructure by upscaling. PitPoint is the designated CPO for a majority of the municipalities and in this role maintains data on charger placement. This meant that detailed data from the frontrunning Dutch municipalities on e-mobility (as seen figure 2a and 2b) was available for this research.

4.2. Data analysis BIS

The initiative for this thesis came from working experience with the database used by PitPoint. This database contains inputs like charger numbers, charger location, municipality in which the charger is placed and in which step of the implementation process the charger is currently in. The expectation was that, even while the municipalities in the sample selection work along a homogenous workflow by the MRA-e project, the lead time per municipality differed strongly. By creating an overview per municipality and the respective lead time per charger, an average lead time per charger per municipality was found. This overview is represented in Table 5 in chapter 5.

Data for this table was derived from BIS, a database software used by PitPoint to track the progress of individual chargers in the implementation process. For the creation of table 5, data from BIS was exported into an Excel file for easier data processing. Data analysis started on December 1st 2018. For this overview data between dates January 1st 2017 and 30th November 2018 were used. Chargers that started their process before January 1st 2017 were removed, as were chargers that were not finalized on November 30th 2018. This made sure the dataset only contained chargers that went through the entire implementation process in the evaluated time period. Additionally, chargers that were removed or replaced from their designated location within the given timeframe were also excluded from the analysis, as these were different from the standard implementation process and in general have long lead times, skewing the results of actual placement. In total, data from 883 chargers was used to create an overview of lead time per charger per municipality. Then the average lead times were calculated by dividing the total lead time in days by the amount of implemented chargers in the given timeframe.

4.3. Literature study

After the lead time data analysis, a literature study was started. Aim of this study was (i) to explore the implementation process for public chargers, (ii) the different approaches municipalities have for charger placement, (iii) variables that are expecting to have influence of lead time and (iv) to find governance theory along which the existence of the found variables could be explained (MSF). This, combined with working experience in the field of charger placement, led to a list of provisional variables that were expected to be of influence on the lead time per municipality. Academic literature was found on Scopus through the Utrecht University Library, but the topic of public charger infrastructure proved to be in its infancy. Additionally, grey literature like national and municipal policy documents on electric mobility were used.

4.4. Expert interviews

Because of the lack of academic literature to verify the found variables, expert interviews were held to bridge this gap. These experts were chosen because of their experience in charger placement, working in or with municipalities and with writing policies for e-mobility at interest groups or CPO's. Aim of the interviews was to verify the found variables in the literature and when possible to extend on these based the results of the research. The experts were directly contacted by the researcher, through employees of PitPoint and by experts themselves who were suggesting other experts. The expert interviews were conducted along a semi-structured interview plan (Bryman, 2012). Respondents were asked if they allowed for the interview to be recorded and if the name of their organization could be mentioned in the final report. Names of the experts are not mentioned because of privacy reasons. Each respondent was given a fixed set of questions for each variable from a topic list to provide their insight, but no particular order was given to these and the respondents had a lot of room to provide additional input on the variables and to expand beyond that. A total of four experts were interviewed from the following organizations: Stichting ElaadNL , Municipality of The Hague, Nederlands Kennisinstituut voor Laadinfrastructuur (NKL) and PitPoint. The interviews were held in the period between January 10th and February 15th 2019 (see appendix A, table 24 for more information). The interviews were transcribed using NVivo and coded along the found variables.

The interviews provided insights in the importance of some of the found variables. The quotes below provide an impression of the insights gained:

Stichting ElaadNL: ''In the Netherlands, there are two strategies for rolling out electric charging infrastructure: Demand driven, in which an e-rider request a charger at the municipality and strategic placement, in which the municipality places a charger at a public place such as a train station, museum or shopping center. I do expect that the process as it is now, thus by request, is not suitable for the long term. Municipalities should shift their focus towards strategic placement.''

Stichting ElaadNL: ''The introduction of plug-in hybrids in the Netherlands was a catalyst for the creation of public charging infrastructure. The sudden, and high amount of requests for chargers by citizens made Dutch municipalities realize that electric driving was going to be a permanent fixture in their day-to-day policy and that plans had to be made. Unfortunately there is a large discrepancy between municipalities right now, some are improvising every time and others are thinking about the whole picture''

Stichting ElaadNL: ''From the cases I have seen, the political support and the goal a municipality strives for, are the things that set a process in motion. Without these two a municipality will always lack behind.''

Municipality of The Hague: ''We [the e-mobility department of The Hague] operate under the radar of own local council. This makes us very effective, because no one pays attention to us. However, this makes us also a bit vulnerable because if you're not on the political agenda it is harder to get funding. However, I do think that the political support we had in the beginning is a major part of our success today.''

Municipality of The Hague: ''In my experience, the most important variables for lead time are the individual working on e-mobility and the influence this person has on the politics. Also, the political support from a municipal board makes all the difference. If a board dares to go for it, you will see results almost immediately.''

Municipality of The Hague:'' We prevent ownership by the person requesting the charger, by not informing them when the charger will be placed. We just place them, without looking at parking space availability or parking pressure. The one place we 'lose'[by placing a charger with two sockets] will get filled up by another EV soon anyway. Maybe this is just something that works in the big city, but at least this approach works for us.''

Municipality of The Hague: ''Also, we are dealing with the issue of legal obstacles in our own way. Basically, we do not have any legal issues with chargers, because they have the same legal status as a waste bin or a park bench. Citizens cannot protest on the placement of these objects. We noticed that citizens don't really mind a charger in their street as well, so we barely get any complaints. Last year we had to reposition two chargers, out of the 250 that we placed that year.''

NKL: ''Municipalities still consider electric mobility as a project with an end date and not as a structural process within their organization, but they are obliged to have an e-mobility policy by the end of next year. This means they need to think about embedding this topic into their day to day practice.''

NKL: ''The current policies for electric mobility are depending on the knowledge that is available within the municipality. For instance, knowledge on the placement of the charger is not hard to obtain and is also not that hard to grasp, but as soon as the traffic ordinance comes into play, municipalities tend to freak out. They exaggerate the impact of the legal process on the total implementation process, while making a traffic ordinance for a charger, or for an entire neighborhood for that matter, should be a standardized process.''

PitPoint: ''We often see that municipalities have the tendency to heavily weigh parking pressure into their decision making. I have seen a lot of good proposed charger locations being declined because the municipality thought that the chargers would cause disturbance in the neighborhood. I believe municipalities sometimes listen too much to the complaining minority and waste excellent charger locations because of it.''

PitPoint: ''From my experience, the effectiveness of a municipality heavily depends on the person working on electric mobility. Some municipalities have personnel that is knowledgeable and motivated to make e-mobility work. For others, placing chargers is just something they have to do along a ton of other projects, meaning e-mobility does not always get the attention it needs.''

The expert interviews confirmed that the previously found variables were potentially of influence on the lead time for charger placement. The interviews resulted in the addition of two other variables: Parking pressure and political support. The experts believed that parking pressure until now has been too much incorporated in the decision making process of municipalities and that objections from citizens were too often honored, resulting in longer lead times. Also, they believe that the political support by a municipal board can be seen as a precondition for a successful EV policy, which includes a short lead time. Concludingly, they believe that these variables cannot be considered separately from each other and they are closely connected, sometimes even depending on each other.

Variables
The results from the expert interviews, combined with outcomes of the literature study resulted in nine variables that were found to have an expected influence on the lead time for charger implementation (see table 2).

Table 2: Found variables used in this research

Variable	Motivation for choosing this variable
E-mobility goal	Literature research showed that municipalities with a clear EV policy and complementing e-mobility goal have more EVs, indicating a potential relationship between the policy and lead time of charger placement. Additionally, some experts stated that an e-mobility goal is a nessecity for a succesful policy.
Legal process	The traffic ordinance, permits and objections from citizens are part of the legal process for charger placement. Some are bound to fixed legal timeframes wich slow down the process. Working experience showed that different workarounds to this exists in order to try and shorten lead time, hence the choice for this variable.
Manpower	General expectation will be that more manpower can have a positive effect on lead time because mutiple processes can be done simoultaneously, as stated in MSF theory.
Decision making process	Working experience showed that the number of decisions/ departments a charger request will have to go through by the respective municipality can cause differences in lead time.
Available funds	Literature showed that costs can be a delaying factor in charger placement. Additionally, working experience showed that the available funds per municipality differ. This can have influence on the lead time.
Knowledge	Research showed that a lack of knowledge could be delaying factor in charger placement. Additionally, working experience showed that the level of knowledge differs per municipality. Indicating that this variable can be of influence on the lead time.
Projection data	Working experience showed that municipalities who use projection data have a different approaches towards e-mobility. Projection data entails the collection of several parameters such as zipcode, income, familly composition, building size and distance traveled by commuters for specific areas within a municipaltity (often on neighbourhood level). This is than plotted onto a map which shows the predicted amount of new EVs per area (see appendix D, figure 25). Municipalities can use this map for location selection for new chargers. This type of data is available from consultancy firms and is also known as the 'planning map' approach. Variable chosen to see if the usage of this data is of influence of the lead time.
Parking pressure	Chargers take up existing parking space. Municipality can choose to include this in their argument to place a charger. Working experience and expert interviews showed that municipalities have different views on this.
Political support	The exisitence of an electric mobility policy is often a wish or decision made by the municipal board. Experts believe this variable is an important step in having a succesful e-mobility policy.

Variables were derived from literature study, working experience and verifying interviews with experts. The expert interviews added two variables: parking pressure and political support.

Operationalization of variables
Table 3 shows which indicators were used to measure the variables used in this research.

Table 3: Operationalization of variables

Dependent variable	Indicator
Lead time	- Short: <180 days Medium: 181-364 days Long: >365 days

Independents variables	Indicators
E-mobility goal	- Yes or no - Internal goal or external goal - Content of the goal
Legal process	- Way of municipality in dealing with traffic ordinance and objections
Manpower	- Amount of FTE within the municipality responsible for charger placement
Decision making process	- Place of the process within the municipal organization - Amount of people involved in decision making process
Available funds	- Available budget to place chargers in Euro's - Sufficient, neutral, insufficient (according to municipality)
Knowledge	- Amount of experience from personnel in placing chargers (months/ years). Sufficient: >24 months; Neutral: 13-24 months; Insufficient: <12 months. - Type of sources used for knowledge input
Projection data	- Using data yes or no - Using data to create planning map yes or no
Parking pressure	- Included or not included in decision making process
Political support	- Yes or no

For each variable the indicators are given that are used to measure the variable.

Figure 14 shows the conceptual framework of this research. It shows the relationship of the found variables compared to the found lead time. The variables are the instruments available to municipalties in order to place public chargers. This research seeks to find which of these variables are of most influence and why these variables exist at municipalities or not.

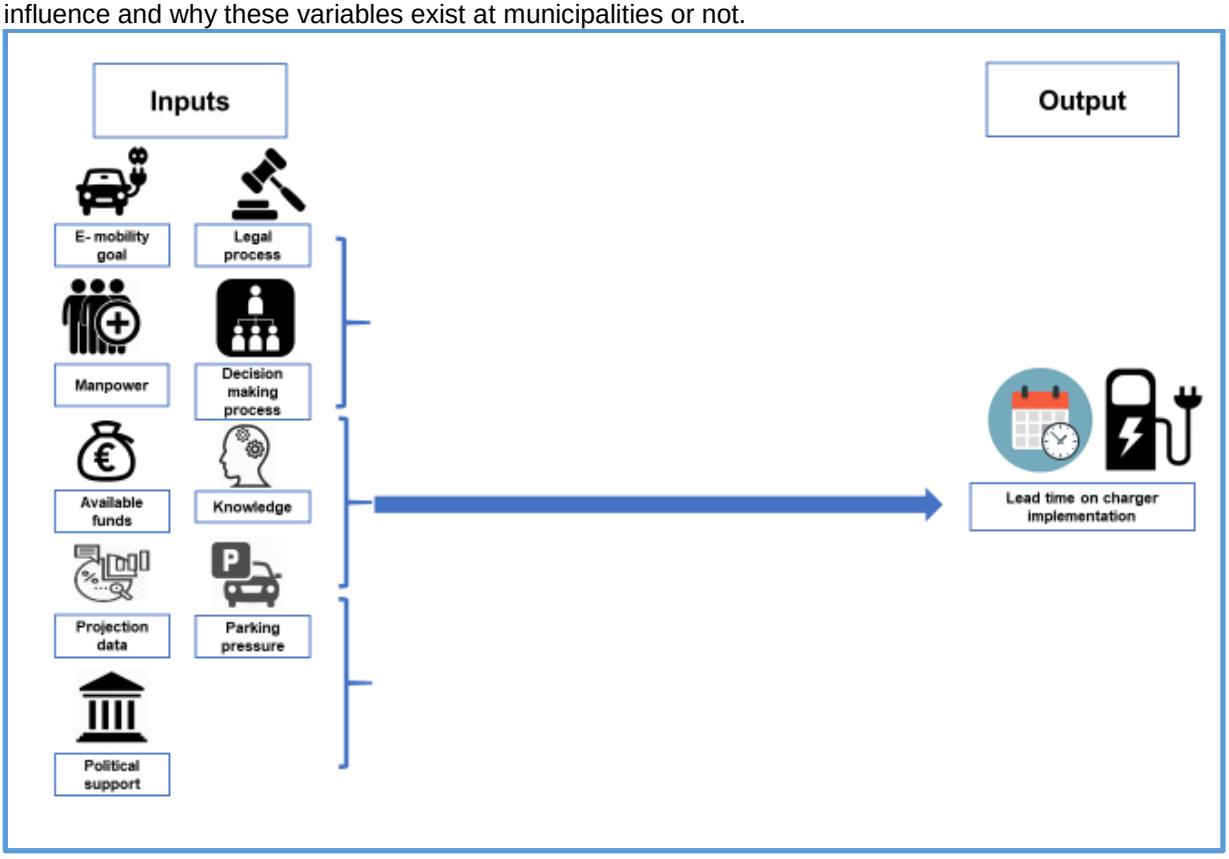


Figure 14: Conceptual framework.

4.5. Survey

Following the literature study and verifying expert interviews on the variables, a survey for MRA-e municipalities was set up. Aim of this survey was to collect data for each of the found variables from

participating municipalities to see if these variables influence the lead time for charger placement. Additionally, the results of the survey were used to select case studies to explore this influence in depth in a later stage of the research. The survey was conducted through Microsoft Forms, an online tool to create surveys. This tool was chosen because of the integration within the Microsoft office package making it easy to use for respondents, the possibility to easily export results into Excel and because no costs were involved for using this program. Contact information for each municipality was readily available from the BIS database and respondents were contacted through this information. Respondents were send a link to the survey, along with a guiding e-mail explaining the survey and its place in this research. Respondents were asked to provide the name of the municipality they represented, so case studies could be selected in further steps. Besides this, respondents were not asked any questions involving personal information. Respondents were given the opportunity to provide additional information on their answers or to ask questions to the researcher (in the end four participants had questions, which were answered within 24 hours). The survey results were only visible for the researcher and not by respondents or PitPoint, This to make sure the research stayed independent.
The chosen population for the survey were the participating municipalities in the MRA-e project (*N*=80). This means the results from the survey are representative for the MRA-e population, but because this group is more advanced with e-mobility (see figure 2a and 2b), their lessons learned can be used to formulate recommendations to other municipalities outside the MRA-e region.
The survey was answered by 30 municipalities (although this counts for 27 observations because the BUCH organization comprises four municipalities; Bergen, Uitgeest, Castricum and Heiloo) between January 22nd and February 28th 2019. The results from the survey are shown in chapter 5. The survey questionnaire is added in appendix B.

4.6. Case study

4.6.1. Case study selection

Based on the found lead times from the data analysis and the results from the survey, eight municipalities were selected for case studies in the next step of the research. Selection criteria were the number of chargers placed within the timeframe of January 1st 2017 and 30th November 2018. This number was set at a minimum of ten chargers. This number was set to ensure that the implementation process was completed multiple times by a municipality, meaning it has at least basic experience in charger placement. Additionally, this number caused for extreme results from the data analysis to be excluded, such as municipalities with only one charger and very short or very long lead times. Next, the found lead time was a criteria as well, so municipalities with a long lead time (longer than 365 days), medium lead time (between 181 and 364 days) and short lead time (less than 180 days) were selected. Furthermore, municipalities with a similar amount of chargers but with a strong difference in lead time were selected. For example, municipalities who had 60 to 70 chargers placed within the time period, but with very different lead times. Also results from the survey were used for case study selection. These included: the budget for charger placement and e-mobility ambition. Another criteria were municipalities who were are not taking part in the MRA-e project, but are within the same geographical area. In the end the following municipalities, in no particular order, were chosen (see table 4).

Table 4: Selected case studies

Municipality	Argument
Haarlem	Long lead time, high number of chargers, high amount of funding available
Houten	Short lead time, average number of chargers, elaborate EV policy
BUCH organization	Long lead time, low number of chargers, no policy, limited budget
Nieuwegein	Short lead time, average number of chargers. Not using MRA-e approach.
Almere	Average lead time, high number of chargers, no EV policy
Alkmaar	Long lead time, high number of chargers
Zeist	Long lead time, high number of chargers, no EV policy
Utrecht	Member of the G4 cities, not using MRA-e approach
The Hague	Short lead time, high number of chargers, no e-mobility goal, not using MRA-e approach (based on result from expert interview).

Municipalities were selected based on their lead time, number of chargers and results from the survey (budget, ambition, available policy documents).

The selected municipalities were contacted through the known e-mail address used during the survey and asked if they wanted to participate as a case study. Six of these municipalities agreed to participate,

two municipalities elected not to take part in the research. Additionally, the expert interview with the representative of the municipality of The Hague, provided sufficient input to consider this a case study as well. This led to a total of seven case studies for this research.

In the next step of the research an interview list for the case studies was developed. The questions on this list were based on the nine variables, the results from the literature study on MSF and when possible on policy documents from the municipality that were studied beforehand. Like the expert interviews, the case study interviews were conducted following a semi-structured interview strategy where each question per variable was asked, but without a fixed order and with room for the respondent to elaborate on the specifics of their municipality (see appendix C for the interview list used at the case studies).

The case studies were performed in the period between April 5th and May 6th 2019 and were all done at the respective municipal halls of the different case studies (see appendix A, table 25 for more information). Respondents were asked if they allowed for the interview to be recorded and if the name of their organization could be mentioned in the final report. Names of the experts are not mentioned because of privacy reasons. The interviews were transcribed using NVivo and coded along the found variables and MSF theory.

4.6.2. Data analysis

First, the case study interviews were analyzed using NVivo and the influence of each variable was evaluated. Per case study each variables was given a score of 'helping', 'hindering' or 'neutral' based on the information given by the interviewees, the results from the survey and the experience of the researcher on the topic. When possible, quotes from the interviews were provided to show why a certain score was given (see appendix E, table 26). Second, for each variable the impact on the found lead time is given. The approaches mentioned by the municipalities to shorten the lead time are ranked (i)short, (ii)medium or (iii) long lead time along the indicator given in table 3. When possible the observations from the survey were included. Third, each case study was described along the MSF theory. The problem, politics and policy streams were described, as well as potential policy windows and policy entrepreneurs and if any coupling of the streams occurred. Fourth, for each study the existence or non-existence of the variables was explained by analyzing the reasons that were behind the approaches the different municipalities took in attempt to reduce lead time on charger placement.

5. Results

This chapter shows the results from this research. It starts with the found lead times resulting from the data analysis in the BIS database, followed by the most important results from the survey. Hereafter, the results of the case studies are addressed. First, these start with an overview of the variables which municipalities experience as helping, hindering or neutral in their charger placement process. Second, the impact on the lead time of the approaches used by the municipalities are explored. Third, the existence of the current e-mobility policy for each municipality are described along the MSF theory and lastly, the existence or non-existence of the variables are given for each case study.

5.1. Average lead time per municipality

Table 5: Average lead time in days for a number of participating municipalities in the MRA-e project

Municipality	Number of chargers	Avg. Leadtime per charger (days)
Akersloot	1	135,00
Houten	74	164,55
Amstelveen	3	189,33
Soest	12	190,08
Amerongen	2	230,50
Bussum	25	246,84
Lelystad	23	297,57
Hilversum	50	300,26
Almere	126	320,24
Enkhuizen	11	352,73
Purmerend	24	353,00
Naarden	18	371,61
IJsselstein	14	384,21
Castricum	18	388,78
IJmuiden	10	405,70
Schagen	14	406,93
Krommenie	16	415,00
Zeist	41	420,15
De Bilt	10	421,70
Huizen	19	429,47
Utrecht	13	437,85
Heerhugowaard	29	440,00
Hoorn	20	455,65
Leusden	11	456,55
Baarn	7	468,14
Avenhorn	1	470,00
Alkmaar	67	478,61
Andijk	1	479,00
Assendelft	14	489,57
Haarlem	66	494,03
Zaandam	53	494,94
Beverwijk	15	533,93

Badhoevedorp	10	543,20
Hoofddorp	32	550,25
Nieuw-Vennep	13	559,54
Bilthoven	12	576,58
Broek op Langedijk	5	576,80
Aerdenhout	2	657,00
Ankeveen	1	674,00

Lead time for a charger is from the day of the formal request from an EV owner till the day the charger becomes operational for the EV owner and the general public. Data from the period of January 1st 2017 until 30th November 2018 (source: PitPoint, 2018).

Results from the data analysis show that a discrepancy in the lead time for charger placement between the participating MRA-e municipalities exists (see table 5). This varies from 135 days for the shortest lead time to 674 for the longest lead time, although these are figures for municipalities with only one charger. When the criteria used to select the case studies are taken into account (minimum of ten chargers), this gives a difference between 164 days for the shortest lead time and 576 days for the longest lead time, thus still showing large differences in lead time between municipalities.

5.2. Survey results

As stated in section 4.7. the results of the survey provided input for the selection of the case studies. The results of the survey are described below.

FTE per municipality

Figure 15 shows the amount of Full Time Equivalent (FTE) for the 27 municipalities who responded to the survey. It shows that 20 municipalities have less than 1 FTE available for the topic of e-mobility. Meaning in practice, that the personnel responsible for e-mobility are working on other projects besides e-mobility. In a few cases the available amount of FTE is even less than 0.1. Implicating that at these municipalities e-mobility only gets limited attention.

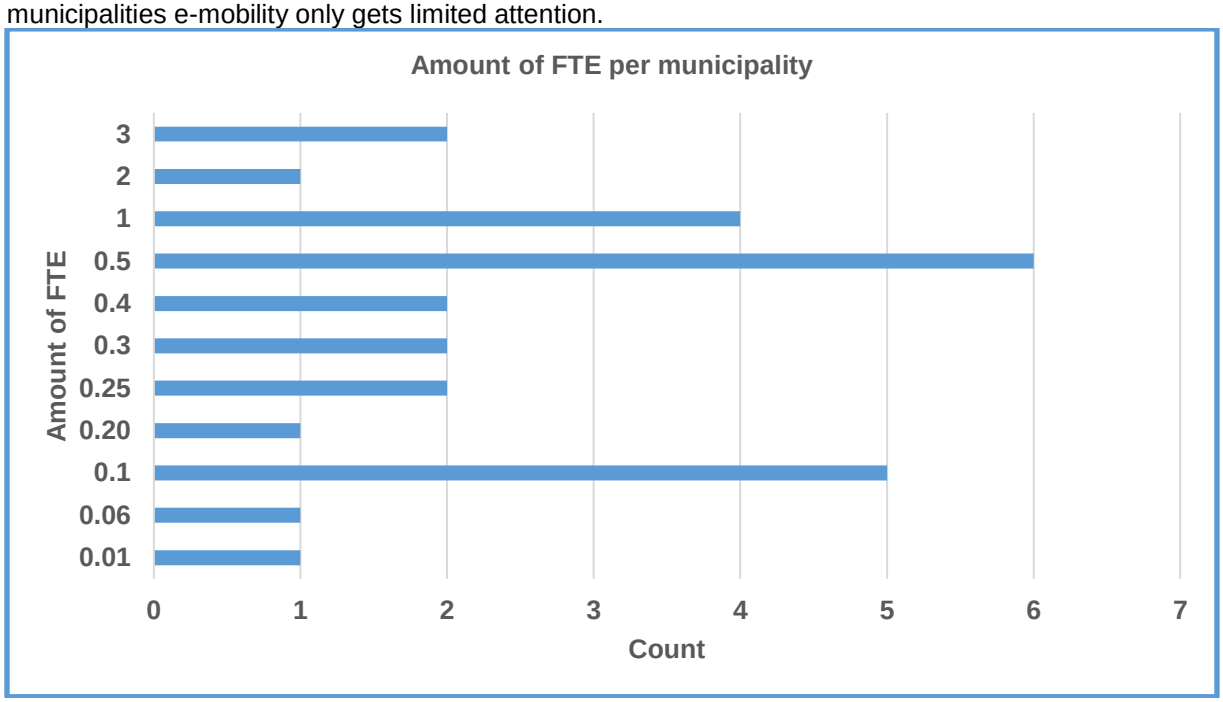


Figure 15: Amount of FTE available for e-mobility per municipality. *Vertical axes states the amount of FTE, horizontal axis states the number of observations from the survey.*

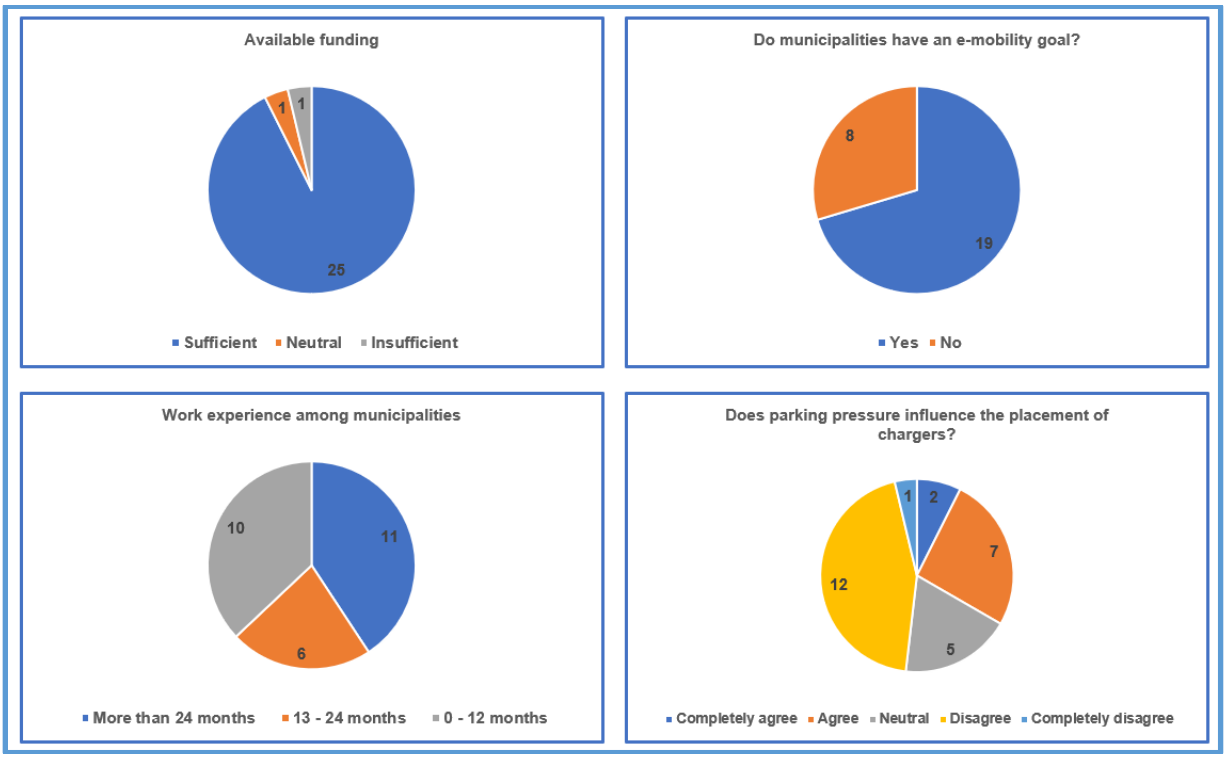


Figure 16: (i) Available funding, (ii) use of mobility goal, (iii) working experience and (iv) using parking pressure in decision making.

Available funding
The pie chart on the top left in figure 16 shows whether municipalities think they have sufficient budget to place public chargers. The majority, 25, believes they have. With one municipality which scores neutral and one respondent stating the budget is currently insufficient. Exact budget figures are not given because of potential sensitivity.

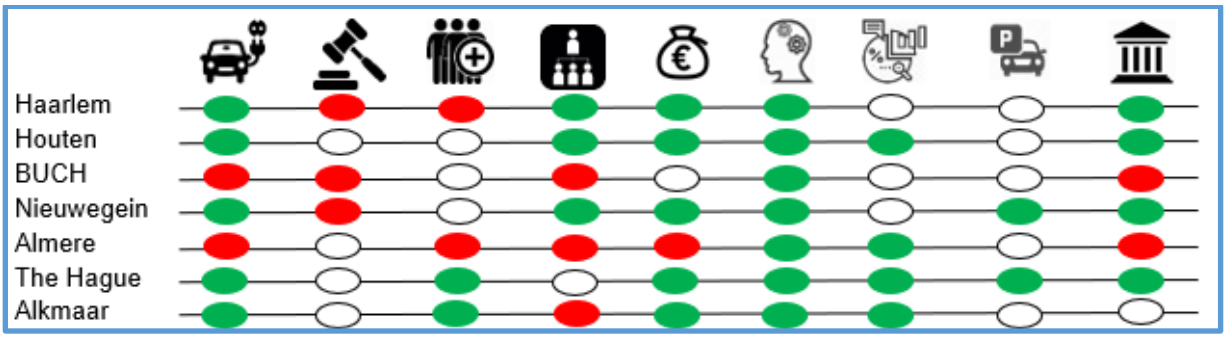
Mobility goal
The pie chart on the top right in Figure 16 shows that over two third of the responding municipalities have an e-mobility. This can either be a goal which is communicated externally, or only used internally within the municipal organization. Eight municipalities stated they have no goal, or are thinking about formulating a goal.

Work experience
The pie chart on the bottom left in figure 16 reflects the amount of experience municipalities have with placing public chargers. The chart shows that the amount of experience differ greatly between municipalities. Indicating the motivation for municipalities to pursue electric charging infrastructure.

Parking pressure
The pie chart on the bottom right in figure 16 presents the degree to which municipalities incorporate parking pressure into their decision for charger placement. It is clear that a majority does not consider this variable, while a third (the categories ‘completely agree’ and ‘agree’) does.

5.3. Results per case study and per variable

Figure 17 shows the results per case study and per variable. Per municipality (vertical axis) each variable (horizontal axis) is given a colored code: green, white or red indicating if a variable is helping, neutral or hindering according to the municipalities.



Legend:

	Helping
	Neutral
	Hindering

Figure 17: Overview of the hindering, helping or neutral variables for municipalities in their implementation process of public chargers. *In appendix E an detailed version of this figure is given. Per variable a short description or quote is provided to explain why a certain score is given.*

First, only the BUCH organization and Almere say they are hindered by the fact that their organization does not have an e-mobility goal. The rest states it helps them, even it is an internal goal only. Second, the variable hindering the process the most among all case studies is the legal process. Neither case study municipality states that this process helps them to achieve a shorter lead time, mainly because fixed legal time frames are included. Third, manpower is a variable with a negative influence as well. Only The Hague and Alkmaar state they have enough manpower available. Fourth, the influence of the decision making process between the case studies is mixed. BUCH, Almere and Alkmaar say this is hindering them, while for Haarlem, Houten and Nieuwegein the decision making process is short and helps these municipalities. The Hague is the only municipality that experiences its decision making process as neutral for the lead time. Fifth, the available funding for charger implementation is not an issue for the majority of the case studies. Only Almere experiences a lack of funding and BUCH states they have the minimum budget required, but nothing more. Sixth, knowledge on charger implementation is at sufficient level for all municipalities. Knowledge on the topic is readily available at multiple sources and easy to grasp. None of the municipalities experiences an increase in lead time because of their level of knowledge. Seventh, the usage of projection data for new EVs is mixed. Houten, The Hague, Alkmaar and Almere all use this type of data, but the effects vary. Houten and The Hague use the data pro-actively to search for new charger locations, while Alkmaar uses the data to place additional charger right next to existing ones based on usage data. Almere currently uses the data to try and convince the municipal board to take a more proactive stance on e-mobility. Municipalities not opting to use this kind of data believe they feel they do not need to, or because they do not have the resources to get this information. Eight, parking pressure is seldomly included in the decision making for charger placement at the case study municipalities. The general stance on parking pressure is that municipalities know this sometimes exists, but choose to promote e-mobility above parking space availability. In the rare instances this is included, the common approach is to place a charger with just one socket. Lastly, four municipalities state they have political support from their municipal board and thus helping them in rolling out the public charger infrastructure. BUCH and Almere, however miss this support and believe this hindering their lead time on charger placement. Additionally, the lack of political support at these two case studies result is more hindering variables compared to other case study municipalities.

5.4. Combined results per variable – and their effect on the found lead times

The section below analyses the results for each variable for all case studies. Different approaches per municipality for the same variable are compared to the found lead time, indicating if a certain approach is of influence on the lead time. When possible the results from the case studies are expanded with the results from the survey. This is indicated per variable.

5.4.1. E-mobility goal

Dutch municipalities have a diverse approach for setting e-mobility goals (see table 6). For instance Haarlem, The Hague and Alkmaar only have an internal goal for the placement of chargers. They argue that setting a goal internally for the own organization has a positive effect on the process of placing chargers. They also believe that setting a goal externally can lead to placement of chargers on wrong places just in order to reach the targeted number, which will lead to a decrease in quality of the charging

infrastructure. Additionally, they believe this can also lead to a negative image on EVs by residents or the municipal board. This argument is in line with the reasons why the BUCH municipalities and Almere have neither an internal or external goal set for a number of chargers. On the other hand of the spectrum are the municipalities of Houten and Nieuwegein. These made their placement goals public in their policy documents. They believe in electric mobility and they are convinced in being transparent to their residents will lead to more acceptance for chargers and to increase their charging infrastructure further.

Table 6: The effect of an e-mobility goal on the lead time of charger implementation

Type of E- mobility goal	**External mobility goal**	**No mobility goal**		**Internal mobility goal**
Arguments for choosing this type	To be transparent	To prevent mistakes being noticed by the public (for instance: not enough chargers placed)		To push within own organization
	To promote electric driving			To prevent mistakes being noticed by the public (for instance: not enough chargers placed)
				To prevent loss of quality of infrastructure
Found lead time on charger implementation for municipality with respective mobility goals *(Number indicates amount of observations from case studies and survey combined).*	**2**	**1**	**18**	**6**

	<180 days
	181-365 days
	>365 days

The results in table 6 show that municipalities with an external mobility goal have a shorter lead time for charger implementation than those with an internal goal or even no goal. Suggesting that setting an external e-mobility goal as an organization will have a positive effect on the lead time.

5.4.2. Legal process

All municipalities experience the legal part of the implementation process as hindering or neutral (as seen in figure 17), although the variation in dealing with this variable differs strongly (see table 7). For example the municipality of The Hague places chargers during the six week objection period in attempting to speed up the implementation process. Houten, with its planning map approach, made a traffic ordinance for an entire neighborhood instead of per individual charger to speed up the placement process and to simplify the administrative process. Although this took up a lot of time upfront, Houten does currently not experience any legal obstacles with this approach, making this a neutral experience for Houten. In addition, almost all municipalities intent not to publish too much on their decisions to place chargers (sometimes in combination with other measures above), besides the legally binding places such as the Staatscourant and the local newspaper. They believe parking is an emotion (see also parking pressure below) and providing too much information or too many contact moments with residents will lead to more objections and thus more delays on implementation. Haarlem has experienced this backlash first hand. In an attempt to being transparent and including residents in the process it provided more contact moment which led to an increase of objections compared to before this approach was in effect. This is causing Haarlem further delays in its implementation process which still has its effect today.

Table 7: The effect of different approaches to legal issues on lead time of charger implementation

Type of approach to overcome legal obstacles	**Place chargers during objection period**	**Planning map**	**Publish a traffic ordinance, but keep additional publishing to a minimum**
Arguments for choosing type	To speed up the implementation	To lessen the work load per charger	To try and keep objections to a minimum
		To make electric driving more accessible	To let the process continue without hick ups
Found lead time on charger implementation for municipality with found legal approaches			

	<180 days
	181-365 days
	>365 days

The results above show that municipalities all try to minimize the amount of information on charger placement towards residents to avoid objections. However, this method by itself is not a guarantee for a shorter lead time. Only municipalities who combined this with additional measures such as a planning map or changing the legal status experience a shorter lead time.

5.4.3. Manpower

Only two municipalities, The Hague and Alkmaar, replied to have sufficient manpower for this topic, currently and in the future. Houten, BUCH and Nieuwegein believe their current manpower provides them with enough capacity for the near future, but they do expect a shortage of personnel in the coming years if the rollout of EV keeps continue to grow. Haarlem and Almere state they are currently undermanned which is leading to a backlog of requests and objections to be answered in Haarlem and a longer implementation time in Almere. Additionally, a large number of municipalities experience a rapid change in personnel on the topic, ''My predecessor was here for 6 months and his predecessor for 3 months'' (BUCH municipalities), arguing that this swift swapping of personnel could lead to quality issues.

Table 8: The effect of the degree of manpower on lead time of charger implementation

Degree of manpower	**Sufficient**	**Sufficient for now, but insufficient if growth continues**	**Insufficient**
Reason for this degree of available manpower	Municipal board wants to promote electric driving	Municipal board wanted to kick start electric mobility, current manpower the result of that	Electric mobility is important for the municipal board, but no extra funding available. Municipal board is reactive to the topic.
		Electric mobility is a topic, but no a 'hot topic'	
Found lead time on charger implementation for			

municipality with degree of manpower						

	<180 days
	181-365 days
	>365 days

The results in table 8 show that manpower has a diverse impact on the lead time of charger implementation. Clearly, municipalities who indicate to have insufficient manpower right now are dealing with an increased lead time. On the other hand, municipalities with sufficient manpower can also suffer from an increase in lead time. This suggests that the effect of manpower differs per municipality and that more manpower is not always better. In addition, there seems to be a rapid shift between personnel on the topic in several municipalities (differing between 3 to 6 months).

5.4.4. Decision making process

In four of the municipalities (Haarlem, Houten, Nieuwegein, Alkmaar) the decision making process within the municipal organization involves one or two people. In practice this means that the interviewee is the one responsible for site selection and checking this location along the placement criteria . The second person is often someone from another department (legal, traffic, police etc.) who can act as back-up to provide additional input if needed, or deals with the handling of objections. The municipalities of BUCH and Almere on the other hand experience an internal decision making process that involves a lot of different actors and in the case of BUCH this even includes an actor who is unwilling to cooperate, leading to a backlog of requests to be handled and a longer lead time for charger implementation.

In addition, multiple municipalities stated they have a hard time with finding the right place for electric mobility in their organization. Some include this in their traffic department, while others see it as a sustainability subject. This struggle is further enhanced by the fact that multiple departments such as traffic, legal, parking etc. are also involved in the process. This means that in a lot of cases there is no clear owner of the topic of electric chargers, which can lead to an increase in lead time.

Table 9: The effect of the decision making process on lead time of charger implementation

Decision making process	**Number of people involved**				
	1 to 2 people		2 or more people		
Found lead time on charger implementation for municipality with specific type of decision making process					

Table 10: The effect of the decision making process on lead time of charger implementation

Decision making process	**Place in organization**			
	Known		Unknown	
Found lead time on charger implementation for municipality with specific type of decision making process				

	<180 days
	181-365 days
	>365 days

The results in table 9 and 10 show that the impact of the decision making process is diverse. Having just 1 or 2 people responsible for the entire process can have a positive effect, but is no guarantee. In addition, the place of the process in the organization seems to have a stronger effect. Municipalities who have a process with clear responsibilities benefit from a short to medium lead time compared to a medium to long lead time for municipalities in which these responsibilities are unknown.

5.4.5. Available funds

Only the municipality of Almere experiences a lack of funding for the placement of chargers. This is caused by the reactive nature of the municipality and the fact that electric driving is not on the political agenda of the board and if it is on the agenda, it is for something negative such as a charger that needs to be removed or relocated. All other municipalities state they have enough funding from the municipal board to achieve their mobility goals. This is helped by the fact that the provinces of Noord-Holland, Flevoland and Utrecht all have expansive subsidy schemes for municipalities to place chargers.

Table 11: The effect of available funding on lead time of charger implementation

Degree of available funding	**Sufficient**		**Neutral**	**Insufficient**
Reasons for available funding	Budget freed up by municipal board Subsidy from province CPO places chargers for free		Cooperation with other municipalities, skewed share between them	Municipal board only provides budget for EV when it causes trouble
Found lead time on charger implementation for municipality with degree of funding *(Number indicates amount of observations from case studies and survey combined).*	**3**	**22**	**1**	**1**

	<180 days
	181-365 days
	>365 days

Table 11 shows that a majority of the municipalities have sufficient funding at their disposal, be it either by their respective municipal board, province or the business plan of the CPO. However, this is no guarantee for a short lead time, because municipalities with sufficient budget can also suffer from longer lead times. On the contrary, municipalities with neutral or insufficient budget all have longer lead times.

5.4.6. Knowledge

All municipalities believe they have sufficient knowledge on charger placement in order to be effective in the process. Knowledge on the topic is recently developed and available from multiple sources. Favorite sources are MRA-e, Stichting ELaadNL, the CPO and the Dutch Institute of Electric Charging, NKL (Nationaal Kennisinstituut Laadinfrastructuur). Only one municipality, Almere, hires personnel from an external party (EV consult) in order to be up to date. Also, all municipality state that knowledge on this topic is something you gain by doing and that they are not dealing with ‘’rocket science’’ (municipalities of Haarlem, BUCH, The Hague, Alkmaar), suggesting that the knowledge for this topic is easy to grasp.

Table 12: The effect of the level of knowledge on lead time of charger implementation

Level of knowledge	**Sufficient (longer than 12 months)**			**Insufficient (shorter than 12 months)**
Reasons for available knowledge	Knowledge from MRA-e, CPO, Stichting ElaadNL or NKL			n/a
	Getting experience by doing			
Found lead time on charger implementation for municipalities with level of knowledge *(Number indicates amount of observations from case studies and survey combined).*	3	4	20	n/a

	<180 days
	181-365 days
	>365 days

The results in table 12 show that the level of knowledge on the topic is not a deciding factor in final lead time of charger implementation. While all municipalities have a sufficient amount of knowledge, their individual lead times differ. Suggesting that other variables besides knowledge have an larger impact on the lead time.

5.4.7. Projection data

Five out seven municipalities use data from external parties to get insights in the growth of EVs within their city. This data is used to select future charger locations (Houten, Nieuwegein, The Hague, Alkmaar). The interviewee of Almere uses the data in order to try and convince the municipal board of the importance of EV in the future. Two municipalities, Haarlem and BUCH don't use data to predict the growth of EVs, but instead rely on common sense, ''The richer neighborhood is more likely to buy EVs than the poorer neighborhood'', (Municipality of Haarlem).

Table 13: The effect of using new electric car ownership on lead time of charger implementation

Projection data	**Using projection data**			**Not using projection data**
Reasons for using or not using data	To shorten the process of implementation			Municipality already knows by itself where the need for future chargers is
	To convince the municipal board to take a different approach			''Thinking about using data in the future, but no capacity [funding and manpower] right now''
	To get insights in future charger locations			
Found lead time on charger implementation for municipalities respective to their usage of data for new electric cars				

	<180 days
	181-365 days
	>365 days

Table 13 shows that not using projection data to predict the usage of new EVs does lead to an increased lead time in charger implementation. On the other hand, making use of the data is no guarantee for a shorter lead time. Suggesting that having the data is one thing, but using it effectively is another.

5.4.8. Parking pressure

Parking space availability is in most of the cases an emotion with residents according to municipalities. Municipalities know that parking pressure can be a problem in certain neighborhoods, but this does not hinder them to place a charger anyway. According to municipalities the placement of a standard charger, with two sockets, will only 'remove' one parking spot for ICE vehicles because one spot will be replaced by the e-rider. In some cases municipalities consider placing a charger with one socket instead of two, but this happens only on rare occasions.

Table 14: The effect of including parking pressure in placement process on lead time of charger implementation

Including parking pressure in placement process?	**No**			**Yes**
Reason for inclusion or not	Placing a charger with one socket one loses one parking spot, but that one will be filled up quickly with the next e-rider			Only if parking pressure is really high, then we place just place socket
Found lead time on charger implementation for municipality and their view on parking pressure *(Number indicates amount of observations from case studies and survey combined).*	**3**	**1**	**14**	**9**

	<180 days
	181-365 days
	>365 days

The results above show that municipalities who include parking pressure will end up with a longer lead time, however, those who do not include this have no guarantee for a shorter lead time.

5.4.9. Political support

None of the municipalities from the case studies experiences hindering from the municipal board. In three of the municipalities (Alkmaar, Almere and BUCH) electric driving is specifically not on the political agenda, but something they are reactive on. In these municipalities there is minimum budget to place chargers and they put in the minimum amount of effort. In the rest of the municipalities (Haarlem, Nieuwegein and The Hague) the municipal board has either a majority if pro-environmental parties that strongly support electric driving or long term plans for electric driving were made before and the current policy is a result of that (Houten).

When data from the survey is included, two groups of municipalities emerge: one with political support and one without political support. Reasons for not having political support can be the fact electric mobility is not a topic on the political agenda, of if a municipal board has a reactive stance on the topic.

Table 15: The effect of political support on lead time of charger implementation

Political support by municipal board	**Yes**		**No**	
Reasons for support or lack of support	To promote electric driving		Not a topic on the political agenda	
	To improve air quality		Reactive stance of municipal board	
	Majority of pro-environmental parties in municipal board			
Found lead time on charger implementation for municipalities *(Number indicates amount of observations from case studies and survey combined).*	**3**	**12**	**1**	**11**

	<180 days
	181-365 days
	>365 days

The data in table 15 shows that having political support for electric driving can lead to a shorter lead time, but this is no guarantee. Having no political support on the other hand will lead to medium to long lead times.

5.5. MSF per case study

After looking at the impact of the approach from the different variables, each of the case studies is analyzed along the MSF to see how the current policy for EV came into existence. For each municipality a short description per stream is given (if applicable) and analyzed if any coupling of the streams occurred. This is then visually represented in a respective MSF figure for each municipality.

5.5.1. Haarlem

Problems stream
The municipal board of Haarlem wants to improve quality of life for inhabitants by cleaner air and less noise, and also wants to be less dependent on fossil fuels. Indicators at Haarlem show that fossil fuel powered cars are seen as the causes for these problems.

Politics stream
GroenLinks is largest party in Haarlem, having a major stake in the municipal board (9 out 39 seats). This party has a policy focus on environmental issues and sustainability. GroenLinks boosted the existing policy for e-mobility by freeing up a budget to place 350-400 chargers in the coming years. This decision was supported by the national mood on EV.

Policy stream
The indicators mentioned in the problem stream led to more attention from the municipal board on e-mobility. There is no clear actor that pushed this data towards the municipal board.

Policy window
The municipal board, with GroenLinks as the major environmental party, used the opportunity of their instalment to free up budget for this policy for the coming years.

Policy entrepreneur
GroenLinks party of Haarlem.

Did a coupling of streams occur?
Yes, the problems and politics steams were combined to create a new policy. The new formed policy is more proactive compared to the reactive state from the previous policy, although the effects are not visible yet because Haarlem finds itself in a transition period (see figure 18.

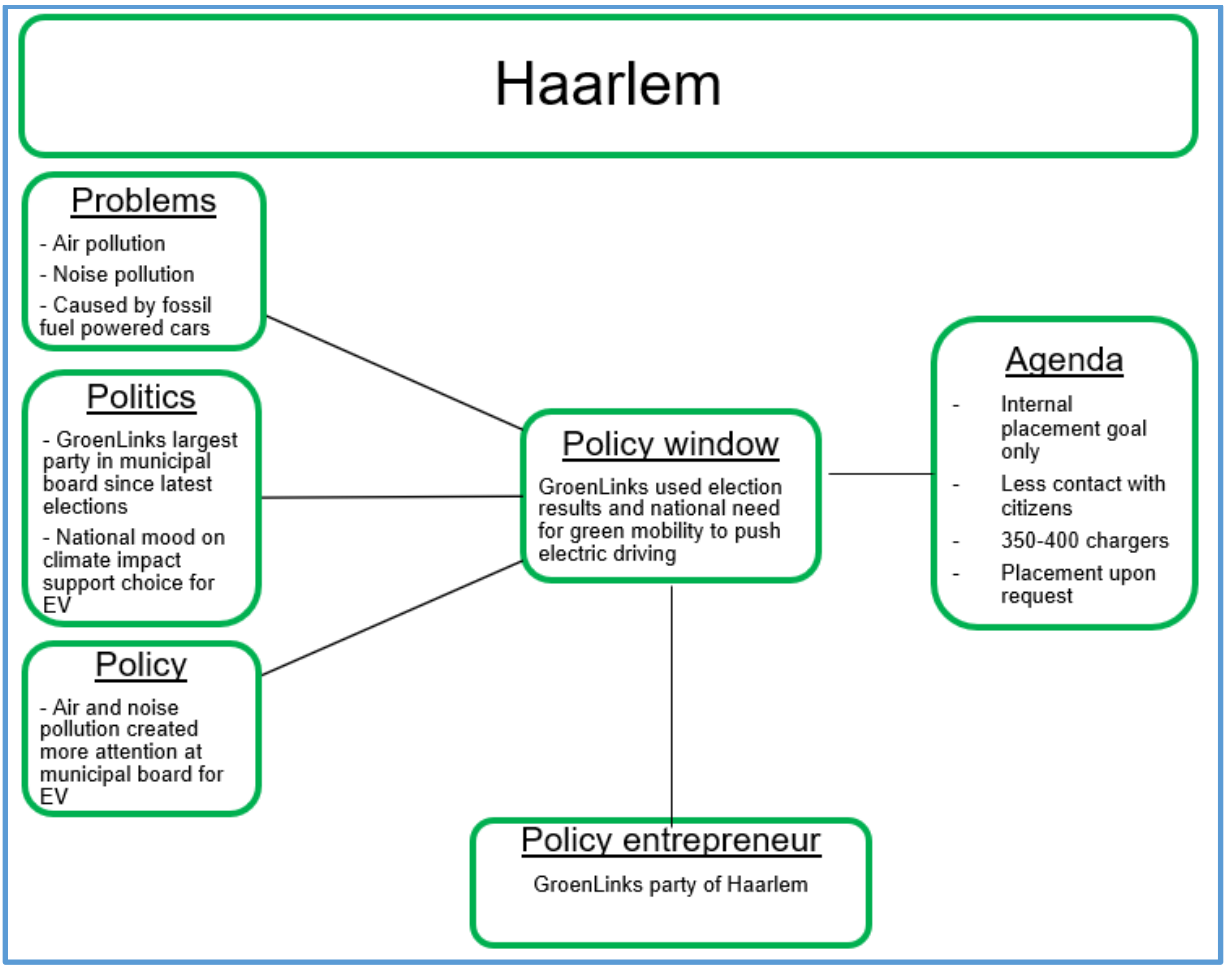


Figure 18: MSF model for municipality of Haarlem. *Based on the case study the contents of the problem, politics and policy stream are given, as are potential policy entrepreneurs and policy windows that led to a policy outcome.*

5.5.2. Houten

Problems stream
Houten has always been a municipality with a strong focus on sustainability and mobility, so the decision to set up a specific policy for this was quite easily taken. Additionally, the increasing demand for chargers by PHEV owners a couple of years ago was the indicator which caused a shift towards e-mobility from the board.

Politics stream
A combination of Christian and pro- environmental parties in its municipal board set the tone for an elaborate e-mobility goal. This also resulted in the e-mobility policy plans being just a 'hammer piece' for the municipal board, without the need for a debate on these plans.

Policy stream
The e-mobility policy is derived from Houten's main sustainability goal and written down in detail in the e-mobility policy document for the period 2018-2020. The current policy is one of pro-active placement of chargers instead of reactive placement compared to the norm in the market. This is the result from both the board and the alderman for sustainability who wanted to push for more EVs in the municipality.

Policy window
The wish of the municipal board to be sustainable and communicative city helped policymakers to push through their plans of the planning map approach.

Policy entrepreneur
Municipal board of Houten

Did a coupling of streams occur?
Yes, the coupling between all three streams was made at a previous stage which resulted in the sustainability policy of Houten. The current e-mobility policy is an extension from this in which Houten has aimed to be the most quiet and clean city in 2040 and wants to place a total of 103 chargers by 2020 (see figure 19).

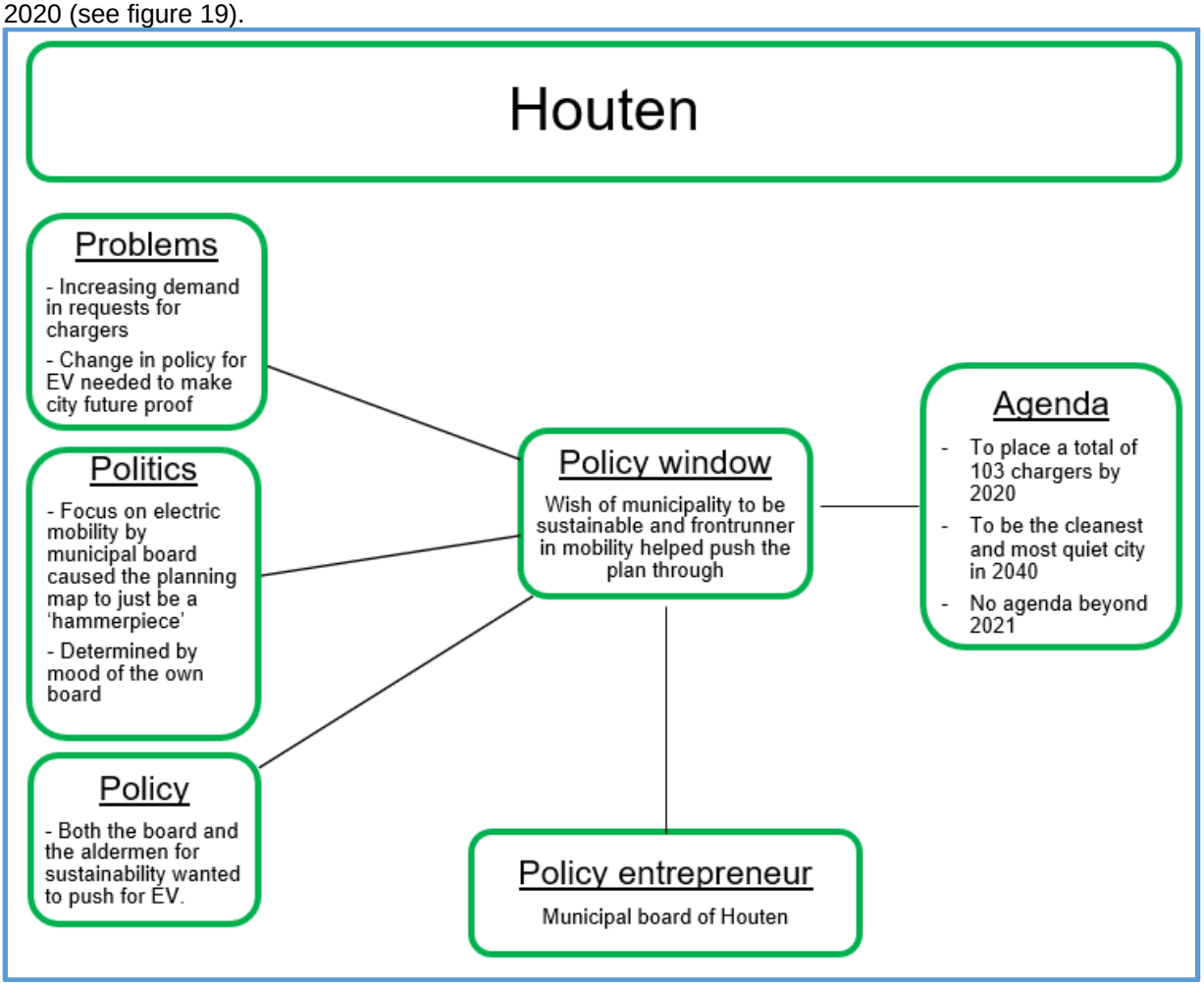


Figure 19: MSF model for municipality of Houten. *Based on the case study the contents of the problem, politics and policy stream are given, as are potential policy entrepreneurs and policy windows that led to a policy outcome.*

5.5.3. BUCH organization

Problems stream
BUCH is aware that electric driving is something it should focus on, because indicators like air pollution and an increasing number of requests for chargers show this. However, it is not on the political agenda right now and thus not yet seen as a problem.

Politics stream
The current municipal boards of the four municipalities all have a VVD majority. Although this political party is known to favor car usage, this not the case for electric cars. The municipal boards within the BUCH organization do provide a budget for placing chargers, but this is minimal and only covers the standard placing costs, so any additional costs have to be paid from somewhere else.

Policy stream
Electric mobility is not a topic fighting for attention of the municipal board right now. No particular actor is pushing this topic to the board.
Policy window
n/a

Policy entrepreneur

n/a

Did a coupling of streams occur?
No, BUCH has indicators showing that e-mobility is something it should work on, but this problem is being picked up the board or pushed by a policy entrepreneur. There is currently no policy is place which boosts charger placement, making BUCH reactive on the topic (see figure 20).

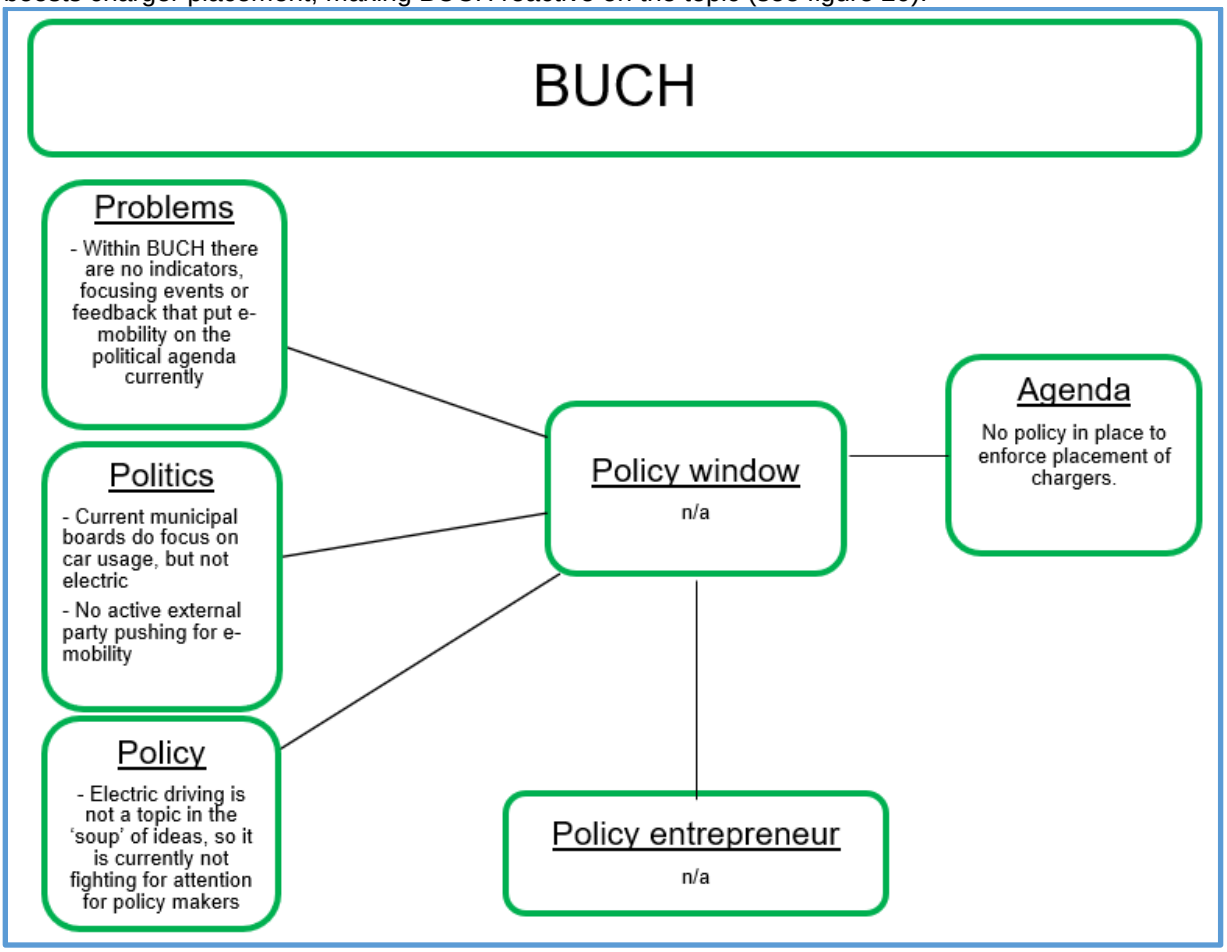


Figure 20: MSF model for the BUCH organization. *Based on the case study the contents of the problem, politics and policy stream are given, as are potential policy entrepreneurs and policy windows that led to a policy outcome.*

5.5.4. Nieuwegein

Problems stream
As seen before in Haarlem and Houten, indicators on air quality and noise pollution caused for attention for e-mobility by the municipal board. This is strengthened by the increased number of request for chargers by EV owners.

Politics stream
While the municipal board of Nieuwegein does not have a pro-environmental majority, the board does focus on climate action. Also, because the initial demand from plug-in hybrids started the electric driving demand, the board only had to expand on this to provide a charging infrastructure for EVs as well.

Policy stream
Before the introduction of the current sustainability route map in Nieuwegein, a standalone e-mobility policy was already in place, but much weaker than the current one. With the new route map this policy was strengthened.

Policy window
Sudden demand for chargers for plug-in hybrids a few years ago opened started the placement of chargers. The sequential desire of the municipality to become climate neutral in 2040 gave the opportunity for e-mobility policy to be expanded.

Policy entrepreneur
Interviewee from municipality of Nieuwegein. Person helped setting up the initial policy for e-mobility for plug-in hybrids and saw the opportunity to expand the policy when the route map was being proposed.

Did a coupling of the streams occur?
Yes, although this happened already in an earlier stage when the general sustainability policy was created. The policy entrepreneur used this general policy, combined with the indicators in the problem stream to expand on the existing e-mobility policy (see figure 21).

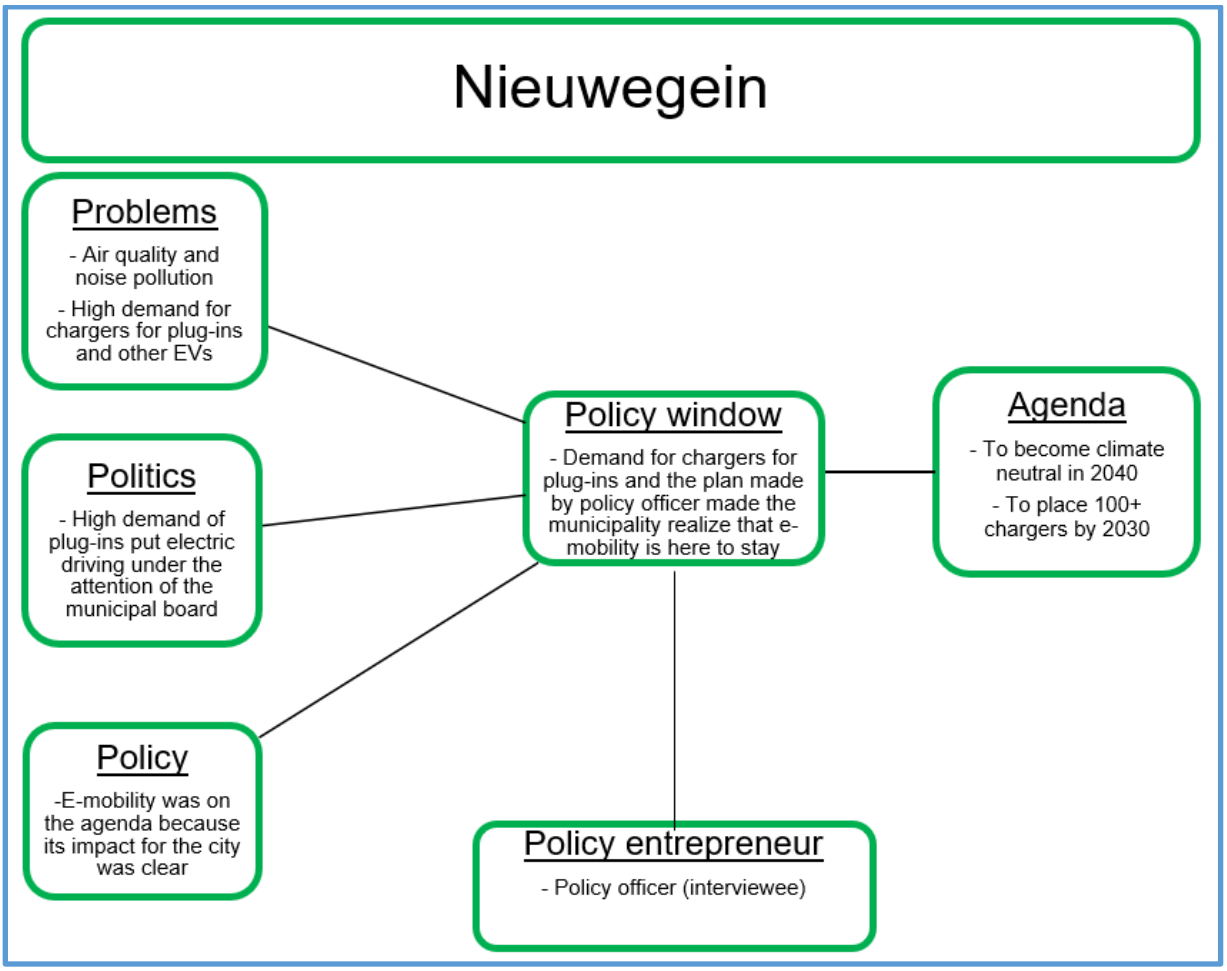


Figure 21: MSF model for municipality of Nieuwegein. *Based on the case study the contents of the problem, politics and policy stream are given, as are potential policy entrepreneurs and policy windows that led to a policy outcome.*

5.5.5. The Hague

Problems stream
A sudden demand for chargers from plug-in hybrid owners made The Hague aware of the fact that electric mobility was becoming a permanent fixture within the city. Additionally, indicators on air quality from the previous National Air Quality Plan showed that this could be improved.

Politics stream
The municipal board of The Hague already had funding from the National Air Quality Plan and used this to place chargers. The board did not hesitate to free up funding for the placement of additional charger

to make to city future proof. It did not set an external goal for e-mobility because the board believed this would lead to more problems than benefits.

Policy stream
Because of the sudden demand for chargers, the decision was made to place 250 chargers per year for a 4 year period (ending 2019). Chargers would be placed upon request, but with little to no communication towards residents.

Policy window
The peak in demand for chargers caused the Hague to expand their policy beyond PHEV usage and this opportunity was used by the municipal board to free up funding for additional chargers and manpower.

Policy entrepreneur
Interviewee from municipality of The Hague, together with the municipal board. The municipal board saw the opportunity to make the city more future proof by placing more chargers, interviewee on the other hand saw it's chance to request more funding and manpower to realize this.

Did a coupling of streams occur?
Yes, the problems stream and the politics stream were coupled. This was done using the indicators from the previous air quality program and the growing number of charger requests. The new policy led to the placement of 1000 chargers in four years (see figure 22).

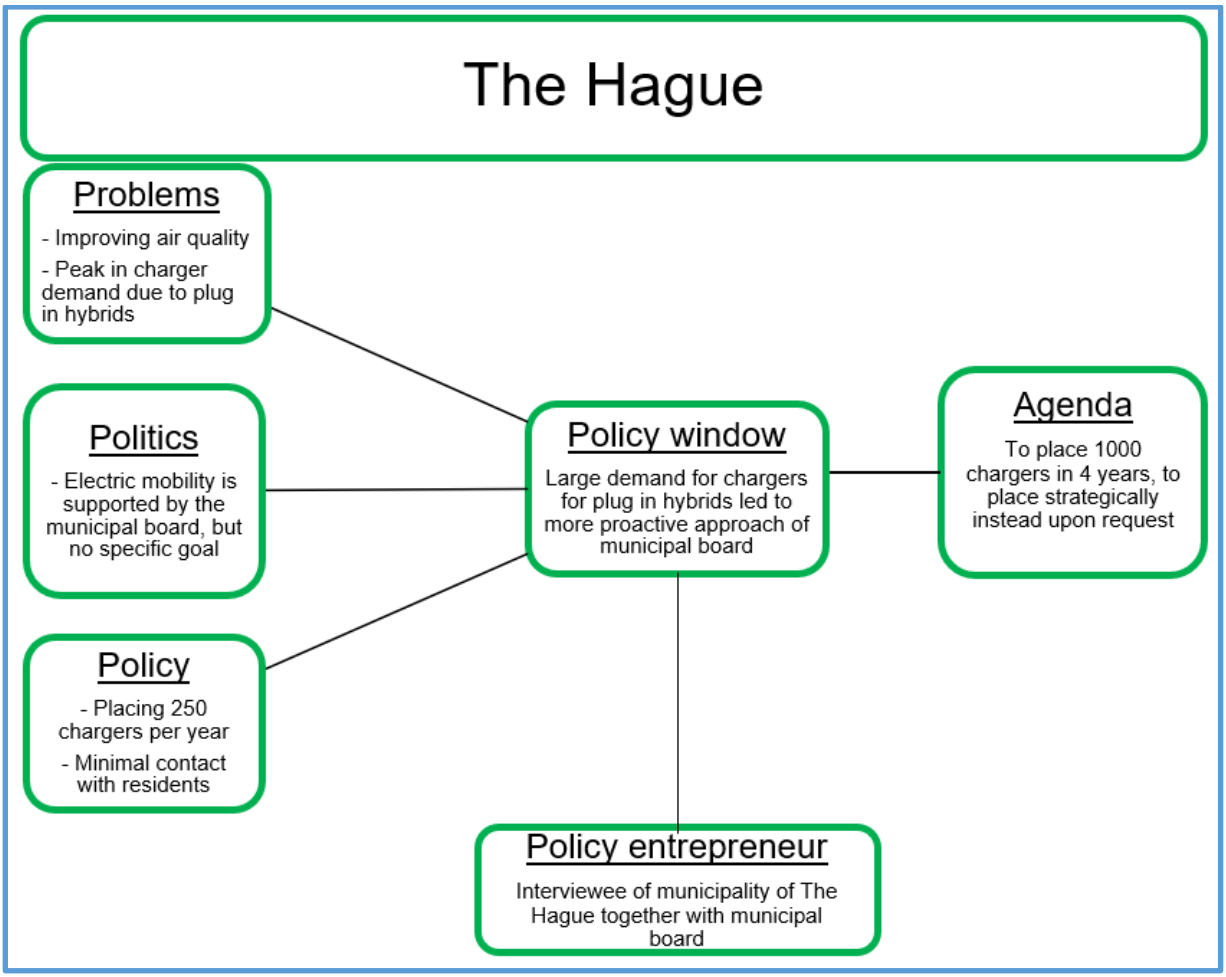


Figure 22: MSF model for municipality of The Hague. *Based on the case study the contents of the problem, politics and policy stream are given, as are potential policy entrepreneurs and policy windows that led to a policy outcome.*

5.5.6. Almere

Problems stream
E-mobility in Almere is primarily a reactive subject. When the subject is discussed in the municipal council, it is mainly caused by the high amount of objections for charger placement (focusing event), or when chargers need to moved (indicator).

Politics stream
The topic of e-mobility does not have a clear owner in Almere. The responsibilities for charger placement are either unknown at the respective departments, or the topic shifts between departments, making it inconsistent.

Policy stream
E-mobility only appears on the radar of policymakers when it creates problems. This is a cause of the reactive stance of the municipality.

Policy window
Interviewee expects that the municipality of Almere will decide for a more proactive placement policy in one of the coming municipal board meetings, meaning a potential policy window in the future.

Policy entrepreneur
Interviewee is hired by the municipality of Almere to speed up the implementation process. Interviewee wants to achieve this by making use projection data and the current lead time on charger placement within Almere to show the improvements that can be made. Interviewee expects that the municipal board will start towards an active approach, away from the current reactive approach.

Did a coupling of the streams occur?
No, there no coupling of the streams in Almere as of yet. Current policy entrepreneur attempting to couple these by using projection data and indicators from the problem stream (see figure 23).

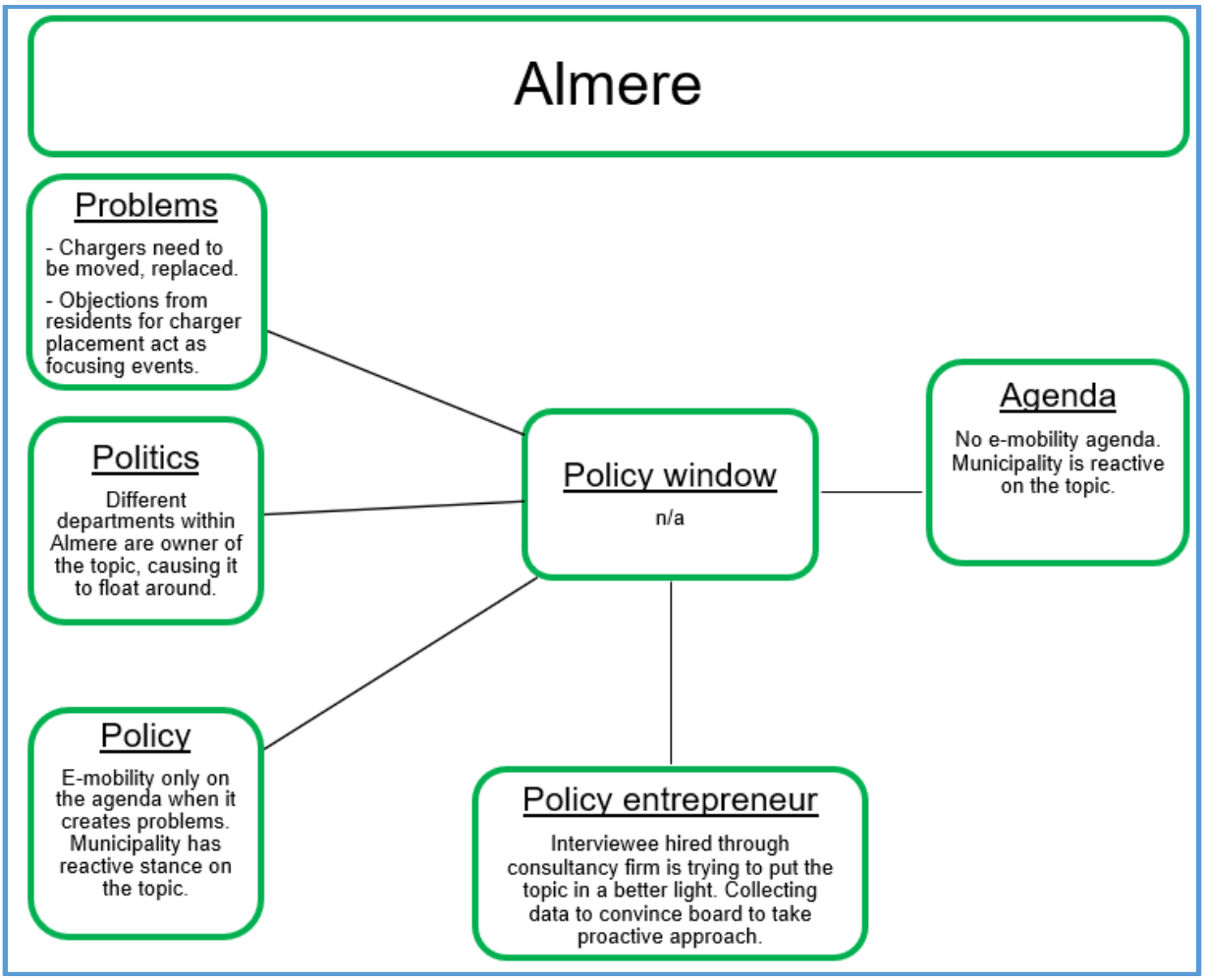


Figure 23: MSF model for municipality of Almere. *Based on the case study the contents of the problem, politics and policy stream are given, as are potential policy entrepreneurs and policy windows that led to a policy outcome.*

5.5.7. Alkmaar

Problems stream
Increasing demand for chargers for EVs are the main indicator for Alkmaar that e-mobility is becoming a fixed policy item. This is caused by the influx of PHEVs a couple of years ago. Additionally, the former alderman of traffic believed e-mobility was only available for the rich, but should be available for everyone (indicator).

Politics stream
The municipal board of Alkmaar had the wish to combine its separate e-mobility goal and sustainability goal into one policy.

Policy stream
E-mobility got a lot of attention from the municipal board because their focus in sustainability and the wish to combine these two policies.

Policy window
No policy window opened up in Alkmaar as of yet.

Policy entrepreneur
The former alderman of traffic had a passion for sustainability and was interested in electric driving. He used his political position to manipulate the municipal board to get more funding and accessibility for electric driving.

Did a coupling of the streams occur?
Yes, the problems and politics stream are coupled but this had not yet led to a policy window. The former alderman of traffic succeeded in providing extra budget for charger placement, but this has not led to a new policy (see figure 24).

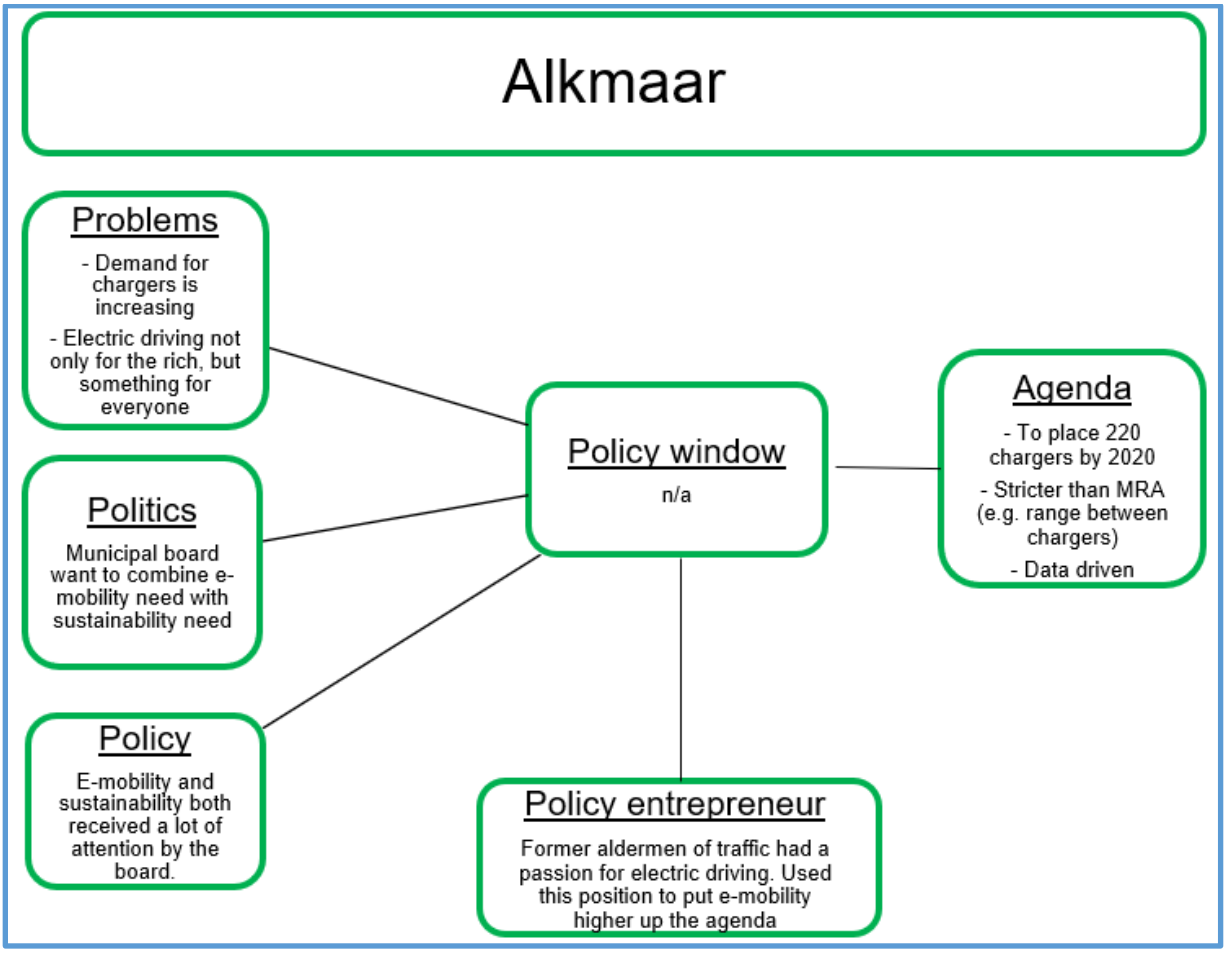


Figure 24: MSF model for municipality of Alkmaar. *Based on the case study the contents of the problem, politics and policy stream are given, as are potential policy entrepreneurs and policy windows that led to a policy outcome.*

5.6. Variable existence per case study

Figure 17 showed whether a variable was helping, hindering or neutral for the case study municipalities. Based on the methods these municipalities use along these variables in attempt to shorten their lead time and the MSF analysis, the reasons why these variables are existing or not is further explained below. For each study an overview is given for the variables that exists in its current policy and which are not.

Note: because some variables are always present in one way or another (for example the legal process) these variables are considered existing when a municipality attempts to address this and not existent when no actions are taken.

5.6.1. Haarlem

The political party of GroenLinks acted as a policy entrepreneur in Haarlem and used its installment in the municipal board to free up funding for e-mobility. It coupled the problem stream (air and noise pollution), the politics stream (national mood on the climate agreement) and the policy stream ('EVs are the solution') to create a new e-mobility policy.
However, this financial boost has not (yet) resulted in a reduction in lead time. The additional budget is not spend on extra manpower which the municipality is lacking. Furthermore, the extra budget is not spend to improve the decision making process or to improve knowledge by getting projection data. The

indicators in the problem stream do not spot parking pressure and this thus not included in the decision making process, although this has a positive effect on the lead time.
In all, this means the e-mobility process in Haarlem has a lot of support, but in practice this has not let to a shorter lead time because the available funding is not used (see table 16).

Table 16: Variable overview of Haarlem

Existent	*Non-existent*	*Reason*
E-mobility goal		Set by GroenLinks party. Internal only
Legal process		Chosen to publish as little as possible to reduce lead time
	Manpower	Lacking manpower, no extra resources to gain more
	Decision making	Standard approach, no actions yet to make more efficient
Available funding		GroenLinks freed up extra funding to support EV growth
Knowledge		Already available
	Projection data	Chosen not to use it, using common sense instead
	Parking pressure	Not included in decision making
Political support		GroenLinks installation at municipal led to support for EVs

5.6.2. Houten

The municipal board of Houten was convinced that electric mobility was the solution for the found air and noise pollution (problem stream) and to achieve their sustainability goal (policy stream). The board acted as a policy entrepreneur and coupled the problem stream and policy stream to create a new e-mobility policy. The new resources for this policy were used to create a non-standard approach at which chargers would be placed strategically based on data instead per request. This planning map approach significantly reduces the lead time for Houten. The only non-existent variable in Houten is the inclusion of parking pressure in the decision making. The municipality deliberately chose not to include this, because it believes in the potential of EVs (see table 17).

Table 17: Variable overview of Houten

Existent	*Non-existent*	*Reason*
E-mobility goal		Externally stated by municipal board to support policy
Legal process		Changed to incorporate new planning map approach
Manpower		Freed up by the municipal board
Decision making		Improved by extra input from knowledge and data
Available funding		Freed up by the municipal board
Knowledge		Already available, plus hired extra knowledge externally
Projection data		Used to change the decision making process
	Parking pressure	Not included in decision making process
Political support		Board sees EVs as solution, so freed up extra resources

5.6.3. BUCH organization

The case study of the BUCH organization shows one variable that is positive to the lead time: knowledge, although the impact of this variable is minimum. All others are hindering or neutral. This is because the organization has no political support for e-mobility from any of the four participating municipalities. This causes for a minimum budget to install chargers and a minimum amount of personnel to guide this process. Biggest hurdle for BUCH is the decision making process which involves a non-cooperating actor which slows down the process. This means no streams were coupled before and currently there is no policy entrepreneur trying to couple these either. This results in a reactive policy for EVs with a long lead time. Thus, the non-existence of the variables in BUCH are the consequence of a lack of political support from the municipal board (see table 18).

Table 18: Variable overview of BUCH organization

Existent	*Non-existent*	*Reason*
	E-mobility goal	EVs not on radar of the board, so no goal set
	Legal process	Standard process, no workarounds to reduce lead time

Manpower		Minimum amount available. Personnel works on other projects as well
	Decision making	Standard approach, even significantly hindered by non-cooperating actor
	Available funding	EV not on radar of the board so only limited funding available
Knowledge		Plenty of resources available to get knowledge from
	Projection data	EV not on radar of the board
	Parking pressure	Not included in decision making process
	Political support	EV not on radar of the board

5.6.4. Nieuwegein

The e-mobility policy at Nieuwegein is derived from the sustainability policy in which the three streams of MSF were coupled before. Political support provides an e-mobility goal and funding. This support however, is not used to gain additional knowledge or manpower to streamline the process. Nieuwegein uses the resources it already had. There was an attempt by the policy entrepreneur for EV to use projection data but this did not succeed due to lack of capacity, although their CPO provides them with this data recently. The short lead time within Nieuwegein is a result of the cooperation between the CPO, grid operator and respective departments of the municipality (see table 19).

Table 19: Variable overview of Nieuwegein

Existent	***Non-existent***	***Reason***
E-mobility goal		Derived from previous sustainability policy
	Legal process	Standard process, no workarounds to reduce lead time
Manpower		Already available
Decision making		Already available from previous policy
Available funding		Freed up by political support
Knowledge		Already available
	Projection data	Explored the option, no capacity available
	Parking pressure	Not included in decision making process
Political support		Derived from previous sustainability policy

5.6.5. The Hague

Current EV policy in The Hague is a continuation of the former air quality program, meaning the streams of MSF were coupled in a policy window in the past. Existing budget and manpower are continuation of this. Strong points of the Hague are its manpower (5 FTE) and the municipality placing chargers during the objection period (albeit with the risk of removing them later) which significantly reduces lead time. Policy entrepreneur for this e-mobility decision was the interviewee of The Hague. Additionally, the choice for strategic placement (so based on data) instead of requests also shorten the lead time, because no communication with a requestee has to be included in the process.
This case shows that The Hague is a municipality who is benefitting from years of experience with placing chargers and uses this experience to standardize the placement process and knowns which variables are slowing this down and deliberately choosing not to include these (see table 20).

Table 20: Variable overview of The Hague

Existent	***Non-existent***	***Reason***
	E-mobility goal	'Setting a goal is dangerous'
Legal process		Multiple workarounds in place to shorten process
Manpower		Continuation of previous policy
Decision making		Responsibilities known because of long working experience
Available funding		Continuation of previous policy
Knowledge		Already available by working experience
Projection data		Used as input for new locations
	Parking pressure	Not included in decision making process
Political support		Continuation of previous policy

5.6.6. Almere

The municipal board of Almere has the wish the speed up the placement process, but provides no resources to achieve this and is currently even reactive on the topic.
The lack of an e-mobility goal leads to a lack of attention for additional funding to improve the current decision making process, which also has no clear ownership. However, current personnel has sufficient knowledge on the topic and this led to the municipality deciding on chargers in batches of 5-10 instead of individually. This the strong point of Almere, which leads to a medium lead time.
Current policy entrepreneur for EV tries to use projection data to gain extra support and funding to improve the decision making process. This means there is no coupling of the steams for e-mobility in Almere as of yet and that most of the non-existence of the variables are cause by a lack of political support (see table 21).

Table 21: Variable overview of Almere

Existent	*Non-existent*	*Reason*
	E-mobility goal	EV not on agenda of the board, so no goal set
	Legal process	Standard approach no workarounds
	Manpower	Lack of manpower, but hired externally
	Decision making	Process unclear in organization, shift between departments
	Available funding	No support, so no funding available
Knowledge		Hired from external source
	Projection data	Board does not think about it, policy entrepreneur using it to convince board to change stance on e-mobility
	Parking pressure	Not included in decision making process
	Political support	Not on the agenda, only when problems occur

5.6.7. Alkmaar

The current e-mobility policy in Alkmaar is partly an effort from the former alderman of traffic. Acting as a policy entrepreneur this person freed up budget for chargers by convincing the municipal board that driving EVs is not only for the rich, but should be available for everyone. Unfortunately, this did not led to additional political support. This means Alkmaar has to make use of its existing resources. While most the variables are helping, these positive effects are made redundant by the decision making process. This involves too many actors and slows the process down. Leading to a long lead time (see table 22).

Table 22: Variable overview of Alkmaar

Existent	*Non-existent*	*Reason*
E-mobility goal		Set by municipal board. Internal goal only
Legal process		Publish minimum to reduce lead time
Manpower		Already available
Decision making		Exists, but is major cause for delay
Available funding		Done by former alderman of sustainability who acted as policy entrepreneur
Knowledge		Already available
Projection data		Municipality thinks about initiating the data
	Parking pressure	Not included in decision making
	Political support	EV not in the problem stream

5.6.8. Explanation for existence

Results from the case studies shows that the existence of a majority of the variables are caused by the political support from the municipal board. This support is used to get extra resources (funding, manpower, knowledge, projection data) to improve it decision making process and to create work arounds for the legal process.
This mechanism works the other way as well. The lack of political support leads to the non-existence of multiple variables. This support is crucial to get extra funding and other resources to be able to optimize the charger placement process. Additionally, the municipalities are aware that when parking pressure is included in their decision making, this will result in a longer lead time. Therefore, they deliberately choose not to include this.

6. Discussion

Expected and unexpected results
This research aimed to seek and explain the variables within Dutch municipalities that are of influence on the lead time for public charger placement. It found that the mix of these variables differs per municipality and that this a consequence of the political stance of the municipal board on e-mobility. This influence of the municipal board was to be expected considering its position in policymaking. However, results showed that political support on e-mobility does not always guarantee a short lead time. As seen in the case of Haarlem, political support from the GroenLinks party freed up significant budget for public charger infrastructure, but the budget is not spend to improve the implementation process. This in contrary to other municipalities with political support, like Houten and The Hague which have a short lead time. This can be explained by the origin from which the streams in the MSF are coupled. When looked closer at the former case, the coupling of the streams was done from the political stream, which led to an ideological approach. Implying that the political support for e-mobility was to show the intentions of the new installed board, but no concrete plans were in place to use this budget, resulting in a longer lead time. The latter cases were coupled from the problem stream. This meant that solutions were consequential and aimed at improving the indicators which were the cause of the problem. This suggests that coupling from the problem stream instead of the political stream leads to a shorter lead time for municipalities. Further research along MSF with a larger sample of municipalities should prove if this is to be the case.

Connected to mentioned above is a point of reflection on using MSF in this research. While MSF theory has shown to be effective in analyzing policy changes, the assumption that all streams need to be coupled to achieve policy change is often contested (Sabatier, 2007; Robinson and Eller, 2010). Results from this research add to this. For instance, in case of The Hague the e-mobility policy is derived from the former air quality program. The policy entrepreneur of The Hague coupled the problem stream and policy stream to form this new policy, while the political support from the politics stream was already in place. Meaning that coupling was done with just two streams. This is supported by research by Pot et al. (2018), who used MSF to analyze how long term decisions by Dutch municipalities were made. They concluded it is not necessary for all three streams to be coupled, for successful policies to be in place.

Limitations
The focus of this research was on the role of municipalities in the process of public charger implementation. While municipalities have a significant role in this process as seen in chapter 2, they cooperate with other actors, meaning that the influence on the found lead time is not solely the responsibility of the municipalities. For instance the role of the CPO's and their respective contractors are not considered in this research. Their influence on the lead time is expected to be minimal as these actors are depending on the work done by the municipalities at the start of the process and their commercial stance implies they are actively attempting to reduce lead times because this saves costs. Additionally, the grid operators who are responsible for arranging the physical connection between the charger and the electricity grid are not included as well. Their role has been considered as a variable in this research, but was opted not to. This was done because Dutch municipalities are not able to choose a grid operator freely. In the Netherlands, the grid operators act within specific geographical boundaries, meaning the influence of the grid operator is expected to be equal for large groups of municipalities. Further research on the impact by the CPO, contractor and grid operator are needed to provide a complete picture of the influence of all actors in this process. This research is currently being performed by Stichting ElaadNL.

Connected with the point above, all municipalities with a short lead time (<180 days) who participated in the case studies all found themselves within the geographical area of grid operator Stedin, who operates in large parts of the provinces of Utrecht and South Holland. The municipalities who were dependent on the services from grid operator Liander, operating in the provinces of North Holland and Flevoland, all showed longer lead times. The sample of the case studies is too small to say anything about a correlation between these two variables. Therefore more research on the influence of the grid operator is needed. Again, this is currently being performed by Stichting ElaadNL.

Sample selection
The population of municipalities used in this research is almost exclusively (with the exception of The Hague) part of the MRA-e project. While the prognoses from Over Morgen showed that municipalities in this geographical area are better prepared than the rest of the Netherlands, this still means that the

selected sample is not completely representative for the whole country. This frontrunner position however, can be used to provide lessons learned and recommendations to municipalities who score insufficient in these prognoses for 2020 and 2025. Additionally, the number of case studies was attempted to be expanded beyond the MRA-e project, but time constraints for this research prevented this.

Expert interviews
In order to bridge the literature gap on public charger implementation, expert interviews were held to verify the found variables. These expert all had working experience in e-mobility and public charger placement. These interviews verified the found variables, expanded on these and provided new insights in the topic to the researcher. The addition of the variable 'political support' in this research was substantial to the outcome; the existence of the political support within a municipality is responsible for the mix of variables which cause for a long or short lead time. The addition of the variable of 'parking pressure' however, was not substantial. None of the participating municipalities in the case studies took this variable into account, seeing it as an emotion by residents rather than a hard criteria.

The use of the variable 'parking pressure' as a separate variable, instead of including this in the variable decision making stems from the results of these interviews.

Added value of the research
Electric mobility is growing rapidly in the Netherlands and all municipalities will have to address the challenges related to this. One of these challenges in the obligation for municipalities to have an e-mobility policy by the end of 2020, as agreed in the NAL. The lessons learned from this research can be used as building blocks for the creation of such policy. Another challenge is the lack of public infrastructure in large parts of the Netherlands, as shown by the prognoses from Over Morgen. Municipalities who score low on these prognoses can use the results of this research to come up with an implantation strategy this fits within their organization and results in a lead time that is as short as possible.

Future outlook
While the growth of EVs causes for benefits for the broader energy transition and provides cleaner air and less noise pollution in cities, the growth of public chargers in the streets can be a blessing in disguise. While current refueling infrastructure for fossil fuel powered cars is concentrated by petrol stations outside residential areas, placing public chargers means these 'refueling stations' are placed in the street and often in plain sight for people from their living room window. The growing number of chargers is already causing a Not-In-My-BackYard (NIMBY) trend, with an increasing amount of objections against charger placement. This means municipalities will have to find a balance between placing chargers to promote EV usage and honoring the wishes of its residents. Currently, alternatives for chargers are being explored by multiple actors. For instance, chargers within lampposts or induction charged parking spots. More information on these alternatives can be found here.

7. Conclusions & recommendations

Conclusions
This research aimed to answer the research question:

How can the observed variation between municipalities in the time it takes to develop a public charging infrastructure for EVs be explained?

It did so by data analysis from previous placed public chargers in participating municipalities in the MRA-e project *(sub question 1.1).* Analysis showed significant discrepancy in lead times for individual municipalities, despite having a homogenous workflow. Lead times differed from 135 days for the shortest lead time, to 674 days for the longest lead time. The cause for this difference was a further focus of this research.

After the data analysis, the implementation process for public chargers was analyzed *(sub question 1.2).* Municipalities are one of many actors involved in this process and have multiple responsibilities. First, they receive the request from an EV owner for a public charger. Second, the municipality checks for a suitable location for this charger near the address of the requestee. Third, municipalities check, together with other actors, this location along a set of criteria to see if it is suitable for a public charger. Fourth, the municipality is responsible for making a traffic ordinance and to communicate this document to residents in the proposed area. Fifth, when no objections have been given on the traffic ordinance, the municipality informs the CPO that a charger can be placed. In this step any additional permits (e.g. digging permits) are given to the CPO as well. When there are objections for the proposed location of the charger, the municipality is responsible for handling these and to either come up with a comprise or find a new place for the charger. While the municipality is not the sole actor in this implementation process, it has a critical position because it is responsible for initiating this process and controlling it in many steps as well. This makes that the way this process is embedded in the municipal organization causes differences in lead times between municipalities *(sub question 1).*

Next, working experience in public charger placement, literature study and expert interviews were used to derive nine variables which were of expecting influence on the lead time for charger placement for municipalities. These were: (i) e-mobility goal, (ii) legal process, (iii) manpower, (iv) decision making, (v) available funding, (vi) knowledge, (vii) projection data, (viii) parking pressure and (ix) political support *(sub question 2).*

These variables were further explored with a case study approach. Cases were selected based on the results of a survey among MRA-e municipalities. This led to seven case studies at Dutch municipalities: (i) Haarlem, (ii) Houten, (iii) BUCH organization, (iv) Nieuwegein, (v) The Hague, (vi) Almere and (vii) Alkmaar. Aim of the case studies was to see if any of the nine variables were of influence on the found lead times. The different approaches for each variable at each municipality were compared to the found lead time to see which approach is most helpful in reducing this lead time (see table 23).

Table 23: Most effective approach per variable to reduce lead time

Variable	Best approach to reduce lead time
E-mobility goal	External set goals published in policy documents led to shorter lead times. Presumably these goals helped the performance of municipalities.
Legal process	(i) Placement of chargers during the objection period (small risk); (ii) Create traffic ordinances per neighborhood instead of per charger *('planning map' approach)*
Manpower	Designated personnel for e-mobility is more effective than those who are dealing with multiple projects at once.
Decision making	Less steps and less departments involved in decision making, makes this process more effective.
Available funding	Minimum funding enables municipalities to place chargers. Subsidy schemes from national and provincial projects often provide this budget.
Knowledge	Sufficient knowledge was already available at all municipalities that participated in this research. They gained knowledge from multiple sources like the VNG, NKL or their CPO's.
Projection data	Using this type of data provides insights in new and/or strategic charger locations

Parking pressure	Not including parking pressure in decision making reduces lead time
Political support	Political support for EVs frees up additional resources which can be used to optimize the implementation process

Also, the case studies provided insights in the existence of these variables by using the Multiple Streams Framework *(sub question 3).* Results from the case studies shows that the existence of a majority of the variables are caused by the political support from the municipal board. This support is used to get extra resources such as funding, manpower, knowledge and projection data for new EVs to improve the decision making process and to create work arounds for the legal process.
This mechanism works the other way as well. The lack of political support leads to the non-existence of multiple variables. This support is crucial to get extra funding and other resources to be able to optimize the charger placement process. Additionally, the municipalities are aware that when parking pressure is included in their decision making, this will result in a longer lead time. Therefore, they deliberately choose not to include this. This finding is in line with the expectations from the expert interviews, who suggested this variable next to literature study.

Recommendations
Based on the results of this research, recommendations to improve the process of public charger placement are formulated for Dutch municipalities and their policy makers. These are provided for each of the nine variables explored in this research and end with general recommendations *(sub question 4).*

Recommendations per variable

E-mobility goal
Set an external e-mobility goal for the municipality and publish this in a policy document. This goal can entail a number of chargers your organization wants to place in a certain time period or a number of chargers you want to place before a certain date. Because municipalities are obligated to have an e-mobility policy by 2020, this step could be incorporated while formulating this policy.

Legal process
The traffic ordinance is the component which bring the most delay to the implementation process for a municipality. Specifically the creation of a traffic ordinance per individual charger can be time consuming. Municipalities with a short lead time were successful because of using a planning map approach or placing chargers during the six week objection period. Using a planning map approach can be time consuming at the start, but will lead to a shorter lead time later on. Placing chargers within the objection period will immediately speed up the process because the six week waiting period is excluded, but involves the risk of removing the charger when an objection gets filed. In the end, the traffic ordinance should be a standardized step in the process of implementation, meaning municipalities should consider making these in batches (for example per 10 chargers) instead of per individual request or via a planning map approach at which they make an traffic ordinance for an entire neighbourhood.

Manpower & decision making
This research has shown that municipalities struggle with finding the right place for e-mobility in their organizational structure and that personnel is sometimes unaware of its responsibilities for e-mobility. Additionally, public charger infrastructure is often treated as a project instead of a structural element within the municipal organization. This can be overcome by (i) reducing the amount of projects in which current personnel on e-mobility is involved and assign specific personnel who can work on e-mobility. This will create ownership for e-mobility within the organization.(ii) Ensure continuity for the personnel working on e-mobility. Results of this research show turnover of personnel can be frequent (sometimes every few months) resulting in loss of knowledge and experience on this topic. (iii) Choose only relevant departments for your organization for e-mobility and improve the process from there. Practice has shown that municipalities with less departments involved had a shorter lead time. These only had one or two departments involved in the entire process.

Available funds
Due to the market effects of the last of years, the price for chargers is dropping (some CPO's even offer chargers for free), meaning that the costs involved are not substantial. Additionally, subsidy schemes from national and provincial projects are often sufficient to place public chargers with a minimal budget. However, having enough budget is no guarantee for a quick process. When this budget is only spend

on the chargers itself, a lot of potential is wasted. When possible, invest in extra knowledge and use projection data input to gain insight in future charger locations.

Knowledge
Currently, knowledge on charger placement criteria and basic technical knowledge is sufficient at all municipalities. However, a number of municipalities struggle when they encounter problems in the legal process. For instance when making a traffic ordinance or dealing with objections. This can be overcome by knowledge sharing between municipalities. Knowledge on public charger infrastructure is shared through multiple sources, like the VNG, NKL or can be gotten from the CPO's.

Projection data
The usefulness of this type of data is supported by the examples of Houten and The Hague. Using this type of data in general leads to a shorter lead time because of increased insights in potential charger locations. However, while the effects of this variable are clear, the financial requirement to get this data is often a barrier. An option is for municipalities to form a collective budget in order to afford such kind of investment.

Parking pressure
Not including parking pressure in the decision of placing a charger leads to a shorter lead time. The amount of EVs is growing rapidly, as seen in the introduction and the one parking spot municipalities 'lose' by placing a charger is going to be filled up quickly. By placing chargers placement without this criteria this will not only shorten the lead time, but speeds up the transition towards EV usage as well.

Political support
Looking at successful cases and expert opinions, political support is the foundation of a successful e-mobility policy with a short lead time. Having support of the municipal board will provide access to valuable resources that are needed to shorten the lead time on chargers. Beware of the policy entrepreneurs in your municipality (can be either citizens, policymakers or interest groups, or be the policy entrepreneur yourself). Use the data you have from the existing chargers in your municipality to show their importance and convince the municipal board of making resources available for e-mobility.

General recommendations

(i) Placement of chargers based on request by EV owners, which is the current standard among municipalities, appears not to be suitable for the long-term. Considering the rate of placement as stated in the introduction, the current way of placement upon request is too slow and too reactive. Municipalities who are still developing an e-mobility policy could consider leapfrogging placement upon request and start immediately with strategic placement, only placing chargers upon request as a complementing approach instead of a leading approach.

(ii) All Dutch municipalities should develop an e-mobility policy. This is currently not the case. Such policy should include a vision for all types of charging solutions, private, semi- private and public and should include charging options both within and outside the built up area within the municipal boundaries. Municipalities are obligated to have such policy in place before the end of 2020 as agreed in the NAL (NAL, 2019). This will help municipalities to get a better picture of what a public charger infrastructure entails and what is required by their own municipal organization. Additionally, (future) EV owners know what to expect from their municipality, which in turn can lead to more EVs, as seen in research by NKL (NKL, 2019).

(iii) Municipalities should consider connecting their e-mobility policy with the regional energy strategy (Regionale Energiestrategie, RES). E-mobility is part of the larger energy transition and does not stand on its own. For example, there are initiatives within municipalities to disconnect dwellings from the existing gas grid and to provide energy by heat pumps or solar power. By connecting e-mobility to these other energy transition projects, it will get a more solid foundation on the municipal policy.

(iv) Legal component of current implementation process takes up a lot of time, especially with the six week waiting period for objections. For an overall improvement this period should be

reduced. However, this is part of a national policy and municipalities have no influence on this. Municipalities could consider joining forces and make an appeal to the national government to shorten this period, in favor of the energy transition.

(v) Share knowledge and experience from the MRA-e project with other similar efforts in the Netherlands. Currently there are similar concessions in Brabant-Limburg, Gelderland-Overijssel and Groningen-Drenthe, but according the charging prognoses of Over Morgen these are lacking behind compared to MRA-e. These regions should of course not have to invent the wheel themselves, but can use the experience of others to developing a robust public charger infrastructure.

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Appendices

A: List of interviews

Table 24: Detailed information on expert interviews

Organization	Function	Date of interview
Stichting ElaadNL	Market analyst	12th of February 2019
Municipality of The Hague	Policy officer e-mobility	15th of February 2019
PitPoint	Realization manager	10th of January 2019
NKL	Policy writer	24th of January 2019

Table 25: Detailed information on case study interviews

Organization	Function	Date of interview
Municipality of Haarlem	Process manager & contract manager	5th of April 2019
Municipality of Houten	Program manager sustainability	12th of April 2019
BUCH organization	Coordinator Traffic & Transport	15h of April 2019
Municipality of Nieuwegein	Program leader Nieuwegein energy neutral & advisor environmental issues	23rd of April 2019
Municipality of Almere	Consultant Sustainable Mobility (hired by Almere through EV consult)	25th of April 2019
Municipality of Alkmaar	Policy advisor for Traffic	6th of May 2019

B: Survey questionnaire (In Dutch)

Beste gemeente,

Elektrisch rijden is inmiddels niet meer weg te denken uit het dagelijkse straatbeeld. Het aantal elektrische voertuigen neemt jaarlijks toe en vanaf 2030 zullen alle verkochte voertuigen in Nederland een elektrische aandrijving hebben. Om deze transitie voor iedereen mogelijk te maken dient er daarom, naast de oplaadpunten op eigen terrein, een publiek netwerk van laadpalen te worden gerealiseerd. Omdat het hier de publieke ruimte betreft is dit een taak van de gemeenten. Echter, niet elke gemeente hanteert dezelfde werkwijze en heeft dezelfde instrumenten tot zijn beschikking om deze laadinfrastructuur te realiseren.

Deze enquête is onderdeel van een Master Thesis afstudeeropdracht voor de Masteropleiding Sustainable Development aan de Universiteit Utrecht. Doel van deze enquête is het verzamelen van initiële data van gemeenten in hun beschikbare instrumenten en hun visie op het realiseren van een publieke laadinfrastructuur. Op basis van deze data zullen in een vervolgstap enkele gemeenten worden gekozen om nader in te gaan op specifieke ervaringen. Om deze selectie te kunnen maken vraag ik u daarom om bij vraag 1 uw organisatie te selecteren. Data van uw organisatie is niet zichtbaar voor andere deelnemers en zal vertrouwelijk worden behandeld.

Het invullen van deze vragenlijst duurt ongeveer 10 minuten en uw input is van grote waarde voor het vervolg van het onderzoek.

Alvast bedankt.

Sjors van Mourik
Universiteit Utrecht - Master Sustainable Development

Vragenlijst
Vraag 1: Organisatie
<selecteer uw antwoord >

Vraag 2: Hoeveel FTE's *(full time equivalent)* zijn er binnen uw organisatie werkzaam die zich bezighouden met het realiseren van publieke laadpalen?
<vul uw antwoord in>

Vraag 3: Hoeveel budget (€) was er in 2018 binnen uw organisatie beschikbaar voor het realiseren van publieke laadpalen? (Indien definitieve gegevens voor 2018 nog beschikbaar zijn, geef een schatting)
<vul uw antwoord in>

Vraag 4: Is er binnen uw organisatie een financieringsplan voor de komende 5 jaar voor het creëren van een publieke laadinfrastructuur?
<ja>
<nee>

Vraag 5: Hoeveel ervaring, gemiddeld per persoon, heeft het huidige personeel binnen uw organisatie dat zich bezighoudt met het realiseren van publieke laadpalen?
<0 tot 6 maanden>
<7 tot 12 maanden>
<13 tot 18 maanden>
<19 tot 24 maanden>
<langer dan 24 maanden>

Vraag 6: Stelling: Onze organisatie beschikt over voldoende kennis over het realiseren van publieke laadpalen om dit effectief te kunnen uitvoeren.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 7: Stelling: Het personeel verantwoordelijk voor het realiseren van publieke laadpalen binnen onze organisatie heeft de vrijheid om zelf beslissingen te nemen in dit proces, zonder de tussenkomst van een leidinggevende of interne toets.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 8: Stelling: Bij het plaatsen van een publieke laadpaal gaat het publieke belang van deze voorziening boven eventuele bezwaren van omwonenden.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 9: Onze organisatie heeft een doelstelling opgesteld om een X aantal laadpalen per jaar te realiseren.
<ja>
<nee>

Vraag 10: Onze organisatie heeft een doelstelling opgesteld om een X aantal laadpalen in jaar Y te realiseren.
<ja>
<nee>

Vraag 11: Stelling: Het realiseren van publieke laadinfrastructuur is een prioriteit voor onze organisatie.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 12: Stelling: Wanneer onze organisatie een aanvraag krijgt voor een publieke laadpaal, dan is ons doel om deze zo snel mogelijk te plaatsen.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 13: Stelling: Wanneer onze organisatie een aanvraag krijgt voor een publieke laadpaal, dan is ons doel om deze zo nauwkeurig mogelijk af te handelen.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 14: Stelling: Het realiseren van publieke oplaadpunten binnen onze gemeente wordt bemoeilijkt door een gebrek aan beschikbare parkeervakken.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 15: Stelling: Onze organisatie heeft een duidelijk beeld over op welke plekken een publiek oplaadpunt noodzakelijk is.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 16: Stelling: Als gemeente hebben wij een duidelijk beeld in welke mate het aantal elektrische voertuigen binnen onze gemeente toeneemt.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 17: Stelling: Onze organisatie is in de huidige situatie niet in staat om het aantal aanvragen voor publieke laadpalen op tijd te kunnen realiseren.
<Helemaal mee eens>
<Mee eens>
<Neutraal>
<Oneens>
<Helemaal mee oneens>

Vraag 18: Vragen of opmerkingen

Heeft U n.a.v. deze vragenlijst nog vragen of opmerkingen, dan kunt u onderstaand veld gebruiken of kunt U contact met mij opnemen op onderstaand e-mail adres:

s.mourik@students.uu.nl

C: Interview list case studies

Table B: Interview questions per variable for the case studies

Variable	Question(s)
E-mobility goal	Was the decision for the current EV policy based on an e-mobility goal? Or perhaps vice versa? What was/were the reasons(s) for this decision? Was there a certain individual or political party who pushed on this decision?
Legal process	Did the decision for the current EV policy included a strategy to overcome legal obstacles? Such as the ability to protest etc. What was/were the reasons(s) for this decision? Was there a certain individual or political party that pushed on this decision?
Manpower	How did the decision came about for the amount of manpower on your current electric mobility policy? What was/were the reason(s) for this decision? Was there a certain individual or political party who pushed on this decision?
Decision making process	How does the decision making process for charger placement looks like in your municipality? Who has which role and which tasks are a part of this? How many people are involved? Who takes the final decision to place a charger? (is this one person, or multiple?) What was/were the reason(s) to design the process like this? Was there a certain individual or political party who pushed on this structure?
Available funds	How did the decision came about for the amount of available funding on public charging infrastructure in your municipality? What was/were the reason(s) for this decision? Was there a certain individual or political party who pushed on this decision?
Knowledge	How did the decision came about to decide whether you want to have the knowledge in-house or to hire a consultant for this topic? What was/were the reasons(s) for this decision? Was there a certain individual or political party who pushed on this decision? Which sources do you use to get information on charger placement?
Projection data	Was the decision for the current EV policy based on input of the likelihood of new electric cars within the municipality? What was/were the reasons(s) for this decision? Was there a certain individual or political party who pushed on this decision?
Parking pressure	Is parking pressure part of your current decision making to place a charger? What was/were the reasons(s) for this decision? Was there a certain individual or political party that pushed on this decision?
Political support	Was there any political support within the municipality for the current EV policy? Can you explain in which way this political support caused the current policy to emerge?
Lead time *(aimed towards recommendations)*	Is a short lead time a priority for your municipality? What do you think is the biggest obstacle in shortening the current lead time in your municipality? If applicable: What do you, as a municipality, need in order to achieve a more efficient implementation process?

D: Example of project data usage

The image below shows an example of a planning map, which was made using projection data. The image shows for the municipality of Houten, the amount of new EVs predicted by the year 2020 (image from 2017) and specifies this by neighborhood. Input like this was used by the municipality of Houten to decide on new charger locations, before the requests were even done.

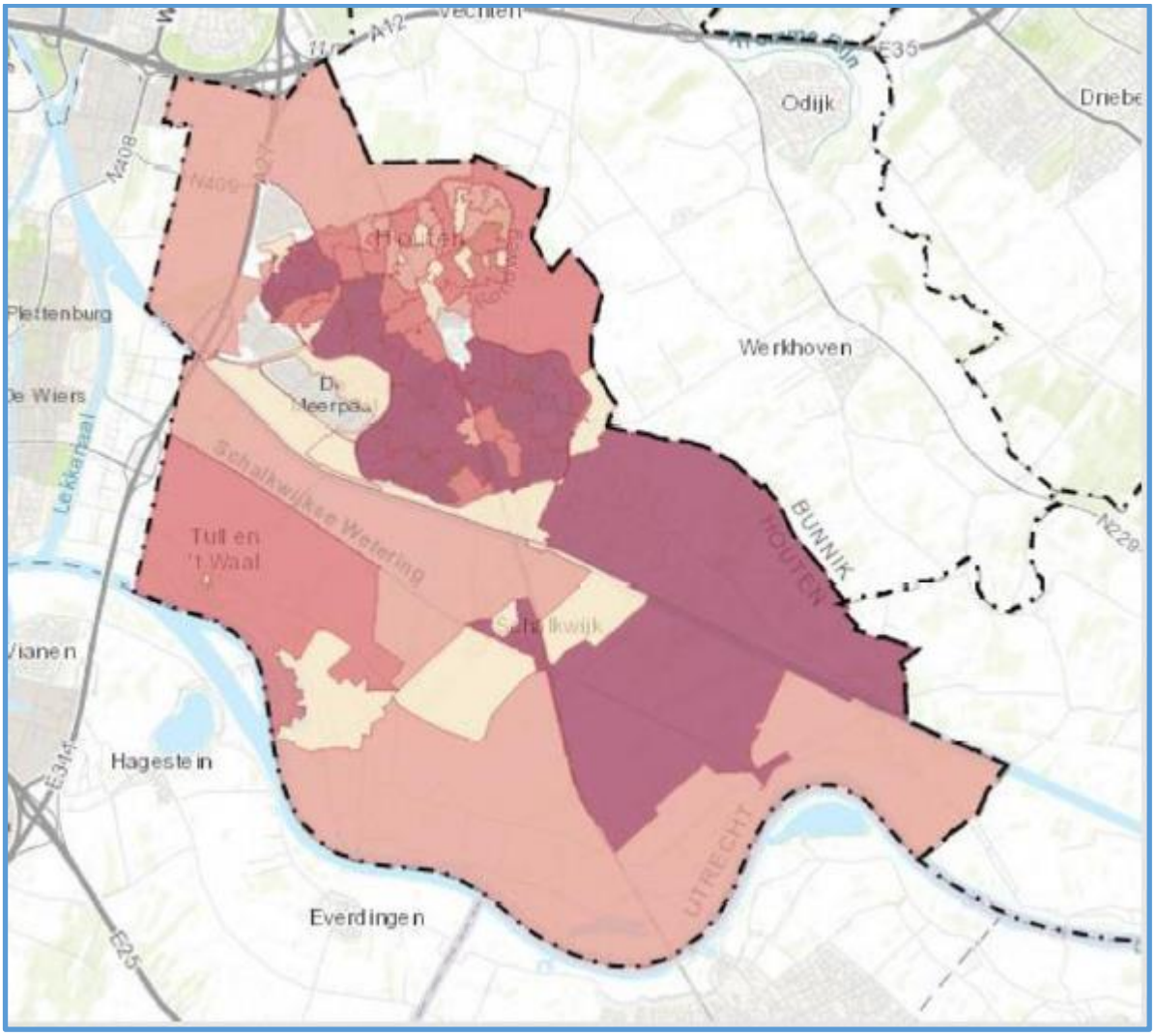
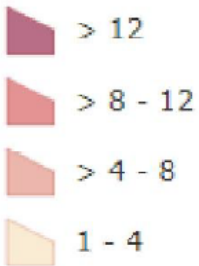


Figure 25: Example of projection data usage by the municipality of Houten

Legend:
Number of cars by 2020.



E: Results per case study per variable

Table E shows helping, hindering or neutral effect of the variables for each municipality. A quote or short description is given to indicate why a certain score is given.

Table 26: Overview of the hindering, helping or neutral variables for municipalities in their implementation process of public chargers. *Per variable a short description or quote is given to explain why a certain score is given.*

Legend:

	Helping
	Neutral
	Hindering

Case study	E-mobility goal	Legal process	Manpower	Decision making process	Available funding	Knowledge	Projection data	Parking pressure	Political support
									
Haarlem	Internal goal to place 350 to 400 in coming 5 years	Lots of objections, because of own efforts of municipality to include residents. This approach has been dropped, but consequences still remain.	Backlog of requests for public chargers, more manpower needed. This is a consequence of the approach from the municipality (see Legal process).	Involves 1 person (interviewee), this makes the process quicker.	GroenLinks is the largest party in the municipal board, freed up funding for coming years to place chargers	''Experience by doing, also knowledge from MRA or CPO if needed.''	''We don't use data for this, just common sense. There is more chance new electric cars are bought in the richer neighborhoods.''	''Haarlem does not experience a parking space availability problem as such, only when some requests conflict with the parking space availability then this becomes a problem.''	GroenLinks is the largest party in the board, it freed up funding for coming years to place chargers
Houten	External goal in policy plan public charging infrastructure; 75 additional chargers by 2020	Houten chose to use a planning map; pre selecting charger locations in advance in order to speed up the process of the traffic ordinance. But this took up a lot of time upfront.	''We have one person working on the topic for one day a week. Good for now, but uncertain from 2021 onwards.''	''The one person working one day a week on this is also the person with the final responsibility, without the need to report to a senior. This speeds up the process.''	Municipal board freed up budget. ''Budget sufficient for the coming years, also the price for chargers is dropping, making this a less relevant issue.''	''We get knowledge from Over Morgen to create the planning map, all other knowledge on this topic we got internally because we are placing chargers since 2010.''	Houten uses data from Over Morgen to get insights in new electric car ownership. It also believes its unique characteristic (Houten is a relatively new city) helps in the even spread of electric car ownership and not just specific neighborhoods.	''Due to the increase of cars in the city, there is starting to get an increase in parking pressure among all neighborhoods. However, we do think we have enough available parking spots right now, it is mainly the sentiment of 'losing parking space' by residents when a charger is placed.''	''The planning map approach was a so-called 'hammerpiece' at the board. Meaning it did not need a debate, but was immediately approved by the board.''
BUCH	Neither internal or external goal	BUCH experiences a slow traffic	''Personnel switches quickly on	''Working together with 4	''BUCH is a cooperation between 4	BUCH gets the knowledge	''Of the four cities, Heiloo and Bergen	''I do not agree with the sentiment of	BUCH municipalities have a VVD

		ordinance process, which is further enhanced by a poisoned cooperation with the police who is also involved in the process.	this topic, but we have sufficient capacity for now.''	municipalities, but still they have different approaches'' ''Our process is further delayed by a bad relationship with the police, all in all I think the process involves too many layers.''	small cities with different budgets, meaning different contributions. In addition, it is not clear who has the final responsibility on paying the bills''.	from lots of different sources (MRA-e, CPO, Over Morgen, websites) and believes it has sufficient knowledge to successfully place chargers.	have the most cars and the more expensive cars, so my gut feeling tells me these places need more chargers then Uitgeest and Castricum.''	resident that we are removing parking spaces. We are only changing the designation of the spot.'' In addition, BUCH states it still needs to learn to communicate this properly to residents.	majority, but do not actively stimulate electric driving. So electric mobility is a passive topic for the boards.
Nieuwegein	External goal to place 130 chargers by 2021. This is a priority for Nieuwegein	''We do not experience a lot of objections in current approach, but six weeks is a lot of time to waiting, if this can be shorter that would be nice.''	''This topic takes about a quarter of my time right now, so 0,25 FTE. This is sufficient for now, but seeing the growth of the topic this can become insufficient quite soon.''	Involves two people: interviewee and traffic expert of Nieuwegein. Interviewee is person with the final responsibility. Also, Nieuwegein changed the requirement of chargers being within 250 meter of each other to 100-150 meter.	''Our CPO places the charger for 0 euro, so we have minimal costs. In addition the route map freed up sufficient budget for the future.''	Nieuwegein gets the knowledge for placement from their CPO, but also gains experience by doing. Personnel responsible does not experience a lack of knowledge.	''We thought about using a planning map approach, like Houten, but did not have the capacity. We are talking with Park&Charge about possible other approaches, so we do have the data, but still need to find a way to use it.''	''The argument of parking space availability, is always an argument from the residents. Therefore, we always ask the requestee for their preferred location to take the path of least resistance.''	''The board knows electric driving is something for the future, so it wrote the road map towards 2040 and freed up budget to achieve this. ''
Almere	Neither internal of external goal. ''Setting a goal is dangerous, you can place chargers at unwanted places, just to	''Helping because we now declare two parking spaces per charger instead of one. Hindering because we get a lot of objections for	''Shortage on capacity till 2018, we have way less personnel compared to similar sized cities. If Almere wants to get proactive	It is unknown who the owner is for each specific part of the process within the organization. Also no ownership of the process at	''I need to fight for funding for chargers, let alone more capacity and or manpower.''	''We hired consultants from EV consult who work at the municipality for one day in the week.''	''We use planning maps to inform the municipal board on the importance of electric driving and they are slowly using this in their decisions.''	''Parking pressure is something that is experienced in different ways. In the past the municipality had the tendency to always follow this emotion	''Municipal board is reactive, most of the time it reacts to objections or other legal stuff. It shows no intention to become proactive in the coming

	reach your numbers.''	charger locations.''	instead of reactive we need more personnel.''	one specific department within municipality.				and look for alternatives. Now we rarely include parking pressure anymore in our decision process.''	period, which is does need to become.''
The Hague	Internal goal to place 1000 chargers in a 4 year period.	''We give a charger the same legal status as a waste bin or a park bench, this helps in reducing the amount of objections.''	''Including myself we have 4 to 5 FTE on the topic. I don't understand other municipalities don't do the same.''	Our process includes about 3 people, me (responsible for location selection), a traffic specialist and someone from the legal department.''	''We get a budget from the municipal board. This helped us a lot in the start, but now when the project is almost over.''	''We get our experience from doing, also knowledge from ElaadNL and other departments with our municipal organization.''	Over Morgen provides us with data on the need for chargers for neighborhood. This data was then provided to the board as input for our current policy.''	'In order to avoid protest, we do not seek contact with residents. We just place the charger. Also, I think in the larger cities, people care less about these things.''	The board let us operate beneath the radar, which helps us, because they believe in our approach, resulting in less pressure.''
Alkmaar	Only internal goal to place 220 chargers by 2020.	'We try to publish as less as possible, besides the legal obligation, to avoid objections.'' ''We changed the requirement of 250 meters, to 150 meter.''	'It takes me about half a day a week to get the work on e-mobility done, and don't foresee a shortage of personnel soon'	'It is mainly me who makes all the decisions for charger locations etc. I do get some support from legal for objections, but that's it.'' ''But the process overall (so including those outside the municipal organization) involves too many parties.''	'Thanks to the efforts of our former traffic alderman, the municipal board freed up a more than sufficient budget to place a large number of chargers. Also, the current price is quite low due to subsidies.''	''Knowledge is something you gain by doing, and knowledge for placement is no rocket science. I do however, lack the technical knowledge sometimes so then I refer to our CPO.''	''We used data from Over Morgen to make a map of our city with potential locations. Besides some practical issues, this was helpful for us to see to growth of chargers for the future.''	''We always use the parking pressure monitor when we are placing a charger and to take this into account. But this is no strict requirement. It does happen sometimes that we place a charger with only 1 spot instead of 2.	E-mobility is not really a hot topic in our municipal board. They freed up the necessary budget, but there is no specific goal. The board knows this is a topic for the future and needs to be supported, but is not actively involved.''

Legend:

	Helping
	Neutral
	Hindering