



Smart and sustainable mobility: two different worlds?

A multiple case study about the governing of smart mobility practices to reduce the
environmental impact of mobility

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Master's thesis in the Spatial Planning programme – Urban and Regional Mobility

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Summary

In the last decades sustainable mobility and smart mobility have become two dominant domains, in both academic research and in the practice of urban and regional mobility planning. The two domains certainly show some similarities, regarding the vision, objectives, plans and programs that are involved, but they also show some differences. This thesis explains that sustainable and smart can relate to each other in different ways and argues that sustainable should be predominating the smart domain; that smart should be the means and sustainable the end. That this is not always the case nowadays, is explained with help of different perspectives on smart cities and smart mobility. These can be summarised as either technology-centric or citizen-centric. From a citizen-centric perspective it is crucial to consider human well-being and the environment. As the focus is on the consequences of mobility, smart mobility should aim at reducing CO₂-emission and energy use, and improve the quality of living.

Local governments play a crucial role in the development of smart mobility. Many new concepts and projects are initiated on a local scale and benefit from governmental support in different ways. Public authorities are required to determine what type of smart mobility initiatives are desirable and deserve support. In this playfield of smart mobility, public authorities can take on different roles. Which role is suitable depends on the context, no general recommendations can be formulated about that. Therefore, in this thesis a multiple case study is executed to explore different contexts of smart mobility initiatives and to discuss the role of the local governments in these.

The cases that have been studied are located in the Dutch cities Eindhoven and Utrecht, both large cities but with their own characteristics and problems. In Eindhoven a closer look is taken upon Mobility-S, the public-private partnership that plans, regulates and innovates mobility on Strijp-S, and the upcoming pilot for Mobility as a Service, in which the municipality of Eindhoven is launching customer. In Utrecht the program Smart Solar Charging is analysed, which combines solar energy generation with electric shared cars on different locations, and the program Multimodal Accessibility of Utrecht Science Park, where smart mobility initiatives are limited so far but where one can find a lot of potential for discussion.

A number of important lessons is learnt after executing the case studies in Eindhoven and Utrecht. One lesson concerns the role of the local government, which may differ depending on the context. During the research different roles came across, the one not explicitly more useful or successful than the other. Local authorities can be very present, take an active role by initiating projects or by strict regulation. On the other hand they can be less present, nonetheless playing an active role but particularly on the background, by funding and otherwise supportive measures. In the latter case

initiatives come from market parties or from society and public authorities can decide to join in as a participating government. In between are some more mixed perspectives on governments' actions. All models of those government roles are found during the case studies, but this does not lead to general recommendations, except that it is important for local public authorities to decide what is their strategy.

Another important lesson is about the vision of local governments on smart and sustainable mobility. If environmental concerns are taken serious by a municipality, and if she strives to a better quality of living for their citizens, the negative environmental consequences of our mobility system should be minimalised. Hence, the sustainable domain should be prevailing the smart domain. New and smart applications of technology in the field of mobility are more than welcome, but they should always contribute to a more sustainable mobility system, to a better environment. That is the message that local governments, in sake of their citizens, should spread and that is the vision they should comply with.

Preface

Slightly more than one year ago, I started with the master Spatial Planning at Radboud University. Choosing one specialisation course was hard for me, I doubted between a course about Cities, Water and Climate Change and a course about Urban and Regional Mobility. Eventually I decided to follow both and, somewhat later, to write my thesis about a subject that would fit in both specialisations: sustainable mobility. In consultation with my supervisors at Sweco, the company where I did an internship, I came to the idea to focus on new, so called 'smart', mobility concepts and the sustainability components of these.

The process of delineating my research was not easy, since the field of new mobility concepts is emerging rapidly and a lot of interesting projects caught my attention. Also, the question to what extent I was going to operationalise sustainability in my research was a question I had to address. I was tempted to, and did, take several side-paths to study topics as car-free cities, zero-emission distribution and other interesting topics. All connected to sustainable mobility, but to a lesser extent relevant to study in the light of this research.

My internship supervisors at Sweco, Rob van Hout and Jeroen Quee, helped me delineating my research and also they thought along about the case studies I executed. Their experience in the field and their connections helped me finding the right persons to talk to. Moreover, they helped me to find my way in the organisation of Sweco. I would like to thank them for that. I would also like to thank my thesis supervisor Professor Henk Meurs. With his constructive feedback and sharp questions he pointed me in the right direction when that was needed.

After a period of over six intensive months I am glad my thesis is finished and I am happy to present it. I hope that the vision I present in the thesis will become more widespread the coming years. Hopefully I can contribute to this when I start working for Sweco, which I am really looking forward to.

Table of contents

1. Introduction.....	1
1.1 Problem statement.....	1
1.2 Research questions	4
1.3 Scientific relevance.....	5
1.4 Social relevance	6
2. Theoretical framework	7
2.1 Smart cities	7
2.2 Governance of smart cities.....	8
2.2.1 Governance	8
2.2.2 Four perspectives on the role of the government	9
2.2.3 Participation and collaboration in the smart city discourse	10
2.3 Approaches to smart cities.....	12
2.4 Sustainable mobility	14
2.5 Conclusion	15
2.6 Conceptual framework.....	16
3. Methodology	17
3.1 Research philosophy	17
3.2 Case study.....	18
4. Case study	20
4.1 Eindhoven.....	20
4.1.1 Policy ambitions of Eindhoven	20
4.1.2 Eindhoven as smart city.....	21
4.1.3 Smart Mobility in Eindhoven	23
4.1.4 The relation between smart and sustainable mobility in Eindhoven.....	28
4.2 Utrecht.....	31
4.2.1 Policy ambitions of Utrecht	31
4.2.2 Utrecht as smart city	33
4.2.3 Smart mobility in Utrecht	35
4.2.4 The relation between smart and sustainable mobility in Utrecht	41
5. Findings	43
5.1 Relations between smart and sustainable mobility	43
5.2 Smart sustainable projects in Eindhoven and Utrecht.....	45
5.2.1 Eindhoven.....	45
5.2.2 Utrecht.....	46

5.3	The role of local governments: a reflection	47
6.	Conclusions.....	50
6.1	Conclusion and policy recommendations	50
6.2	Reflection and recommendations for further research	52
Literature		53

1. Introduction

1.1 Problem statement

The current trend of urbanisation puts high pressure on the available space in cities. Urbanisation is expected to continue the coming decades, resulting eventually in a situation where almost 70% of the world population will live in urban areas in 2050 (OECD, 2012). For the countries of the European Union, this was already 72% in 2014 (Eurostat, 2016). This growing concentration of people gives rise to major challenges related to economic prosperity, social well-being and the environment in cities (Ahvenniemi, Huovila, Pinto-Seppä, & Airaksinen, 2017). Focussing on mobility in this sense, the primary concern is the increase of traffic. Since more people will be living in urban areas, there will automatically also be more movements of people, travelling to and from their destinations in these areas. This is a major challenge for urban planners, especially in already crowded and congested cities, knowing that there is a continuing upward pressure on the travel system from urban population growth (Lyons, 2016).

Except congestion, cities also have to deal with the environmental impact of mobility. The movement of people has major implications for energy use and emissions (Lyons, 2016). Approximately 20% of all CO₂-emissions in the European Union originates from the transport sector and the sector accounts for about 33% of all energy consumption (Berger, Feindt, Holden, & Rubik, 2014). Within the transport sector, urban mobility accounts for a high amount, almost a quarter, of the CO₂-emissions (EC, 2013). Therefore the European Commission calls for a significant reduction of greenhouse gas emissions (GHG) and energy use in their White Paper on Transport (EC, 2011). With the underlying ambition to limit climate change below 2°C, “the EU needs to reduce emissions by 80-95% below 1990 levels by 2050” (EC, 2011, p. 3). The transport sector is required to reduce at least 60% of the emissions by 2050.

The subtitle of the White Paper, “Towards a competitive and resource efficient transport system”, indicates that the ambition of the European Commission is twofold: urban transport should enable economic growth, but also diminish its energy use and emissions. The Commission mentions innovation and technology as important possibilities to reach these goals. Research and policy should support technological improvements, as these will contribute to a more efficient and sustainable transport system, is the belief (EC, 2011). In the broader field of research and practice of transport planning there has been an increasing consensus over the last decade that innovative technologies can have positive effects for urban mobility (Lyons, 2016). The belief that modern technologies can help improving urban mobility systems, or urban systems in general, resounds in the concept of ‘smart mobility’, or ‘smart cities’ more generally spoken.

The number of publications and programmes regarding smart cities has considerably increased since 2010, after the EU started embracing and supporting smart city projects (Ahvenniemi et al., 2017). What one understands exactly as smart cities differs. Whole studies have been executed to compare, combine or criticise definitions and implementations of smart cities. However, the role of technology seems to be regarded as one of the key elements of the concept (Albino, Berardi, & Dangelico, 2015; Bolivar & Meijer, 2016; Caragliu, Bo, & Nijkamp, 2011). The most, so to say, basic notions of a smart city are thus 'technology-centric', but different approaches have evolved over time (Martin, Evans, & Karvonen, 2018). As Lyons (2016, p. 2) mentions, the "[...] interpretation now extends beyond being technology-centric to (also) recognising people and community needs". Martin et al., (2018) state that the concept has recently been connected to visions on sustainable cities. In line with this, smart city visions offer possibilities to achieve social equity and environmental protection "in parallel with digitally catalysed economic growth" (Martin et al., 2018, p. 2). There is more attention for the broader positive effects of smart cities in this sense.

However, there are serious concerns regarding the component of sustainability within current visions on smart cities. Lyons (2016, p. 2) states that "sustainability is often but not always referred to in definitions of smart cities. Martin et al. (2018, p. 2) add, based on a literature review, that the smart city concept "as a whole does not emphasise concerns of sustainability". To illustrate their point, they mention five tensions between visions on smart and sustainable cities. One of tensions is that the use of technologies to integrate and optimise infrastructure leads to majors gains in efficiency, but that the proclaimed environmental protection can be criticised as a form of 'greenwashing'. The focus on realising efficiency savings leads to a tendency that the reduction of environmental impacts is often neglected in smart city visions (Martin et al., 2018).

Moving back to the transport sector, it is thus questionable whether a focus on innovation and technology has a positive (read: diminishing) effect on the environmental impact of urban mobility. Lyons (2016) argues that the lens of transport planners may have become too much technology-centric and that sometimes technological opportunities may become "solutions looking for problems" (Lyons, 2016, p. 5). Leaving the main environmental concern of urban mobility nowadays unaddressed, which is to reduce energy use and emissions. Some critiques are even more fierce, stating that smart mobility practices may lead to more energy use and emissions (Ringenson & Höjer, 2016). Their argument is that certain smart mobility initiatives will make urban transportation more efficient and comfortable, resulting in increasing travel demand and more car use.

Therefore, Papa & Lauwers (2015) argue that the concept of smart mobility should go beyond innovative technological solutions. Urban mobility systems that are truly smart take advantage of technology to improve quality of life and the process of decision-making. Going beyond technology

and aiming for quality of life and sustainability ambitions is what Papa & Lauwers (2015, p. 543) call “smarter mobility”. Put differently, they state that mobility innovations have to include sustainability and quality of life planning in its goals and planning practice. This requires a collaborative and cross-disciplinary approach to mobility and city planning. Inspired by Gehl’s ‘city as a place’-approach (Gehl, 2010), Papa & Lauwers plead for a “citizen-centric approach” to smart mobility. When policy measures are formulated or implemented, their evaluation should not be solely based on consequences for the mobility system, but on the consequences for the urban system and the lives of citizens in general. Following this approach, smart mobility can deliver more sustainable mobility and, in the end, a sustainable, prosperous and inclusive future for urban citizens.

1.2 Research questions

It becomes clear that the relation between the concepts of smart and sustainable mobility is disputed. As Lyons (2016) states, policymakers should be mindful of this relation and how it evolves. Governments, on all different levels, have embraced smart mobility initiatives, while the contribution to sustainability is unclear (Haarstad, 2017). As described above, smart mobility initiatives do not self-evidently reduce the environmental impact of mobility and even can result in an increasing impact. For many governments, it is far from clear how they can or should adopt smart mobility initiatives and how these can contribute to broader goals, such as inclusiveness or sustainability. The aim of this research is therefore to contribute to the knowledge of governing smart mobility practices, with a focus on the environmental effects. More specifically, the research objective is as follows:

This study will gain insights in how local governments can govern smart mobility in a way that it reduces the negative environmental effects of mobility, in order to formulate policy recommendations for urban mobility planning that is smart and sustainable.

Following the research objective formulated above, the main research question of this study is:

What roles can local governments take on and which instruments can they use to govern smart mobility practices and how do these factors influence the environmental impact of urban mobility?

To come to a well-considered answer to this question, the following sub questions need to be answered:

- Where do the concepts of smart mobility and sustainable mobility collide and where do they correspond to each other?
- What are possible roles a local government can take in the broader smart city framework and how can these roles be applied in the smart mobility framework?
- How do the local governments of Utrecht and Eindhoven shape/steer the governance of the smart city framework and how are key stakeholders involved?
- How do the local governments of Utrecht and Eindhoven regard the opportunities of smart mobility for their cities and how are these connected to environmental benefits?
- Which role and instruments do the local governments of Utrecht and Eindhoven take to govern smart mobility initiatives and how does this influence the environmental impact of urban mobility?

1.3 Scientific relevance

The field of smart mobility is one that is being studied increasingly over the last decade (Ahvenniemi et al., 2017). A large share of the studies focusses on the technological aspects of smart mobility and how this can improve the efficiency of urban mobility systems. But, as Lyons (2016) states, technological sophistication should not be the main point of attention. Multiple goals are applicable to an urban mobility system; effectiveness is not the only objective. Another one is sustainability. The relation between smart mobility, or smart cities in general, and sustainability is nevertheless a fewer studied topic.

Little academic literature about smart cities addresses the energy and environmental sustainability problem in general, indicate Chatfield & Reddick (2016). Their literature study points out that many aspects of smart cities have been studied, such as the role of citizens in smart city planning, geographic information systems (GIS) for smart city management, the use of data and sensors in smart cities and location-aware government services in smart cities. But, the researchers conclude that these studies “did not address the critical nexus between smart cities and environmental sustainability. In consequence, these studies failed to view smart city implementation as a potential innovative solution to the growing environmental sustainability problems faced by urban cities and communities” (Chatfield & Reddick, 2016, p. 760).

This research is conducted to gain more insights in this possibility, in the relationship between smart and sustainable mobility. Important aspirations were to analyse what aspects of smart and sustainable collide and what aspects correspond to each other. The scope of this research is more specifically directed at the governance of smart mobility. This approach will offer some new insights about how local governments could act if they strive to reduce the environmental impact of mobility. The relation between the two concepts is analysed in theory, but thereafter this study also provides insights from practice, since a multiple case study is conducted. The large Dutch cities Eindhoven and Utrecht will be investigated. Lessons learnt from these cases are translated into policy recommendations and recommendations for further research.

1.4 Social relevance

Mobility is a basic human need and gives us access to places, where we can participate in activities and fulfil our needs. On the other hand, mobility also has significant negative externalities, such as emissions and energy use. Because of this, mobility is a large contributor to climate change. Governments at all levels are nowadays concerned with climate change mitigation policies, aiming at reducing the effects of human action on the environment. Urban mobility is therefore an important subject to take along in order to meet certain climate mitigation objectives, such as decided upon in the Paris Agreement for example.

As said, the ability to freely move around between locations, and to be able to participate in activities is a basic human need. Mobility offers this opportunities and is therefore of crucial importance. The current trend of urbanisation put high pressure on urban mobility, in other words the ability to move around quickly is in danger. Technological improvements can offer solutions for this, but it is important to take social and environmental consequences into consideration as well when implementing new measures. This research contributes to the knowledge that is needed for local governments about how to implement smart mobility in a way that it contributes to the broader goal of ecological sustainability.

On this point, a certain hesitation and indecisiveness is noticeable amongst policymakers. Local governments are searching for their own understanding of smart mobility and what it has to offer their cities and surroundings. They are wrestling with questions such as how to apply smart mobility in their policy, how to take a position in the governance playfield and what they should aim for. This study provides examples of smart mobility practices in relation to the environment. In that way, it shows that smart mobility can have different objectives and different outcomes. Local governments can, by taking a certain stand, influence the playfield of smart mobility and hence influence the impact it can have on urban mobility and the environment. This study eventually formulates policy recommendations for local governments who aim at reducing the environmental impact of urban mobility.

2. Theoretical framework

In this paragraph, the concepts that are central in this study will be introduced and provided with some fundamental theoretical backgrounds. The first section will elaborate on the emergence of the smart city concept in the broader field of urban planning. This is followed by a review about the governance aspect of smart cities. Although not the focus of this thesis, some ethical considerations related to the governance aspect will shortly be discussed. The next section analyses different approaches to smart cities and smart mobility. After this, the discourse of sustainable mobility will be discussed. The final part of this chapter brings the two concepts together and studies more in depth what the contradictions and similarities are between those concepts. The chapter ends with answering the first sub question of this research.

2.1 Smart cities

The concept of the smart city has evolved rapidly over the last decades into a key pillar or strategy in many policies. However, the rise in popularity of the concept has been accompanied by an increase of discussion and debate about it. Both academics and planners indicate smart cities as a ‘buzzword’, without any significant meaning. Haarstad (2017) calls these kinds of concepts ‘empty signifiers’. Such concepts leave room for different interpretations, hence there are many of them. This section will shortly provide an overview of the different interpretations of smart cities.

Albino et al. (2015) describe the emergence of the smart city concept, that was first used in the 1990s. They explain that the focus in the first years was on the importance of new ICT for modern infrastructures in cities. As explained in the introduction chapter, this strong orientation towards technology was the most common approach these days. The belief in smart cities was (and in many cases still is) based on the persuasion that diffusion of ICT throughout cities can stimulate economic growth, by increasing efficiency and thereby competitiveness of urban systems (Caragliu et al., 2011). Hollands (2008) also emphasises that ICT plays a key role in smart cities, but points out that there are many different meanings related to the smart city concept. One meaning could be, for example, “the application of a wide range of electronic and digital applications to communities and cities”. Another meaning could regard smart cities “as spatial territories that bring ICTs and people together to enhance innovation, learning, knowledge and problem solving” (Hollands, 2008, p. 305). The many different definitions that are present, can be explained by the presence of multiple approaches towards smart cities. Section 2.3 will elaborate on these different approaches. First, section 2.2 discusses the governance of smart cities, as well as some ethical considerations.

2.2 Governance of smart cities

A crucial aspect of smart cities, in order to meet its objectives of creating a better quality of life and reducing their environmental footprint, is that of well-conceived and effective governance frameworks. Dameri & Benevolo (2016) state that this is a relatively under-studied field, compared to aspects of smart cities such as information technology. Smart cities are not only about the technological dimension, but also have a dimension that highlights the role of institutions and the community (Nam & Pardo, 2011). This section will explore what, according to relevant academic literature, is important when studying the governance aspect of smart cities, and more specifically smart mobility.

2.2.1 Governance

Dameri & Benevolo (2016) have carried out an extensive literature review around the governance aspects of smart cities. According to them, “Governance refers to the relationships among individuals, interest groups, institutions, and service providers in the ongoing business of government” (p. 695). However, it is not only about the subjects and actors involved. The exercise of governance also encompasses mechanisms, instruments and processes. To illustrate this, they distinguish “formal political instruments, such as laws, rules, municipal ordinances, and territorial policies, and noninstitutional mechanisms, such as public–private partnerships, subsidiaries, negotiations, citizen participation, the role of the so-called ‘civil society’, and many of the ways in which subjects other than institutional bodies cooperate to lead a community” (p. 695). Smart city movements are generally characterised by a shift in responsibility, where the municipality steps back and different stakeholders are more involved.

In the light of this discourse, it is interesting to distinguish different roles a local government can take on. Geerlings, Lohuis & Shiftan (2012) plead for policy integration, that consists of policy cooperation and coordination. This is important, according to them, to avoid policy conflicts and to create more efficient policies and synergies between policies. In such cooperation, Geerlings et al. (2012) emphasise inter-organisational cooperation. This poses questions to the different roles a government can take on in such cooperations. According to Rhodes (2012), in the coordination of governance the state can ‘govern governance’ in three ways. The state can set the rules of the game (regulation), use storytelling to steer other actors (organise dialogues, foster meanings and beliefs), and distribute resources (money and authority). In this vision, the government is still the actor that steers.

Meadowcroft (2007, p. 302), on the other hand, states that “governance for sustainable development implies a process of ‘societal self-steering’”. His vision is that the society as a whole should be involved in the critical questioning of existing practices. He is accompanied in his opinion by Philips (2012), who

considers civil society of crucial importance in promoting active citizenship and not only as service providers. In summary, there are different opinions about the role that a government should take on in the governance of smart cities. Clearly visible is a trend towards more appreciation of governance in which the role of the government becomes less steering and more collaborative.

2.2.2 Four perspectives on the role of the government

This vision was also the starting point for a more thorough analysis on the role of the government in contemporary society, described in the report 'Leren door Doen' (2014). In this report, written by the Dutch School for Public Administration (NSOB) and the Netherlands Environmental Assessment Agency (PBL), contemporary society is described as "the energetic society". The fundamental idea is that citizens have and strive for their own objectives; that citizens themselves take the initiative, where the government used to do this, or did not do it at all. The NSOB and PBL plead for the term *government participation*, instead of citizen participation. Their argument for this is partly explained above, but will be made more clear in the following section. The different perspectives on government roles, according to the NSOB and PBL will be introduced. After this, it should be more clear what is meant by the energetic society and government participation.

The NSOB and PBL distinguish four perspectives on the role of public authorities. The more classic role of public authorities is described as the *legitimate government*, in which procedural punctuality is important. The structure is strong hierarchical and legitimacy and rightful acting are fundamental principles (NSOB, 2014). Following a more traditional top-down structure, public authorities decide what is in the sake of the public good and what is required from other parties. A change in the structure of public administration came with the introduction of New Public Management (NPM). The government is still hierarchically organised, but outsources some of its responsibilities. Constantly kept in mind is the efficiency of the governmental bodies and the delivery of services to their citizens, who are regarded as 'customers' (NSOB, 2014). From this perspective, NSOB talks about the *performing government*.

In the third perspective, which is called the *networking government*, the hierarchical relation between government and other parties changes. There is a more horizontal approach with market parties and society. The process of objective-setting does not take place within governmental bodies anymore, but in interaction with important parties. Public authorities have to be cooperative and responsive, as they are required to sense what is demanded from societal actors and have to make agreements with them. Such structures take shape in public-private partnerships (PPP) and conventions (NSOB, 2014). Important to notice is that it often still is the government that initiates the collaboration and strives for their own policy objectives. They remain a central actor in the cooperation.

This is different in what the authors of the report call the *participating government*. This perspective sees that public value is created within society. One can think of citizens' initiative, self organisation or social entrepreneurs. They create their own goals, priorities and coalitions. The role of the government in such structures is less prominent, less obvious. She can participate in certain initiatives, but whether the government is involved is more often a consideration made by the others in the network, not by the government herself. Therefore, the NSOB speaks of a *participating government* (NSOB, 2014) and 'vermaatschappelijking', socialisation. Stating and producing the public value takes place within society and public authorities leave or share the central position in the public domain.

These four different perspectives on the role of public authorities will help in the empirical part of this research to interpret the governance playfield and the actions undertaken by municipalities. As indicated by the NSOB, these perspectives are not only meant to be as describing a historical development, but they can also exist alongside each other and mix, according to different places, situations and policy fields.

2.2.3 Participation and collaboration in the smart city discourse

In the field of smart cities, many researchers emphasise the importance of bottom-up and cooperation. For a transition towards a smart city, the involvement of other actors than governmental is crucial. A city that is governed top-down will never be smart, it will need coordination and collaboration to share innovative visions and implement concrete initiatives (Dameri & Benevolo, 2016; Snow, Hakonsson, & Obel, 2016). Snow et al. (2016) argue that a greater collaboration should be fostered between policymakers, companies, entrepreneurs and citizens. Dameri & Benevolo (2016, p. 697, *numbers added for structure*) add that, in general, three main categories of additional actors are being distinguished: "(i) citizens, civil society, people, and communities; (ii) firms, included those offering specific solutions for SC implementation; and (iii) public and private organizations supplying public services". Collaboration with and between these actors is essential, since it provides access to new knowledge, technologies and markets, improves the process, speeds products to the market, decrease the cost of solutions development and reduces risk (Snow et al., 2016).

In the context of policy making, it is important to reach consensus among all these different actors about concepts as smart city and smart mobility. As Albino et al. (2015) state, this will be further discussed in the next paragraph, there is a lot of confusion about smart cities because it has a lot of different dimensions. Confusion or vagueness about what exactly is understood as a smart city or smart mobility can be seen undesirable in the context of policy making. It often leads to ineffective and inefficient policies, because of several reasons. Firstly, at the start of a process there might be controversy about the scope of the concept: "what do we see as smart mobility and what not?".

Secondly, without a clear definition it is hard to monitor the effect of a measure and that makes a thorough evaluation difficult.

On the other hand, an interesting theory is provided by Haarstad (2017). He describes why the discourse of smart cities has become so popular recently. Most relevant to review here are the possibilities for governance innovations and political opportunities. The smart city discourse is, according to Haarstad, attractive for cities because it opens up existing structures and governance models. As 'empty signifier', it offers "the opportunity for a range of actors and institutions to operationalize them for their own purposes and to use them to mobilize resources and ideas for their own agendas" (pp. 424-425). Moreover, it can be a mean to bridge institutional and policy conflicts, and to invite different stakeholders to collaborate, by embracing and striving for the concept of 'smart'. There is now a broad societal consensus that smart is a desired goal. It is difficult for parties to be against it, because as Haarstad (2017, p. 425) states: "who does not want to be smarter?". Simultaneously, this offers the possibility to integrate other agendas, such as that of sustainability, into the decision-making process.

Although the aim of this study is not to explore how governments can 'abuse' the concept of smart cities to achieve other objectives such as a reduced environmental impact, this theory offers an interesting view on the possibilities that the concept of smart cities brings along, by *not* precisely delineate the definition for it.

2.3 Approaches to smart cities

When comparing the two definitions of a smart city given by Hollands (see 2.1), one could draw up different visions about what people actually see as a smart city. The latter definition, “spatial territories that bring ICTs and people together to enhance innovation, learning, knowledge and problem solving”, fits better in the notion of critics who thought that the concept of smart cities was too much technology-oriented. Such critics, for example Albino et al. (2015), state that the component of ‘people’ and/or ‘community’ is often missing. However, “these are the protagonists of a smart city, who shape it through continuous interactions” (p. 9). In their opinion, a city that focusses on technological improvements only is not a smart city. Therefore, many researchers pleaded for a broader understanding of the smart city concept. According to Caragliu et al. (2011) the role of human capital and education should be stressed in urban development. Nam & Pardo (2011) distinguish, apart from the technology dimension, also a human dimension and an institution dimension. In other words, an approach emerged that highlights, more than technology, the social structures in cities.

The human dimension, as explained by Nam & Pardo (2011), is about smart people. People who “generate and benefit from social capital” (p. 285). For these kind of smart cities (Nam & Pardo indicate the existence of strongly related definitions of creative, humane, learning and knowledge cities) the human infrastructures are of crucial importance for city development, for example the presence of knowledge networks, creative occupations and a diverse mix of enterprises. In essence, this dimension regards a smart city as a city that fully exploits its human potential. The institutional dimension is about smart communities “in which government, business, and residents understand the potential of information technology, and make a conscious decision to use that technology to transform life and work in their region in significant and positive ways” (California Institute for Smart Communities, as quoted in Nam & Pardo, 2011, p. 286). This definition shows that a smart city can also be operationalised as a city that is governed in a ‘smart’ way, with new governance relations, decision-making, participation and collaboration. The institutional dimension stresses this aspect.

One of the conclusions that Albino et al. (2015) draw from their study is that the confusion about the smart city concept is explicable by the emergence of these different dimensions of smart cities. As they state, the concept has been used to describe developments in two different kinds of domains. The first is that of hard domains, consisting among others on buildings, energy grids, mobility and logistics. The second is that of soft domains, about education, culture, policy innovation and governance. The role and application of ICT in each of these domains is different. In the first types of domains ICT can play a decisive role, while in the latter ones it mostly plays a supportive role rather than being decisive (Albino et al., 2015).

Another way in which the smart city concept can be regarded differently is explained by Papa & Lauwers (2015). Focussing on urban mobility, they distinguish a technology-centric approach, a consumer-centric approach and a citizen-centric approach. In the broader field of smart cities, especially the differences between the technology- and citizen-centric approach are relevant to review here. The technology-centric approach, “provides a vision of smart mobility as capable of maximizing its efficiency thanks to a large and widespread use of ICT. Such a vision, which has been largely sustained by multinational companies, leaders in the sector of ICT manufacturing, focuses on infrastructural innovation” (p. 545). Two important remarks can be made about this approach. First, it puts ICT central and sees it as independently operating systems offering solutions for (efficiency) problems in urban systems. This matches the explanation of Albino et al. (2015) about hard domains. Second, it pays attention to the governance aspect, stating that in this approach innovation and improvements are provided by multinational companies, which implies that community needs are not per se taken into consideration.

The citizen-centric approach, on the other hand, views technology as only one aspect of a more complex system. It views smart cities as “a system capable of using ICT in an extensive and intelligent way, in order to improve the overall urban performances and, above all, the quality of life of citizens” (2015). For this approach, community needs and citizens’ active role in the transition are key elements of smart cities. Hereby it also pays attention to governance, stating that the integration between technological and social innovation should be ensured, by involving communities and creating conditions for learning and innovation. Also, the approach pleads for a focus on the local context.

The distinctions that Papa & Lauwers and Albino et al. describe thus show major similarities. In summary, both distinguish a technology-based approach and a citizen- or community-based approach. Moreover, both distinguish a more corporate, business-driven transition towards smart cities striving for innovation and efficiency and, on the other hand, a governance of smart cities that emphasises bottom-up initiatives and a more collaborative process towards smart cities. It can be concluded that nowadays there is a broad understanding of smart cities and what issues are related to them.

2.4 Sustainable mobility

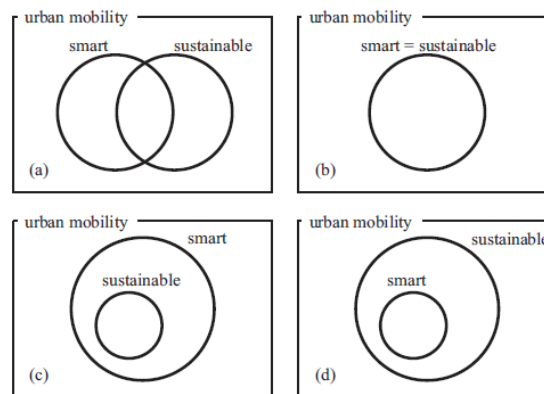
One of the issues that is strongly related to smart cities is the sustainability paradigm. In recent academic literature and planning practice is an increasing awareness that the concepts of smart cities and smart mobility can have positive effects on the broader urban system. Sustainability is, together with quality of life and social inclusiveness, increasingly being mentioned as a possible positive externality or objective of smart city and smart mobility projects. This section will introduce some core principles of the sustainable mobility paradigm. In the end of the chapter subsequently, the link between the concept of smart and sustainable in urban planning will be discussed.

Sustainable mobility is, just like smart mobility, a popular buzzword. However, this concept has come into attention somewhat earlier and is regarded as the predecessor of smart mobility as most popular buzzword in urban mobility planning (Ahvenniemi et al., 2017; Lyons, 2016). The concern for sustainable mobility came forward from a broad-based concern of climate change. The awareness that mobility causes serious problems regarding air pollution, emissions and high amounts of energy use, gave rise to the call for sustainable mobility. Recently, the call for a more sustainable urban mobility has been revitalised and reinforced by United Nations' Paris climate agreement signed in 2015. A few years earlier, the European Union also decided that it had to curb its emissions (EC, 2011). There is extensive documentation available from all governments levels, pronouncing the ambitions to achieve more sustainable mobility.

Reduce CO₂ emissions and energy use often is not the only objective concerning sustainability. A lot of definitions operationalise sustainability in a broader sense. Generally, it is described from an economic, social and environmental viewpoint (Banister, 2007). As Campbell in his famous paper – 'Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development' (1996) – explains, sustainable development is always balancing on the interface between economic growth, environmental protection and social justice. More recently, sustainable urban development has been defined as "achieving a balance between the development of the urban areas and protection of the environment with an eye to equity in income, employment, shelter, basic services, social infrastructure and transportation in the urban areas" (Hiremath, Balachandra, Kumar, Bansode, & Murali, 2013). This study focusses, while not undervaluing the importance of economic growth and social justice, on the environmental aspects of sustainability.

2.5 Conclusion

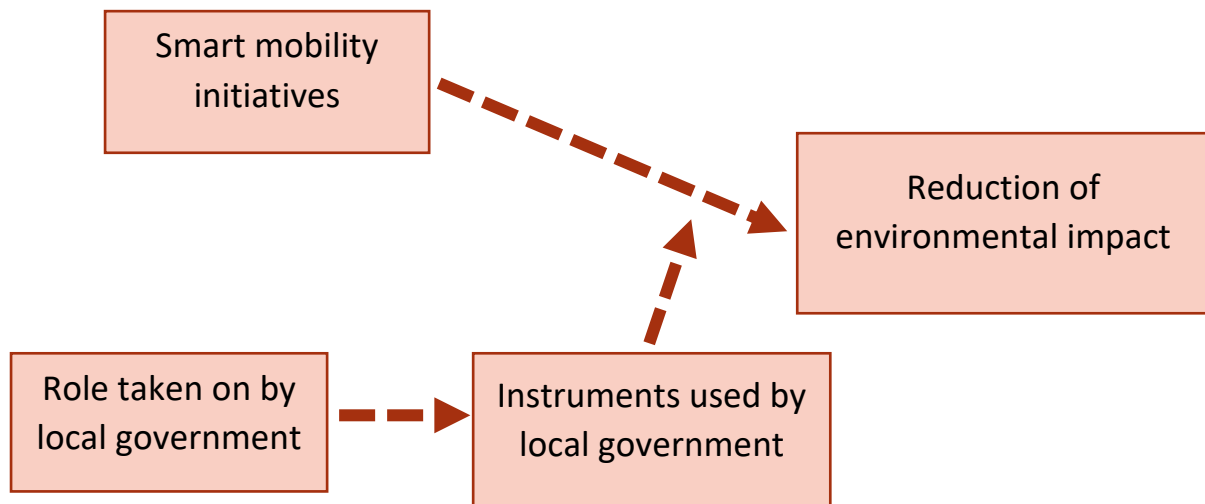
One would expect, given the above-illustrated developments in terms of population growth, urbanisation, climate change, technological innovation and economic prosperity, that the pursuit of smart and of sustainable cities and urban mobility are closely connected. However, this is a classic example of that one plus one not automatically counts for two. As stated in the introduction chapter, often the concepts of smart and sustainable are not or poorly connected in city's visions. Lyons (2016) presents a very interesting schematic presentation of the possible relations between the concepts smart and sustainable (figure 1). During this study, these relations have been kept in mind as they offered the possibility to roughly compare the visions that different cities have, regarding smart and sustainable mobility.



**FIGURE 1: SCHEMATIC PRESENTATION OF POSSIBLE RELATIONS BETWEEN THE CONCEPTS SMART AND SUSTAINABLE
MOBILITY (LYONS, 2016)**

2.6 Conceptual framework

In this study, the relation between the governance of smart mobility and the outcomes for environmental sustainability has been explored. Emphasised is the role that local governments take on and the instruments they use to influence smart mobility initiatives.



3. Methodology

3.1 Research philosophy

In order to deliver a proper research proposal, some important decisions have been made in the preparation phase concerning the research design. This chapter discusses the research philosophy that is adopted based on the aim of the research, the sources of data that are to be used, the methods of data collection and data analysis, and eventually how this has led to an answer on the research question. The research question of this study consists of two parts, namely “what roles can local governments take on and which instruments can they use” and “how do these factors influence the environmental impact of urban mobility”. As such, the research question appears to be an explanatory question. This has certain consequences for the type of research that is conducted (Farthing, 2016).

The question *how* certain roles of a local government and used instruments influence smart mobility practices is an open question, meaning that it is not formulated as a hypothesis already indicating a certain expectation. Therefore, an inductive approach to this research was appropriate (Farthing, 2016). With such an approach, the researcher starts without pre-conceived ideas as in a theory that requires testing, although consciousness is required about the fact that a researcher is never free of any pre-conceptions. His interest in a certain theme and his values are socially structured and are therefore always (at least for a tiny bit) at presence in the design and execution of the research (Farthing, 2016). However, an inductive approach holds that one starts without a certain theory.

To be able to explain the influence of government roles and instruments on smart mobility practices, it was required to first map the different roles and instruments a local government can take on and use. Considering the findings of the literature review, there is already quite some academic knowledge about this. Hence this requires no further research. However, in order to assess the influence of these aspects on smart mobility practices, it was important to analyse this in a specific context. Therefore, a multiple case study has been carried out. This way of research offers the possibility to analyse in-depth certain aspects, such as planning policies, in a local context (Flyvbjerg, 2006).

3.2 Case study

The fact that is chosen for a multiple case study does not mean that the objective in advance was to evaluate the performance of multiple cases. Rather, the aim of the multiple case study was to give an overview of the diversity of effects that certain government roles or instruments could have on the environmental impact of smart mobility practices. When only one case would be studied, this would mean that only one or a small number of government roles and instruments could be analysed, implying that no meaningful conclusions could be drawn about the effects of these aspects.

Although Flyvbjerg (2006) states, contrary to conventional views on case studies, that these studies can be suitable for generalisation and thus contribute to the development of theories, it was not the aim of this study to draw conclusions that are suitable for generalisation. The development of practical knowledge that is context-dependent is, as Flyvbjerg (2006) argues, not less valuable than general, theoretical knowledge. However, the aim of this research was to formulate policy recommendations about how local governments can position themselves and can use certain instruments to influence the environmental impact of smart mobility practices. It was thus required to identify a number of best practices in the cases that are studied, that can be implemented in other contexts as well.

The case study has been executed as follows. Based on a first exploration of smart mobility programmes and practices, the cities of Utrecht and Eindhoven are selected as cases. This because both cities do believe that smart mobility offers possibilities for certain policy objectives. However, the expectation on beforehand was that both cities have different perspectives on smart mobility and different objectives in mind. Later on in this study, the difference between these perspectives will be dealt with more elaborately. It would be very interesting to discover how certain differences in visions and objectives influence the role a government takes and how this subsequently affects the contribution that smart mobility makes in the light of reducing the environmental impact of mobility. Due to the restricted time and resources that are available for this study, it was not possible to analyse integral smart mobility programs and practices of both cities. The focus therefore will be on a limited, but well considered, amount of smart mobility initiatives. An additional advantage of this is that the selected cases have been studied in-depth.

After this quick exploration, a thorough policy analysis has been executed. The visions, policy objectives, plans, programs and proposed and implemented measures are analysed first via desk research. Then in-depth interviews with key stakeholders have been conducted. Interviews are of added value because they can reflect certain values and opinions and provide this study of the necessary understandings about how a government's role and policy instruments work out in practice (Farthing, 2016). It is important to not only interview representatives of local governments, because,

since they make and implement the policies, this will give an one-sided view on the story. Moreover they are unlikely to criticise their own role. Therefore, more diverse types of stakeholders have been interviewed. As Farthing states, not only those who implement policies, but also those affected by them should be questioned (Farthing, 2016).

For this study, it is important to do interviews with representatives of several types of local businesses, as they can have different roles. First, most businesses attract customers or visitors and thereby create traffic. They have interest in being accessible. Second, businesses employ people and may therefore (strive to) influence the travel behaviour of their employees. Third, businesses can contribute to smart mobility practices as inventor, designer, producer or subcontractor of a smart mobility initiative. The first and second reason are also applicable to institutions that function as public service providers, which can be both public and private parties, for example an university. A number of interviewees is selected because of their function in or involvement with such a type of stakeholder.

The following list mentions the persons that have been interviewed. Since all interviewees were Dutch, the interviews were executed in Dutch. Citations are literally translated into English, with the highest prudence, to prevent that the own interpretation of the author is reflected in the citations. This remark is also applicable to all citations that were originally written in Dutch, such as policy documents from the municipalities and ministries.

Eindhoven:

- Eddy Jongen, parking advisor at Mobility-S¹;
- Jan-Willem van der Pas, strategic coordinator smart mobility at the municipality of Eindhoven;
- Gert Sanders, regional mobility coordinator at the province of Noord-Brabant;
- Erik Staps, transport planner at the municipality of Eindhoven.

Utrecht:

- Derk Dohle, policy advisor at the province of Utrecht;
- Carolien van Hemel, director at Utrecht Sustainability Institute;
- Taco Jansonius, logistic coordinator at Goedopweg;
- Marjolein van der Stok, project manager Utrecht-Oost at U15².

¹ Mobility-S will be introduced in paragraph 4.1.3.

² U15 is a regional alliance of more than 200 employers in and around Utrecht, aiming for sustainable mobility.

4. Case study

This chapter presents the findings of the multiple case study. The two cases, Eindhoven and Utrecht, will be dealt with one after the other, starting with Eindhoven. In both cases, first the policy ambitions of the municipality will be described. Second will be an analysis of the vision both cities have on the smart city concept. And third, different smart mobility practices will be discussed. For Eindhoven, these are the project area Strijp S and the pilot with Mobility as a Service. For Utrecht, these are project area Utrecht Science Park and the programme Smart Solar Charging. Eventually, both case studies will end with an evaluation of the smart city projects in relation to the broader policy ambitions of the municipality in question.

4.1 Eindhoven

4.1.1 Policy ambitions of Eindhoven

In the relevant policy documents that have been studied, several ambitions of the municipality continuously return. These ambitions are apparently key issues for the municipality in all policy fields. This section provides an overview of the key ambitions the municipality of Eindhoven mentions, as found across different policy documents.

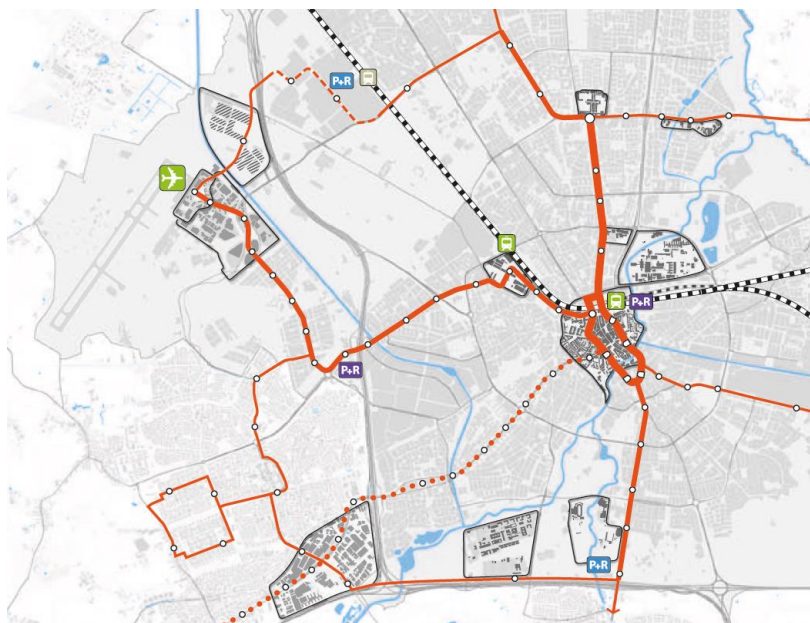


FIGURE 2: THE ECONOMIC ACTIVITY CLUSTERS OF EINDHOVEN (GEMEENTE EINDHOVEN, 2013)

Eindhoven likes to call herself an innovative city where technology and creativity are omnipresent. The city wants to strengthen the (inter)national leading position of her economic activity clusters, which are well known for their technological expertise and innovative character. In the policy document 'Eindhoven op Weg' (Gemeente Eindhoven, 2013) they refer to these clusters as “places to be” (figure

2). The accessibility of the places to be is a focus point in the municipalities' strategy, as well as the connectivity between these places. The clusters in question are:

- High Tech Campus (HTCE), an innovation district with companies as ASML, IBM, NXP and Philips;
- Strijp-S, a large former Philips factory area now home to creative industries and residents;
- TU/e Science Park, the location of the Technical University;
- Brainport Industries Campus (BIC), the future location for high tech manufacturing industry.

Securing a good accessibility for these places is of crucial importance for the development of the tech sector in Eindhoven and thereby for the economic development of the entire city.

The vision is that these clusters, as well as the living environment, should be attractive areas. Therefore, the municipality strives to improve the quality of life and to be a true healthy city. Quality of life means that there is enough space for pedestrians and cyclists, for spontaneous meetings on street, for green areas (Gemeente Eindhoven, 2015). Eindhoven also wants to be a versatile city, hence they embrace the concept of social inclusiveness as an important guiding principle. The municipality wants to prevent the city from developing in two different speeds, by securing the position of lower economic classes and providing a good living environment for everyone (Gemeente Eindhoven, 2016a).

Another key issue is sustainability. The municipality has very progressive and thorough ambitions, that is they want to curb 95% of all CO₂-emissions in 2050, compared to 1990. This is in line with the Climate Agreement of the national government (Klimaatberaad, 2018). Furthermore they want Eindhoven to be energy neutral in 2035 (Gemeente Eindhoven, 2016a). They realise that it is necessary, in order to meet these goals, to transform into a gasless society and have a zero-emission mobility. The accessibility of the different core clusters thus has to be assured without the negative effects of mobility, such as air pollution and energy use.

In short, these are the main points the municipality of Eindhoven has put its focus on the last few years. The next section will introduce the vision of the municipality regarding the smart city concept.

4.1.2 Eindhoven as smart city

One of the elementary components of Eindhoven's identity is technology and innovation. This resounds in the vision of the municipality that Eindhoven should develop as a 'smart city'. In the municipality's leading policy document, the coalition agreement of 2014, she describes what she understands as a smart city: "a city that optimally uses the forces of technology, ICT and design (thinking) for the benefit of her citizens. A city that actively opens up as living lab for companies and knowledge-based institutions, with strengthening well-being, jobs and sustainability as goal"

(Gemeente Eindhoven, 2014, p. 8, own translation). There is a strong belief that the use of technology and the urge for innovation are factors that contribute to the economic development as well as the quality of life in Eindhoven.

But it does not stop there. In the Climate Plan of 2016 the municipality goes a step further and describes that Eindhoven wants to develop as ‘smart society’ (Gemeente Eindhoven, 2016a). This is about actually putting people in the first place. As a smart society, Eindhoven builds on its tradition of innovation and design, but with humans on a central place. Being an intelligent community means that people and companies come with creative solutions for problems they face in daily life. Solutions that are not being imposed from above, but that arise from co-creation. The ambition is to create a smart and inclusive society, not *by* technology but *with* technology. Where efficiency is crucial for smart cities, quality of life is crucial for smart societies.

Although it is important to understand what Eindhoven regards as a smart *city* and what their ambitions are in this sense, in the case of this study it is even more relevant to look at the definition of smart *mobility* that the municipality uses. Analysing several policy documents, however, has not brought any clarification in this aspect. The board of the Metropoolregio Eindhoven mentions smart mobility in their ‘Bereikbaarheidsakkoord Zuidoost-Brabant’, but it focusses on how it works and to what it can contribute. The report speaks of: “smart mobility provides opportunities for ...” and “users deliver digital information that, after analysis, lead to improved solutions” (Metropoolregio Eindhoven, 2016, p. 7, own translation). The most recent policy document of the municipality of Eindhoven for mobility specifically, ‘Eindhoven op Weg’, dates from 2013. Here, smart mobility as concept is not being mentioned at all. However, the aim is that mobility should be smart, efficient, clean, healthy and safe. These findings give, perhaps somehow incorrect, the idea that the local authorities in Eindhoven do not exactly know what they see as smart mobility.

Some recent developments are more promising. Earlier this year, the municipality presented her new coalition agreement. It is understandable that in such a general document no detailed information about smart mobility is provided. However, to illustrate her vision, the municipality mentions some smart mobility solutions, such as smart traffic lights for cyclists (Gemeente Eindhoven, 2018). Erik Staps, transport planner at the municipality, explains some more about the recent developments (Staps, 2018, p. 1, personal communication): “Indeed, there is no concise definition of smart mobility. We are currently working on an implementation programme. That is based on a roadmap, the Roadmap Smart Mobility 2050”. The municipality presents a certain vision in this roadmap, which functions as a guide for the implementation programme. Staps: “What do we need in 2045? [...] What then, are logical steps to take right now?”.

As discussed in paragraph 2.2, having a shared idea of what smart mobility is and what it can contribute to might be very helpful in order to implement smart mobility measures effectively and efficiently. It thus appeared that Eindhoven does not have clearly defined the concept. However, the city is regarded as a front runner in the field of smart city and has already done a lot. Perhaps the municipality demonstrates here that it is able to use the concepts of smart city and smart mobility without precisely delineating the meaning of them. Put differently, one could say that Eindhoven started with defining their vision instead of defining smart mobility. This appears for example in the above described vision of the municipality on the concept of a smart society. With this vision, she proves to have very sharply identified broader issues that can be influenced by technology and design.

It thus seems that Eindhoven has a clear image of what a smart city, or smart society, is or could be and what effects it could have for a city. Therefore it will be interesting to investigate on certain smart city initiatives in Eindhoven, in order to be able to analyse whether this vision is translated into practice, into actions, that really contribute to the ambitions of a smart society. Although it seems quite promising that the municipality has an understanding of what a smart city or society can bring about, it still is visionary policy language, written on paper. One can wonder how these wonderful promises work out in practice. How does the municipality act to live up to these ambitions? Where do the initiatives come from and what is the role of the municipality in the governance process?

4.1.3 Smart Mobility in Eindhoven

The following section describes certain programs and initiatives in the field of smart mobility. Eventually, an analysis can be made about these smart mobility initiatives. Do the municipality's principles of a smart society play a role in these projects? And if they do so, they could be very helpful examples for other cities.

Strijp-S

An exemplary location where the innovative and technological character of Eindhoven comes forward is Strijp-S. This district, located very close at the north-western side of the city centre, was formerly owned and used by Philips. Many innovations found place here, and new products were made like the light bulb, television and even electric shavers. From 2002 on, however, Philips started to relocate their business and gradually left the area (Park Strijp Beheer, 2018). Since then, the area of Strijp-S is in hands of Park Strijp Beheer, a public-private partnership (PPP) between the municipality of Eindhoven and VolkerWessels (a large building concern). When Philips left, the municipality and VolkerWessels united themselves with the idea to restructure the area. The mission of this cooperation was to transform the industrial area in an urban subcentre for residential, working, cultural and commercial use (Park Strijp Beheer, 2007).



FIGURE 3: URBAN DESIGN PLAN OF STRIJP-S. SOURCE: WWW.VESTIGINGSLOCATIES.NL

The objective was to develop Strijp-S as a creative city, which is formulated in the following vision (Park Strijp Beheer, 2007, p. 85, own translation): “In 2015 Strijp-S appears to be the best example of the transformation of a historically important industrial complex into a dynamic, post-industrial urban district wherein culture and technology play the leading role”. Anno 2018, it has become clear that Strijp-S has definitely been transformed into a creative urban district. With a diverse offer in residences (rent and buy), creative enterprises, culture and some educational facilities, it can justly be called an urban subcentre. Hence the area has definitely not lost its innovative character. Although there are no factories of Philips anymore, the area is nowadays regarded a ‘living lab’, where innovative products and services can be demonstrated, developed and scaled up (Mobility-S, sd). And this also applies for the field of mobility.

Smartparking

Concerning mobility, there is a progressive policy on Strijp-S. But before going into detail about the mobility policy on Strijp-S, it is important to introduce the organisation of mobility management in the area. Park Strijp Beheer has installed an independent sub-organisation called Mobility-S, which is responsible for the mobility and accessibility of the area. This organisation takes care of the public parking facilities for cars and bikes and invests in the development and innovation of the mobility system on Strijp-S (Mobility-S, 2018). In the PPP it is agreed that Mobility-S has full responsibility and an exceptionally high amount of autonomy to manage mobility in the area. According to Eddy Jongen (parking advisor at Mobility-S), it is unique in The Netherlands, for example, that such an organisation is authorised to manage public parking on the street (Jongen, 2018). Street parking is traditionally

managed by public authorities, because it is concerned with tax money. This is different from private parking at offices for example. On Strijp-S, Mobility-S controls both.

Mobility-S has the ambition to minimise car use in the area, whereby as a consequence less parking places will be needed (Mobility-S, 2018). This ambition is formulated together with the municipality and to achieve it, certain choices and significant changes have to be made. They try to reduce the car usage with their parking policy, which is a nice example of the progressive mobility policy on Strijp-S. In their parking policy, the standard parking ratio per dwelling or per office space is released. Instead, they look at what is really needed, based on expectations and statistics from other cities. In the case of new building developments, both residential and offices, Mobility-S advises how many parking places are needed, how many of them have to be built and how many of them already exist elsewhere in the area. Sometimes there is the possibility to use an available rest-capacity, or that the parking places of an office location and a residential building can be shared (Jongen, 2018). Combining new developments with already existing parking places and connecting demand and supply is part of a project that is called Smartparking.

Also part of this project is the development of a district-wide parking system, by which residents, employees and visitors can find, reserve and pay a parking place online. Because there are different parking-lots, run by different companies, it was hard to develop a parking system that points people to the right parking place, or to combine parking on multiple parking places. Therefore Mobility-S invested in a system called Parkrest, an online platform covering the different parking systems (Jongen, 2018). This system is also flexible, so that in the case of an event in the area visitors are steered in the right direction and for other people parking places remain reserved. So, on the one hand, finding a parking place is made easier and on the other hand the number of required parking places is diminished by smart and efficient organisation of the parking places. This fits within the vision of Mobility-S, in the sense that it does not want to reduce car use by discouraging it, but by providing and stimulating alternative transportation options (Bloemen, 2016).

Alternative Mobility

Stimulating alternative mobility on Strijp-S takes place in multiple ways. Firstly, by providing shared bikes. There are two bike sharing systems in the district: Hopperpoint and the own system of Mobility-S. The first one is a commercial shared bike provider, with seven docking stations in. The bikes can be unlocked and locked with the accompanying mobile application, which registers the use and thereby the payment. This system is ideal for short trips within the city, because the bikes can be handed in at any docking station in the city (Jongen, 2018). The latter one is provided by Mobility-S. The bikes can be picked up and handed in at the reception of Strijp-S. This system is especially meant for employees and visitors in the area and can be used to cycle to, for example, the city hall for an appointment. Its

limitation is that one has to return the bike at the reception. The reason that there are two different bike sharing systems, is as Jongen says: “because we wanted to test two things simultaneously” (2018, p. 2, personal communication).

Secondly, Mobility-S works together with shared car providers. At the moment Greenwheels, FreetoGo and Amber are providing cars in the district. Greenwheels is the car sharing service of the Dutch railway institution (NS) and offers cars at train stations and other strategic locations throughout cities in the whole country. At Strijp-S, there are two locations to pick up a Greenwheels car: at the train station Strijp-S and at the central road Torenallee. People use a special card or the Greenwheels app to use the car. The cars need to be handed in at the original location (Greenwheels, sd). FreetoGo is a shared car service that works with local car dealers. It is a commercial system offered by the association of Volkswagen, Audi and Seat dealers. Local car dealers reserve a share of rental cars for the Freetogo system, which works similar as Greenwheels. On Strijp-S there is one location where these cars can be picked up, at the Torenallee (Free to go, sd). Amber is a provider of shared electric cars, BMW i3's, and is an independent commercial enterprise. Their vision is “to provide worldwide on-demand zero-emission mobility and by this contribute to the energy transition and liveability in cities” (Amber, 2018). Cars can be picked up and delivered at any Amber hub with a mobile application. In Eindhoven there are seven hubs, one of them is located at the Torenallee at Strijp-S.

Mobility-S is facilitating these car sharing systems by offering them a parking place. The cars of Amber for example are located opposite to the reception of Strijp-S, at the ‘charging lounge’. Here is a charging station and next to it an office space, where users can have a meeting or relax (Jongen, 2018). For every shared car that is provided, Mobility-S is allowed to develop 4 fewer parking places. To stimulate the use of them, Mobility-S promotes these systems amongst the residents and companies in the area. They also cooperate and think along with companies in the area that want to have their own fleet of shared cars for their employees. They think about how many cars are needed, what the companies can save compared to buying parking places and how they can have benefit from it, for example by advertising with their name on the cars (Jongen, 2018). And in the end, Mobility-S contributes to the extension of the network of the shared car services, by offering them a new location. This fits perfectly in their innovative character and in their ambition to reduce car use.

Mobility as a Service-pilot

The mobility services of Hopperpoint, Amber and FreetoGo are already shortly introduced in the section above. The services are initiated by market parties and offer shared bikes and shared cars. This section first provides some more context around the initiative of Hopperpoint. After that, the upcoming national programme about MaaS-pilots will be discussed. The pilot in Eindhoven will start in

2019 and it is most likely that the shared mobility services mentioned here will become part of this pilot.

Hopperpoint has been introduced in Eindhoven in 2016. It was the first shared bike system that allowed users to hand in their bike at a different location as where they got it (Provincie Noord-Brabant, 2016). Other systems, such as OV-fiets, offer this as a service for which users have to pay an additional fee. The province of Noord-Brabant has invested in the project to get it off the ground. Being a very promising initiative, the aim for Hopperpoint was to develop twenty locations where the 'Hoppers' could be used. The municipality of Eindhoven has put herself in a role of launching customer, by establishing one of the first so-called hubs at the city hall. In the meanwhile, there are seven locations where the bikes are available (see figure 4).

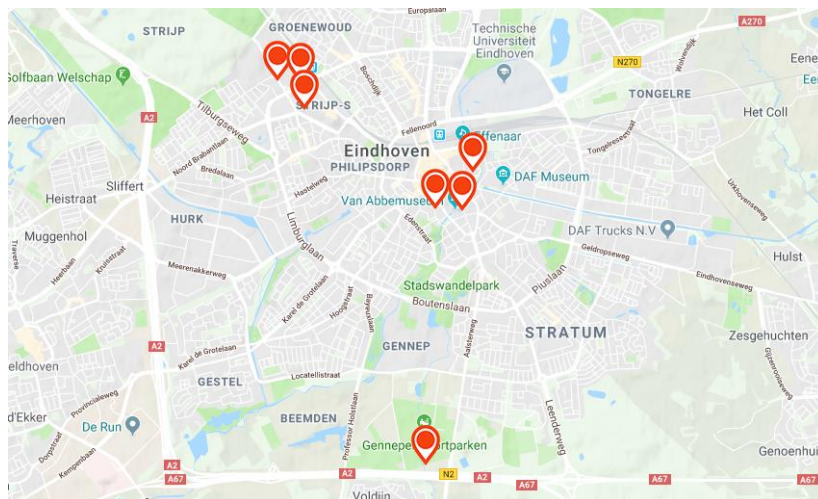


FIGURE 4: LOCATION OF HOPPERPOINT 'HUBS', INCLUDING STRIJP-S (3), MUNICIPALITY'S OFFICES (2) AND HOTELS (2).

SCREENSHOT TAKEN FROM WWW.HOPPERPOINT.NL

Hopperpoint will probably become part of a pilot that the municipality of Eindhoven is going to do with Mobility as a Service (MaaS). The municipality participates in the national program of the Ministry of Infrastructure & Water Management (I&W) about MaaS-pilots. Eindhoven is one of the seven places where regional pilots will be executed. The pilot in Eindhoven focusses on 'sustainability' and, more specifically, on the own organisation. This focus is motivated by the fact that the municipality has the ambition to be an emission-free and 100% sustainable organisation by 2025 (I&W, 2018). Therefore, the pilot will foremost aim at providing sustainable alternatives for the business trips of the municipality. This comprises 810.000 kilometres in private cars of employees and almost 700.000 kilometres for other movements, such as trips in the municipality's vehicles by the park-keeping or cleaning service. Together, the business trips of the municipality are good for 1,5 million kilometres per year (I&W, 2018).

The idea is that there will be one MaaS-platform that offers several travel options. Hopperpoint could be one of these options offering shared bikes, just like Amber could be an option for shared electric cars. Employees can use the MaaS-platform to plan, book and pay their business trip. The pilot will start with a small group of employees, to be able to quickly optimise and avoid risks as capacity shortage. But eventually it will become more widely available, also for other large companies and citizens that are interested. Therefore, the platform will also provide options that are not emission-free, but employees of the municipality will be restricted from using these. The pilot is planned to start in 2019 (I&W, 2018).

By executing this pilot, the municipality of Eindhoven once again strengthens her role as launching customer. An important issue with shared bike systems, as well as with other MaaS solutions, is this role as launching customer. Jan-Willem van der Pas, strategic coordinator smart mobility at the municipality of Eindhoven, warns for the negative effects this can have: “we have to be careful that we do not create a locking on the market” (Van der Pas, 2018, p. 3, personal communication). The municipality therefore was open and transparent in the tender for a shared bike system, and she also does not actively promote Hopperpoint in public talks or documents, says Van der Pas. “But we do say: pick a shared bike system and develop it”. This is because the municipality still values her role as encourager.

4.1.4 The relation between smart and sustainable mobility in Eindhoven

The space, both physically and institutionally, that is required to experiment with all these innovative mobility concepts is available at Strijp-S, because it is regarded a ‘living lab’, or ‘proeftuin’ in Dutch. Developing, demonstrating and upscaling new products and services is the core business of this lab. This shapes the profile of the area in economic terms, as one of the ‘places to be’ in Eindhoven where technology and design are omnipresent. Simultaneously, the living lab strives to develop innovative products and services that contribute to the quality of life of its users. The belief is that this will result in a more social, comfortable and sustainable city life (Mobility-S, sd). This section will provide an analysis of the sustainability ambitions and to what extent the smart mobility initiatives contribute to these ambitions.

Overall, in the ‘Climate Plan 2016-2020’ the municipality of Eindhoven has formulated the ambition to reduce CO₂-emissions with 95% in 2050, compared to 1990. Since mobility causes 29% of the emissions in Eindhoven, the municipality regards mobility as one of the main assignments: “the transition to entirely emission-free mobility” is an “essential condition” to reach 95% reduction (Gemeente Eindhoven, 2016a, p. 35, own translation). The municipality wants to integrate emission-free mobility in all her traffic- and transport plans, and develop a strategy to phase out fossil fuel in

motorised traffic. Strijp-S is seen as a living lab, where new innovations can be tried out in practice. These will be evaluated and if appropriate new products and services can be spread out across the city and beyond.

The ambition to reduce the amount of cars in the area is a shared ambition between the municipality and Mobility-S. To reduce the number of parking places can hereby be seen as both a measure and a goal. A measure, because a limited availability of parking places stimulates, if not forces, people to use other travel modes than the car to come to Strijp-S. A goal, because every parking place that can be removed, can be transformed into a more attractive place (Jongen, 2018). A place to live or to work, which is interesting economically seen, or a place for green, which contributes to a more liveable area and is interesting in terms of climate adaptation. Less parking places requires other travel modes that make Strijp-S easily accessible.

Offering alternatives for traditional car use perfectly fits in the vision of the municipality of Eindhoven: “the measures to reach reduction of emissions by mobility are directed at limiting car use, by applying smart mobility measures, stimulating cycling and public transport, and at making car traffic more sustainable by stimulating emission-free driving, by electric mobility” (Gemeente Eindhoven, 2016a, p. 47, own translation). The alternatives that are available at Strijp-S, as explained above, include shared (electric) cars and shared bikes. Business trips within Eindhoven, to the city centre for example, can easily be made without emitting CO₂ by using the shared bikes. The cooperation with a bike sharing platform that has docking stations across the city is a very good way to guarantee the emission-free connectivity between the places to be in Eindhoven, which is strived for by the municipality (Gemeente Eindhoven, 2016a). With Hopperpoint, a good start is made, but so far the docking stations are only located around Strijp-S, the city centre, the city hall and at one hotel in the southern part of the city. The range could be improved by investing in locations at the High Tech Campus and the TU/e.

The (electric) shared cars enable business trips with longer distance, to other cities for example. The fact that employees need to travel to clients or meetings at other locations is often a reason for them to take their car to work. When there is the possibility to use a shared car to make these trips, this can help convince people to travel to work by bike or public transport. The multiple shared car providers all have their advantages and disadvantages, but in the context of emission-free Amber is the only one in Eindhoven who provides electric cars. Offering parking locations with charging facilities is also a measure that Mobility-S takes to encourage electric driving. This is partially motivated by the municipality’s ambitions, but on Strijp-S they also noticed an increasing demand for electric charging from the market. Moreover, potential tenants can be encouraged to come to Strijp-S when there are

good facilities like electric charging (Jongen, 2018). So except an imposed, or agreed, strive for sustainability, such developments are also a reaction to demand from the market.

All in all, the total package of new, alternative mobility concepts that Mobility-S provides seems to have objectives that in the end exceed mobility and even accessibility. All measures that are taken in the district, with the application of innovative technologies, are aiming at an improved quality of life and a reduction of emissions. Smart solutions thus, culminating in sustainability.

Within the national programme for MaaS-pilots, the municipality of Eindhoven is differentiated in her focus on the own organisation, but certainly in sustainability ambitions as well. A quick analysis of the presentation of the seven pilots learns that they can be divided in four general categories. One category of pilots is primarily aimed at improving or maintaining the accessibility of a specific area. Those are the pilots in Rotterdam (Rotterdam-The Hague Airport), Amsterdam (Zuidas) and Utrecht (Leidsche Rijn). Another category is focused on transport for people with reduced mobility as well as improved transport options for rural areas. Those are the pilots of Groningen-Drenthe and Twente. One is aimed at experimenting with cross-border services, that is the one in Limburg. Then one primarily aims for sustainability and that thus is the pilot in Eindhoven (I&W, 2018).

MaaS is a smart mobility instrument that provides and simplifies the use of alternative transport options, and therefore highly appropriate to enhance sustainability. This is acknowledged in almost every pilot presentation, but the extent to which the emphasis is put on sustainability differs. For example, the one of Rotterdam says: “During the pilot, it will be investigated to what extent MaaS can contribute to four societal goals, traffic efficiency, space efficiency, environmental efficiency and social efficiency” (I&W, 2018, p. 2, own translation). The pilot presentation of Amsterdam speaks of sustainability as one the key goals of employers that are interested in MaaS. Moreover, Amsterdam sees a role for MaaS in their challenge to reduce the amount of cars in the public space, in order to keep the city liveable. In the end, Eindhoven takes the cake regarding sustainability, with their pilot that specifically targets for “sustainable and CO₂-emission free mobility movements” (I&W, 2018, p. 4, own translation).

Coming back now to the question posed in the beginning of previous paragraph, which was: “to what extent do the municipality’s principles of a smart society play a role in the smart mobility initiatives?”. In her vision of a smart society, the municipality sees a crucial role for technology and design, but in a way that humans are central. An intelligent community where innovation arises from co-creation and is aimed at improving the quality of life of the citizens. Read again, with this in mind, the section above and one can conclude that Eindhoven indeed understands how to translate their vision of a smart society into practice, and that Strijp-S might be an example for others.

4.2 Utrecht

4.2.1 Policy ambitions of Utrecht

The general spatial strategy of the municipality of Utrecht is comparable to that of Eindhoven. In that sense, that Utrecht also puts emphasis on developing certain economic hotspots in which urban development is concentrated. Utrecht has to cope, perhaps even more than Eindhoven, with population growth. The expectation is that in 2030 the city will have a population of around 400.000, which is an increase of almost 20% compared with 2015 (Gemeente Utrecht, 2016a). This growth will partially be facilitated in projects that are already under construction, such as the newly-built district Leidsche Rijn. To facilitate the rest of the population growth, Utrecht wants to redevelop already existing parts of the city. In policy terms, this is called 'infill development' ('inbreiding' in Dutch). This infill development will take place in the Beurskwartier and the Merwedekanaalzone, two large areas in transition (figure 5).

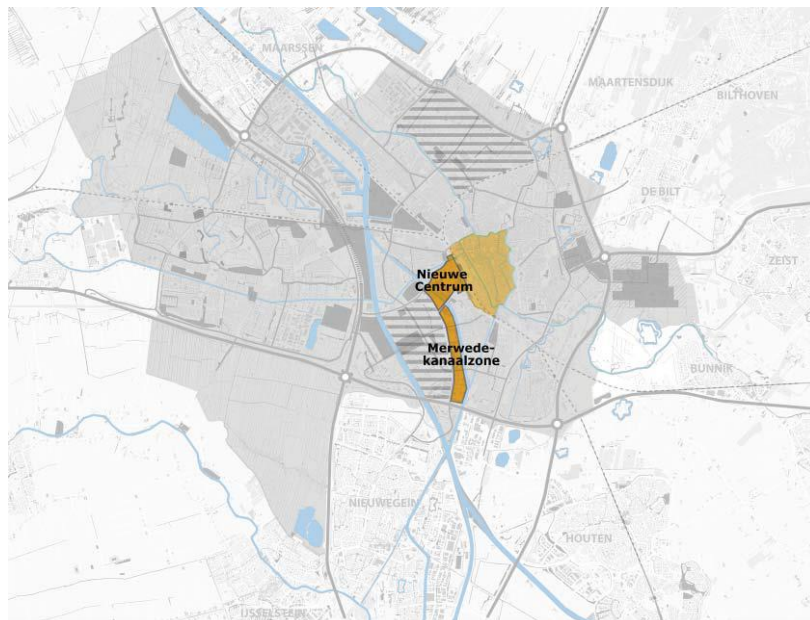


FIGURE 5: MAP OF UTRECHT. HIGHLIGHTED ARE THE PRIORITISED LOCATIONS FOR INFILL DEVELOPMENT; THE 'NIEUWE CENTRUM', OF WHICH THE BEURSKWARTIER IS PART, AND THE MERWEDEKANAALZONE (GEMEENTE UTRECHT, 2016A)

Next to this infill development, the municipality has thus indicated 'hotspots' (figure 6). These areas, where economic development will be clustered, are:

- Inner city and central station area;
- Utrecht Science Park (USP, where the university, college and medical centre are located);
- Leidsche Rijn Centre (the centre of the new district Leidsche Rijn, west of the old city).

By this, Utrecht creates dense areas with a highly urbanised character. Important for the municipality is that inhabitants find it "enjoyable" to live in the city (Gemeente Utrecht, 2016b). However, she

realises that “enjoyable” is not the same for everybody and that where one likes a more dynamic surrounding, another one prefers a more quiet surrounding. Therefore, an important feature of Utrecht is its diversity in living environments. The municipality states in her ‘Spatial Strategy’ that this already is the case in Utrecht and that it wants to continue using this quality in new urban development (Gemeente Utrecht, 2016a).

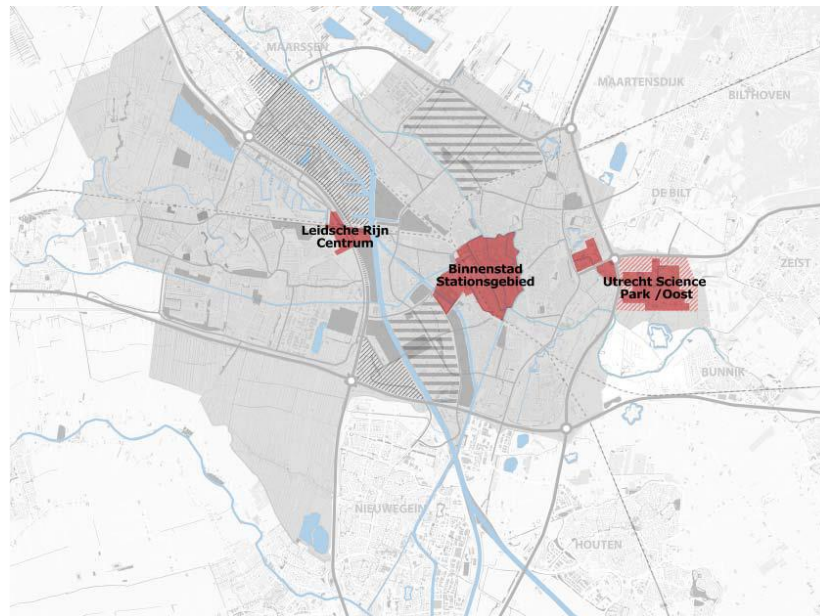


FIGURE 6: PRIORITISED LOCATIONS FOR ECONOMIC DEVELOPMENT, FROM LEFT TO RIGHT; LEIDSCHER RIJN CENTRE, THE INNER CITY AND UTRECHT SCIENCE PARK (GEMEENTE UTRECHT, 2016A)

Coherent with a good quality of living is the ambition of the municipality to be a healthy city. Living in Utrecht should be healthy, in the most basic sense of the word, meaning that the air and soil are clean and nuisance is limited. But also healthy in a more comprehensive meaning, namely that people who live in the city have a job or have education that fits them, or that they are involved in society one way or another. For the municipality, “healthy urbanisation” is a leading principle: Utrecht should be a city where peoples’ living environment “invokes a healthy life style, stimulates them to move, is lively by the city’s recreational and cultural function and where meeting is self-evident” (Gemeente Utrecht, 2016a, p. 13, own translation). On some locations, the municipality therefore deliberately prefers to strengthen the public space and green areas.

An issue that is also considered as important by the municipality is climate change. Ambitions are twofold in this: on the one hand the municipality wants to contribute to the reduction of CO₂-emissions and on the other hand she aims to prepare the city for the inevitable temperature increase and the consequences thereof (Gemeente Utrecht, 2016a). The policy is thus aimed at both climate mitigation and adaptation. In the Energieplan (Gemeente Utrecht, 2015), the municipality pronounces the ambition for Utrecht to be climate neutral in the future. 2030 is mentioned as the year this should

be achieved (Gemeente Utrecht, 2017b). To achieve this, significant changes should be made in heat supply, energy supply and in the transport sector.

Compared to Eindhoven, the overall ambitions show major similarities. Facilitating population growth as well as economic activity, together with a good quality of living, health and climate are regarded as the most important issues currently in both cities. The next section will analyse whether the vision of the municipality of Utrecht as a smart city is also comparable with that of Eindhoven.

4.2.2 Utrecht as smart city

Where the municipality of Eindhoven truly has the vision to be a smart city, or even a smart society, by using technology and innovation to improve life, the municipality of Utrecht does not speak of any 'smart city' ambitions in their policy documents. One important ambition that she highly values is that the city is a frontrunner in 'Healthy Urban Living' (Gemeente Utrecht, 2018). The city accommodates many knowledge-based institutions operating in the health sector, mainly at the USP. Because of the central location in the country and good cooperation between different institutions, that are located there, it is a very attractive location and competitive cluster of activity. USP is seen as the heart of the health-related economy in the Netherlands and is frontrunner in the field of medical health care and sciences (Gemeente Utrecht, 2016a).

Besides this, Utrecht also positions herself as education and knowledge city (Gemeente Utrecht, 2016a). The combination of young, high educated people³ and the strong position of the health-related economy makes Utrecht a true 'Health City'. To stay up front, steps forward are continuously being taken to innovate. New possibilities of technologies are extensively being applied for this. Utrecht also wants to contribute to national policies aiming for Healthy Urban Living, by sharing knowledge and experience. Therefore, a declaration of intent is signed between the municipality of Utrecht, the province of Utrecht and the ministries of Economic Affairs and of Infrastructure and Environment: "Living Lab Utrecht 'Smart and Healthy City'" (Staatscourant, 2016). Being a smart city thus seems not to be an ambition in itself, but technology does play a role in achieving the ambitions regarding health.

Technology is also important for the municipality concerning data. Utrecht does a lot with (open) data, trying to improve safety, health and mobility. In the field of open data, Utrecht wants to maintain its position as "frontrunner" (Gemeente Utrecht, 2018). As the first municipality in the Netherlands, she appointed an 'information commissioner'. Moreover, she has an online open data platform, where citizens and other interested parties can find all kinds of data. Publicity of information is an important

³ Important to notice is that the municipality of Utrecht in their latest coalition agreement explicitly states that she does not want to highlight and focus on higher education, but rather wants to promote and strengthen vocational education. Utrecht as education city has the ambition to make the city more inclusive.

principle for the municipality (Gemeente Utrecht, 2018). The next section describes how these aspects come back in the municipality's vision on smart mobility.

The concept of smart mobility is not directly mentioned in the relevant policy documents of the municipality. However, the title of the most recent traffic plan is 'Slimme Routes, Slim Regelen, Slim Bestemmen', meaning 'Smart Routes, Smart Organising, Smart Zoning' (Gemeente Utrecht, 2016b). This reveals the municipality's opinion that all mobility measures have to be smart. Examples of measures that are being mentioned are: adjusting traffic lights, individualised travel information and influence mobility behaviour by information campaigns and experiments in the public space. In general, the municipality regards mobility management, behavioural change and MaaS as the three aspects of smart mobility (Gemeente Utrecht, 2016b). But in the end, the municipality of Utrecht does not seem to have a clear definition of what smart mobility is.

The province of Utrecht, who closely cooperates with the municipality to improve the accessibility of for example USP, does have a definition: "Smart mobility is a generic term for all smart developments in the mobility system. It concerns developments in data analysis, autonomous vehicles, automation in traffic- and mobility management and new mobility services" (Provincie Utrecht, 2018, p. 46, own translation). The province also has a more abstract view on what smart mobility is, from a governance perspective: "Eventually, smart mobility concerns a development process in which interests of the government, businesses and citizens are being synchronised in a world with new possibilities" (Provincie Utrecht, 2018, p. 46, own translation). Here, smart mobility is regarded as a window of opportunity, to change the status quo; establishing new governance structures and using new technologies.

In the 'Meerjaren Perspectief Bereikbaarheid', the municipality describes what can be achieved with smart mobility. It "contributes to an optimal distribution of the available traffic capacity" (Gemeente Utrecht, 2017a, p. 25, own translation). The province has a more elaborate description of the opportunities smart mobility brings along. A selection from the 'Mobiliteitsprogramma 2019-2023' is that smart mobility can help to keep important locations accessible, that it can be used to better connect demand and supply, integrate and use modalities, and that it makes mobility more efficient, which saves energy (Provincie Utrecht, 2018).

All in all, the belief seems to be present that all kind of new technological possibilities can help the city move forward. The vision that resounds the most is that smart mobility measures will lead to better synchronisation, more comfort, or in other words, more efficient mobility. Following the vocabulary of Papa & Lauwers (2015), policy makers in Utrecht see smart mobility from a rather technology- or consumer-centric approach.

4.2.3 Smart mobility in Utrecht

In this paragraph, the policy and practice of the municipality of Utrecht around smart mobility will be discussed. Certain programs and initiatives in the field of smart mobility will be described, and thereafter it will be evaluated to what extent these contribute to the broader ambitions of the municipality.

Utrecht Science Park multimodal traffic management

Utrecht Science Park (USP) is one of the ‘hotspots’ of the municipality for economic development. In this area, numerous large knowledge-based and health-related institutions are located (see figure 7). Amongst the most important are the Utrecht University (UU), the HU University of Applied Sciences Utrecht (HU), University Medical Center Utrecht (UMC) and the recently opened Prinses Maxima Centrum, which is the largest centre for pediatric oncology in Europe. Together, these and other institutions daily attract ten thousands of employees, students and clients and this number is growing. The area attracts more and more students, companies and, with that, employees. As a consequence, the area faces major accessibility issues. Not only the roads, but also bicycle paths are highly congested and the public transport can barely deal with the amount of travellers (Algemeen Dagblad, 2018) (DUIC, 2017). As Jan van der Velden, director of USP, says: “this is the success of the USP and we have to cherish it, regarding the enormous economic interest for the region” (DUIC, 2018).

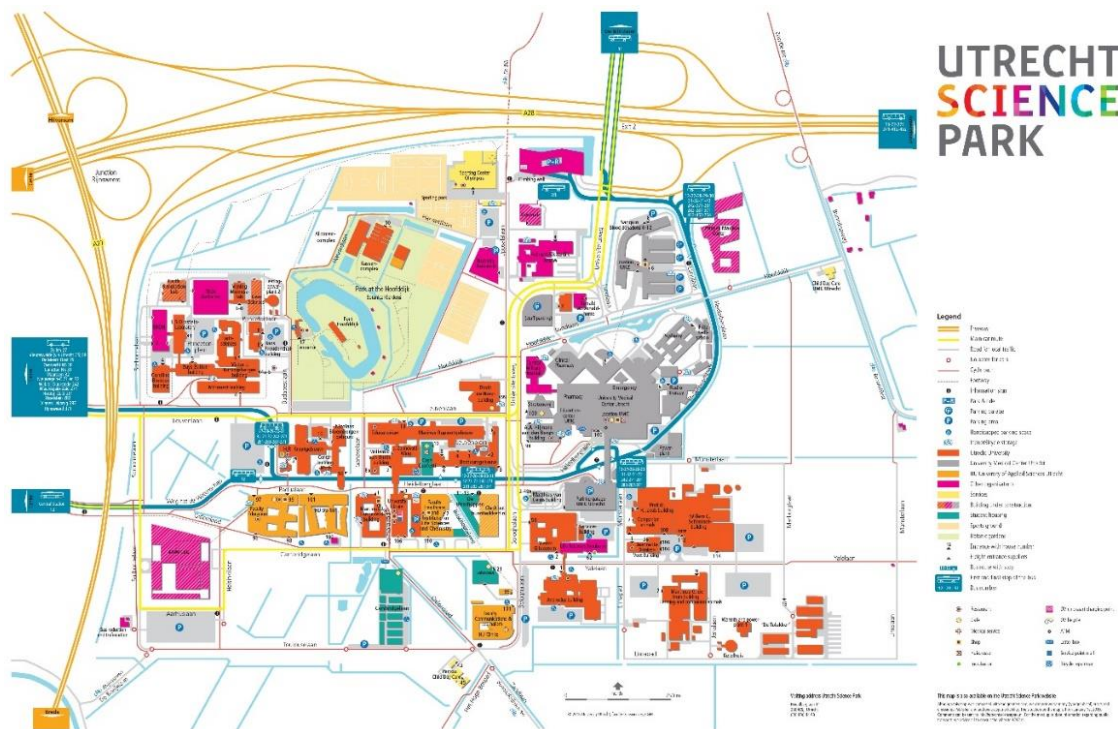


FIGURE 7: MAP OF UTRECHT SCIENCE PARK, SITUATION IN 2016. MAIN INSTITUTIONS ARE THE UTRECHT UNIVERSITY (RED), UNIVERSITY MEDICAL CENTER (GREY) AND HU UNIVERSITY OF APPLIED SCIENCES (ORANGE). SOURCE:

WWW.UTRECHTSCIENCEPARK.NL

Action is thus needed, both on the short term and the long term measures have to be taken to improve the accessibility of the area. With the construction of the light rail connection between Utrecht Central Station and USP, a large step could be made, but it will not be running until the end of 2019. Other measures are thus necessary. This section describes the measures that have been taken so far in the field of smart mobility and analyses the role of different stakeholders in these processes. One important stakeholder should already be introduced: Stichting USP. This is a foundation, initiated in 2013 by the UU, HU, UMC and the municipality and province of Utrecht. Those parties agreed to cooperate with the ambition to offer an internationally leading location for the clusters life sciences, sustainability and health and, by doing so, to add value to the society and economy of the region (Utrecht Science Park, sd).

As stated on their website, Stichting USP wants to achieve her ambitions by: “promoting collaboration between knowledge institutions and innovative companies, developing alliances in the region, offering facilities to starting entrepreneurs, acquiring business, improving facilities, advancing the liveability and enlarging the reputation of USP as location for knowledge-intensive activity” (Utrecht Science Park, sd). Accessibility can here be seen as a facility that contributes to the attractiveness of the area. Therefore, Stichting USP closely works together with the municipality and province of Utrecht in the field of mobility. Examples of measures that Stichting USP and the local authorities have recently taken are the construction of the light rail connection and the extension and intensifying of the bus network, including the improvement of connections to the nearby train stations of Bilthoven, Lunetten, Vaartsche Rijn and Bunnik (DUIC, 2018). Still, more needs to be done. Smart mobility can offer opportunities by providing alternatives for the car and making these more attractive. Stichting USP is therefore involved in certain smart mobility projects.

Campus Bike

One of those projects is Campus Bike, a bike sharing system that works similar as Hopperpoint in Eindhoven. The bikes are provided by and can be accessed and locked with the mobile application of GoAbout. It has multiple docking stations, located spread over the USP terrain, at the Park & Ride, at the train stations of Bunnik, Lunetten and Bilthoven, and at multiple companies in the direct surroundings (Utrecht Science Park, sd). In number of locations and number of bikes, the Campus Bike project is larger than Hopperpoint. A strong advantage of Campus Bike is that local companies, such as Sweco and Merus, actively cooperate in the project. Their employees use Campus Bike and thereby contribute to the coverage of the network and the demand for bikes, by which they support the project. Employers can do a lot, notices Marjolein van der Stok (project leader at U15 for Utrecht-Oost). They can, for example: “change their policy, facilitate shared cars and bikes, but it is way stronger when their neighbours also join in” (Van der Stok, 2018, p. 2, personal communication).

Another strong characteristic of Campus Bike is that it is initiated and implemented in a good cooperation between multiple parties. As Stichting USP is the initiator of the project, the most important knowledge-based and health institutions and the municipality and province of Utrecht are represented in the implementation of the project (Van der Stok, 2018). The project arose from the common interest those parties have, that is to increase the attractiveness of the area for existing and potential institutions and companies. By improving the accessibility of the location the area is a more attractive location for new (high-qualified) institutions and companies in the health sector, in other words the competitiveness of the location is raised. Attracting new businesses in the same sector is important for the concept of a campus, that “knowledge-based institutions that are located close to each other have more interaction, which results in even more knowledge” (Van der Stok, 2018, p. 6, personal communication).

The Campus Bike as smart mobility measure contributes to the last-mile accessibility of the USP. It is a last-mile solution that provides an alternative in multiple respects. First, for people travelling by public transport. Since there is no train station at USP, people who use public transport have to travel by bus to this area. With Campus Bike, those people that prefer to bike instead of being stuffed in a bus have a healthy and affordable alternative to travel from one of the near train stations to the area. And for those people travelling to a location on USP that is further away from a bus stop, it offers even improved accessibility by public transport. Second, the last-mile accessibility is also improved for those travelling to USP by car. Since the centrally located parking lots often were full, and the traffic to and from them was highly congested, a new parking garage was built on the edge of the area offering Park & Ride. People can park their car there and travel to their final destination by bus or by Campus Bike for a reduced price. Again, Campus Bike provides a healthy and affordable alternative for the last mile.

Campus Bike is smart in the sense that it uses technology, such as a mobile application and GPS, in order to enable bike sharing. With this concept, alternative modes of mobility are encouraged, as well as leaving the car on the edge of the area. These measures contribute to the liveability, safety and health of people at the USP. Thereby, Campus Bike is a successful initiative in the light of Healthy Urban Living. It is in accordance with the policy ambitions of the municipality of Utrecht to create an economic hotspot that is accessible, but where the quality of life is elementary.

Park & Ride De Uithof

The Park & Ride that is mentioned above, is also a measure that is taken in the light of improving the accessibility of the USP. Although the construction of a large parking garage on its own cannot be seen as a smart mobility measure, several actions have been taken around the construction of this parking garage that fit within the ‘smart’ framework. One of these actions is the placement of a Campus Bike docking station in the garage, as explained above. Another action is an integrated ticketing system for

the parking place and the public transport. Since the garage is built on the edge of the area, most people still need to cover some distance to their final location. For those people, an integrated parking ticket is available that offers them access to the buses and trams at USP at a very low price (Utrecht Science Park, sd). These can be booked and paid online and in advance. Combining parking with such possibilities is a nice example of smart mobility.

We Drive Solar & Smart Solar Charging

We Drive Solar is a project in which shared electric cars are offered. The vehicles drive, as the name already reveals, on solar energy. Smart Solar Charging is an extension of this project, in which the solar energy that has been generated locally, can be stored in the car batteries and used at a later moment. This mechanism of charging and discharging offers multiple opportunities, as will be discussed below. Furthermore, this section will describe how such a project is governed, what role the different actors take on and what results it offers for more sustainable mobility. But first, an introduction about the project. How did it originate and how does it work?

We Drive Solar – the beginning

The We Drive Solar project started around ten years ago in Lombok, a neighbourhood in Utrecht located closely to the city centre (We Drive Solar, sd). An entrepreneur was offering internet services, LombexNet, and he decided that he wanted to generate the required energy in a sustainable way. Therefore he placed solar panels on the roof of multiple buildings, also on schools that wanted to cooperate. He realised that he needed a buffer to store the excessive energy when there was sun, to be able to use this when there was no sun. Therefore a charging system was placed in his garden and later, another one was placed next to the public road. Then, the idea emerged to attach shared cars to the system. The question was who was going to facilitate these shared cars, but ultimately the internet entrepreneur decided to do this himself. He cooperated with Renault, that developed the Renault Zoë with vehicle-to-grid technology, especially suited for this charging system (Van Hemel, 2018).

In Lombok, inhabitants that were interested to use the electric shared cars could subscribe to We Drive Solar. With a mobile application, people were able to reserve and manage their booking. Charging stations were placed at different locations within the neighbourhood. Together with this, one or two parking places were reserved for the vehicles. Inhabitants could not only use the service, but also cooperate in the project by placing solar panels on their roof and thereby contributing to the energy supply. This is realised in the project 'Smart Grid: rendement voor iedereen', which means 'profit for everybody', and later developed into the larger project Smart Solar Charging (Van Hemel, 2018). The preliminary idea was that by using the battery of the cars, a more efficient energy grid emerged. Energy that is generated, but cannot be used directly, can be stored in the battery and later be discharged, to

supply one's house with energy. Or the energy can be delivered to the larger energy network of the energy operator.

Actors and the governance of the project

The number of users slowly increased and in the meantime other parties were involved, such as the Utrecht Sustainability Institute (USI). Together with the USI, LomboxNet developed the programme of Smart Solar Charging. The primary aim of this programme is “to make it possible to locally generate very much sustainable energy within the built environment” (Van Hemel, 2018, p. 2, personal communication). In solar energy they see two different value models. One is the flexibility in the energy system, to which decentralised, fluctuating energy sources contribute. When individuals can offer their car battery as a buffer for the energy operator, the solar energy they generate creates value. The other value model is a connection with mobility, in which solar energy is seen as an alternative for fossil fuels. Given the relative low price of solar energy, it has good concurrency position when using it as fuel. People are then able to ‘sell’ their energy for more interesting prices.

Different actors are important in the Smart Solar Charging programme. First of all the initiator of it, LomboxNet. This actor and her motives to develop the programme have been described already. Another actor that also has been mentioned, but not properly introduced, is USI. Van Hemel, director of USI since 2015, explains that USI is a platform that manages knowledge transfer on the one hand and is directly involved in the planning, financing and directing of programmes and projects on the other hand (Van Hemel, 2018). The institute, founded in 2010, aims for sustainable solutions in the city and region of Utrecht, mostly within the themes energy, water and circularity. The added value of such an organisation is that it has a large network within a certain field and that it can help bringing relevant actors together. This can help in making programmes more efficient or more effective, because available knowledge of different parties can be applied.

From the private sector, energy company Stedin is interested to cooperate in the programme. The reason for that is, as Van Hemel says, they want to build experience from practice. They want to see how new developments in energy grids, in combination with electric vehicles, evolve. By participating in a programme such as Smart Solar Charging, they gain first-hand insights (Van Hemel, 2018). The same applies to Renault, the car company that supplies their Renault Zoë's. The Zoë is an electric car that is specially equipped with vehicle-to-grid technology, which enables the use of the car battery as storage. Renault does not cooperate with Zoë's in the Smart Solar Charging project because they want to have two-hundred cars driving around in Utrecht, they do that because they see Utrecht “as *the* partner for innovation” (Van Hemel, 2018, p. 8, personal communication, *Italics added for emphasis*).

For the public sector, especially funding is an important task in the project. This starts on the European level. The European Regional Development Fund (ERDF) is an important subsidiser of Smart Solar Charging. On a national level, money that was made available for innovative projects has been invested in the project, to be able to do the initial pilot in Lombok. Moreover, funding was provided by the Province of Utrecht (Smart Solar Charging, sd). All these government bodies acknowledged the value of such an innovative project. On the more local level, more executive tasks become visible. The municipality of Utrecht is responsible for the public space and thus for appointing the charging points and actually placing them. Van Hemel is delighted by the progressive attitude of the municipality regarding sustainable generation of electricity and regarding electric shared mobility. She invested a lot in charging points, initially regular ones but later also with smart solar system. The municipality also saw her chances here, in sharing her expertise and innovative projects with good results. The cooperation with the municipality was straightforward and full of understanding, which definitely contributed to a good starting from where the project could evolve (Van Hemel, 2018).

Upscaling

Since the pilot in Lombok was regarded successful, the need arose to experiment on a larger scale and in different situations. At the moment, Smart Solar Charging is expanded towards five pilot locations, which are called 'living labs'. Except Lombok, the project now also takes place in Utrecht in the area of Utrecht Central Station and USP. In the region the living labs are in Houten, together with the municipality of Houten and a project developer, and in Zeist, together with Triodos Bank (Smart Solar Charging, sd). The USI had an important task here, namely to entice other parties to invest and participate in new pilots. The aim was to cover (as much as possible) different 'types' of users and organisations that cooperate.

The above-mentioned living labs differ in multiple aspects. Lombok is residential, meaning that the solar panels are spread over the area and charging points should be located at the public road. The users are heterogeneous, numerous and relatively unorganised. The living lab at Utrecht Central Station is mostly facilitated by the Jaarbeurs, the large conference centre. Solar panels are here placed on the roofs of and exploited by the Jaarbeurs, therefore the generation and use of energy is different, more concentrated. Jaarbeurs is the main customer regarding energy. But users of the cars are diverse, for example visitors of the Jaarbeurs, employees from the nearby located municipality, and in the future perhaps travellers to and from the train station. On USP, the involved actors are the UU and HU. Solar panels are concentrated on their buildings and users are foremost the employees of these institutes. In Zeist, the cooperating partner is Triodos Bank. This organisation places solar panels on their building and has the ambition to transform their vehicle fleet into electric vehicles. They want their employees to make zero-emission business trips.

The USI functions as project leader, is responsible for the financial aspects of the project, but is also the promoter and connector between the different participants. Van Hemel stresses that it is of enormous importance to have a stable, trustworthy and longterm relationship between the different parties, to enable such a long lasting transition in both the energy grid system as in the mobility system. The fact that the USI is a stable party, and the strong cooperation with Renault, helps in making Smart Solar Charging a reliable project to invest in.

4.2.4 The relation between smart and sustainable mobility in Utrecht

In the projects that have been analysed in the case study, the municipality does not take an initiating or leading role. In some projects, however, they do participate, whether or not in an active role. In the Campus Bike project for example, the municipality takes place in Stichting USP, the actor that initiated and executes the project. The municipality works together in this foundation with the large institutions that are located at USP. In Smart Solar Charging, the municipality acts more as a facilitator. She carries out multiple tasks in this project. First, she supports it financially. Second, she creates physical space (on the streets, to place charging stations) and institutional space (legal support such as exceptions on laws and allowing energy grids and charging stations) to make it possible to execute the project.

Within some other projects, that have not been analysed extensively during this study, the municipality of Utrecht uses her legislative power to oppose certain restrictions. An important example is that of city distribution. With strict time schedules for supplementing stores and cafés in the inner city, the municipality forces parties to organise their supply processes smarter, more efficient (Jansonius, 2018). Another running project concerns the routing of trucks entering the city. The municipality wants that large trucks stay on the main roads as long as possible on their routes to the shops. Therefore they created a system with which they follow trucks of certain distributors and they can prioritise those trucks that use the preferred routes at traffic junctions (Jansonius, 2018). With such measures, the municipality tries to influence the logistic movements in the city, by forcing and rewarding measures.

The municipality has thus not taken an initiating or leading role so far, like the municipality of Eindhoven which calls herself a launching customer. However, it seems that the municipality does not hesitate to financially and institutionally support projects that they regard promising. This facilitating and supportive role of the municipality receives a lot of appraisal (Van Hemel, 2018).

Nevertheless, some remarks need to be made regarding smart and sustainable mobility in Utrecht. The point that the municipality strives for more sustainable mobility is clear, that they favour walking and cycling in core areas as well, that they have restrictive or limiting policies for cars and city distribution as well, but very clear and unambiguous policy about the role of smart mobility is missing in the sustainability policy. The consequences of this are visible. On USP, a very progressive location with lots

of knowledge present, the number of smart mobility initiatives that are of respectable scale is very little. Only Campus Bike, the Park and Ride and, very recently, Smart Solar Charging are smart mobility projects that have been implemented. Thereby comes that the governing of mobility on USP is rather unorganised. The institutions have their own regular meetings with each other, where new ideas are discussed and policy has to be made. But the organisations participating here are very large and bureaucratic, with many different people with different responsibilities. As a consequence, it is not clear who discusses what and who decides what. The governance of the area is very hard to understand, also for people who work there themselves (Van der Stok, 2018).

A stronger vision of the municipality would be very helpful for other parties in Utrecht to do something with this, argues also Van der Stok (2018). The vision should not be strict about what is and what is not allowed, because that would limit creativity and innovation. Nevertheless, with a stronger vision on smart mobility the municipality could take a stand. When she composes a certain frame, this could have interesting consequence, since this facilitates different stakeholders in their discussions (Van der Stok, 2018). It would make decision-making about smart mobility measures more efficient.

Coming to an answer to the essential question of this section now, which is how the municipality of Utrecht influences the environmental impact of mobility by the role and measures she takes to govern smart mobility initiatives. The municipality is open for new ideas and new applications of technology, but could be more clear about what she values. The efforts the municipality makes in the light of more sustainable mobility are admirable, but could be improved by making optimal use of technology in the right direction. In this way, she is not dependent upon wonderful private initiatives such as We Drive Solar but can, as organisation, actively promote and contribute to smart mobility initiatives that truly help making urban mobility more sustainable.

5. Findings

The projects that have been analysed in the case studies show, in general, a strong relationship between aspects of smart mobility and sustainability. Given the objective of the research, that is to examine how local governments can influence smart mobility initiatives so that they contribute to more sustainable mobility, projects that show this strong relationship were regarded as the most interesting. The focus has therefore deliberately been put on projects where the concepts of smart and sustainable both were recognisable, instead of on projects that are specifically smart or sustainable. How this relationship is shaped exactly, differs per project. This section will elaborate on the different relations that Lyons identifies and how these emerge in practice.

5.1 Relations between smart and sustainable mobility

The different Venn diagrams presented by Lyons, as described in chapter 2, offer a clarifying framework to explain the different relations (figure 8). Let's start with an example. The municipality of Eindhoven has a vision in which innovation is appointed as a crucial factor for the economic development of the area. It is a distinctive character of the city of Eindhoven and therefore innovation is seen as a goal in itself (Staps, 2018; Van der Pas, 2018). However, the city also has serious ambitions regarding climate mitigation, in other words reducing emissions. If good coordination is lacking, these different ambitions can live alongside each other. It is highly plausible that certain measures that are taken do contribute to the innovative character of Eindhoven, but do not address a sustainability component. One can think of innovations directed at increased efficiency. The other way around, measures directed at sustainability can be taken without using innovative technologies. Finally, measures can be taken that address both components. Such a scenario is illustrated by diagram A.

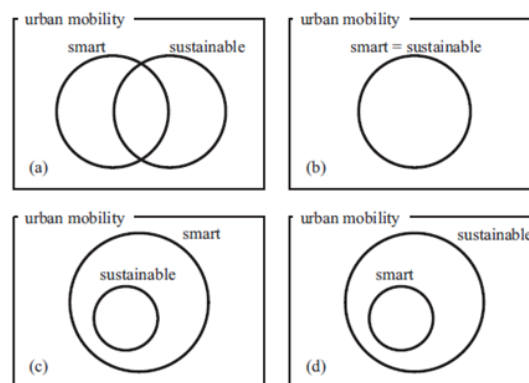


FIGURE 8: VENN DIAGRAMS ILLUSTRATING THE RELATIONSHIPS BETWEEN SMART AND SUSTAINABLE MOBILITY (LYONS, 2016)

The coordination between the components that is lacking in diagram A, is found in diagram B. Lyons (2016, p. 5) advocates that this situation “may, for some, depict an optimal reality in that all that is

smart is sustainable and vice-versa". In this scenario, the terminology and the meaning of both concepts have converged. An example could be the introduction of Campus Bike at Utrecht Science Park. Were technological developments go hand in hand with stimulating the use of public transport in combination with cycling. Although sustainability is an important objective for the Campus Bike project, it is also aimed at improving the last-mile accessibility and interconnectedness of locations at the USP. Therefore, one cannot claim that sustainability is the main driver behind Campus Bike and therefore the conclusion that in this project the sustainable component is dominating the smart component would be premature.

The relation between the components get a more hierarchical character in diagram C and D. Diagram C represents a situation where the smart component has the upper hand, which means in practice that developments may become too technology-centric. As Lyons (2016) also states, this can be regarded as a 'dystopian' situation. Since the objective of this thesis is to identify possible instruments by which a local government can steer away from such a situation towards a situation where sustainability is more important, no situations or measures are described that are represented in diagram C. Nevertheless it would be very interesting to also identify this sort of situations, as sort of 'worst practices': examples of undesirable situations that should be prevented.

Diagram D, finally, illustrates the situation in which the sustainable component dominates the smart component. Or in other words, smart is seen as part of sustainable. Lyons (2016, p. 5) describes this very stylish as "a stronger level of stewardship over urban futures". Policy makers should be aware of the influence they can have on how this relationship is evolving. Different examples that have been discussed in the case study show that this insight is becoming more present lately. In Eindhoven, for example, the vision on smart society is regarded to contribute to the quality of life in the city. Technology plays a submissive role in the ambition to be a liveable, healthy city without emissions. A meaningful citation is: "solutions *with* technology and not *by* technology" (Gemeente Eindhoven, 2016b, p. 3, own translation, Italics added for emphasis). The vision becomes more tangible in the upcoming MaaS-pilot, in which different shared mobility systems will be combined and used to transform the municipality's mobility into zero-emission mobility. It is very clear that in this case sustainability is the end and technology a means.

Were Lyons advocates to bring the different paradigms together, to *align* them, I would like to plead for a more dominating role for sustainability. Smart mobility measures, making use of the possibilities technological innovation brings along, should make a contribution to objectives as reducing CO2-emissions. Together with this, the liveability of a city can be improved.

5.2 Smart sustainable projects in Eindhoven and Utrecht

This section assesses to what extent the projects that are analysed in the case study are good implementations of smart sustainable policies. That means that a critical look will be given at the ideas behind the project and the effects the projects have. The Venn diagrams will be used to indicate the different relationships between smart and sustainable that will become visible.

5.2.1 Eindhoven

On Strijp-S in Eindhoven, Mobility-S wants to reduce the number of parking places and thereby the number of cars in the area, to create a more liveable city district. They hope to achieve this by reducing the existing stock of parking places and by only developing an amount of new parking places that is really necessary, regarding new developments. Mobility-S tries to reduce the demand for parking places by improving high-quality public transport and by offering shared mobility options. Also, their Smartparking system aims to better integrate the different parking systems that are used in the area, to make it easier to use the available parking places more flexible (in case of an event for example). But on the other hand, this Smartparking system makes it easier to park and thus to come to the area by car. So then, what is the problem they want to solve with this solution? Is it the fact that people cannot easily find a parking spot at the moment, or that there are too many cars in the area? The solutions that are provided now are directed at two different, slightly contradictory, ambitions. Reflecting on the diagrams presented by Lyons, this situation fits best in diagram A.

If in this case the approach would be even more from a citizen's perspective, the attention should be shifted completely to how the area can be optimally accessible *without* further improvements that make travelling to the area by car more attractive. This is a rather extremist point of view and it is understandable that decision makers do not want to totally discourage car use at this moment. The ambition to reduce the number of cars in the area and to reduce the amount of parking places is already a good step in the direction of a better liveable city district. But, when one keeps the objective in mind to reduce CO₂-emissions with 95% in 2050, one could advocate for a policy wherein sustainability is even more at the centre of attention. Such policies would be represented by Lyons in diagram B.

The MaaS-pilot in Eindhoven is an example of a programme that fully strives for an optimal use of new technologies to contribute to sustainability goals. Here applies the same as what is described just before, that such a programme is represented in Lyons' diagrams as diagram B, or even as diagram D. Obliging their employees to do their business trips in a way that is zero-emitting, by offering multiple providers of shared mobility services, is a perfect example of an optimal use of technology as instrument with sustainability as the ends. The providers that are likely to offer their services to the

municipality include Hopperpoint, the shared bike system, and Amber, with their electric shared cars. With this idea, the municipality wants to be a good example of how a government not only can promote sustainable mobility, but also actively work on making her own mobility sustainable.

5.2.2 Utrecht

The programme on multimodal accessibility of USP is in essence not about smart mobility, but about maintaining and improving the accessibility of USP in all possible ways. Smart mobility is one of the solutions that can contribute to this. But how does the smart mobility policy relate to the sustainability ambitions? Let's start with the Campus Bike project. This shared bike system has elaborately been described in chapter 4. The Campus Bike is a measure that primarily aims for enlarging the attractiveness of public transport. Because it improves the last-mile accessibility, the belief is that people are encouraged to make use of public transport more often. Therefore, this measure can be regarded as directed at sustainability by making use of technological possibilities. Lyons would argue that such a measure perfectly fits in diagram B or D. Although no direct information could be found that validates this statement, the extensive analysis and first-hand experience as user by the researcher serve as a sufficient support for this thesis.

Another measure at USP that has been described is the Park & Ride with integrated public transport tickets. The same contradiction strikes up here as with the Smartparking project in Eindhoven. On the one hand, the different actors at USP want their area to be a liveable, attractive location, according to the principles of Healthy Urban Living. Therefore, the Park & Ride is located at the edge of the area, keeping cars out of the centre of the area. To support this, enormous investments are made to improve the accessibility of USP by public transport. But on the other hand, the construction of an exorbitant large parking garage can be seen as an invitation for car owners to travel to the area by car. Offering them discount on public transport services within the area is, moreover, a present or even a reward, for those people travelling by car. In the end this may even have a worsening effect on the accessibility of USP, since the already highly congested highways and other access roads around USP will get even busier. The proof therefore is already available: the discussion about enlarging the highways around USP has started. Moreover, by relocating parking places to the edge of the area, nothing changes in the amount of CO₂-emissions and energy use. The relation between sustainable measures and smart measures on USP could thus currently be illustrated by Lyons' diagram A. Better integration between the different measures is desirable, seen from a citizen-centric perspective.

One project that already works on this integration is Smart Solar Charging. LomboxNet and USI, the initiator and developer of the project, recognise the value that can be generated by solar energy. It is not only well suited for providing sustainable energy to houses, but can also be linked with electric cars

on the street. In so doing, value is created in two ways. More important however, in the light of sustainability, is the fact that it facilitates electric cars and provides them with local generated sustainable energy, derived from the sun. This project exceeds the domain of sustainable mobility, because it contains much more than only mobility. In the end, however, the strong link that is created between solar energy, charging and discharging and zero-emission mobility makes it a very interesting project when analysing the sustainability ambitions within the smart mobility playfield. If a light is thrown upon the Venn diagrams of Lyons, this project would definitely be placed in diagram D, because it is very clear that sustainability is the main aspect and smart is only a, though very important, means to achieve it.

5.3 The role of local governments: a reflection

In this section, some remarks will be made about the role of the municipalities of Eindhoven and Utrecht, based on the four perspectives presented by the NSOB report. The four different perspectives are said to be not following up on each other, but rather live next to each other, presenting a dynamic playfield in which governmental bodies find themselves. The question asked here is how the municipalities relate themselves to the domain of smart mobility.

In chapter 2 a tendency has been described of academics pleading for smart cities that acknowledge the value and essence of human capital. Not only Nam & Pardo (2011) with their human dimension on smart mobility, or Papa & Lauwers (2015) with their plead for a citizen-centric perspective, but an increasing number of scientists embrace this vision. In accordance with such a vision on smart cities fits a government in a participating role, not in a dominating one. There needs to be consciousness among public authorities that citizens can organise themselves, that society can shape public value and can initiate new projects. The attitude of governmental bodies should be open and responsive, as new, innovative concepts do not benefit from opposing forces such as strict legislation. Moreover, governments are required to be facilitating and supporting. Initiatives that take place on a small scale often need funding or otherwise (institutional) space to implement their ideas. All of these characteristics are expected from public authorities, regarding the participating government perspective.

An exemplary situation of a government in such a role is seen with the municipality of Utrecht in the Smart Solar Charging project. The most important remark to make here about the role of this local government is probably that she acted in the background. That is not to say that their role was passive or unimportant, on the contrary: the municipality of Utrecht was an important actor in enabling the project to grow. Based on Van Hemel's statements, the municipality deserves compliments for their open and responsive attitude. Open in the sense of valuing the initiative and not blind staring to

existing structures and legislation. Responsive in essence means that public authorities are approachable and willing to think along with the initiator, in order to achieve certain change. These characteristics are particularly visible in this project, as the municipality created space for charging stations in the neighbourhood Lombok and was very compliant about the energy supply regulation. As Utrecht is a frontrunner in sustainable energy generation and wants to stay up front, the public authorities were very involved and driven in the cooperation, states Van Hemel (2018). Altogether, one may say that the municipality of Utrecht is very well participating in the project Smart Solar Charging.

In another project, that has been analysed during the case study of this research, the local government operated merely as a networking government. This is the case on Strijp-S in Eindhoven, where Mobility-S is a public-private partnership between the municipality and a development company. Established in 2002, the municipality tries to achieve their policy ambitions such as reduced car usage via this PPP. The municipality in this situation is rather a central actor, which results in the situation that local authorities, although in consultation with other parties, decide what is in sake of the public good and what measures should be taken. There is, however, still space for innovative partners to introduce and execute new applications of technology in the mobility field. This characterises the city of Eindhoven as innovative city; it is therefore that the municipality supports it. The result is an area with lots of experimentation, as well in the field of smart mobility as in other fields, but where the initiative and the decisive power is mostly in hands of the larger, more established organisations.

The other project in Eindhoven researched here is the upcoming MaaS-pilot, in which the municipality takes the leading role. By making her own business trips emission-free, she hopes that other parties follow the good example. It is more difficult to discuss this project from only one of the four perspectives on government roles, rather it seems that two perspectives combined deliver the best possibility to discuss the role of the Eindhoven government. The municipality focusses on their own functioning, their efficiency and their environmental footprint, and can therefore be rewarded for their effort from the performing government perspective. As a launching customer, she outsources some of their services (mobility services for their own employees) to market parties that offer the different modalities and the MaaS-platform. Working together with market parties can in this sense also be analysed from the networking perspective, in which public authorities and market parties have a more horizontal relation. Seen from this perspective, it would be very helpful if the municipality of Eindhoven will evaluate and share their experiences in the near future with the market parties providing the services, but also with other interested institutions and market parties. By doing so, she will create and spread more knowledge about those new forms of mobility and be an example on how others also can make their mobility emission-free.

Considering the different projects discussed above, it is difficult to determine which of the perspectives on the role of the government is more or the most promising, relating to zero-emission smart mobility projects. The context, both geographically and institutionally, is different in both cities. The one (Utrecht in this case) may have more worries about population growth, while the other (Eindhoven) will be more worried about the growth of their economic potential and attractiveness. The preferred way of governing certain issues can depend on a wide range of factors, political for example, and should therefore not be questioned in general.

However, in certain projects it can be interesting to see how smart sustainable mobility policies would have evolved if the local government had taken on another role. Would Smart Solar Charging already be a success and would it have been expanded to five locations if the government was less supportive and facilitating? Would it have come off the ground at all if the government was initiating it herself? Would Strijp-S still have had only two shared bike providers if the government was less present in the area? Would the area look differently nowadays if the PPP was not established to cut down the car use in the area? Those questions can and will not be answered, but they justify that local governments should make very well-considered decisions about how to put themselves in a certain role. Because this role will certainly affect the way a project evolves and eventually affects the way our mobility and environment take shape now and in the near future.

6. Conclusions

6.1 Conclusion and policy recommendations

In the light of the main research question, that was formulated as: *“What roles can local governments take on and which instruments can they use to govern smart mobility practices and how do these factors influence the environmental impact of urban mobility?”*, this study has explored different projects in the cities Eindhoven and Utrecht. All projects described here are examples of mobility policies that address the smart component, the sustainability component, or both. The relationship that evolves between these two different components can differ, as is explained with help of the Venn diagrams presented by Lyons. This study advocates for a strong orientation towards sustainability, towards the reduction of CO₂-emissions and energy use by mobility. Therefore, it is required that policy makers adopt a vision that fits within diagram B, where smart and sustainable are two interdependent components, or even more ideally within diagram D, where sustainable is the major component and smart the minor one, the means to the end.

This vision then should lead to projects and programmes that are primarily aimed at sustainability. The case study has illustrated that such projects can be governed in different ways. The initiator of a project can for example be a local entrepreneur, such as with LomboxNet. But it can also be a larger company, a municipality herself (whether or not commissioned or supported by higher governmental levels), or a combination of those parties. The latter is the case with Strijp-S, where the municipality cooperates with multiple companies and institutions in the area to govern the mobility projects. Also, a municipality can position herself in a very active and progressive way towards new developments, or can choose to operate more in the background. The former is seen in Eindhoven, where the municipality is a launching customer in the new MaaS-pilot. The latter is seen in Utrecht, with the Smart Solar Charging project in which the municipality is not actively involved. This does not comprehends that the municipality is not supportive or progressive. On the contrary, in this specific project the municipality has proven to be very open and supportive for such an innovating, sustainability-driven project.

It should thus be said that there is not one single proper way of policy-implementation and project design in the case of smart mobility. What works in one district of a city might not work in another one, but may work in a comparable district of another city. Local authorities can take on different roles, according to what they think works good in a specific situation. It is however of crucial importance that a government consciously decides what role she takes, as this influences a project significantly. Based on the case study, some exemplary government roles and instruments can be listed here. To start, experiments seem to be an useful instrument. The process of developing new technologies, and

applying them in different ways and different places may result in new insights. Insights about the effectiveness and efficiency of the measures, but also about preferences that different stakeholders may have. Experiments, also known as pilots, such as Smart Solar Charging and the national MaaS-pilot, are highly valuable to learn from. The experience and knowledge that it produces could be adopted in other, new projects in the field of smart sustainable mobility policies. The exchange of experience and knowledge is an important prerequisite for this.

Furthermore, cooperation in the form of public-private partnerships, for example, is an instrument that shows some promising results in the analysed projects. By cooperating with companies and other institutions, a municipality may enlarge the support for certain policies and thereby improve the effectiveness of new measures. A good example is the governance of mobility on Strijp-S, where Mobility-S manages the mobility practices. Despite giving some autonomy to this PPP organisation, which moreover results in creative and innovative solutions, the municipality is still able to guide, monitor and intervene the implementation of her mobility policy. Cooperation with parties that have ideological and often long-term oriented ambitions is, besides, a favourable thing to do. This often results in solid and confident project relations, as appeared with Smart Solar Charging. Parties that do not only look at quick wins, but at long-term results for a prosperous future, are reliable partners for investing in new mobility solutions.

Last but not least, in order to establish policies with a better integration of smart mobility and sustainability ambitions, it is crucial that local governments carry out a strong vision on new mobility possibilities. A vision that states that sustainable mobility is an absolute must, that new developments always should contribute to a more sustainable and more liveable city and that technology does not play a leading role but a serving role. If mobility with as little as possible negative environmental consequences has to become the point of departure for future mobility policies, a change of perspective towards smart mobility is needed. Where the most common perspective nowadays puts technology, efficiency and the experience of the mobility user central, it should change towards a perspective that takes the environment as a starting point, in which mobility takes place, and which puts citizens that live in that environment in front.

6.2 Reflection and recommendations for further research

The demarcation of a research is a tough task and a continuous process. During the execution of the research, many very interesting aspects have been move past, sometimes put forward by interviewees and sometimes passed by during the literature review. Aspects that are closely linked to the subject of the research, smart mobility and its relation with sustainability. To name a few: sustainable city distribution, the development of mobility hubs and mobile applications for cycling stimulation. The choice to analyse a limited number of projects implies that other interesting projects cannot be taken into account. The choice for the projects has been based on a number of criteria: the availability of information on beforehand, the availability of proper interviewees that are well involved in the projects, and of course suitability of the projects for a research into the sustainability aspects of smart mobility initiatives.

Especially the subject of city distribution appeared to be a relative understudied field and also a theme that could be more engaged in local policy-making for sustainable mobility in cities. Local governments can and should do more to influence the logistic movements in and around their cities. It also appeared that some already try to do so, but do not have enough knowledge or experience about the topic. Research in this direction is thus highly needed.

Some final remarks need to be made about how this thesis has to be seen. With this thesis, no attempt is made to formulate certain universal pronouncements or generalisations about the relation between smart and sustainable mobility. Rather, the objective was to explore which different roles local governments can take upon and which instruments they can use to govern smart mobility practices. Moreover this study provides some practical insights about how the relationship between the smart and sustainable domain evolves differently in practice and discusses how these differences could be explained. With this insights, the smart mobility practices that reduce the environmental effects of mobility can be explained and can be considered as best practices for policy makers that aim for future mobility policies that are both smart and sustainable.

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