CHALMERS
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Residential parking practice

The role of housing companies in stimulating a transition towards sustainable mobility solutions.

Master's thesis at the Challenge Lab

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Master's Thesis FRT 2017:13

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Abstract

This thesis has been conducted in an innovative educational setting, that of the Challenge Lab at Chalmers University of Technology where students are equipped with tools and methods in order to identify 21st century sustainability challenges (Part I) and try to tackle them (Part II). The subject of mobility attracted our interest as a field with serious challenges but also great momentum. Intelligent Transportation Systems (ITS), car-sharing initiatives and other innovative business models are disrupting the transport sector. Urban developers in Gothenburg try to face the shortage of land in order to respond to the increasing demand for housing. Parking is considered the unstudied link between transportation and land use. Therefore, this study addresses ① What are the drivers and barriers to a transition towards a parking practice with lower parking rates? and ② How can housing companies play a role in stimulating a transition towards sustainable mobility solutions? To address these questions, interviews were conducted with 12 professionals from housing companies, property developers, mobility providers, consultants and researchers. Further, a survey was run in order to identify tenants' perception and understanding of the issues related to mobility and parking, as well as their openness to change. These methods were followed by a dialogue amongst 10 relevant stakeholders. The multi-level perspective was adopted to allow for data understanding and categorisation. The method of backcasting contributed to demonstrate a way of co-creating a strategy for approaching a desirable future. The results of this thesis illustrate a rigid sociotechnical system with inflexible policies, unfair parking prices and the lack of a common vision amongst stakeholders. To overcome these barriers some niche level activities are recommended. First, we have identified a need to create a common vision amongst relevant triple helix actors (public, private sector and academia) to be able to provide guidance for a transition. Furthermore, housing companies should experiment with innovative concepts via demonstration programs. The existence of broader networks or coalitions and the assurance of continuity in the monitoring, evaluation and assessment of these processes is essential for the success of such measures.

Keywords: Challenge-Lab, backcasting, transition management, niche-level activities, sustainable mobility solutions, parking norm, residential parking

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1.Introduction

After the introduction of Challenge Lab (section 1.1), a description of the master thesis background follows (section 1.2).

1.1 Challenge Lab

In 2014, Challenge Lab launched as an effort from Chalmers University of Technology to combine research, knowledge and innovation (the knowledge triangle) in order to pinpoint long term challenges within the five knowledge clusters in western Sweden, namely: Urban Future, Marine Environment and Maritime Sector, Green Chemistry and Bio-based Products, Sustainable Mobility, and Life Science (Holmberg, 2014).

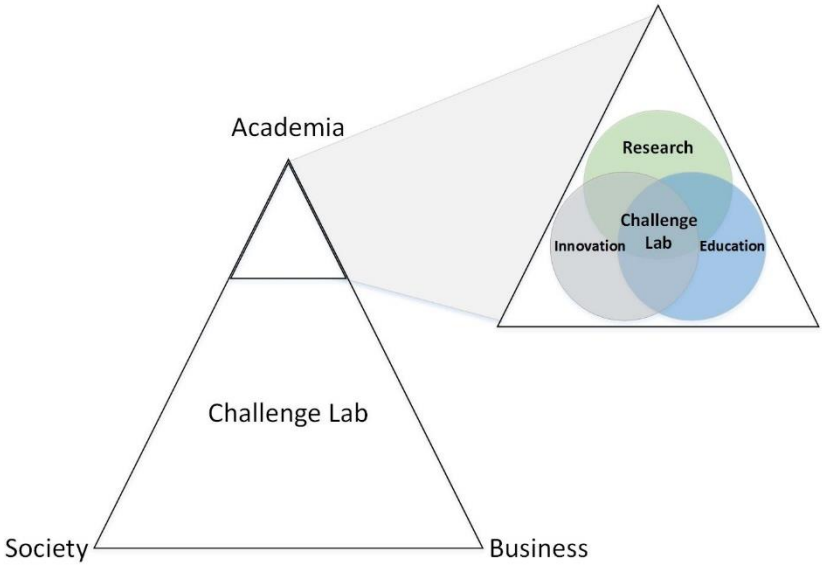

Figure 1 Challenge Lab in the centre of the regional knowledge cluster

Challenge-Lab provides a unique platform where students work transformative, with a visionary mindset in order to identify unexplored opportunities within the triple helix (society, business and academia). Students' neutrality allows them to act in an integrative way, where solutions can be found through co-creation between the different parts of the society. Thus, the Challenge Lab mission as formalised by (Holmberg, 2014) is to give the students the opportunity to work across disciplines and from a challenge-driven perspective.

During the spring of 2017, 16 students from 11 different master program are writing their master thesis at Challenge Lab. The variety of scientific backgrounds make Challenge -Lab a unique platform where interdisciplinary collaboration can flourish and innovative ways of thinking can be generated and promoted. Through the lab, the students are provided with tools to learn about their own strengths and weaknesses and enhance their leadership skills.

A Challenge Lab thesis is conducted in two distinctive phases. During Phase I, students research regional sustainability challenges to increase their understanding about the current status quo. Through the method of backcasting, the students set up a framework for a sustainable future which is used to challenge the present situation. Following an iterative process, students form groups of two and finally end up with a research question that feels meaningful to them and has a potential to create a change towards a more sustainable path.

In the second phase of Challenge Lab, the pairs of colleagues investigate the research question, formed in Phase I, making use of the methods and tools which they had been familiarised with, during the Challenge Lab course and Phase I.

1.2 Thesis Background

United Nations and other environmental organisations and fora have as top priority the climate change mitigation. The global temperature rise is one of the most complex global challenges that the planet is facing. According to (NASA, 2017), since the late 19th century, the planet's average temperature has risen about 1.1 degrees Celsius, with 2016 to be the warmest year on record. This change is largely owed to increased carbon dioxide and other human-made emissions into the atmosphere. Land transport-related greenhouse emissions (GHG) have more than doubled, since 1970, having the faster increasing rate than any other energy end-use sector. Moreover, 94% of transportation total energy demands covered by 53% of global primary oil consumption making automobility a highly oil dependent industry (Sims & Schaeffer, 2014). Given these facts, the current mobility system has been considered unsustainable in many respects and partly responsible for the important global climate challenges. Therefore, many scholars have addressed the need for a transition towards more sustainable transport future (Banister, 2008; Geels, 2012; Nykvist & Whitmarsch, 2008; Owens, 1995; Urry, 2004; Whitmarsh, 2012). This transition can only be realised by deep structural changes in sociotechnical system (Geels, 2012).

At the end of Phase I, we identified two main elements of the transportation system, which can act as leverage points and ally forces towards a sustainable transportation system. These are mobility services and parking practice.

More specifically, every transport system, like rail transport or sea transport, has three elements: vehicles, rights-of way, (tracks and oceans respectively) and terminal capacity (stations and sea ports in our examples). The automobile system has cars, roads and parking lots. Two aspects of it, differentiate automobility from all other transport systems. The first is the enormous terminal capacity that the system requires because of the great quantity of cars and the bigger quantity of parking lots. The second pertains to the fact that motorists park free for almost all their trips since off-street parking requirements shift the cost of automobile terminal capacity from the transport sector to other sectors of economy (Shoup, 2011). High levels of car ownership, with almost one car per two residents in Sweden (Nykvist & Whitmarsch, 2008) enlarge these problems.

Planning for parking can have a contribution to challenges related to land allocation but its role in transitions at the transportation sector is wider. Parking is the least studied link between urban planning and mobility. As part of a general call for transdisciplinarity both in research and in practice (see section 2.2), scholars such as (Banister, 2008), claim that the link between land use and transport should be strengthened. The reason is that parking planning, through several measures, can contribute to decrease the car use while at the same time create availability, accessibility and traffic safety (Envall, 2016). What is more interesting, is the ways that this contribution can be realised. Measures like removal of minimum parking requirements can be a driver not only for less privately owned cars but also for alternative mobility services or radical innovation and experimentation. If we take under consideration

Atkin's (2014) claims that Intelligent Mobility developments such as MaaS[1], bring new opportunities and act as a disruption force for the transportation status quo, we can start considering parking practice as a leverage point for broader changes within automobility.

Meanwhile, at a local level our research and interaction with local actors during Phase I showed a gradually increased interest in the field of mobility and parking practice. More specifically, the municipality and the Urban Transport Administration of Gothenburg, are preparing a new parking policy (Stadsbygggnadskontoret, 2017), expected to be ready until November, 2017. Property managers and housing companies express their willingness to focus on mobility and move towards lower parking rates. Thus, our interest on sustainable mobility and urban development along with the chance to deal with a tangible need for a sustainable transformation were the main drivers for this thesis with the following research question and the two sub questions:

What is the role of parking practice in stimulating a transition towards sustainable mobility solutions?

- What are the drivers and barriers to a transition towards a parking practice with lower parking rates?
- How can housing companies play a role in stimulating a transition towards sustainable mobility solutions?

We anchor our study in theory of Multi-Level Perspective (MLP) on transitions (Geels, 2002) and we centre our analysis on Backcasting methodology.

2.Theory

In this chapter, theoretical concepts and tools applied in Phase I and II of the thesis are described.

2.1 Challenges related to systemic changes and transitions

Persistent problems and severe environmental challenges, like climate change and air-pollution challenge humanity. Environmental policies have been criticised as unsuccessful in bringing about societal transformations, involving a change in both technology and behaviour (Rotmans, et al., 2001). Loorbach, et al. (2010) claim that these problems can only be dealt with through specific kinds of network and decision-making procedures. Focus has been shifted to other governance approaches such as transition management. Indeed, transitions and system innovation are recently of increased interest within academia, society and the business world, since they are expected to achieve "jumps in environmental efficiency" (Geels, 2005). Rotmans, et al. (2001) define transition as "[...] a gradual, continuous process of change where the structural character of a society (or a complex subsystem of society) transforms". However, this transformation of structural societal characteristics, also mentioned as systemic change, is neither linear nor easy. It is associated with problems related to systems' complexity

[1] MaaS refers to app-based services that provide users with access to multimodal transport offerings including, for example, public transport, car and bicycle pools and ride-sharing schemes. These are provided by an ecosystem of mobility service providers brought together by an independent operator or 'mobility broker' (Sarasini, et al., 2016).

and complicatedness, well-established and inertial entities as well as techno-institutional lock-ins, which are further analysed in the paragraphs below.

Sociotechnical systems are well-established and robust, making them resilient to changes. Geels (2002) developed a transition theory based on a dynamic multilevel analytical framework about technological transitions, according to which changes in sociotechnical systems happen on three levels: niche, regime and landscape level (Figure 2). Starting from the most rigid of the three levels, the **landscape** is the broader context, the external structure that sustains us. In the literal sense, it entails the world around us: spatial arrangements, urban layouts, traffic and electrical infrastructure, factories, etc. In a metaphorical sense, it includes political ideologies, beliefs, values, the media landscape, etc. The landscape is the least prone to change in comparison with the regime and niche levels. Sociotechnical **regimes** are "the semi-coherent set of rules carried from different groups" (p.1260). They refer to deep structural rules and practices that provide guidance to people's perceptions and actions. According to Geels (2002), seven main categories can be identified in this level: "Industrial networks, techno-scientific knowledge, sectoral policy, markets & user practices, technology, infrastructure and culture & norms". Although incremental innovations can be and are generated within regimes, regimes are stable and therefore resistant to change. By contrast, radical innovations are generated in niches. By **niches**, (Geels, 2002) means protected spaces which allow for experimentation with radical innovations. At the niche level, there are three main processes: the adjustment of expectations and visions, learning processes and the creation of social networks. The outcomes of these procedures can be shared visions which act as guidance for internal innovation activities, coalitions, alliances or transitions arenas and of course radical innovations (Geels, 2012; Kemp, et al., 1998; Hoogma, et al., 2002).

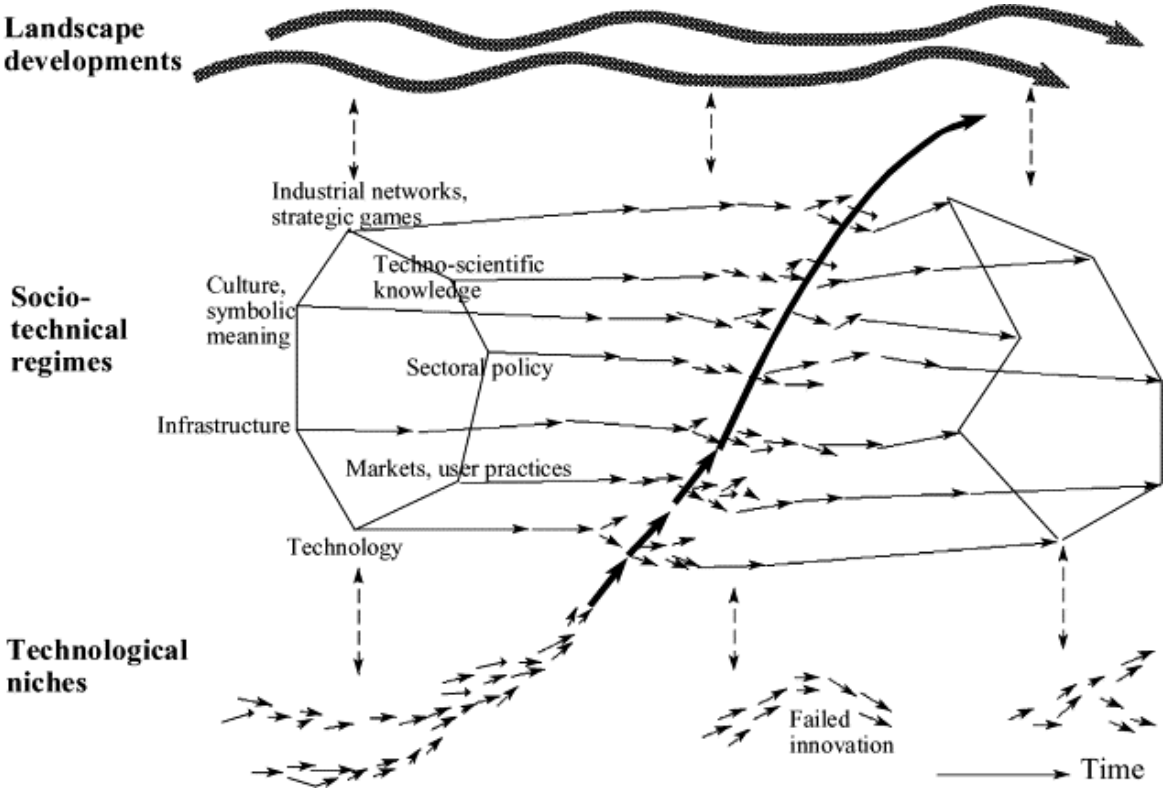

Figure 2.A dynamic Multi-Level Perspective (MLP) on transitions (Geels, 2002).

The three levels are interrelated and interwoven in a nested hierarchy, such that the niches are embedded in regimes and regimes are embedded in landscape (Geels, 2002). This division of the system into three levels helps to investigate and further understand how the system works and how changes happen.

The regime level is characterised by limited adaptive capacity due to infrastructural and institutional lock-ins (Whitmarsh, 2012). Lock-ins are a set of barriers and obstacles to change which are deeply entrenched in different levels of sociotechnical systems (Sarasini, et al., 2016). According to Unruh (2000), lock-ins occur due to combined interactions amongst technological systems and governing institutions and they explain how macro-level barriers hinder the diffusion of novelties. These techno-institutional lock-ins seem to be significantly more important constraints on policy options compared to other factors such as technological limitations (Unruh, 2000). In order to escape from path dependent processes and lock-in inertia Unruh (2000) points out two system-external sources: technological and social/institutional. He emphasises the need to understand lock-in escape as "a series of complex, interconnected changes in multiple variables" (p.321) rather than a result of a single change.

More specifically if we focus on challenges related to transport, we can see that like other existing regimes, the road transportation system "suffers" from lock-in mechanisms and path dependencies. Lock-ins can be regulations that create market entry barriers, resistance from vested investments, sunk costs in infrastructure, machines and competences (Geels, 2002). Path-dependences are not created in a linear fashion but via the ordering of events or processes through time that crucially affects their establishment over years and decades (Urry, 2004). A characteristic example is the petroleum-fuelled car and the associated regime of automobility. Urry (2004) considers automobility to be "the quintessential manufactured object" (p.25) produced by the most emblematic firms of 20th- century capitalism. Some automakers have defined large-scale mechanised mass production, giving rise to concepts such Fordism and post-Fordism. Automakers have invested great amounts and such that different types of resources (capital, workforce, research funds, knowledge etc.) are associated with the automotive regime. Such investments ensure the perpetuation of the regime, making it difficult for automotive actors to identify for developments beyond their scope. This is what Whitmarsh (2012) calls infrastructural and institutional lock-in, confirming previous MLP analyses and emphasising regime's limited adaptive capacity.

Transportation should not be considered as one single regime. Geels (2012) is critical to innovation studies which place the car industry as pivotal actors in automobility regime. Automobility comprises other regimes linked to other transport modes such as busses, bicycles, train etc., which Geels (2012) names subaltern regimes. These subaltern regimes have also long history, embedded beliefs, institutionalised practices and capabilities which shape systems with multilevel dynamics, making them difficult to change (Andersson, et al., 2014). Urry (2004) refers to "an extraordinarily powerful complex constituted through technical and social interlinkages with other industries" (p.26). Moreover, sociotechnical regimes include many social groups like manufacturers, policy makers, users, civil society and special interest groups with well-established mindsets and practices. A typical example can

be transport and city planners who take existing practices for granted and reproduce the regime through their system of reasoning and choices (Geels, 2012).

Another important challenge related to transitions in transportation system is behavioural lock-in or inertia. Car ownership and usage trends are not optimistic, nor are they accompanied by substantial increases in public transport (Nykvist & Whitmarsch, 2008). Culture, one of the seven dimensions of the sociotechnical regime (Geels, 2002), plays a decisive role in stabilising the existing regime. Banister (2008) questions the premise that travel is an activity on its own and argues that mobility is a derived demand and a connector between other activities. Moreover, the car has been associated with cultural values such as freedom, status, progress, autonomy and privacy (Geels, 2012) and has been mentioned as the "major item of individual consumption after housing" (Urry, 2004, p.26). Automobility is consistent with the dominant culture which defines the good life and the appropriate means for it (Urry, 2004). Despite the fact that current megatrends favour sharing and millennials seems to value access over ownership (Burrows, et al., 2014), there is still an inveterate cultural preference for private property competing against collective ownership and undermining car or bike sharing schemes (Geels, 2012). Beyond the "love affair with the car" and the "joy of driving" an attitude-behaviour gap does also exist, expressing a difference between the choices that citizens would do based on their environmental concerns and the choices that they actually make as consumers. The reasons behind this inconsistency are also an area for further research because changes in travel behaviour are integral to transitions towards sustainable mobility (Banister, 2008).

2.2 The need for transdisciplinary approach and the integration of different perspectives

Complex systems and complicated challenges lack clearly defined boundaries and it is very difficult, if not impossible, to fall into specific disciplines and be addressed by a single scientific realm. Environmental problems appertain to this category involving many interconnected issues which require cross-institutional and transdisciplinary cooperation (Russel, et al., 2008). But what do scholars mean with transdisciplinarity? Transdisciplinarity lacks a universally accepted definition, although there is consensus in the current literature that it is a problem-oriented research approach (Jahn, et al., 2012). Mobjörk (2010) considers transdisciplinarity to be an extended knowledge production which includes a variety of actors and involves an open perception of different forms of scientific and non-scientific knowledge. This combination of "interdisciplinarity" – an 'inner-scientific' cooperation – and the participation of 'extra-scientific' actors seem to be the common ground for the definition that scholars give to the term.

Integration is an essential feature of transdisciplinarity (Mobjörk, 2010). With regard to sustainable mobility, Sarasini et al. (2016) support the integration of different types of activities and research perspectives through two approaches: "integration in practice" and "integration in research". Integration plays a decisive role in the alignment of transport system with sustainability principles. "Integration in practice" involves collaborations between the public and private sectors through the engagement of relevant stakeholders, while "integration in research" concerns a transdisciplinary approach that combines perspectives

like transition management, sustainability assessment, business modelling, multi-stakeholder processes and urban design amongst others (Sarasini, et al., 2016). Sarasini et al. (2016) also argue that policies about transport system are fragmented, calling for further integration in practice. One key issue is the integration of urban planning and transport policy. On this topic, Banister (2008) claims that the links between land use and transport should be reinforced and Shoup (2011) contends that parking is the unstudied link between transportation and urban planning. Public policy, applied through parking fees, public transport subsidies, congestion charging, city-centre accessibility should ideally integrate economic, environmental, transportation and social perspectives.

With regard to climate change mitigation in transport, focus is given to technology improvements, physical infrastructure, economic instruments and to a lesser degree behavioural change and alternative institutional arrangements (Schwanen, et al., 2011). There is also criticism that individual measures, such as "getting the price right" and land use measures do not have adequate effects across the range of environmental impacts of transport (Owens, 1995). The transport field has further been criticised for being plagued by a "vehicle-based paradigm" (Jones, 2012). Therefore, Schwanen, et al. (2011) argue that social sciences should be combined with existing prevailing techno-economic and psychological approaches. Sarasini et al. (2016) address the need for demand-driven, transdisciplinary research that leverages the social sciences as part of applied approach. The benefits of this are threefold, both in terms of research and practice (Schwanen, et al. 2011). First, the mitigation of transport's contribution to climate change can be perceived as a multiplicity of context-dependent social processes. Second, a greater range of methods and epistemological frameworks become available. Third, a different set of questions is likely to emerge.

Geels (2012) suggests that in order to intervene in sociotechnical systems, co-evolution and multi-dimensional interactions between industry, markets, technology, policy, culture and civil society are essential and should be researched. Whitmarsh (2012) acknowledges the contribution of MLP to transport and sustainability research by providing a more integrated and systemic perspective on sociotechnical change. Whitmarsh also argues that insights from natural, behavioural and political sciences and perspectives should also be incorporated into the MLP to explain how behavioural change occurs. Given individuals' reluctance to change travel habits, these insights that Whitmarsh (2012) mentions are critical. Finally, these perspectives can be utilised to investigate political actions such as lobbying or voting for green transport systems, which are also a way to influence the transport system.

3.Methodology

This section consists of two parts. Phase I describes the methodologies used to formulate research questions. Phase II, outlines the methods applied to conduct backcasting activities.

3.1 Phase I – The research question

The following chapter contains the methodology used during phase I of Challenge Lab. The backcasting method has been used and four constituent parts of this process are presented as subchapters.

3.1.1 Backcasting step 1: Defining Criteria

The very first part of Challenge Lab consists of defining students' personal strengths (inside-out) and setting up criteria for a sustainable future (outside-in).

During the first week, the focus was on self-awareness, getting to know ourselves and our peers better. For this, two tools were used: An exercise called "Coat of Arms" and a workshop for self-leadership. In the "Coat of Arms" exercise each student introduced him/herself to the rest of the group by answering the following questions:

1. Who am I?
2. What makes me feel concerned?
3. What makes me happy?
4. Why did I choose Challenge Lab?

The other inside-out tool was a self-leadership workshop aimed at getting to know one's personal values, strengths and weaknesses. Students reflected upon their own principles and prioritised them. Through storytelling, students shared life experiences related to their values. Afterwards, we took part in the strength deployment inventory (SDI), an exercise aiming to make us understand that overdone strengths can be weaknesses and obstacles in our collaborations. As a follow-up question, we defined and placed ourselves in terms of team roles, within SDI triangle (figure 3), far or closer to the triangle angles: focus on people, focus on performance, focus on process.

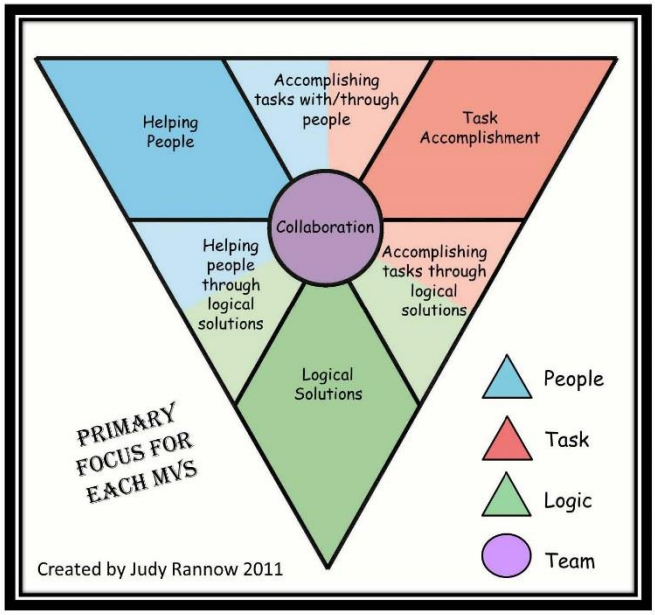

Figure 3. The SDI triangle (Totalsdi, 2017)

In general, the inside-out perspective helped us understand ourselves and our peers. It contributed not only to self-awareness but also to consciousness of others' motivations, background and expectations. This helped later in the group formation since the students could be matched in pairs in a complementary way.

Regarding the outside-in perspective, theories and concepts relevant to sustainability were introduced to students, starting with the four dimensions of sustainability; ecological, economical, societal and well-being (Holmberg, 2015). Then, students developed their own criteria for a sustainable future. We were divided into four groups, one for every dimension and each group's results were discussed, confirmed or altered by the whole Challenge Lab group.

The final criterion can be characterised as broad and general, but was the common denominator of sixteen different people, with different ideas, values and point of views. Since all students are supposed to use them in their thesis, the criteria should be general and flexible. The final criteria are:

Well-being

- Everyone meets human basic needs (subsistence, protection), such as health, security, food, water, sanitation, recreation, shelter, energy.
- Human life fulfils psychological needs, such as affection, understanding, participation, idleness, creation, identity etc.
- Everyone has the equal opportunity and freedom:
    - To choose or to opt out
    - To express one's identity
    - To define and pursue their own goals, objectives and commitments without limiting others' freedom or harming others.

Societal

A sustainable society is a system of individuals built upon the following criteria:

- Empowerment
- Equity & Justice
- Trust (such as between individuals, transparency)
- System for well-being (maintain access to food, medical service, support & safety)
- Openness to Development and Novelty

Nature

- Nature is not subjected to systematic increase of concentrations of substances*.
- Substances* are not extracted in a way that disturbs the balance of natural cycles.
- Nature exists in harmony as one system, enabling ecosystem services and biodiversity.

* A species of matter of definite chemical composition

Economy

The economic system is an instrument that enables the other criteria, to be met efficiently and effective in such a way that:

- Resources* are used indefinitely non-depleting.
- It ensures a fair distribution of resources*

- It is resilient to disturbance and disruption and is flexible enough to adapt to changing conditions
- It facilitates transparency and trust

*Resources include natural and man-made.

3.1.2 Backcasting step 2: Present Situation

The second step of backcasting involves tools from both the outside-in and inside-out perspective in order to assess the present situation.

To get a first understanding and a starting point to work with, two representatives from Västra Götaland Region made a presentation about region's long term strategic goals. Chalmers vice president Anna Dubois had also a presentation about Chalmers Areas of Advance. These two presentations gave students an insight about how Chalmers and the region are working with long term sustainability goals. Insights from the presentations constituted the first input to the three thematic whiteboards, one for each focus area: Circular Products and Services, Urban Futures and Mobility.

What had been found from the inside-out perspective was used as a starting point for the outside-in part. This part consists of three dialogues with participants of the triple helix (figures 4, 5, 6), one for each focus area: Circular products and services, Urban Futures and Mobility. These dialogues were run exclusively by students, some of whom facilitated the process and some posed relevant questions aiming to elicit as much information as possible from the participants in the dialogue. Through the third one, the dialogue about Mobility, a very interesting conversation was generated and valuable information was extracted. For the first time, the concept of MaaS was extensively discussed and the challenges of innovative mobility schemes uptake were elaborated.

Stakeholders	**Representative**	**Organisation**
Industry	Nils Hannerz, Head Industrial Bioeconomy Klas Cullbrand, Head of group	Innovation and Chemsitry industries in Sweden Chalmers Industriteknik
Academia	Isabel Ordonez, PhD	CTH
Society	Lena Heuts, Cluster manager	West Swedish Chemistry and Material Cluster

Figure 4. Stakeholders - Circular products and services dialogue

Stakeholders	**Representative**	**Organisation**
Industry	Ulf Östermark, Head of ecological sustainability Christine Olofsson. Sustainability manager	Framtiden AB Älvstranden Utveckling AB
Academia	Paula Fermenia, Docent Jonas Nässén, Senior researcher	CTH CTH
Society	Linnea Lundberg, Project engineer	Circular flows and water management board
Civil Society	Pär Johansson, Coordinator	Yes In My Backyard (YIMBY)

Figure 5. Stakeholder - Urban futures dialogue

Stakeholders	Representative	Organisation
Industry	Lina Olsson, Project manager	CLOSER
Academia	Sönke Behrends, PhD Tommy Svensson, Professor Sinisa Krajnovic, Professor, Head of AoA Transport Steven Sarasini, Researcher	CTH CHH CTH RISE Viktoria
Society	Malin Andersson, Head of department	Trafikkontoret, City of Gothenburg
Civil Society	Alvar Palm	YIMBY

Figure 6. Stakeholders - Mobility dialogue

The issues that came up during the dialogue were grouped into general categories (infrastructure, public, behaviour and environment) for further analysis (figure 7).

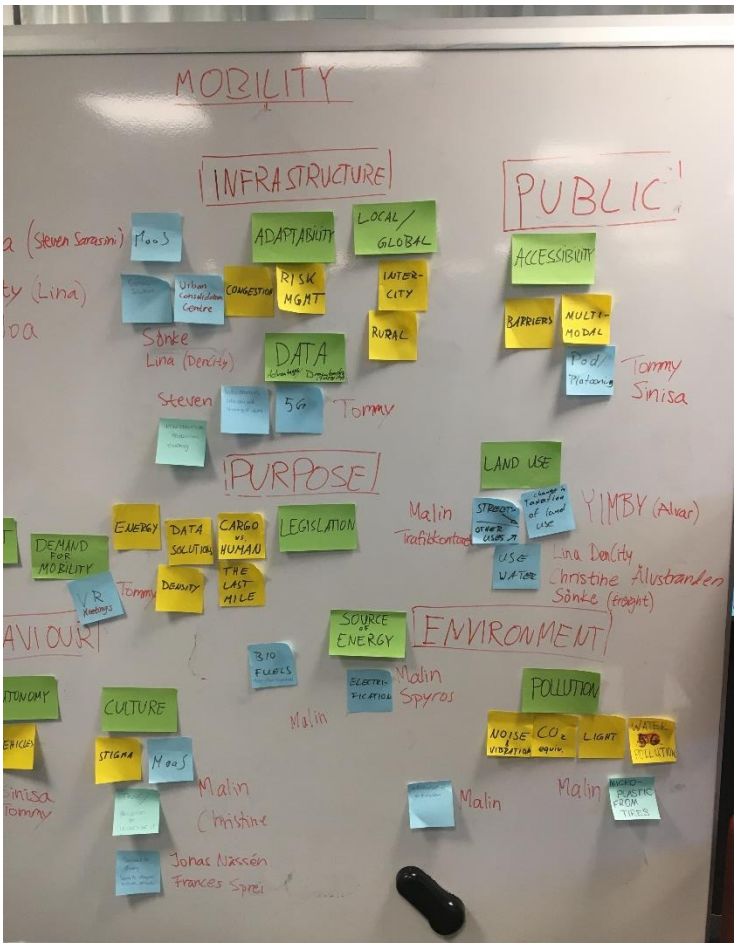

Figure 7. Grouping of issues from the mobility dialogue

3.1.3 Mapping the leverage points

The information gathered from the previous steps was used to define leverage points and then envision future solutions, again for each one of the three categories: Circular products and services, Urban Futures and Mobility. The leverage points were first categorised and then merged into fewer categories, since in this point we started narrowing down each category's

scope. Once the different leverage points within each focus area had been narrowed down enough, the following questions were asked:

1. What can Challenge Lab do? (Define a clear starting point.)
2. Who are the stakeholders connected to this starting point?
3. Which other leverage points is this leverage point connected to?

After several iterations, each group of students presented their finalised leverage points. These leverage points were put into clusters as can be seen in Figure 8.

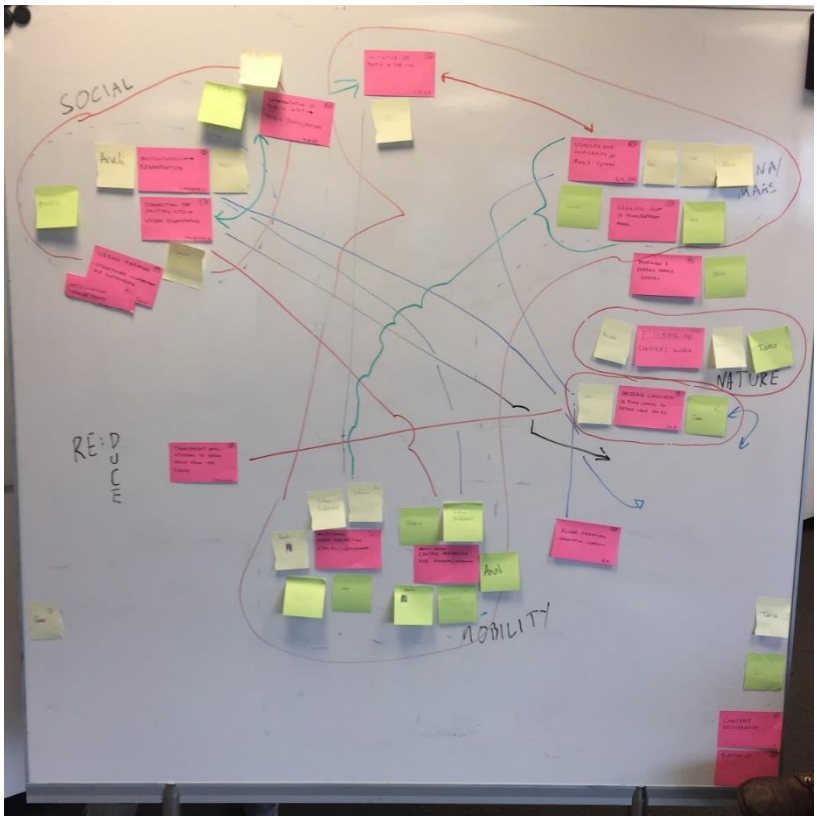

Figure 8. Cluster of leverage points after several iterations

The new categories were named:

- Social
- Reduce
- Mobility
- Nature
- Arena / Maas

Many of the leverage points could not be easily clustered since they pertain to several categories. The purpose of this step was to understand each leverage point in relation to others and see their connection rather than sort them under one category. Linkages between leverage points from the mobility cluster and leverage points from social, nature and arena/MaaS clusters formed a dense network, confirming our thoughts that Mobility is a field with a lot of momentum and many aspects. The identification of the different challenges and

issues related to mobility, helped us understand the complexity of the problems at hand and prepared us for Phase II as well.

3.1.4 Finalising our research question

After specific leverage points had been defined, the next step was to formulate research question and create groups of two. Each student presented what (s)he would like to work with and what viewpoint (s)he had on the leverage points. This, together with study backgrounds, fields of interest, personal strengths and values constituted the inputs into the final process where eight pairs were formed. Each pair further defined its own research question.

As we have already mentioned, the field of mobility and innovative schemes, such as MaaS attracted our interest quite early in the process. After having discussed with housing companies, we decided to approach the sustainable mobility solutions from another perspective, less researched but still tangible. We identified their willingness to move towards a future with less parking spaces. The upcoming parking policy was also supposed to enable this kind of changes. There, we identified a great opportunity to study possible mobility solutions that could replace parking lots. This is still related with MaaS and other mobility services but also involves the field of urban development. The final form of the research question crystallised as:

What is the role of parking practice in stimulating a transition towards sustainable mobility solutions?

- What are the drivers and barriers to a transition towards a parking practice with lower parking rates?
- How can housing companies play a role in stimulating a transition towards sustainable mobility solutions?

3.2 Phase II

After having defined our research question, at the end of Phase I, the actual study begins. In this phase, which consists the main part of our thesis, we follow the backcasting framework and we use the following methods of data collection: desktop research, interviews, survey and a dialogue.

We consider desktop research to be the most appropriate method to begin with. By studying academic papers and publications, public documents and organisations webpages, we gained a quick overview of the scientific areas that we are interested in, namely mobility and parking practise. By utilising results from other primary research, we managed to save time and clarify our research focus. In some cases, we realised that the information that we were aiming to uncover was already available and this was helpful in two ways. First, it eliminated the need and cost to conduct our own research. Secondly, it sharpened our research questions and oriented us far from questions that had already studied. Building upon others' research is an effective way to work, since we did not have to reinvent the wheel. Although, we faced some limitations with desktop research, which made us to continue with other methods. To begin with, the available data were not sufficient to meet our needs and answer precisely to our research question. The more we differentiated and sharpened our thesis scope, the less we could find secondary data. Moreover, information from desktop research was not always up-

to-date. In the field of MaaS for example, changes are happening in a rapid way and maybe a research report written some years ago has little or no relevance to the current situation. Finally, our research is focused on Gothenburg. The specifics of this locality and the attitudes of local stakeholders were not easy to find through desktop research. Thus, semi-structured interviews and a survey were conducted in order to answer to that need.

The main advantage of interviews and face-to-face meetings is that both verbal and non-verbal communication take place providing the interviewer with a better understanding of the given answers, their validity and sincerity. Interviewees' emotions such as enthusiasm or discomfort caused by some questions can give a more holistic view of the answer. Moreover, with personal communication, the interviewer can clarify questions and concepts in real time and keep the interviewee focused until (s)he answers to the point. On the other hand, the results and the quality of an interview heavily rely on interviewer's ability to gather data and extract information. Interviewees may feel pressure that will make them comply with what they imagine to be an accepted or desired answer, preventing them from telling the truth, thus challenging the validity of the findings. Of course, interviewers' biases aggravate the results. As a last weakness of the interviews, we can state that they are time consuming and therefore the size of the sample is limited.

Risks with interviews such as influence over the interviewees and small sample can be faced with surveys. Since we would like to have the input from as many tenants as possible, but we did not have the time to interview a substantial amount of them, we sent out a survey. This way we managed to gather data without investing time to meet and interview them. Moreover, standardised surveys, like the one we conducted, are relatively free from several types of errors. Although, data errors because of non-responses or misunderstanding of what is asked may exist. Another weakness of the method is that certain answer options may be interpreted different by respondents, leading to blurred data. Even worse, the provided answers in the survey do not satisfy the participant who cannot propose his/her own answer which would have enriched the data collection and it is what happens in an interview or in a dialogue.

In the dialogue, that it was chronologically the last data collection method that we applied, we tried to counteract the limitations and the drawbacks of the other methods. Isaacs (1999) claims that dialogue opens new horizons in organisational learning since it is a means for promoting collective thinking and communication. It can be a powerful tool for stakeholder engagement but its effective application demands knowledge, preparation and practice. In our dialogue, we addressed the more controversial topics and asked for specific answers. Stakeholders with contrasting opinions or different understanding had the chance to discuss or question each other practice. They also had the possibility to build on other people's knowledge and draw valuable conclusions. The direct way of communicating adds value to the process and generates interesting and vivid discussions. Unfortunately, the dialogues need very careful facilitation in order to balance dynamics and allocate the time in a fair way. Some participants claim more time for themselves, leaving no space to other people. Further, there is the risk that the discussion derails and loses focus. Thus, the result of the dialogue subjects

to facilitators experience and capability to keep discussion on track and allow participants to express themselves within the time limits of a dialogue.

3.2.1 Backcasting as a potential transition enabler

The traditional way of doing things: run business, govern and protest have not given us the progress needed to achieve sustainable development, thus alternative ways and different paths should be sought after Hohnen (2001). Verily, centralist or autocratic models of leadership are recently questioned and a distinction between management as a more technocratic procedure and leadership as a way to empower people and to serve a shared vision, is currently made. In the case of sustainability, the need for a visionary and collaborative approach is even stronger (Hemmati, 2002). Rukato and Osborn (2001) state that many challenges and issues today "cannot be addressed or resolved by a single set of governmental or other decision-makers but require cooperation between many different actors and stakeholders" (p.1). According to them, prerequisite for a successful resolution of that issues is the fully involvement of all parties in finding solutions, implementing them and monitoring their results.

More specifically in mobility, the need for integration in terms of stakeholders, projects and policies is pervasive. Banister (2008) refers to integrated stakeholder interests through participatory processes as a necessary measure to overcome private car ownership and secure commitment to sustainable mobility. As an example, MaaS hinges on multi-stakeholder collaborations between public and private sector organisations. Up until now, these collaborations do not exist in the transport sector (Sarasini, et al., 2016). According to the authors, collaborative approaches to integration should focus both on actors that constitute the MaaS business model ecosystem, like individual mobility service providers and on a broader range of stakeholders with different perspectives and interests, like private and public sector organisations, infrastructure providers and citizens, who will give legitimacy to MaaS offerings.

The situation is similar in the urban planning discipline. Hawkins and Wang (2012) highlight the importance that stakeholder engagement and participation have for planners who want to promote sustainability and resolve environmental problems. Mechanisms like visioning workshops and consensus-building activities result to a better informed civic public, fruitful negotiations and conflicts mediation during the planning process. Scholars like Francis and Feiock (2011) conduct empirical research to support the importance that local and external organisations can have in local governance. Moreover, Denhardt and Denhardt (2000) emphasise the importance of a collaborative approach to solving local issues in public domain and in policy level.

Backcasting can be utilised in a way that enables the participation of many actors and be considered as a particular type of multi-stakeholder processes. Hemmati (2002) defines multi-stakeholder processes as a tool that can facilitate sustainable development and the transition towards a more sustainable future. More specifically with the term multi-stakeholder processes (MLP), the author describes processes that:

- "*aim to bring together all major stakeholders in a new form of communication, decision-finding (and possibly decision-making) structure on a particular issue;*
- *are based on recognition of the importance of achieving equity and accountability in communication between stakeholders;*
- *Involve equitable representation of three or more stakeholder groups and their views;*
- *are based on democratic principles of transparency and participation; and*
- *aim to develop partnerships and strengthened networks between and among stakeholders*" (p.19).

Moreover, as already mentioned, problems exist in an interconnected social and natural context which leads to a high level of complexity and uncertainty (Russel, et al., 2008). They are system-based challenges, which are difficult to be addressed exclusively by one field of knowledge or one group of actors. Despite many scholars' call for epistemological pluralism, interdisciplinary research (Miller, et al., 2008) and transdisciplinarity (Russell, et al., 2008; Jahn, et al., 2012) there is still great segregation in science and the scientific uncertainty is huge about many problems related to the environment. But how is backcasting relevant to transdisciplinarity and complex sustainability problems?

Holmberg and Robèrt (2000) claim that backcasting is ''a methodology for planning under uncertain circumstances'' (p.3). This uncertainty makes society deal with one problem at a time in a fragmented way. A good illustration of this fact is that many environmental measures have positive effects at specific domains but negative in others, confirming that there is no rationale to deal with trade-offs and rebound effects (Holmberg & Robèrt, 2000). This fact demonstrates a lack of a holistic approach to handle environmental issues and a gap in decision making. Decision making in such complex socio-technical systems demands system thinking (Holmberg, 1998). This involves identification of the principles that rule this system. Once the principles have been recognized, the details in the system can be related to them. Holmberg (1988) claims that by using these principles in combination with backcasting, which is a suitable tool for future planning, decision-makers can get early-warning signals when long-term investments and decisions based on current trends can lead the system to dead-ends.

In general, backcasting identifies the systemic nature of problems and therefore addresses the need for systemic transitions in order to accomplish the goal of the desirable future. That means that backcasting can have a crucial contribution on the handling of complex issues that entail many aspects, many actors and not easily concluded answers.

More specifically, Dreborg (1996) outlines the conditions that favour the use of backcasting methodology (p.816):

- *"the problem at hand is complex and has effects on many societal levels*
- *when slight changes cannot be adequate and the need for radical changes emerges*
- *dominant norms and trends are part of the problem and therefore lead to lock-ins in forecasting*
- *externalities are responsible to a great extent for the problem*
- *the scope is quite broad and the time horizon is far ahead in the future, so deliberate choices cannot be made"*.

As already stated, backcasting is the overarching method for our thesis. Even though the concept of backcasting has a long history, it is only over the last decade that it became well-known and broadly applied, especially in the future and sustainability studies (Vergragt & Quist, 2011). In general, backcasting is a method for planning under uncertain conditions. When it comes to sustainable development, it comprises the procedure of setting the requirements that need to be in place when society will be sustainable and find the strategic steps that will link the present with this future (Holmberg & Robèrt, 2000). In other words, backcasting can be defined as "generating a desirable future, and then looking backwards from that future to the present in order to strategise and to plan how it could be achieved" (Quist and Vergragt, 2006, p.747). During the last years, backcasting gained prominence within future studies, which develop pathways and strategies to the future through the development of scenarios (Vergragt & Quist, 2011).

According to Vergragt & Quist, (2011), there are three classes of scenarios in the future studies (figure 9). They answer to the following questions:

- What will happen?
- What could happen?
- What should happen?

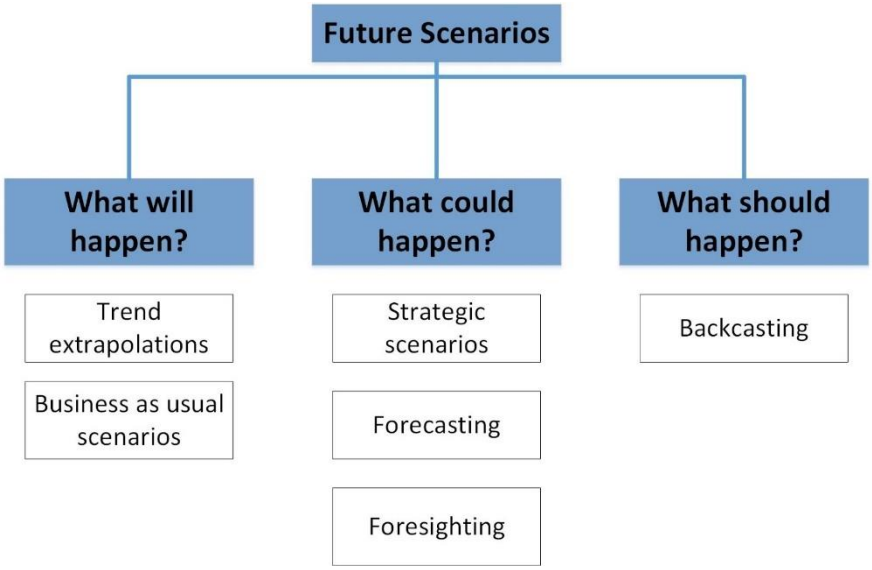

Figure 9. Types of future scenarios

The first class of scenarios, the predictive one, is often called "business as usual". These scenarios do not take under consideration society's complexity and ambiguity so their relevance is limited to short-term predictions about well-defined and stable systems. The second class, the exploratory scenarios create different future "worlds" by mapping trends and uncertainties of the present state. They are used to inspire creative thinking but also stimulate policy development. Backcasting is included in the third class, the normative scenarios. Backcasting is about envisioning desirable futures and after having understood the current situation, the limitations and the possibilities, finding paths and strategies towards this future. What differentiates backcasting scenarios is the systemic approach that they adopt in the transition towards a desirable future. That means that backcasting assumes the need for systemic social transitions in order to reach the desirable future (Vergragt & Quist, 2011).

In that sense, backcasting is closer to “transition studies” than other classes of scenarios. Transition management, being influenced by multi-level perspective, aims to develop a method and a framework for societal transitions towards sustainability. Instead of trying to find solutions to the existing environmental, societal and economic problems, based on the same circumstances that caused them, backcasting method creates energy and momentum by envisioning a desirable future that is more a vision than a blueprint (Vergragt & Quist, 2011).

A large variety and diversity of backcasting versions have evolved. Differences come from the employed methods, the amount of visions developed, the issues and scales of the systems addressed. The foremost differentiating factor and a key question in backcasting is who is responsible for developing the future vision or to put it more generally, whether and how stakeholders’ participation is organised (Vergragt & Quist, 2011).

Participatory backcasting is one type of backcasting, according to which the development of future vision cannot be left to experts but it should involve stakeholders and citizens through democratic processes. It derived from the belief that experts and research groups can be extremely engaged to the present and their technocratic lock-in could put limits to their innovative thinking. “Second order” or participatory backcasting proponents like Robinson et al. (2011) and Eames and Egmose (2011) claim that this type of backcasting promotes the involvement of citizens and increases their commitment by making them co-creators of their future and responsible for it. According to Carlsson-Kanyama, et al., (2008), participatory backcasting can be implemented in workshops with locals who develop images of their future everyday lives in the city after certain amount of years. Although a convergent vision would be the desirable outcome of the participatory backcasting process, several alternative images of the future, are also a valid result.

Backcasting as a particular type of MSP can be applied in a wide range of structures and levels of engagement, from dialogues to consensus-building and decision-making. In order stakeholders’ involvement to be substantial and fruitful, Hemmati (2002) suggests that some guiding principles should be in place. Participation is considered to be one of the most critical characteristics of sustainable leadership. This term implies the substantial involvement of every individual in the matters that affect them and their future. More specifically, the underpinning of participation is that no stakeholder has an objective view that should prevail amongst the antagonistic or different ones. Thus, all relevant stakeholders should have access to critical information and knowledge and be able to contribute to the decision-making processes. In order for meaningful participation and sustainable leadership to be feasible, equity and justice are important prerequisites. Equity in terms of absence of any kind of partiality or bias, does not refer to a pedantic equality which coerces that everyone should be treated identically. It rather pertains to an impartial distribution of opportunities and access to these opportunities according to the needs and the abilities of each individual. The integration of diverse viewpoints, interests and values into a fair compromise and a received agreement constitutes another critical quality of sustainable leadership: the unity in diversity. This value does not imply that the ultimate goal of sustainable leadership should be reaching unanimity amongst all stakeholders. A more realistic approach that contradicts uniformity but

aims for consensus building towards solutions that all stakeholders can own, even if it is slightly differentiated from their initial stand points, is pursued. In that sense, diversity is considered as a chance to find innovative solutions, rather than as a threat.

The benefit from participation is twofold: firstly, the decision made has more chances to be of higher quality and secondly, those who make the decision are more committed to it. By taking part in the whole process, from the initial to the final part, stakeholders' ownership is increased. Stakeholders are involved in resilient relationships and are committed to the emerged solutions. This engagement generated by participation, also decreases the risks at the implementation phase of the suggested solutions. AA1000 Stakeholder Engagement Standard 2011 (AccountAbility, 2011) is a tool which helps organisations to achieve inclusivity, meaning the participation of stakeholders in developing and achieving sustainability. It summarises the benefits of stakeholder engagement. Thus, Quality Stakeholder Engagement can (AccountAbility, 2011):

- "Lead to more equitable and sustainable social development by giving those who
- have the right to be heard the opportunity to be considered in decision making
- processes';
- 'Enable better management of risk and reputation';
- 'Allow for the pooling of resources (knowledge, people, money and technology)
- to solve problems and reach objectives that cannot be reached by single organisations';
- 'Enable understanding of the complex operating environments, including market
- developments and cultural dynamics';
- 'Enable learning from stakeholders, resulting in product and process improvements';
- 'Inform, educate and influence stakeholders to improve their decisions and
- actions that will have an impact on the organisation and on society'; and
- 'Contribute to the development of trust-based and transparent stakeholder relationships" (p.7).

On the other hand, someone could argue that like experts and researchers are bound by their knowledge, stakeholders represent specific interests and values that are not disengaged from the current state. It is what Ascher (1979) calls "assumption drag", namely the difficulty to get disengaged from the present. In that sense, there is not big difference between experts and lay people when they envision the future. Holmberg & Robèrt, (2000) argue for the importance of guiding principles when we apply backcasting and they introduce backcasting from non-overlapping sustainability principles. More specifically they claim that if we expect backcasting to help us coordinate different sectors of society and businesses based on sustainability, then backcasting methodology should be applied from a set of non-overlapping principles. Rather than describing future in detail, these principles should be general enough so that they can act as a framework for different possible futures. As they contend "Future cannot be foreseen but its principles can" (p.8). These principles should be the principles of sustainability which is the outcome, unlike the principles of sustainable development that is the transition process. Moreover, Holmberg & Robèrt (2000) highlight that we should find first-order principles, meaning the core principles that refer to the whole system. What is

important with these principles is that they provide a group of individuals with a shared mental framework so that they can operate as a team.

The application of backcasting is conducted through the four steps of backcasting methodology, as defined by The Natural Step Organisation and Holmberg (1998), are presented below (figure 10):

- Step 1: Defining criteria for sustainability
- Step 2: Describing the current situation in relation to the criteria of sustainability
- Step 3: Envisaging and describing the future
- Step 4: Finding strategies for sustainability

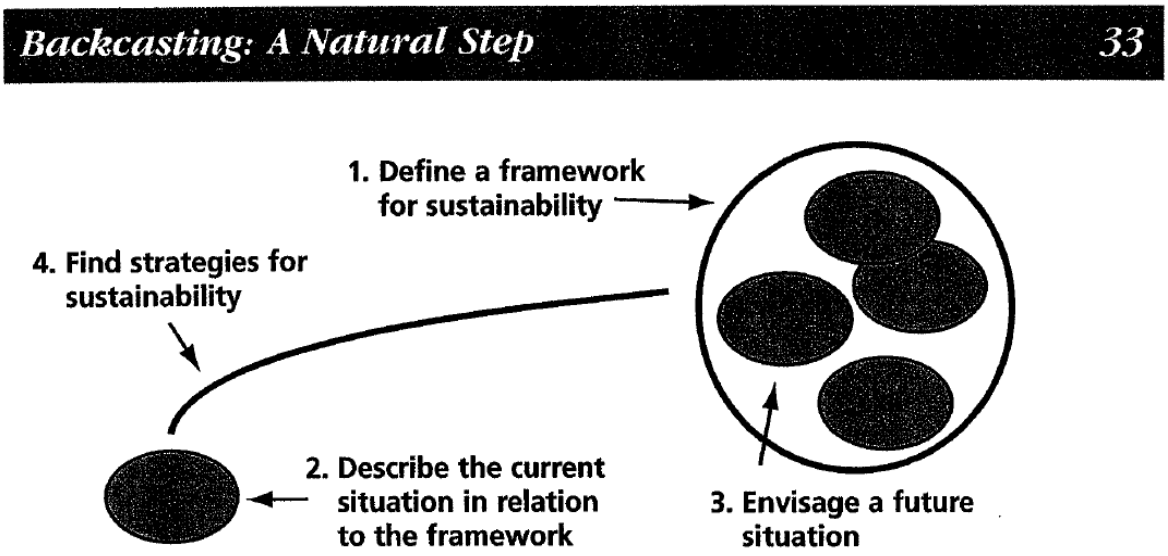

Figure 10. The Steps in Strategic Planning for Sustainability (Holmberg, 1998).

In this thesis, we draw insights from both participatory backcasting and backcasting from sustainability principles. By doing so, we try to leverage advantages from both methods. So, in the beginning we come up with some principles that a sustainable transportation system should have (section 4.1) based on literature review and on discussions during the preparatory Challenge Lab class. Then we define some criteria for an economically, socially and environmentally sustainable parking practice, adjusting the general criteria of sustainability that the whole Challenge Lab team established during Phase I. These principles and criteria provide guidance and serve as a starting point in the discussions with the stakeholder. Through personal meetings, interviews and a dialogue, participants in the thesis have the mandate to modify, discard or enrich the principles and criteria of the desired future. This way, the principles are still an important feature of the backcasting method, offering direction through the whole process but they are also a product of group work. No expert or professional is in charge of setting the principles of a desired future in this thesis. Through interviews, stakeholders describe the way they perceive the current situation (step 2). In the dialogue, all participants together try to decide how a desired future looks like (step 3). More specifically, at the 3rd step of backcasting, where we are supposed to envisage a future situation, we use scenario planning to create more than one possible future scenarios and then choose the most desirable amongst them. *"Traditional planning techniques use predictions, forecasts and projections, but they may not be able to cope with 'disruptive' changes in the environment. A*

more powerful approach is scenario planning, which can be seen as a rediscovery of the original entrepreneurial power of creative foresight in the context of accelerated change, greater complexity and genuine uncertainty" (Kelley, et al., 2003). The main purpose of having scenarios was to conceptualise the input received throughout the literature review, the interview and the survey. At the end, participants in the dialogue tried to identify strategies that will lead us to this commonly agreed future (step 4). These strategies are tested against the previously defined principles and criteria, assuring that we are aligned with them through the whole process.

3.2.1.1 Backcasting Step 1: Envisioning a sustainable transportation system

In this section, we elaborate on how the first step of backcasting was conducted. We present the methodology that was used to create a vision for the transport system of 2050 in the city of Gothenburg as well as sustainability criteria on parking (section 4.1).

Formulation of a vision for the transport system of 2050 in the city of Gothenburg

The process of formulating a vision for the transport system of 2050 in Gothenburg started early on in our thesis. The first form of a vision was created almost immediately after phase I. The first draft of our vision was presented to stakeholders during the interviews in order to initiate the discussion. However, the formulation of the vision has been through an iterative process. During the process of writing the thesis, information has been gathered through both scientific articles and input from stakeholders. This information has been processed in several discussions and brainstorming sessions to continuously improve the vision. After several iterations, a final version of the vision was created which can be seen in section 4.1.

Formulation of Sustainability criteria on parking

As with the vision for the transport system, the sustainability criteria on parking were created through an iterative process that had already started in phase I. The basis of the criteria is the framework for a sustainable future that was created by all Challenge-lab students. Based on this framework the criteria for sustainable parking are divided into four sub-categories; social, economic, well-being and ecological. The criteria are supposed to be concise, and not overlap or contradict each other (Holmberg & Robèrt, 2000). After several iterations and adjustments, the final version of criteria on parking can be seen in section 4.1.

3.2.1.2 Backcasting Step 2: Describe the current transportation system in the city of Gothenburg and the current parking norm

The main tools that were used in this section in order to understand and describe the current transportation and parking system in the city of Gothenburg are interviews with relevant actors and a survey to tenants.

Semi-structured stakeholder interviews

In this section, it is described how the 12 face-to-face interviews were conducted over a two-month period. They were done in a semi-structured way and the methodology for this type of interview can be divided into four steps: planning, doing, analysing and reflecting phase (van Teijlingen, 2014). These four steps did not follow a strict chronological order. Data analysis and reflection upon the first interviews contacted in the beginning of March, generated new

questions that were discussed during the last interviews, in the end of April. The main advantage about semi-structured interviews is that they allow interviewers to ask prearranged questions while at the same time being open to discuss new information and learn about unforeseen issues (McDonald & Rogers, 2014). The result of this four-phase methodology has been primarily used as an input to section 4.2.3, barriers and drivers.

During the planning phase, we identified the most relevant stakeholder and set the main draft of the interview questions. These prearranged questions were supposed to be relevant to the thesis but still general enough for each stakeholder to be able to answer them. However, as described Van Teijlingen, 2014: "(*question*) *order can be modified based upon the interviewer's perception of what seems most appropriate. Question wording can be changed and explanations given; inappropriate questions for a particular interviewee can be omitted, or additional ones included" (p.17).* Thus, depending on the interviewee's profession, minor alterations to the basic set of questions were made. At the end, there were three groups of questions: one for employees from housing companies and property developers, one for mobility providers and one for consultants and researchers. The interview questions were sent beforehand to the interviewees, accompanied with an introduction to our thesis. This short text aimed to inform them about the purpose of the thesis, the anticipated results and the methodological ethics and guidelines that we decided to follow (see Appendix A3).

All interviews were conducted at interviewees' offices and not at the Challenge Lab. At the beginning of each interview, a brief presentation of who we are and what C-Lab is was done. This was done primarily to create a relaxed atmosphere where the interviewee feels comfortable, as recommended by Biodiversa (2014). After the introduction, we asked the interviewees for permission to take notes and record the discussion which in all cases was accepted. Most of the times, the initial order of the questions was not followed. Instead, as stated by Biodiversa (2014), the conversation was allowed to flow naturally in order not to miss out on unknown knowledge from the interviewee. Effective time management of the discussion was needed in order to ensure that all the prearranged questions would be posed within the agreed time of an hour.

During the analysis of the results the aim was to structure and evaluate the output from each interview. In order this to be possible, transcriptions of the interviews were made. Interviewees' answers were archived and utilised to describe the current sociotechnical transportation system in the background section (4.2.1) and the drivers and barriers to a potential transition (4.2.3).

In the reflecting phase, conclusions were drawn from what had been analysed in the previous phase. Here, data from previous interviews also had to be taken into consideration to get a good up-to-date picture, which meant that the amount of information gradually grew after each interview. We also used to reflect upon the interviewees' attitude towards our thesis and to adjust it, if needed in order to be more relevant to the stakeholders' needs and perspectives. This iteration was the main reason why every interview was conducted in a slightly different way from the previous one.

Survey

To understand the tenants' perspectives, a survey was conducted. Tenants can be seen as one of the most important stakeholders since they are users of both parking and mobility services. The survey, which can be found in appendix, mainly consists of questions connected to parking cost. As mentioned by Statistics Canada (2010, p.55): "*A well-designed questionnaire should:*

- *collect data efficiently with a minimum number of errors and inconsistencies;*
- *be respondent friendly and interviewer friendly (if interviewer-assisted);*
- *lead to an overall reduction in the cost and time associated with data collection."*

This means that the desired information should be acquired with as few questions as possible. The survey had ten questions in total, two of which are general demographic ones and eight are related to parking issues. All of them were designed as multiple choice questions, and the respondent could answer only one question from a list of choices. The purpose behind this was to simplify the process in order to be easy for participants to take place. The survey was sent to boards of BRFs by email but due to their unwillingness to share their tenants' contact information, we finally managed to hand the survey out only to one block of flats.

3.2.1.3 Backcasting Step 3: Designing scenarios around housing companies' parking strategies

The use of scenarios was considered to be a useful tool for testing ideas. The scenarios were created over a period of two months through an iterative and creative process. Inspiration was taken from Söderberg (2014) and his proposed strategy on design thinking (figure 11).

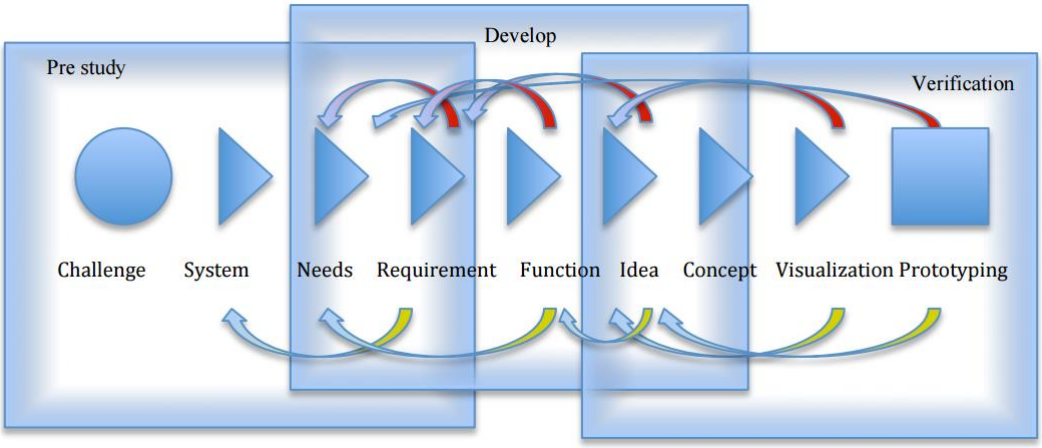

Figure 11. The design thinking process (Söderberg, 2014)

However, only the three overarching processes; pre-study, develop and verification were used. During **pre-study** and through literature review we mapped the current state in terms of mobility and parking. We also studied relevant tested projects to avoid repeating previous work and research that has already been done. The **development** of the scenarios was done simultaneously with the pre-study. When enough information had been gathered, a first draft of scenarios was created. These drafts changed several times due to the continuous flow of information and inputs we were receiving. Especially the interviews acted as an important tool in the scenario development. Here, new information could be gathered but also the current

scenarios had a chance to be tested. This leads to the third part, the **verification** which as has already been mentioned was done in the interviews and later in the dialogue. The purpose of this phase is to test and validate the ideas and concepts which with or without further changes, act as input to the development phase. This iterating process continued until the dialogue, where three finalised scenarios were presented.

First, the "business-as-usual" scenario was inspired by the present-day reality. The second, the "collaborative" scenario was motivated by interviewees' proactive thinking and local sustainability goals. The third scenario, the hybrid one can be regarded as a stepping stone from the current state to the sustainable collaborative scenario. In section 4.3 the scenarios are presented in-depth.

3.2.1.4 Backcasting step 4: Finding strategies to reduce parking rates and scale up sustainable mobility solution

In this section, the process of finding strategies towards the desirable scenario is described. This was done though a stakeholder dialogue.

The first step of organising the dialogue consisted of mapping the relevant stakeholders. This coincided with the organisation of the *semi-structured stakeholder interviews* which are described in section 3.2.1.2. After each interview, we made an informal verbal invitation in order to inform the stakeholders about our intention to hold a dialogue. The day of the dialogue was the 28th of April. A final formal invitation was sent a month before the dialogue. The invitation contained the outline of the dialogue along with the invited participants. Two Challenge-Lab students who also did their thesis within the field of mobility were asked to take the role of secretaries during the dialogue and keep notes.

In the beginning of the dialogue, a short presentation of the thesis was made to introduce the stakeholders to the subject as well as to explain the role that the dialogue has in the thesis. This presentation was designed to be short, concise and act as a starting point for further discussion amongst participants. Then the three scenarios were presented and a discussion was held with the goal to reach an agreement about which of the three is the preferred one. Two exercises were designed in order to engage the stakeholders and create a tangible result from the dialogue which could be utilised to the thesis. These are:

- **Exercise 1: The life puzzle.** The purpose of this exercise was to create a playful and comfortable environment where participants are encouraged to think "out of the box" and probably generate innovative ideas. The stakeholders were divided into three groups and each group received a life scenario (see Appendix D). Each case consisted of a fictional family or individual and the task was to solve the mobility puzzle of their everyday lives. Every life scenario had different conditions depending on where in Gothenburg the fictional characters live and what weekly needs they have in terms of mobility. The groups were given a booklet with state-of-the-art mobility solutions and innovative concepts as a source of inspiration. In the end, each group presented its final proposal to the rest of the participants with the help of pictures, figures and words on a large paper sheet. This exercise, apart from generating some good ideas and

interesting discussions, helped to stimulate a creative thinking process for the rest of the dialogue.

- **Exercise 2: Steps towards a future scenario.** Before this exercise, participants had to agree on which was the desired scenario for them, amongst the three described in section 4.3. The task in this exercise was to brainstorm solutions which could help moving towards the chosen scenario. Stakeholders were asked to write in post-its: ① a feasible solution/step towards the desired future scenario, ②their contribution to realise this solution-what they can do, ③ their limits-what they cannot do and ④ the needed synergies in order to make the contribution real. These post-its were put on a printed visualisation of the backcasting process. The output of this exercise was more concrete compared to the one from exercise one and easier to be utilised and incorporated into the thesis.

A final discussion was held to discuss the results of the second exercise aspiring to find drivers and barriers for the different proposed solutions. At the end, participants were asked to describe their main take-away from the afternoon in Challenge Lab. This check-out session aimed to motivate some reflection on the dialogue and thank the stakeholders for their contribution. The next days, the challenging task of sorting and organising the data was started. Data was gathered from the notes of secretaries, post-its and paper sheets (exercise 1) which transformed into concrete results.

In summary, for the three-hour long dialogue, the schedule was the following:

13:00 - 13:15 Reception at the Challenge Lab
13:15 - 13:45 Check-in
13:45 - 14:15 1st round of the dialogue session (discussion & exercise 1)
14:15 - 14:45 Coffee break
14:45 - 15:45 2nd round of the dialogue session (exercise 2 & final discussion)
15:45 - 16:00 Check-out

4.Results

In this chapter the results gathered in order to answer our research question on "What is the role of parking practice in stimulating a transition towards sustainable mobility solutions?" are presented. The following sections comprise of the results specific to each of the backcasting steps.

4.1. Step 1: Define a sustainable transportation system

Defining a sustainable transportation system is a challenging task since it is difficult to find a commonly accepted definition for it, in current bibliography. However, The Centre for sustainable transportation (2011, p.1) defines it as the following:

A sustainable transportation system is one that:

- *"allows the basic access needs of individuals and societies to be met safely and in a manner, consistent with human and ecosystem health, and with equity within and between generations.*

- *is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy.*
- *limits emissions and waste within the planet's ability to absorb them, minimises consumption of non-renewable resources, limits consumption of renewable resources to the sustainable yield level, reuses and recycles its components, and minimises the use of land and the production of noise."*

Taking into consideration the abovementioned definition, our vision for the transport system of 2050 in Gothenburg can be formulated as such:

We envision an ecologically, economically and socially sustainable multi-modal transportation system of people in the city of Gothenburg for 2050 which:

- is accessible to everyone
- has zero emissions
- is free of congestion
- liberates occupied urban spaces for other uses.

According to the vision, a transportation system should be sustainable in social, economic and environmental terms. The vision consists of four goals to make it more manageable to work with in the thesis. Accessibility has been identified as a significant aspect of social well-being (Holmberg, et al., 2016). Access to social necessities like work, leisure, healthcare and education can contribute to social inclusion and social justice (Farrington & Farrington, 2005). Thus, in our vision for a social sustainable transportation, we use the word "accessibility" to define something broader than access to transportation. We envisage a system that helps access to different fields of everyday life, regardless of gender, age or other sociocultural characteristics. The second criterion, the goal for zero emissions derives from the "Final criteria for sustainability" which were established by the Challenge Lab team during Phase I of our thesis (see section 3.1.1). More specifically, the second criterion is consistent with the one which refers to substance emissions: "Nature is not subject to systematically increasing concentrations of substances". Västra Götaland region aspires to be fossil independent by 2030 (Länsstyrelsen Västra Götalands län och Västra Götalandsregionen, 2016). A vision for a transport system with zero emission can act as a catalyst to realise this goal. Someone could argue that a potential electrification of the transportation system could answer to the need for zero-emissions. In that case, other problems such as congestion and vast urban areas occupation remain. The last two criteria, prevent single solutions and encourage a holistic treatment of the transportation sector. Indeed, automobility is a land-hungry system and many of its problems can be eliminated by less privately owned cars. However, we do not consider the decrease of car-ownership to be a criterion on its own. It is rather a tool that will help counteract congestion and liberate urban spaces from automobility's occupation.

4.1.1.1 Sustainability criteria on parking

The sustainability framework set up in section 3.1.1 has been adapted into criteria for sustainable parking. The criteria are divided into four categories; economic, societal, well-being and ecological criteria.

Well-being criteria

- **It caters for basic human needs:** Although parking on its own cannot provide basic human needs, it should work as a contributing factor for enhancing safety and security.
- **It provides equal opportunity and freedom:** Parking should provide accessibility to all parts of the city, age groups and people with special needs.

Societal criteria

- **Empowerment:** Parking should act as a contributing factor towards a well-functioning society and not as an obstacle.
- **Trust (such as between individuals, transparency):** Citizens should have trust that their expectations are aligned with reality in terms of availability of parking.
- **Equity & Justice:** Parking should be provided in a way that promotes accessibility in all parts of the city, independently of the demographic characteristics of users and no-users.
- **Empowerment:** Citizens should be able to take part and have a say in planning process of parking.
- **Openness to development and novelty:** Parking practice should contribute to transitions towards new forms of mobility, innovative business models and sociotechnical change.

Ecological criteria

- **Ecosystem balance:** Parking should work in harmony with ecosystem services and biodiversity.
- **Substance extraction:** Parking does not contribute to substances being extracted in a way that disturbs the balance of nature.
- **Substance emission:** Parking does not contribute to nature being subject to systematically increasing concentrations of substances.

  * A species of matter of definite chemical composition

Economic criteria

- **It facilitates transparency and trust:** The costs related to parking and their allocation should be visible. A transparent pricing system should generate trust about the price definition and cost allocation within society.
- **It is resilient to disturbance and flexible enough to adapt to changing conditions:** Parking infrastructure should be flexible to future conditions (less cars, electrical vehicles) and adaptive to changing market prices.
- **It ensures fair distribution of resources:** Urban land should be allocated in a way that benefits both those who use parking and those who do not.

4.2 Step 2: The current situation of the transportation system and parking practice.

In this section the current transportation system of people in the city of Gothenburg as well the parking practice and the people's perception about it are presented. The first sub-section describes the findings from the desktop research, which are presented as background to the situation of the current transportation system, both from an international and regional perspective (section 4.2.1). A survey that illustrates tenants' perception about parking practices and prices is described and analysed (section 4.2.2). Finally, the combined input from the survey, semi-structured interviews, dialogue and literature study is presented as drivers and barriers towards a parking practice with lower parking-rates in the city of Gothenburg (section 4.2.3).

4.2.1 Background

In this section, we present some stylised information regarding mobility and parking. We start by describing European and regional trends, policies and goals. Some housing projects, innovative in terms of parking and mobility are cited. Afterwards we focus on the city of Gothenburg and introduce the current and the upcoming parking policy. To conclude this section, we present some innovative projects that focus on MaaS and autonomous cars in Gothenburg.

Urbanisation

As can be seen in figure 12, there has been a clear urbanisation trend internationally for the last 70 years. At present, 54% of the world population lives in an urban setting (United Nations, 2014b). This trend is expected to continue and the anticipated number for 2050 is about 66% (United Nations, 2014b).

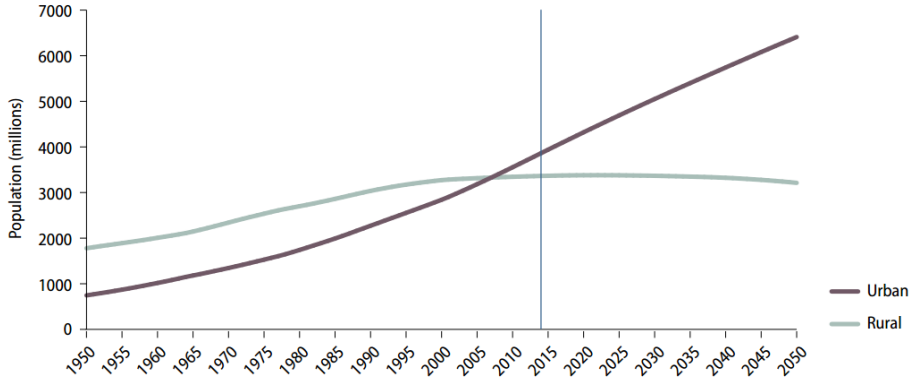

Figure 12. Urban and rural population of the world, 1950-2050 (United Nations, 2014a)

The trend is no different in Sweden, but the prognosis shows even higher numbers for the future. Currently 85% of the Swedish population lives in urban areas and by 2050, a 5% increase is expected (see figure 13) (United Nations, 2014a).

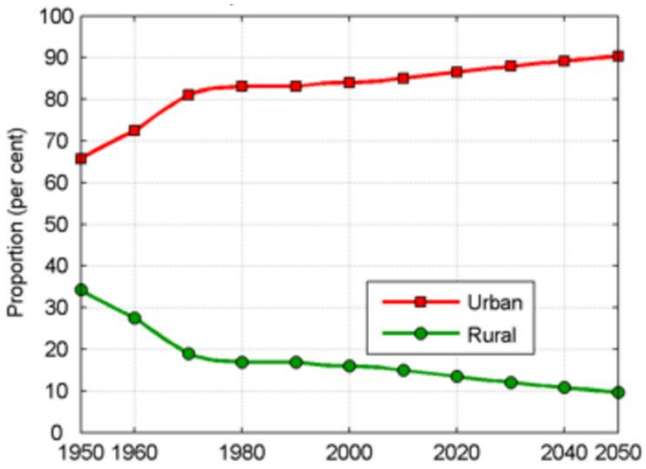

Figure 13. Proportion urban and rural population in Sweden (United Nations, 2014a)

In Sweden, the latest prognosis is that there will be a 20% increase in population from 10 to 12 million people until 2050 (Statistiska centralbyrån, 2017). Combining the increased urbanisation with the population growth clearly shows that the population increase in Swedish cities will accelerate even further in the future. According to Svanström (2015), the reasons for this trend are twofold. First, since there are more people living in urban areas there will also be more childbirths there. This makes the urban population grow faster over time, compared to the rural one. Second, the urban areas of Sweden have accepted the main bulk of immigration, resulting also to increased population.

Strategy on air pollution

There is currently a draft of a National Air Pollution Control Programme (European Environment Agency, 2016). The main objective of this directive is to co-ordinate the 28 EU countries to reduce their national levels of the air pollutants $SO_2, NO_x, NMVOC_s, NH3, PM_{2,5}$ and CH_4. If the draft is accepted, it will put pressure on each member state to incorporate the directive into national law by July 2018, ensuring that it will meet the 2020 and 2030 goals presented in figure 14 (European Environment Agency, 2016). The reason behind this National Air Pollution Control Programme is that the European Environmental Agency highlights that air pollution threatens citizens' health, especially in urban areas. The annual cost for health-related issues connected to air pollution in the EU is estimated to be 330-940 billion Euros. On top of that, air pollution also has adverse environmental effects such as eutrophication, acidification and damage to vegetation (Bourguignon, 2017).

	2020	2030
SO_2	-59%	-81%
NO_x	-42%	-69%
NMVOC	-28%	-50%
NH_3	-6%	-27%
$PM_{2.5}$	-22%	-51%
CH_4	/	-33%

Figure 14. Proposed reduction targets in EU28, compared to 2005 (Bourguignon, 2017)

At a national level, dependency on fossil fuel is seen as an unsustainable pathway. This point of view is shared at a regional level as well and therefore, there is an initiative for making the *Västra Götaland* region fossil independent by 2030. To reach this goal, climate-smart ways of commuting and travelling take centre stage (Länsstyrelsen Västra Götalands län och Västra Götalandsregionen, 2016). Public transport, cycling and walking are key mobility solutions that enable these measures since they are efficient ways of reducing the use of fossil fuels. The large fleets of public transport vehicles are also considered as great starting platforms for introducing new technologies in Gothenburg. This is a view shared at an international level as well; "*These could make a substantial contribution in reducing the carbon intensity of urban transport while providing a test bed for new technologies and opportunity for early market deployment"* (European Commission,2011, p.8).

European and national recommendations on urban mobility and parking

In 2011, the European commission released a report on the future transport strategy for the EU (European Comissionn, 2011). The report makes recommendation about how European countries should handle transport. In the vision presented, and more specifically under *"clean urban transport and commuting"*, the biggest focus is on public transportation. According to the report, this is the best way to transporting people in a dense city. The second major focus is on freight and the importance of efficient deliveries. Together with public transportation, technological fixes such as new types of vehicles are considered to be the future solution for managing freight. Another recommendation is that large employers should be encouraged to develop mobility management plans for their employees. However, housing companies and the residential side of this mobility plan is not mentioned.

The Swedish Transport Administration which is a government agency, responsible for the long-term transport strategy in Sweden, released a report in 2013 on parking in dense attractive cities. Similarly, to the transport strategy for the EU, it presents recommendations and not rules. However, the focus here is on parking rather than on mobility. The most important recommendation is that the market for housing and car parking should be separated. The rationale behind this is that urban areas will be used more efficiently since the market will ensure that no spaces will be left empty or unused which is currently the case. The two main ways of making this transition in a smooth way are by:

1. Creating networks in order to exchange experiences between different cities and landlords.
2. Evaluating current building processes. Evaluations and studies about the cause and effect correlations within parking norms (Envall, 2013), p. 14.

Innovative projects in other parts of Sweden

Gothenburg is not the only city in Sweden where parking and mobility are of broad and current interest. Other cities such as Stockholm, Malmö and Lund have some inspiring projects to demonstrate and some of the cities can be considered to be further ahead in terms of parking regulation and mobility solutions. These examples will not only provide the reader with a broader picture of the Swedish reality but they will possibly generate inspiration for the city of Gothenburg. To explore this, we present some projects that are innovative in terms of mobility and parking. A few words about the parking policy of the city, where the projects are conducted are preceding.

Parking and mobility in Stockholm

In the greater area of Stockholm there are 26 municipalities but only 12 of them have an official parking policy (Envall, et al., 2014). Although the other municipalities do not have an independent parking policy, they usually have rules about parking embedded in other documents. The parking ratio ranges from 0,25 to 1,7 parking lots per apartment with an average of one. Six municipalities have relatively flexible parking regulation, according to which, lower p-ratio can be granted if the property developer provides mobility service such as a carpool. In comparison to Gothenburg, Stockholm is a city with partially more proactive policies but less united in terms of policies and regulations (Envall, et al., 2014).

Innovativ Parkering is a project which aspires to create attractive living environments and new mobility services for city dwellers. It organises parking and manages parking demand in a certain way aiming to save capitals, traditionally devoted to parking construction. Innovativ Parkering's team intends to spend the released resources on new mobility services, such as car sharing, access to cargo bikes (lådcycklar) and intelligent delivery room for goods ordered online. Two new housing projects are currently running under Innovativ Parkering: one in Älvsjö, built by Bonava and one in Haninge built by Riksbyggen.

Bonava's new housing project is situated in Älvsjö and the new tenants will move in during 2018. It is comprised by 157 apartments with an average size of 49 square meters. Bonava describes its target group for these apartments as mostly young people who spend a lot of time outside home. There are several solutions in the project's mobility plan. Examples are subsidised access to carpool for the tenants during the first five years and free public transportion card for those who abstain car and parking. Strategically placed bicycle storage in advantageous positions and the possibility of renting cargo bikes are examples of other solutions to promote bicycling.

Innovativ Parkering's second project, Haningeterrassen is a new project in Haninge center that will provide 600 new houses, a new bus terminal, a centre with health care facilities and an area for entertainment with restaurants. There is also focus on street life that will be enriched

with shops, like a grocery store and areas for people to meet and socialise. The target group is people living alone or couples over 40 who hypothetically need extra room. The larger apartments are suitable for those who want to sell their villa and move to the city centre. Brf Blicken has been designed with the idea to make it easy to stay there without owning a car. Mobility solutions that encourage this lifestyle such as carpool, bike pool and electric cargo bikes has been implemented. Other, less common types of solutions involve discounts on taxi services, trial offers for car rentals and personal travel consultant.

Parking and mobility in Malmö

The existing parking policy in Malmö was adopted in 2010 (Malmö Stadsbyggnadskontor, 2010). The parking ratio ranges between 0,5 and 1 parking lot per apartment. Malmö has already adopted flexible parking policy which encourages mobility solutions such as car pools. However, the policy also states that the majority of housing will be built with a parking rate between 0,7 and 1. The parking regulation gives property developers the opportunity to build with parking rates between 0,5 and 0,7 per apartment, if they provide mobility solutions or other preconditions are in place, such as proximity to public transport. For bikes the regulation defines 2,5 parking lots per apartment. In conclusion, we can say that Malmö is more proactive in terms of parking policy compared to Gothenburg.

The Cykelhuset Ohboy, or 'bicycle house' in English, is a pilot project with 55 apartments and 32 hotel rooms in Malmo. The architecture office, Hausechild & Siegel was the one responsible for Cykelhuset Ohboy. Their vision was to build apartments for an urban future where tenants do not need to own their own car. According to them, they leverage the land and budget usually dedicated to privately owned cars and invest these resources in making life without car smooth and easy.

The Cykelhuset Ohboy is built with a parking ratio of zero since the sustainable mobility is in focus from the beginning of the project. One of the key characteristics of the building is the bike pool, where tenants can rent bikes for exceptional occasions. These bikes can be bicycle trailers, folding bikes, taxi bikes for carrying one to two persons, cargo-bikes etc. As for privately owned bikes, tenants have their own spots in the bike garage on the ground floor and on the mezzanine balcony. Hooks for bicycle suspension can also be set up in the hall. Equipment to fix their bike exists on the yard and in the building. The building is designed in a way that cargo bikes can get into the elevator and the apartments. For example, all doors are 10 cm wider than normal and every door is equipped with a door opener for easier access. Moreover, tenants do not need to stop at their front door while transporting their shopping. The apartments are designed so that bikes can be wheeled right to their fridge, if they desire so. Another design detail is that the elevator opens at front and back so bicyclists never need to turn their bike around. Shopping is also facilitated by delivery boxes which enable e-commerce. Moreover, Membership in carpool is provided for ten years to all tenants. According to one of the Hauschild & Siegel's team member, they chose to collaborate with Sunfleet due to its good infrastructure in the area (many cars in the area - good coverage, easy access, good shared use between offices during daytime and housing at other times etc.). Another reason was the clear structure of how the contract between developer, carpool and municipality work. Finally, a very interesting uniqueness of the project is that Hauschild &

Siegel conducted a survey, open not only to tenants but to everyone, to find out what kind of brand and model of bike they should equip with building's bike pool. They were seeking for feedback and valuable ideas concerning the bike pool's bikes. Finally, the bike pool will include:

- two bicycle trailers for goods transportation,
- two bicycle trailers for children transportation,
- one taxi bike for one or two people (for example older people)
- one cargo bike
- two electric bikes and
- guests' bikes, that will be simple but sturdy city bikes that will be used by many different people (e.g. hotel guests). (Cykelhuset Ohboy, 2016)

A MaaS project, EC2B ("Easy to B"/ "Easy to be"), which incorporates several different modes of transport, including public transportation, is launched by Trivector. Its uniqueness stems from its connection to accommodation since "most trips start and/or end where people live" (p.i). Trivector's MaaS concept offers easy access to various transport modes, booking services, good information and a community for interactions and value creation amongst the users. Customers are the end users but also property developers who include EC2B as a part of an innovative accommodation package. Its connection to accommodation gives property developers the opportunity to add value to their business and allows them to save money by building less parking lots. EC2B is still on a planning stage and a launch date has not been set yet. A feasibility study, financed by Climate-KIC's Pathfinder programme and run by Trivector, Movia, the municipality of Malmö and Copenhagen, shows that the potential implementation of EC2B in Malmö, and to a lesser extent in Copenhagen, could have promising results and thus Trivector aims to turn EC2B into a start-up (Lund, 2016).

Environmental targets for the city of Gothenburg

The city of Gothenburg has set as an environmental goal to reduce the amount of carbon dioxide per person to 1,9 tonnes by 2050. The current carbon dioxide emissions are 4,65 tonnes per person so the municipality aims to a reduction of 59 % (City of Gothenburg, 2014a). In order to reach this goal a strategic objective is to decrease the carbon dioxide emissions from road transport by 80% compared to 2010 levels, by 2030.

The car ownership has decreased over the last 15 years from 355 to 335 cars per 1000 citizen in Gothenburg (Envall, 2016), as can be seen in figure 15. This contrasts with the rest of Sweden where the car ownership has increased. According to (Envall, 2013) this is due to the fact that the older generations have increased their car usage. In Gothenburg except for the main trend, there is also a new one, according to which the younger generations do not see the car as a status symbol. In 1985, 80% of the citizens aged 18-24 years had a driver licence. This had declined to 40% in 2009.

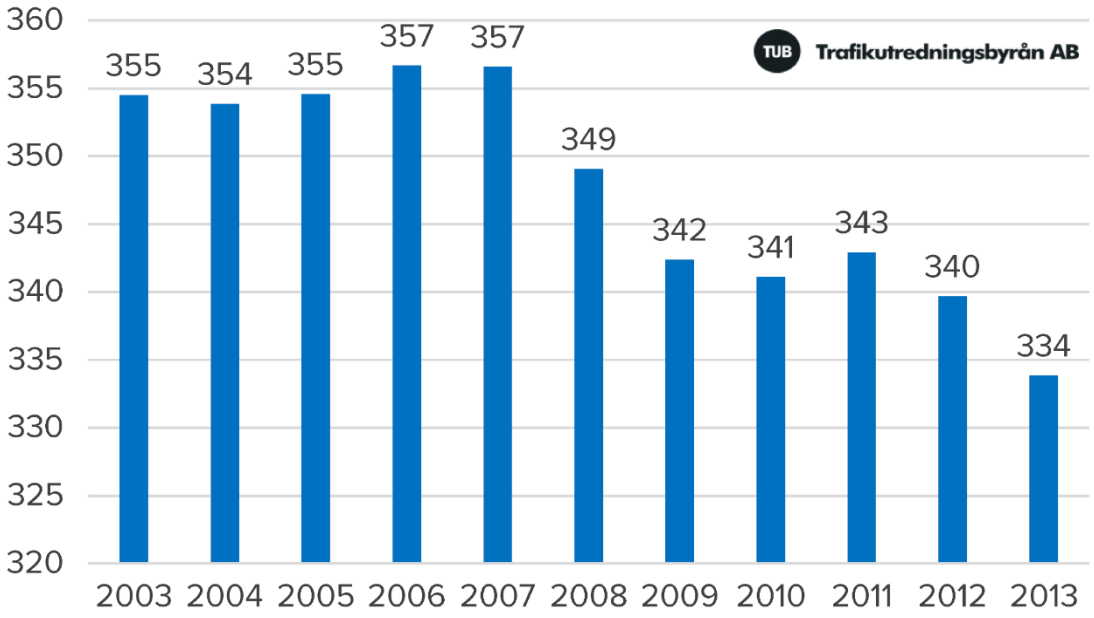

Figure 15. Car ownership per 1000 inhabitant in Gothenburg over the period 2003-2013. (Envall, 2016)

Another measure is a congestion tax, introduced in 2013 with the purpose to decrease congestion and partly finance investments in infrastructure and public transport (City of Gothenburg, 2017). The measure is only active during the day when the car use is higher. The tax is supposed to act as an incentive for commuters to use other means of transportation (City of Gothenburg, 2014b). Compared with 2012, before the congestion tax was introduced, the current amount of traffic at roads where the tax is active has been reduced by 5-6%, as shown in figure 16.

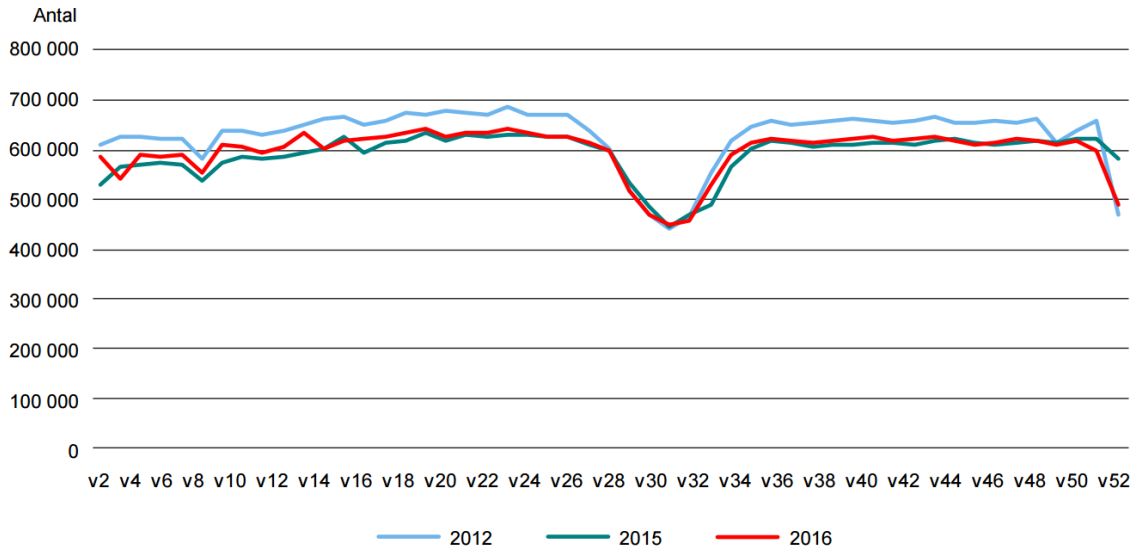

Figure 16. Traffic flows at payment station (Trafikverket, 2017)

The increasing housing prices in Gothenburg

Currently, the average housing price in central Gothenburg is 60 227 SEK/m^2 which is 50% more than the Swedish average of 40 407 SEK/m^2 (Svensk Mäklarstatistik, 2017). During the last year, the prices of housing increased by 10% in central Gothenburg and by 13% in the wider Gothenburg area. According to a report by Boverket (2010), the current housing prices are not in correlation with their building cost. Instead, the deciding factor for the pricing of houses is customer's willingness to pay. Furthermore, some locations are less lucrative for building than others, regardless of how close they are to the city centre. Less central areas or spots in the outskirts of the city are considered more advantageous and cost effective by housing companies, partly due to their proximity to nature (Netzell, 2015). This creates a scene where housing companies, to maximise profit, build further away from the city centre instead of building on the less lucrative spots. A common argument on their behalf is that there is a lack of buildable land in the city. According to Netzell (2015), this is not entirely correct. He highlights housing companies' unwillingness to build to the city's full potential. The reason for this is that there is a lower profitability when building on less attractive ground. Hence the housing companies choose not to build on theses spots in order to keep the housing market at a maximum profitability.

Parking policies in Gothenburg

Guidelines for how to think in terms of parking in Gothenburg were decided in *Parkeringspolicy vid Göteborgs stad* (Stadsbyggnadskontoret et al., 2009). The current parking requirements and policies are stated in *Vägledning till parkeringstal vid detaljplaner och bygglov 2011* (Stadsbyggnadskontoret, 2011). The under public consultation future policy is described in *Riktlinjer för mobilitets- och parkeringsplanering i Göteborg* (Stadsbygggnadskontoret, 2017).

As for the current parking policy, its goal is to: *"Contribute in making the city available for everyone. We should have an attractive and beautiful city with a sustainable city development - socially, economically and ecologically. The parking policy should encourage more people to choose public transport in favour of the car." (*Stadsbyggnadskontoret et al., 2009, p.7). However, the main purpose is to create a common vision for all stakeholders in the city in regards to parking and spread knowledge between different organisations. The current policy has a strong focus on placing both car and bike parking infrastructure in smart locations where it enables new room for new public transport. Reducing the amount of parking is beyond current policy's scope. In 2009 the city was expected to enter an expansive phase with an increased densification. Hence, a common vision in the city of parking's role in the new dense city was needed.

The more important document which gives more concrete limits and rules for how parking can be built and placed is *Vägledning till parkeringstal vid Detaljplaner och bygglov* (Stadsbyggnadskontoret, 2011). In here Gothenburg is divided into three parts as can be seen in figure 17: city, inner town, central Gothenburg and other areas.

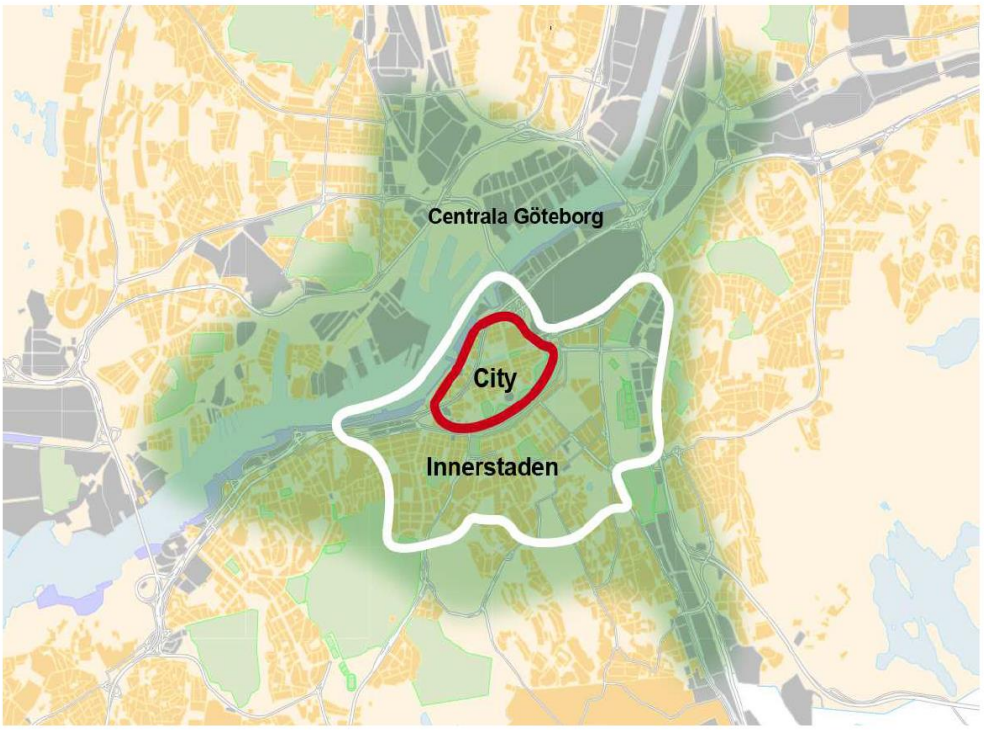

Figure 17. Geographical boundaries according to the 2009 parking policy (Stadsbyggnadskontoret, 2011)

There are different parking demands for the three parts of the city. The first stage during the planning process of a new housing project is to hand in a detailed plan, named “detaljplan”, in the architecture department of the municipality. There, it is briefly explained how the area is going to be utilised, e.g. amount, placement and size of houses. These factors determine the number of parking lots that are going to be built. In a later stage of the planning process, a building permission, “bygglov” in Swedish, is granted. There, the minimum number of parking lots are calculated as a function of the number of apartments. The rules for the number of required parking lots for both the detaljplan and byggolv are cited in table 1.

Apartment, tenant - car	**Detaljplan Parking Lot/1000 m^2**	**Bygglov Parking Lot/apartment**
Apartment, City / Inner city	5,5	0,49
Apartment, Central Gothenburg	6	0,54
Apartment, Other areas	7,2	0,65
Small apartment, City / Inner city	5,5	0,34
Small apartment, Central Gothenburg	6	0,42
Small apartment, Other areas	7,2	0,46
Apartment, visitor - car		
Apartment, City / Inner city / Central	0,6	0,05

Apartment, Other areas	1	0,07
Small house, tenant - car		
Small house, own line-up	2 / house	2 / house
Small house, collective line-up	1,7 / house	1,5 / house
Small house, visitor - car		
Visitor, small house	0,2 / house	0,2 / house

Table 1. Parking rates for residential car-parking 2011 (Stadsbyggnadskontoret, 2011)

As can be seen, in table 1, the further away someone builds from the city centre, the higher the parking requirements are. There are several reasons for this. First and foremost, in the more central areas of Gothenburg, the public transportation coverage is better (see figure 18). Since the dark blue areas in figure 18, are the most accessible in terms of public transport, there is also limited need for car.

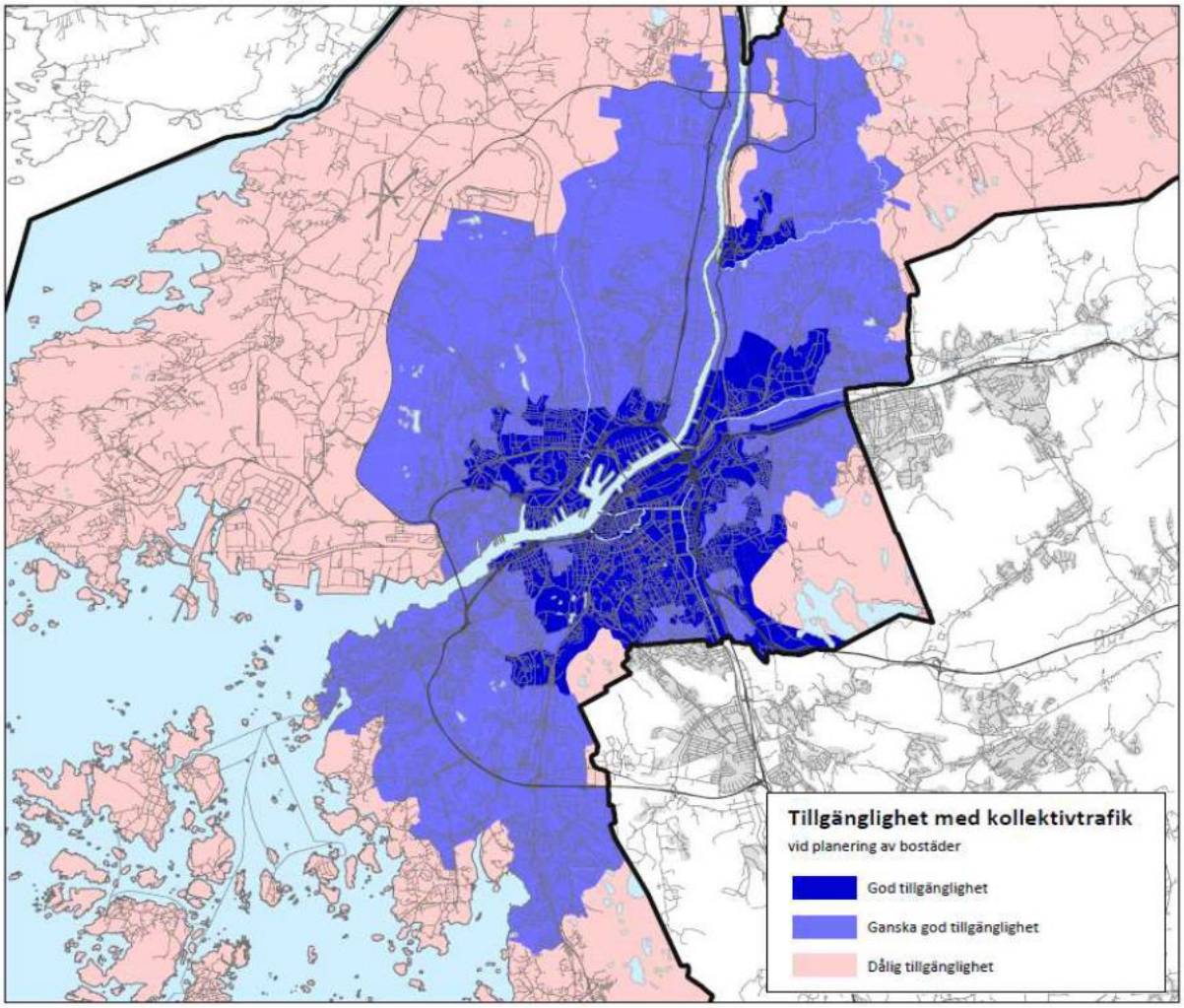

Figure 18. Availability of public transport when planning apartments (Stadsbyggnadskontoret, 2011

The correlation between density, availability of public transportation and car usage for commuting can be also seen, in figure 19, where it is clear that the more central the people live, the less they use a car to commute. Secondly, land is very expensive in the central and dense parts of the city and parking's return on investment is quite low compared to those of houses. Thus, for property developers building houses is a more profitable than building parking lots.

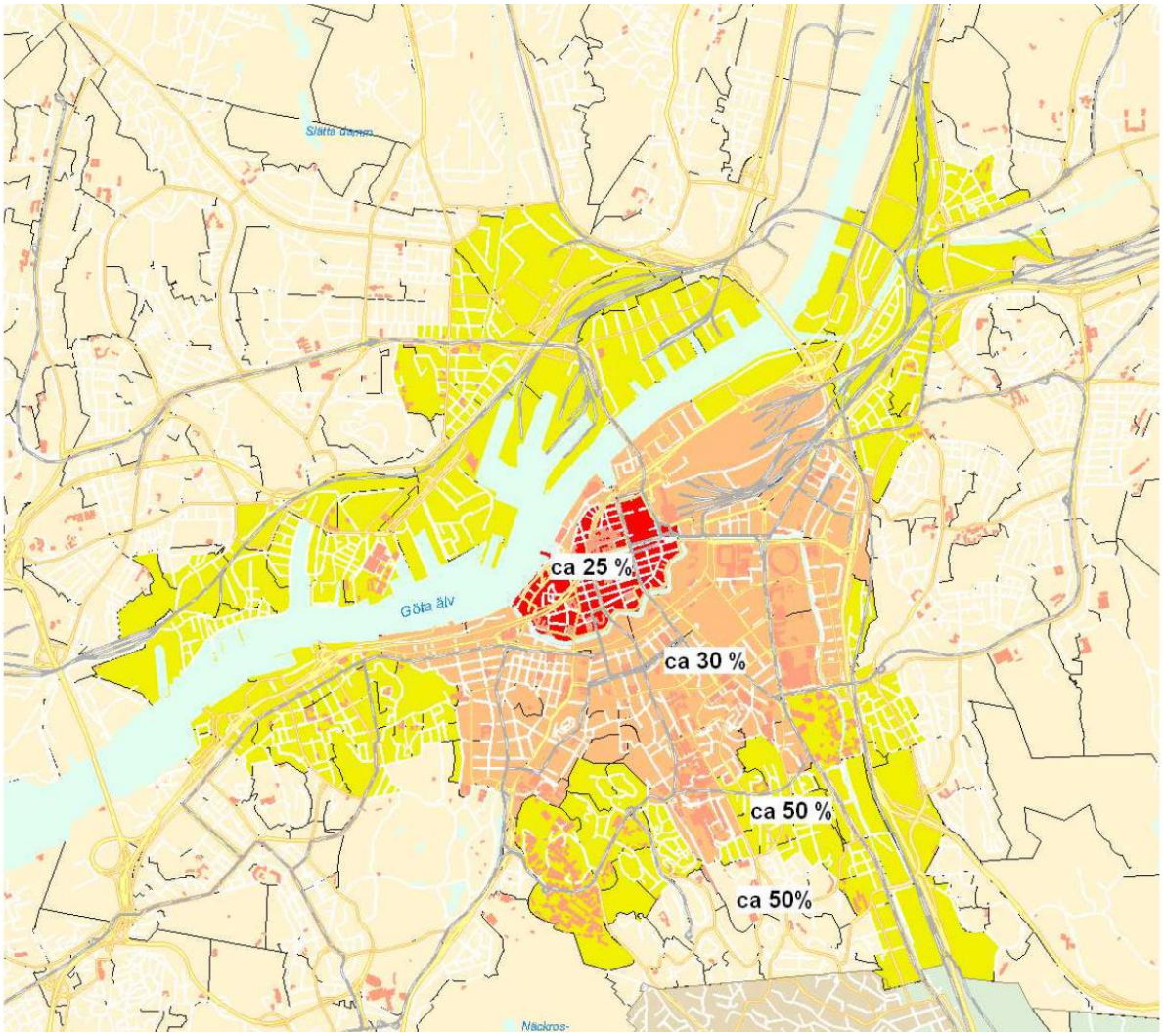

Figure 19. Amount of tenants who take the car to work (Stadsbyggnadskontoret, 2011)

The demand of regulation on bike parking can be seen in table 2.

Apartment building, tenant, storage room - bicycle	**Detaljplan Bicycle Parking Lot / 1000 m^2**	**Bygglov Bicycle Parking Lot / apartment**
Apartment, all of Gothenburg	25	2
Small apartment, all of Gothenburg	25	1,5
Apartment building, visitor, in connection to the entrance		

Apartment, all of Gothenburg	10	1

Table 2. Parking rates for residential bike-parking in 2011 (Stadsbyggnadskontoret, 2011)

In 2015, the municipality of Gothenburg started reviewing the parking policy in order to come up with changes that will align it with the city's plan to promote less car usage (Stadsbygggnadskontoret, 2017). This ongoing process is predicted to end in 2017. The draft of the future policy is under public consultation and feedback has been asked from relevant stakeholders such as property developers and housing companies.

The main difference between this parking policy and the 2011 counterpart is that in the upcoming one mobility is in focus. This means that the main purpose of the policy is to ensure mobility in the city rather than sufficiency of parking. Another big difference is the flexibility of the upcoming regulation. "*Flexible parking numbers mean that the number of parking lots that has to be built can vary depending on the area's specific conditions and the mobility services which are introduced*" (Stadsbygggnadskontoret, 2017). This means that housing companies can replace parking lots with other mobility solutions such as carpools, bike pools, and subsidy of public transportation cards for the tenants. The property developers are also in favour of flexible parking regulation since building parking lots is expensive (Malmö Stadsbyggnadskontor, 2010) Replacing parking lots with mobility solutions will liberate space that will be exploited in a more profitable way, by building housing for example.

In this policy, the process from planning to construction is also modified. A mobility meeting between the housing company and the relevant administrative departments of the municipality is suggested to be held early in the planning process. The reason for this meeting is to ensure that mobility solutions are incorporated into the process from an early stage. After the meeting, the process will proceed either as a normal (*normal hantering*) or a simplified one (förenklad hantering). At normal process, three steps (lägesbedömning, projektanpassning and förslag till mobilitetslösning) are followed to assess how mobility and parking are best managed, in the assessed project. Simplified process means that there are very good preconditions for low parking numbers such as low demand or negative effects on the area from parking lots. If this is the case, the mobility planning process can be shortened and simplified.

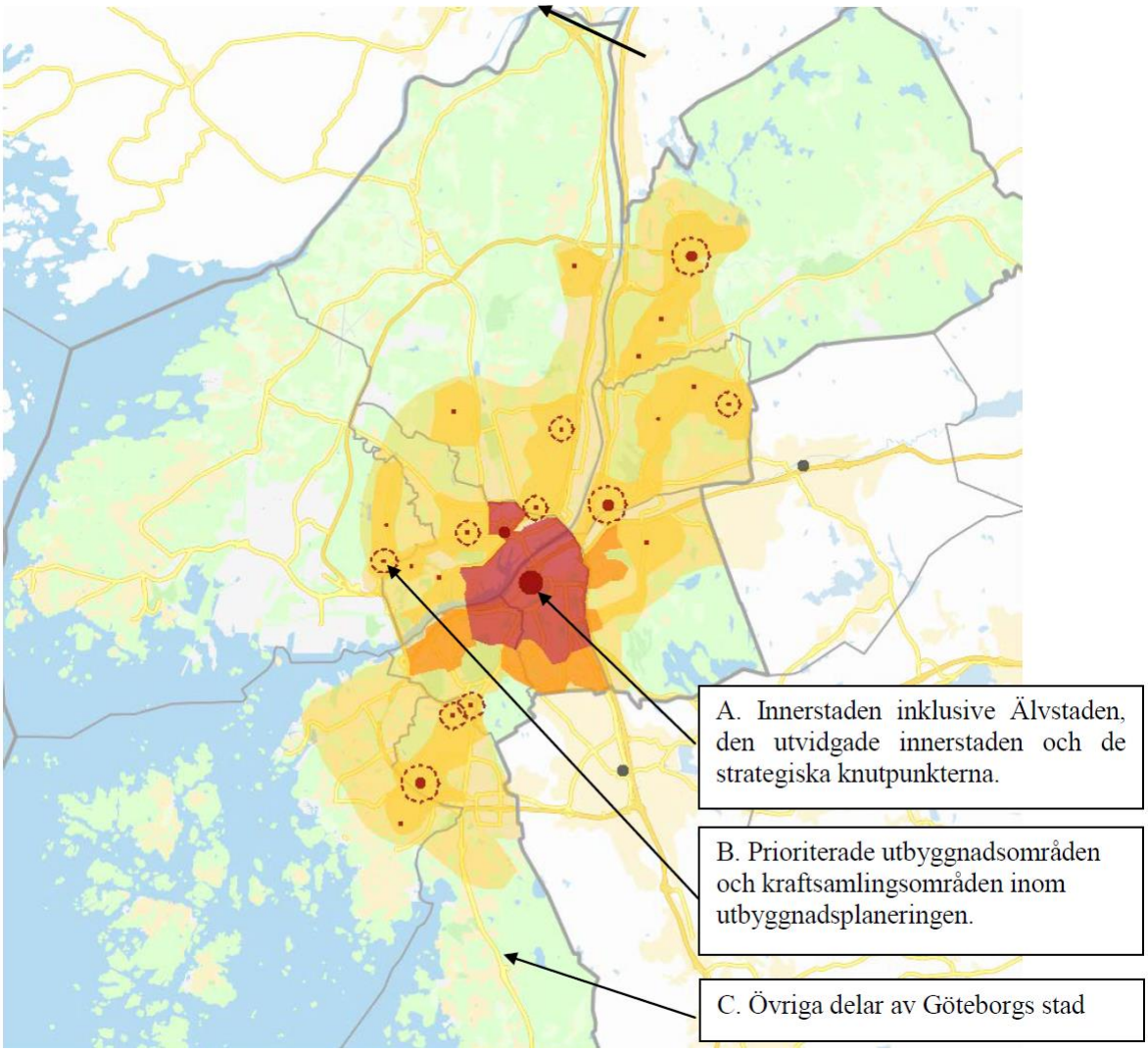

Figure 20. The different mobility zones of the 2017 parking policy. (Stadsbyggnadskontoret, 2017)

Just as with the current policy, Gothenburg has been divided into three zones (figure 20). In this policy, however, the zones have been divided differently. Zone A consists of the areas planned to be the most densified in the future as well as the most important strategic hubs. Zone B comprises prioritised areas of expansion and areas that will receive extra focus in future urban development. Zone C is the rest of Gothenburg. For the different zones, there are different parking demands. Instead of specific parking rates, there are ranges defined by the size of the apartment. Housing companies have the opportunity to calculate parking requirements with the lower number in the range, if alternative mobility services are provided. In table 3, 4 and 5 the parking numbers for zone A, B and C can be seen.

For area A

Size of apartment	1 Rok	2 Rok	3 Rok	4 Rok	5+ Rok
P-rates for car	0-0,2	0-0,3	0,2-0,6	0,3-0,7	0,5-0,8

Table 3. P-rates for Zone A (Stadsbyggnadskontoret, 2017)

For area B

Size of apartment	1 Rok	2 Rok	3 Rok	4 Rok	5+ Rok
P-rates for car	0-0,2	0,1-0,5	0,3-0,7	0,4-0,8	0,5-1

Table 4. P-rates for Zone B (Stadsbyggnadskontoret, 2017)

For area C

Size of apartment	1 Rok	2 Rok	3 Rok	4 Rok	5+ Rok
P-rates for car	0,1-0,5	0,3-0,6	0,4-0,7	0,5-1	0,6-1,2

Table 5. P-rates for Zone C (Stadsbyggnadskontoret, 2017)

*Rok stands for room and kitchen in Swedish. 1 Rok means one combined bedroom / living room, one kitchen and one bathroom

For bikes the rules are the following:

- Minimum one parking lot in a dedicated room for bikes or general storage room / **resident.**
- At least 0,5 bike parking lots / **apartment** for visitors or temporary use of housing.

Innovative projects in Gothenburg

Most of the central areas along the river in Gothenburg will be transformed and densified according to the RiverCity vision (City of Gothneburg, 2012). It is an ambitious project which will create 25 000 new apartments and 45 000 new jobs (City of Gothneburg, 2012). The purpose of RiverCity is to double the population of the inner city through densification, connect the rest of the city with the water. An important aspect of RiverCity is to make the new city centre attractive, accessible and open to all the citizens. Both within the RiverCity vision and the Gothenburg development strategy (City of Gothenburg, 2014c), a key feature for an attractive city is the efficient transportation. Hence, a variety of mobility solutions are mentioned in both documents, such as public transportation, bike pools and pedestrian friendly streets. The daily life is supposed to be manageable by bike, public transport and walking. Within Gothenburg's development strategy there are prioritised areas where transportation nodes will be created to make transportation able to deal with further densification of the city.

Figure 21. Planned placement of parking in Frihamnen (Roth, 2015)

Frihamnen is an example of an area within the RiverCity project and is planned to house 9000 apartments and have 15 000 people working there until 2035 (Roth, et al., 2015). The area is planned to have 25% of the current parking number. This means that instead of 13 400 parking lots which is the amount needs to be built according to the current parking requirements, only 3800 parking lots will be constructed (Roth, ibid). Furthermore, the parking is planned to be in the outskirts of the area, as can be seen in figure 21, but not underground which diverges from the common practise in the city of Gothenburg. Once completed, Frihamnen will be one of the most progressive areas in Sweden in terms of parking practice and mobility solutions.

Brf Viva is another project which acts as an interdisciplinary knowledge lab and an actual housing project which will provide 132 apartments, ranging from 30 to 109 square meters. It is part of the wider Positive Footprint Housing® project that aims to result in increased environmental, social and economic sustainability. Brf Viva's partners consist of the academy, the business community, the City of Gothenburg, Johanneberg Science Park, Göteborg Energi and concerned citizens. Riksbyggen acts as property developer, and the one responsible for facilitating the collaboration and the network amongst the partners.

The project implements a series of measures in order to save both money and resources such as energy and be environmentally friendly. In the long run, the project aspires to produce more energy than it consumes. Some of these measures are the following: photovoltaic system, self-produced electricity, energy-efficient ventilation, smart waste management systems and construction that is analysed and calculated from a life cycle perspective. When it comes to mobility Brf Viva adopts an equally ambitious and radical stance, building with zero parking rate, which means no parking spaces at all. Some measures that could make car ownership less necessary are the provision of access both to a carpool with electric vehicles

and a bike pool with electric bikes and electric cargo bikes. Moreover, tenants will have access to a bike hub with a tool pool where they can fix and repair their bikes. An elevator will facilitate the bike usage by moving from the upper to the lower plateau where the bicycle garage and hub are. Finally, a postal and delivery room while enable shopping from home and answer to the need for individual transportation of goods.

MaaS in Gothenburg

UbiGo is Gothenburg's well-known MaaS project which ran successfully over a six-month trial period. It acted as a test platform where several stakeholders from public and private sector as well as academia were involved (Sarasini, et al., 2016). The project aimed at challenging the need of a privately-owned car and attracted a lot of attention. There were 83 households which took part in the UbiGo project, by paying a monthly subscription adjusted to their transport needs. They had access to existing transport solutions and providers such as public transportation, car- and bike-sharing, rental cars and taxis. Though it was a successful project, UbiGo did not manage to continue after the trial period. Developing UbiGo from a prototype to a fully operational commercial service required financial support which was not found by the end of the trial period. Moreover, there were some institutional barriers. Public transportation is subsidised by Swedish taxes. This means that the MaaS brokerage is also subsidised since it includes the public transportation system on its business ecosystem. Forasmuch as UbiGo was non-profit driven, there was no conflict of interests and the public transportation organisation could join the scope. Due to present laws and regulations, public transport's subsidy was a liability for UbiGo to become a service provider in a typical business context, at the end of the trial period. Hence, an important lesson to be learned from UbiGo, is that there are institutional barriers for MaaS projects due to different regulatory frameworks of sectors and actors involved (Sarasini, et al., 2016).

Another project connected to MaaS in Gothenburg is DenCity, a collaborative venture with stakeholders from industry, academia and society. It is a project run by CLOSER, the Swedish national arena for collaboration within transport efficiency, scheduled to operate from December, 2015 to January, 2018. Frihamnen is DenCity's physical test bed, where the City of Gothenburg wants to demonstrate and experiment with new transport solutions. The main purpose of DenCity is to find mobility solutions and services capable to decrease car use and ownership in a dense city. The project acts as a platform where different solutions and concepts within different fields of mobility can be tested under real conditions. In terms of MaaS, DenCity focuses on creating the future infrastructure which will enable MaaS solutions. DenCity aims at incorporating both commercial actors' and MaaS users' perspectives, looking for solutions that will suit both sides (CLOSER, 2017). Frihamnen is DenCity's physical test bed, where the City of Gothenburg wants to demonstrate and experiment with new transport solutions.

Autonomous cars

Although fully autonomous cars are far from being commercialised, Gothenburg is taking a leading role in pushing the development. The "Drive Me" project is an effort from Volvo to test autonomous cars on the streets of Gothenburg. Here, it is important to differentiate between semi-autonomous and fully autonomous cars (Kantilaftas, 2016). In semi-

autonomous cars, the technology aids the driver, who is still in charge. In a fully autonomous car however, the technology can drive the car without the contribution of the driver. One of the main barriers right now is the legal framework which is not updated in terms of who takes legal responsibility when the driver does not control the car (Kantilaftas, 2016). Another prohibitive factor of fully autonomous vehicles is the cost needed for infrastructure and adjustments in the urban environment. Moreover, adding driverless technology to a car can increase the cost of it by 600 to 900 thousand SEK (Neiger, 2016).

Semi-autonomous cars however, are partially already a reality (Kantilaftas, 2016) and cars that can park without the driver's contribution is a system that Volvo currently is working on (Volvo et al., 2016). According to them, parking is a crucial part in making autonomous cars a reality and research has been done in collaboration with Parkeringsbolaget to make Gothenburg ready for a transition to autonomous cars, in terms of parking. Since there will be no need for space to open doors and handle other human needs, the parking lots potentially could be 10-15% smaller if parked without any people in the car (Volvo et al., 2016). The collaboration between Volvo and the city makes Gothenburg act as a testbed for new mobility technologies such as in this case. This creates possibilities to test new ideas in an innovative test environment and puts Gothenburg in the forefront of new mobility solutions in Sweden.

4.2.2 The survey

The survey was dispersed to five (5) BRF but only one accepted to send it out to its tenants. Finally, seventy-nine (79) households received the survey and thirty-three (33) tenants answered it, which corresponds to a reply rate of forty-two percent (42%). The results can be found in the appendix section B. In survey's sample, there was almost an equal distribution between sexes with an age variation shown in figure 22.

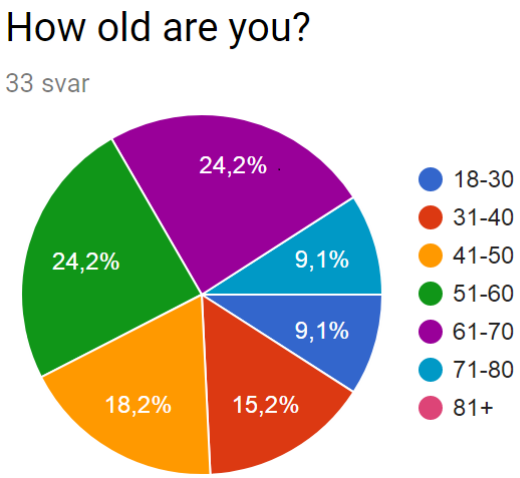

Figure 22. Age of the participants in the survey

The following limitations and reflections about the power of the survey should be taken under consideration while studying its results:

- 75,7% of the participants were over the age of 40 which according to (Envall, 2016), should results in slightly more conservative and car-oriented answers.

- 57,6% stated that they have a car which is above Gothenburg's average 34% (Envall, 2016).
- Since only one BRF answered the survey, results show only the opinion of the tenants of that specific neighbourhood. The conditions of this BFR might be very specific and possibly have a big effect on the attitude of the participants.

Do you think that the price for parking is subsidized or defined by the market?

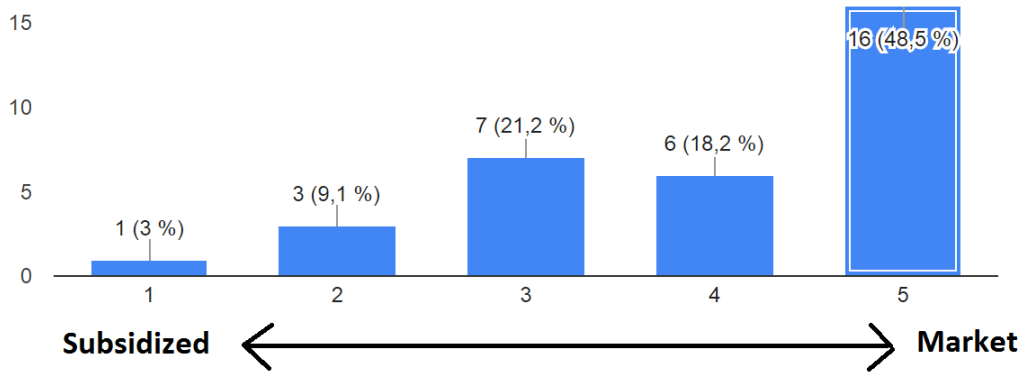

Figure 23. Participants opinion on whether parking is subsidised or defined by the market.

The survey demonstrates that the common perception is that prices for parking are defined by the market and are not subsidised by all tenants (see figure 23). Also, 90,9% of respondents answered that the rent for parking is expensive. At the same time 36,4% of tenants answered that they would accept an increase in price, 36,4% of them do not care or do not own a car and 21,2% would try to get a cheaper parking further away from their apartment. 42,4% answered that they see an advantage of higher parking price as a way to encourage other modes of transportation. Also, 60,6% of tenants see the residential parking price as something which affects their choice to own a car or not.

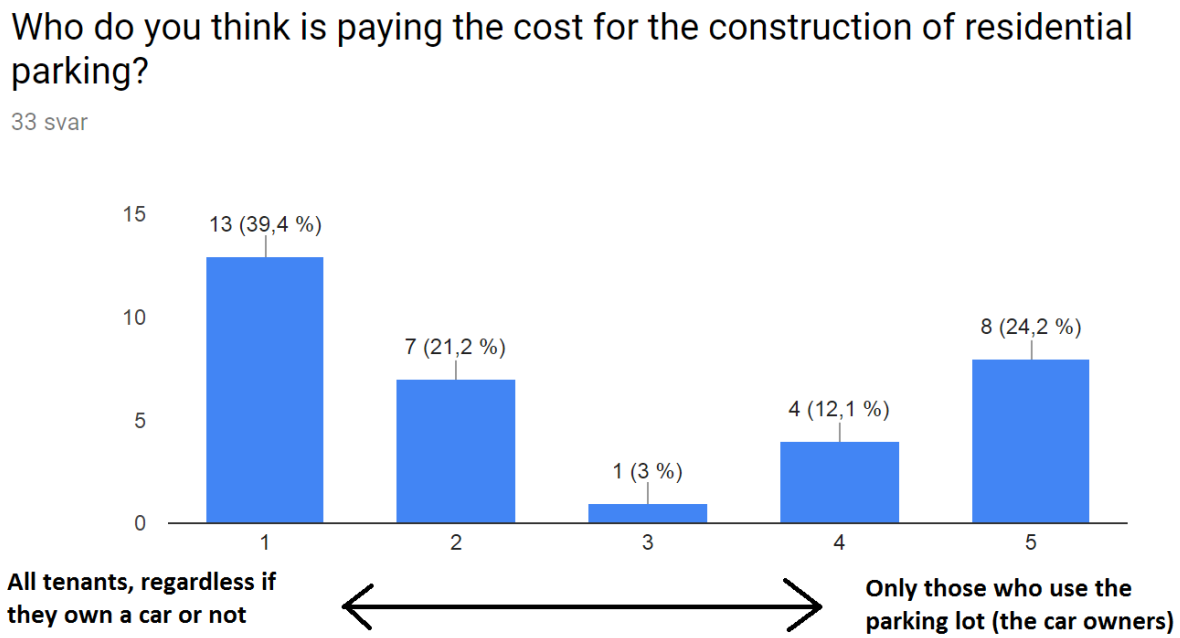

Figure 24. Participants opinion on who is paying the cost of residential parking.

Participants' perception in regards to who is paying for the construction of the parking can be seen in figure 24. The answers are dispersed and it doesn't seem to be a common perception about this issue. By far the most frequent answer for how much a parking lot costs is the range 150 000 – 450 000 kr / parking lot, followed by 33,3% who answered 10 000 – 50 000 kr / parking lot.

4.2.3 Drivers and Barriers towards a paring practice with lower parking rates

In this section, we state the main barriers and drivers to lower parking rates as they came up during the interviews, the survey and the dialogue. A table with the interviewees and the dates of the interviewees can be found at the appendix.

Barriers

As described above, sociotechnical systems of transportation and the related to that, parking system are robust with stabilisation characteristics and resistant to changes.

Rules and regulations

Most of the interviewees consider laws and municipal regulations, like the one which defines the parking rate, to be the most important barrier to change. The coercive nature of law creates a sense of impotence to property developers when they plan new projects that need municipality's approval in order to move forward to the construction phase. Interviewee No3 states: "*The rules and regulations are the biggest barrier since they set the guidelines that our company has to comply with*" (Interviewee No3, Property Management Company No1, Personal Communication, March 23, 2017). Interviewee No2 expresses the same opinion concerning the ranking of the barriers: "*The most important barrier is the policy. First the policy should be in place and after we can act. Of course, there are also practical issues but they are not so important*" (Interviewee No2, Housing company No2, Personal communication March 22, 2017). This quote is interesting for one more reason; it suggests the chronological

order of changes which need to be done. Participants from housing companies that took part in the dialogue also emphasise the need to criticise legal aspects since they block advance. It demonstrates the limited degrees of freedom that housing companies and property developers have or believe that they have. Some interviewees go deeper and bring light to barriers in the policy making level. More specifically, Interviewee No4 pinpoints different mentalities between the majority of politicians in the boards of the municipal housing companies and the local government. He thinks that "*the opposition is more conservative and more in favour of the car, while the steering forces are more towards less cars*" (Interviewee No4, Umbrella housing company, Personal communication, March 30, 2017). Probably a lack of a common mindset in the political spectrum is one of the reasons that cause resistance to changes.

Lack of common mindset and alignment

Interviewee No2 has identified a gap between policy makers and civil servants, resulting from the unclear guidelines and the lack of standardisation in the parking policy. He says: "*The politicians and the policy makers put demands on the housing companies for less cars. We try to do what they want but then we have to deal with the civil servants at the architecture department. They have their own minds and culture but also their own interpretation of the regulation".* He admits that there are different ways to interpret municipal regulation, rising questions for regulations' clarity and standardisation. He adds: "*As a civil servant, you can be quite progressive if you want to. But not everyone is, and some are afraid of making a mistake. If you take initiative, even if it follows the politicians, and something goes wrong, then you are the one to blame*". The same interviewee identifies similar miscommunication patterns in the company he works for, as well: "*In our organisation, there are people lower in the hierarchy who resist changes. They are people who work in reality and speak with tenants. They focus on the problem and the difficulties that they might face*" in a potential increase of parking price for example, like complains and discontentment (Interviewee No2, Housing company No2, Personal communication March 22, 2017). Interviewee No8 claims that the size of the company he works for, makes it difficult to succeed alignment: "*A barrier is that our company (an umbrella housing company) is so big. It consists of many companies with their respective subsections. A common strategy and policy for the whole company would be a way of making the process to more sustainable building easier*" (Interviewee No8, Property Management Company No1, Personal communication April 12, 2017).

Shared beliefs

Shared beliefs that make actors indifferent or reluctant to developments outside their scope are considered lock-in mechanisms that hinder change (Geels, 2012). The car has been named "the dominant culture" and "the major item of individual consumption after housing which provides status to its owners/users […]" (Urry, 2004). Car is directly related to a good quality of life. In the city of Gothenburg, these beliefs have deep roots because of city's long history of car manufacturing. Interviewee No1 thinks that this tradition is a barrier to a less car dependent future: "*Gothenburg is considered a car city and this is a barrier*" (Interviewee No1, Housing company No1, Personal Communication, March 14, 2017). Interviewee No4 agrees with the abovementioned statement but he adds that the generation perspective

differentiates people's stance on alternative mobility solutions like car sharing: "*There is still a big fixation to cars as the main way of transportation in Gothenburg but to some extent, it is a matter of generations. Younger generations are more open to this kind of ideas, while older see the car more as a status symbol*" (Interviewee No4, Personal Communication, March 22, 2017). Housing company's unsuccessful collaboration with a car pool company, which ended because of shortage of members, can be partially explained by this adherence to car-ownership, given the fact that the housing company did some good marketing and subsidised the access to car pool as well (Interviewee No2, Housing company No2, March 22, 2017).

Well established beliefs exist also around parking which seems to be considered as a civil right. Interviewee No7 highlights this fact by stating that: "*Public opinion is very important here. It is considered almost a human right to have parking*" (Interviewee No7, Consultancy, Personal Communication, April 12, 2017) while Interviewee No1 confirms by saying that: "*When buying an expensive apartment, it can be seen as almost a right to have a parking lot"* (Interviewee 1, Housing company No1, Personal Communication, March 14, 2017). A parking lot is taken for granted and it may be difficult to challenge or threat this constant. A reason for that can be that people are not aware of the problems related to parking. For example, Interviewee No4 contends that: *"In Sweden we are hiding the cost for parking*" (Interviewee No4, Umbrella housing company, Personal communication, March 30, 2017) and most of the interviewees also declare that tenants are not aware of the true cost of parking or the fact that it is subsidized by all tenants whether they use it or not (Interviewee No2, No6, Personal Communication, March and April, 2017). A fact that is also proved by the survey we conducted (see section 4.2.3), where 90,9% of the participants consider the residential parking in Gothenburg to be expensive and more than half of the sample thinks that only those who use a parking lot pay for the construction and maintenance of it and not all the tenants.

This is the reason why interviewee No2 highlights the need not only to take action towards more flexible parking practices but also to communicate those actions in a proper way in order to be successful: "*You need a plan about how to replace parking spaces and explain why this is good*" (Interviewee No2, Housing company No2, Personal Communication, March 22). Although no stakeholder and interviewee explicitly expressed the need to open a public discussion around the topic, they implied that the "narrative" about the need for less parking is not commonly-held and this is a barrier towards lower parking rates.

Risks

Most of the stakeholders from housing companies agree that residential parking prices are low because the cost is hidden in the building and maintenance of the whole block of flats, and therefore someone could argue that parking is subsidized by all tenants, regardless of whether they have a car or not. Getting the price right may seems an obvious solution but it entails certain risks. First, in the city of Gothenburg there are several streets where curb parking is for free (City of Gothenburg, 2017). Moreover, the under-priced parking is a widespread tactic that appertains to all housing companies in Gothenburg. These facts make it difficult for any single housing company to move towards real market prices for parking since there is risk to lose all its clients. Interviewee No3 is very straight forward: "*No, our clients don't pay the real cost, but if they had to, no one would use the parking lots and our company*

would be stuck with all the costs and no income" (Interviewee No3, Property Management Company No1, Personal Communication, March 23, 2017). Interviewee No1 sees another risk that is related with uncertainty about the future of real estate market: "*Nowadays, housing market is too good. Everything can be sold. Can an apartment be sold without a parking lot, if the market changes*?" (Interviewee No3, Property management company No1, March 23, 2017). However, this concern is not very popular amongst other interviewees. For example, Interviewee No4 is assertive by stating that: "*Car parking is not a selling argument in Gothenburg anymore*" (Interviewee No4, Umbrella housing company, Personal communication, March 3, 2017).

Risks about changes in pricing policy, collaboration with mobility providers and new business models are related with uncertainty and lack of knowledge as well. Interviewee No7 states that co-operation between housing companies and mobility providers has not been tested in an adequate extent. One of the things that we ignore is, whether housing companies set the right kind of demands on mobility providers. What are for example the qualities that a car pool should have? Low price, availability 24/7 or another characteristic (Interviewee No7, Consultancy, Personal communication April 12, 2017). Interviewee No4 thinks that car-pools "are currently quite expensive" and this prevents housing companies from seeking after collaboration with mobility providers. Moreover, another challenge that Interviewee No7 pinpoints is the lack of stability in terms of ownership: "*It is quite common that a construction company builds a house and then sells it quite fast. It is tricky for a mobility provider to survive this transition to a new owner of the house*" (Interviewee No7, Consultancy, Personal communication April 12, 2017). In general, he argues that understanding each other's business model could be a barrier and therefore more research is needed towards this direction.

Drivers

Pressures on the sociotechnical system of urban planning and mobility create windows of opportunity for changes and radical innovation to happen. Below we cite the most important drivers towards a more flexible parking practice.

A bad market for housing companies

There is a consensus about residential parking being under-priced in most of the cases (Interviewee No1, No4, No8, Personal Communication, March and April, 2017). This renders parking market bad business for housing companies. Moreover, municipality dictates the number of parking lots going to be built to the developers, resulting to a surfeit of parking lots.

Interviewee No4 claims that in Frölunda Torg there are empty parking lots and the ones they rent are very cheap. He generalises by referring to a tradition in low parking prices in the city of Gothenburg and his company inability to charge the real cost (Interviewee No4, Umbrella housing company, Personal communication, March 30, 2017). Interviewee No1 states that the company he works for faces the same problem even in more central areas of the city: "Our customers need less cars than expected when they move to a more central location. Housing company No1 have to some extent problems filling up its parking lots due to this". He also foresees that if the new policy (Stadsbygggnadskontoret, 2017) is accepted, this will lead to

less parking lots being built by Housing company No1 (Interviewee No1, Housing company 1, Personal communication April 12, 2017). This expresses that at present developers build under obligation the actual amount of parking lots even if this is not profitable for them.

Housing problem in the city of Gothenburg

Gothenburg is a city with increasing housing needs that cannot be easily met (Savage, 2016). A contradiction between surplus parking and housing shortfall generates questions about better allocation of resources like capitals and land. Interviewee No2 brings this issue into discussion by saying: "*We have a lot of parking spaces and we need to build houses. The biggest question is whether it is possible to build and provide enough housing while continuing to build with high parking rates*" (Interviewee No2, Housing company No2, Personal communication, March 22, 2017). The need to answer the urgent housing demands can be a driver to simplify the parking requirements for a building permission. It can also be a catalyst for "liberating" land dedicated to parking or permit new buildings to utilise existing parking spaces instead of building news. The high selling price or rent of houses and apartments can also be a force towards urban development with less parking. Interviewee No1 is optimistic that: "*people to a bigger extent are more willing not to have parking in favour of cheaper rent*" (Interviewee No1, Housing company No1, Personal communication March 14, 2017).

Megatrends

Sharing economy has been identified as a megatrend and people have gradually started value access over ownership (Burrows, et al., 2014). This is more manifest in younger generations and housing companies seem to have noticed this alteration. As mentioned above, in the barriers, the car fixation is still an issue but young people distance themselves from "the love affair with the car" discourse and they are more willing to share a car with other people. Interviewee No1 believes that: "*Especially younger generations have a less urge to be car owners*" making them more open to car-sharing, bike-sharing and MaaS concepts (Interviewee No1, Housing company No1, Personal communication March 14, 2017). An opinion confirmed by Interviewee No4 who claims that people's age affects their attitude towards alternative mobility solutions: "*It is a matter of generations. Younger generations are more open to this kind of ideas"* (Interviewee No4, Umbrella housing company, Personal communication March 30, 2017).

Uptake of alternative mobility schemes

Besides current trends and a more favourable stance towards sharing economy, alternatives, like car pools, bike pools or MaaS schemes should be available so that tenants can actually try them and decide themselves. Nowadays most of the housing companies have already collaborated with a car pool company to a restricted number of projects. Most importantly, all of them consider new collaborations and are very positive to look for this kind of solutions if the new policy will be implemented. Interviewee No5 states that housing companies want to move towards new mobility solutions and prepare for future change: "*Housing companies have a big interest in bike pools. They are the biggest pushers for future business. Lately the housing companies have been pushing a bit harder than our own company for a collaboration with us*" (Interviewee No5, Bike pool, Personal communication April 4, 2017). Other

developers are even more proactive and look for more holistic and integrated solutions. Interviewee No6 and No7 presented to us the EC2B, a MaaS scheme which can provide integrated mobility solutions through different levels of subscriptions that housing companies will subsidise for their tenants. This platform will also give tenants the possibility to rent their car to their neighbour, making car-sharing even easier. This idea will first be tested in Lund and later to BRF Viva in Gothenburg. These initiatives create new windows of opportunities and motivate other players in the market to seek for similar solutions, otherwise they will be left behind competitors. This configures a landscape that favours heuristic projects and experimentation with radical innovation around mobility solutions.

Housing companies' price policy and fair cost allocation

Housing companies consider moving towards market prices in parking, even though they will probably meet resistance from their tenants. This increase will burden the car owner who rent or buy a parking lot. As soon as the hidden costs of a car – and parking is one of them- come into focus, probably tenants will turn to other solutions, like car pools which do not include hidden costs (Interviewee No4, Umbrella housing company, Personal communication March 30, 2017). Interviewee No5 claims that *"Not only the car but also the bike parking is expensive. A bike pool is a possible solution to both these problems"* (Interviewee No5, Bike pool, Personal communication April 4, 2017). If the hidden costs of the car become transparent, it will probably make people revise their opinion about car pools being expensive (Interviewee No4, Umbrella housing company, Personal communication March 30, 2017) and stimulate a shift towards alternative mobility solutions like car and bike pools and MaaS schemes.

Benefits as motivators

Interviewee No7 contends that an important driver is the vision of an attractive city for everyone: "If we remove the parking space it has to be replaced with something that adds value, like a bike-lane, car-pool etc. It should create value in the city for everyone". Moreover, in the case of less privately owned cars, traffic and air pollution will be decreased which also improves urban life and can act as a driver to limit car ownership and lower the parking rate (Interviewee No7, Consultancy, Personal communication April 12, 2017). Interviewee No4 adds another dimension, the one of convenience: access to a car pool can means access to different cars. Thus, "tenants can acquire different cars for different type of trips" (Interviewee No4, Umbrella housing company, Personal communication March 30, 2017). If we add the unconcern of finding or paying a parking lot, then the convenience of not having a car can also be a driver for less cars and a favour over alternative mobility solutions.

4.3 Step 3: Design scenarios around parking practice

Comparison between the vision for a sustainable transportation system, described in the section 4.1 and the current situation described in the section 4.2 displays a gap between what we would like to happen and what is actually happening. The difference between the two statuses evinces where we should look for solutions to start approaching the desirable future. It also inspired the generation of the following scenarios.

Business as usual (no flexibility and fragmentation)

This scenario aims to depict the current parking situation in Gothenburg both in terms of municipal regulation but also in terms of housing companies' practice. As analysed in the section 4.2.1, Gothenburg's policy around parking can be characterised by high parking rates and less flexibility. More specifically, in a scenario like this, there are no alternatives for lowering parking rates, leaving no space for housing companies to experiment with new mobility concepts and alternative solutions. The main characteristics of the *Business as usual* scenario are the following:

- **Strict parking policy and high parking requirements**
  The number of parking lots that should be provided are clearly defined by the municipal law (Stadsbyggnadskontoret, 2011) and it is not a point in question for the property developers. What can be discussed is the type of parking (garage, underground, open-air or heated parking etc.) and its placement in the plot.
- **Lack of flexibility**
  There is no room for differentiation from the parking regulation. Alternatives such as replacing parking lots with access to car pools or subsidise the subscription to a MaaS scheme cannot change the parking demands set by the municipality.
- **Silo mentality**
  High level of fragmentation in the process of parking planning. Each project is treated separately and factors such as proximity to public transportation and parking vacancies in the area are not taken under consideration when a new housing project is planned.
- **Fragmented research**
  Transportation and urban planning are two different domains. As mentioned at the theory part, research about transportation is disjointed and fragmented with a focus on technological fixes and policy solutions (Sarasini, et al., 2016). On the realm of urban planning things are also similar. Shoup (2011) pinpoints a gap in research about how urban planning, through land-use controls, like parking, can influence travel behaviour.

Hybrid scenario (more flexibility and less fragmentation)

The *Hybrid scenario* stems from the *Business as usual scenario* with some inputs from Business as Usual" approach still exist. The level of flexibility is different though. The municipal policy about parking permits property developer to build with lower parking rates if they provide some alternative mobility solutions. The decrease in parking ratio is not spectacular but it is possible and this is a significant difference compared to Business as Usual scenario. The main characteristics of the hybrid scenario are the following:

- **Less strict parking policy and high parking requirements**
  The number of parking lots that should be provided are clearly defined by the municipal law and the final permission (bygglov) is granted by the municipality, rendering it the only legitimate stakeholder to approve or reject a plan. The parking rates are still quite high but they are expressed not as absolute numbers but as a range between two values, permitting a more flexible implementation of the policy.

- **Higher level of flexibility**
  The policy permits property developers to build less parking lots as long as the appropriate compensatory measures are in place. These kinds of measures can be subsidy of access to a car pool, a bike pool for the tenants or subsidy of a subscription to a MaaS scheme.
- **A trigger for collaboration**
  Municipal policy's relative flexibility sets the stage for collaborations between property developers or housing companies and mobility providers. Although, these collaborations are not well-established they can stimulate new practices in the urban planning market.
- **Fragmented research**
  The research in the areas of transportation and urban planning is fragmented but some researchers have started calling for transdisciplinarity and integration (Russell et.al, 2008, Schwanen et al., 2011). Jones (2012) refers to the "vehicle-based" paradigm that prevails in the transport field and requests a paradigm shift of the agenda in order to incorporate activity and attitude-based perspectives within field of transport research. Banister (2008) emphasises the importance to strengthen the connection between land use and transportation.

Collaborative Scenario (flexibility and holistic perspective)

As presented in the theory part, a need for integration of research perspectives and different types of activities needs to be fulfilled to develop and adopt more sustainable mobility services, like MaaS (Sarasini, et al., 2016). The *collaborative scenario* aspires to answer to that need for integrated solutions and holistic treatment of challenges related to urban development. Its main characteristic is that it requires multi-stakeholder collaborations amongst different actors such as policy makers, the municipality, researchers, housing companies, property managers and mobility providers (public and private organisations). This kind of collaborations do not currently take place but there is a great need to initiate them since it is impossible for one single company or organisation to solve problems like land scarcity, congestion, air pollution etc. on its own. Until now these challenges have been treated in a rather fragmented and disjoint way, both in terms of research and practice (Sarasini, et al., 2016). In this utopian -if compared with the current situation - scenario, the following conditions are in place:

- **Solutions for areas rather than projects**
  It implies a helicopter-view when planning and managing the supply of parking. This allows different housing companies with nearby projects to design and build in common parking spaces and garages, hopefully resulting to less space needed and cost cuttings.
- **Collaboration with parking companies**
  Parking companies comprise part of the planning for residential parking. Their bigger capacity and space allow servitisation of parking, meaning that instead of hiring a specific parking lot (a physical product), the parking company can hire the access to

the garage. This results to less parking needed and savings in terms of space, material resources and costs.

- **Collaboration with mobility providers**
  Emphasis is on mobility rather than on privately owned car and parking. Collaboration with mobility providers such as car pools, bike pools, MaaS schemes etc. allows lower parking rates.
- **A flexible policy**
  A flexible policy allows all the conditions above. The regulation instead of strictly defining the amount of parking lots for each project, allows holistic solutions for areas by taking under consideration the public transportation coverage of the region, the available mobility services like car and bike pools, the land uses in the area (e.g. shopping centres, vårdcentrals, etc.).
- **Transdisciplinary research**
  The research agenda about transportation utilises social sciences by including activity and attitude-based perspectives according to (Jones, 2012) call for a paradigm shift within the field. Except from interdisciplinary research, namely integration across traditional scientific disciplines, there is also integration between researchers and practitioners. They collaborate adopting a needs-driven approach to define shared problems. Behavioural and attitudinal perspectives, multi-stakeholder processes, transition management and sustainability assessment are integrated, allowing a truly transdisciplinary research (Sarasini, et al., 2016).

4.4 Step 4: Finding strategies to move towards a collaborative scenario concerning the parking practice.

The final step of the thesis coincided with the final step of backcasting methodology. The final dialogue with the relevant stakeholders from academia, public and private sector was the most important part of our thesis since it allowed us to create a protected space, a niche where participants had the chance to discuss about expectations for a future parking practice, adjust the vision that was presented by us, experience mutual learning and generate new ideas. Further information is delivered below.

4.1.4.1 Discussion about visions and expectations

After a short presentation of the current situation and our vision for a sustainable future, we elaborated on the three possible future scenarios about parking policy and practice (section 4.3). After that, a forty-five-minutes discussion, took place. There, participants had the chance to challenge the vision presented by us and initiate a very interesting discussion. First of all, a participant claimed that sustainability is a very broad concept and cannot act as an appealing goal. Thus, s/he suggested that refinement of goals and a definition of "the attractive city" should be done to facilitate the dialogue as well as the transition process itself. Another participant stated that it is important to define not only the attractive city but the challenges that we should overcome to move towards a city like this. Furthermore, participants suggested that we should differentiate between tools and goals, when we describe the criteria for an attractive city or a desired future. Specifically, they criticized the goal of "less privately owned cars", claiming that this cannot be the end but the means to achieve another target

such as less congestion. Luckily, there was a consensus about the fact that parking is a tool to change the attractiveness of the city. This can be done in two contrasting ways, a positive and a negative one. First, surfeit of parking deprives the city of walking, cycling and green areas. It also promotes and increases car use which is directly related to problems such as congestion and air pollution. On the other hand, lack of parking makes the city less accessible by car and subsequently less attractive to some citizens and tourists. Hence, there is need to plan in a way that guarantees both accessibility and lack of negative consequences resulting from the car use. After the discussion, we adjusted our initial vision and shaped the new goals of Gothenburg's sustainable transportation system as described in the section 4.1 and are repeated below:

We envision an ecologically, economically and socially sustainable multi-modal transportation system of people in the city of Gothenburg for 2050 which:

- *is accessible to everyone*
- *has zero emissions*
- *is free of congestion*
- *frees / liberates occupied urban spaces for other uses.*

To summarise, the initial goals that we had set, were modified and adjusted according to participants' points of view and perceptions. Adjustment of expectations and visions is one of the main procedures that takes place in a niche level, and it is crucial for two reasons. First, it provides guidance throughout the whole process. Through dialogue, stakeholders gained insights into other participants' opinions, established a common understanding about the criteria of a desired future and agreed upon goals. These goals gave direction and set a common vision for the next parts of the workshop. Second, the participation in goals' formulation and the co-creation of a desired future brought commitment. Participants felt part of the procedure and took ownership of the results generated through it. Hopefully this commitment will last long after the end of the workshop and affect their professional lives as well.

4.1.4.2 Life puzzle exercise: experimentation with radical innovation and networking

The life-puzzle exercise, described in the method part (section 3.2.1.4) combined realistic everyday problems related to transport with innovative thinking and experimentation. The life scenarios were presented in a playful way, so that participants could disengage themselves from the present state and its limitations and adopt a more innovative and "out of the box" way of thinking. Fortunately, the stakeholders dared to "play" with innovative concepts and came up with interesting ideas. One of the groups came up with a "Foodora" type grocery delivery. They envisioned a sustainable friendly grocery delivery company which offers to its customers the possibility to choose grocery from local supermarkets and grocery stores, place an order to company's digital platform and get the grocery delivered to their home. The same group came up with the notion of a personal drone that will replace routes for good deliveries. They suggested that characters in "Life starts after retirement" scenario can use the public transport and a carpool to eliminate the need for a private-owned car. In contrast the "Elvis is alive" group suggested that the character should keep his car since it is an important part of his identity. This choice was not made without argument in the group. But as (Geels, 2012)

claims one of the procedures that take place on a niche level is the learning process about symbolic meanings.

Equally important to the generation of new ideas and experimentation with radical concepts is the social networking that is taking place in a protected space such as our workshop. In the university and more specifically in Challenge Lab, students' independence creates a safe and neutral environment which promotes openness and trust amongst participants. By collaborating to find solutions to problems, like they did in the life-puzzle exercise or by discussing the challenges of parking practice and policy, they understood other professionals' drivers, barriers and mindsets. This way stakeholders expanded their professional network and maybe planted the seeds for a future collaboration.

4.1.4.2 Steps towards a Collaborative Scenario

As described above (section 4.3) three scenarios concerning parking policy and practice were presented to the participants: business as usual, hybrid and collaborative scenario. Although the participants in the dialogue did not explicitly chose one of the three scenarios (the possible reasons for this are explained in the Discussion Part), they were in favour of the third one, the collaborative scenario. Thus, when they had to suggest steps towards a more sustainable parking practice and policy, they came up with solutions that require co-ordination amongst many actors from public and private sector as well as academia. The proposed solutions can be divided in four main clusters:

- Policy
- Financial measures
- Provision of solutions & alternatives
- Research

Policy

On a policy level, most of the participants perceive the changes that are needed to be done, in terms of municipal parking regulation. They envision a parking norm which still defines the parking ratios in city's different areas, but it also allows less parking lots if there are the necessary conditions. Thus, the need for a **flexible parking norm** is generally accepted. What is not yet well-defined or agreed upon is the level of flexibility. There is not consensus about what should be the minimum parking requirements, or if they should exist at all. Nevertheless, all the participants have identified the need to distance ourselves from the current parking policy, with the high P-ratios and the lack of alternatives. They identify a correlation between high parking requirements and low prices of residential parking. In that sense, some of the financial measures that they proposed, and they will be elaborated below, are closely related to policy level as well.

Financial measures

Most of the participants admit that the parking is subsidized and petition for a change in municipal policy and in housing companies' pricing policy. One of them claimed that we should "make the parking cost visible" and one way to do that is to stop allocate the parking cost to every tenant and instead **rise the parking prices** for those who use the parking. The

participants ask for "***demand driven***" and "***market based***" parking pricing, meaning that the amount of parking lots per housing project and consequently their price should be defined by the law of supply and demand and not by the municipality. They find no reason to regulate the parking market and they claim that the market itself will fix the parking prices. One of them challenged even more the current status quo and suggested to impose **tax on parking**. It is an interesting suggestion that did not discussed or analysed further so that the rest of the group could take a stand. However, it contradicts with the next category of suggestions which prioritises incentives over deterrents.

Provision of solutions & alternatives

One of the participants claimed that there is a fixation with the problems and less focus on solutions. He suggested that instead of concentrating on how to hinder car use and ownership, we should provide those possibilities and solutions that will make alternatives to car ownership attractive and easy. Thus, improved mobility services were a catholic demand made by all stakeholders. Half of them specifically mentioned, that development of **public transportation** is a key step. By better transportation most of them mean a more extensive public network with more nodes and better coverage throughout the whole area of Gothenburg. Others focused on more **shared vehicle solutions**. They envision a future where "mobility needs are met via shared and electrified vehicles". In that concept the role of MaaS "in terms of coverage and availability of alternative transport modes or ownership models" is considered critical. But even less integrated solutions like single car- and bike-pools and increased car efficiency through car-sharing are seen as a way to gradually transform people's behaviour. Other solutions like **sheltered and lockable bike storage** and **digital information boards** with tram and bus timetables in the entrance of buildings are measures that participants from housing companies have already started applying. They consider them as compensating measures for less parking lots and a practise that should be rippled. Another pattern that came up from many participants is the one of **densification**. They stated that a denser city is a more accessible city where the need to own a car is reduced. They also require higher density in terms of housing. Specifically, one of the participants suggested that the number of inhabitants per apartment should be increased and the average square meters per tenant should be decreased. Finally, only one of the participants addressed the need to manage **deliveries of goods** on a local level. This can be seen as only a holistic solution which can increase efficiency and decrease the number of trips.

Research

Many of the issues discussed in the dialogue belong either to the realm of radical innovation (e.g. MaaS) or disrupt the common practice (e.g. flexible parking norm). The uncertainty in both cases, stemming from the lack of experience and knowledge, makes some participants to petition for more research. Specifically, one of the participants referred to the need to **monitor and evaluate mobility solutions** while another demanded "scientifically sound **evaluation of housing** with less parking, combined with mobility services". The latter participant also called for **more funding, good case studies** and **control groups** for research.

5. Discussion

In this chapter, the three level of Multilevel perspective and mainly niche level activities are discussed. The results of the thesis are analysed in relation to theory. Last, we elaborate about uncertainties and limitations of the thesis.

Landscape level

Globally, issues related to climate change are part of a public agenda and hence there are stronger political incentives to take counteractive measures. Furthermore, there is a rapid urbanisation trend in the world which in combination with car use aggravates air pollution in several cities. The use of the car is connected both to climate change and air pollution, making it a relevant political topic especially in dense cities. For example, both European Commission and the Swedish Transport Administration, trough reports about future transport strategy recommend a decrease in car use within cities and instead favour other types of mobility solutions such as public transportation and biking. However, EU's and Trafikverket's reports have a consultative role meaning that they do not have the mandate to impose measures. In terms of actual regulations, there seems to be a gap to the latest research and trends and the policy.

Regime level

The urbanisation in Sweden has contributed to high housing prices in most Swedish cities, Gothenburg included. However, the lack of land is not the only critical factor for an increase in prices. Housing companies' unwillingness to construct housing on less attractive urban ground, makes things worse. Nevertheless, there is a trend in Gothenburg to densify and make the city more attractive. This creates incentive to limit the number of both cars and especially parking lots within the city since they take up space, create noise and pollute. The upcoming parking policy in Gothenburg allows for parking ratios reduction, if sustainable mobility solutions are provided. This policy trend can be seen in several other cities, both in Sweden and abroad. The housing companies also seem to be in favour of this policy change, because it will permit them to build more apartments and less parking, which will be a more profitable business. Finally, in a regime level, two antagonistic trends co-exist: love affair with the car and the rise of sharing economy which values access over ownership.

Niche level

In the theory part of our thesis, in section 2.1, a niche is described as a protected space where three main processes take place: adjustment of expectations and visions, learning processes and building of social networks. The outcomes of these procedures can be a shared vision, radical innovation and coalitions, alliances and transitions arenas (Geels, 2012). In this thesis, we focus on what type of niche level activities can promote a systemic change in Gothenburg.

Lack of a common vision

Based on the results from the interviews, the survey and the dialogue, we identify a lack of common understanding of the challenges related to mobility and urban planning. The discrepancy between actors is tremendous in some cases. For example, all the interviewees

argued that residential parking is subsidised and the car owners pay less than they should to park their car(s). Parking in not a profitable business for housing companies and some of them aspire to move towards market prices. On the other hand, 90,9% of the respondents in the survey consider residential parking in Gothenburg to be expensive and an almost equally high percentage of tenants believe that parking prices are defined by the market (section 4.2.2). This discordance between tenants and housing companies' steering groups results to misalignment within companies' workforce too. Some participants identify a gap between policy makers and civil servants' practice and vision (section 4.2.3). They stated that there is the political will to be proactive in terms of parking policy but civil servants at the architecture department have their own mindset, culture and interpretation of the municipal law.

Absence of a common understanding results to lack of a general accepted vision. Further below we give some examples to support this statement. A future with less privately owned cars is implied in Gothenburg's environmental strategy according to which the carbon dioxide emissions from road transport should be decreased by 80% compared to 2010 levels, by 2030 (City of Gothenburg, 2014a). A similar vision is described in Gothenburg's transportation strategy, where more sustainable transport modes are promoted over car. During the interviews and the dialogue, we also identified a lack of common goals concerning parking practice and mobility plans even amongst people of the same company. The willingness to move towards a more flexible parking practice which will include mobility solutions is an abstract plan rather than an articulated vision. As for the removal of minimum parking requirements that was brought up both during the interviews and the dialogue, no stakeholder took a clear stand. In general, we could not identify a common vision about a desirable parking policy or what an attractive city is, amongst the stakeholders. But there was a consensus about the fact that parking is a tool to change the attractiveness of the city.

The need for a collaborative scenario

During the dialogue, three scenarios around parking practice were presented (section 4.3). From the discussion, it became clear that participants' understanding of the current state resembles. All of them seemed to agree that we are closer to the *Business as Usual* scenario where the parking policy is strict and there are no alternatives for lower parking rates. One of the interviewees stated that they, as a property management company, want to collaborate with mobility providers in order to reduce the amount of parking lots which they build but they are not in control of this issue. In general, most of the stakeholders stated that they do not have the dissertation to affect things inside the scope of their business role, which creates them a sense of impotence and inflexibility. However, the under review new parking policy seems to shift the current status quo to the *Hybrid* scenario since it permits property developers to build less parking lots as long as the appropriate compensatory measures are in place. As compensatory measures, the regulation defines the proximity to public transportation nodes, the subsidy of access to a car pool, a bike pool for the tenants or subsidy of a subscription to a MaaS scheme. Even with the *hybrid* scenario most of the participants feel restrained since they still cannot decide themselves for the number of parking lots that they construct. Moreover, the reduction in parking rate depends on factors that they have no control of, like the public transportation coverage. In *hybrid* scenario housing companies'

interaction with parking companies, mobility providers and researchers is still very weak. For these reasons, a desire to move to a more collaborative scenario was manifest during the dialogue.

Learning processes

Participants in the dialogue agreed that there is a need to change their current practice and all of them expressed their intention of interacting and collaborating more with relevant stakeholders in the future. One of them mentioned that there is need for more research that will provide housing companies with compelling arguments and sound reasoning useful in the decision-making process. The answer to that came from another participant who argued that we do not need twenty years of research before starting doing things. The knowledge is already available, therefore housing companies and mobility providers should not be reluctant to try things because of the fear to make mistakes. Researchers highlighted the need for good case studies, control groups and generally monitoring and evaluation of mobility solutions. Thus, research and practice should be done simultaneously since they cross-feed one another. To share knowledge, follow up on research and gather data is very time-consuming. Participants in the dialogue claimed that it is easier for them to come to workshops- dialogues like the one held in Challenge-Lab and learn through participatory processes. Their claim coincides with (Isaacs, 1999) who considers stakeholder dialogues to be a tool for organisational learning since it promotes collective thinking and uncovers the hidden potentials in any situation.

Networking

As has already been mentioned, during our thesis, academics and researchers involved in the field of mobility, professionals from housing companies and mobility providers were initially interviewed and then brought together to exchange their points of view and experiences as well as experiment with new concepts and innovative ideas. All these took place in a neutral environment, in Challenge Lab arena, run by students with no dependences on companies or pre-existing agendas. The fact that the interviews and the dialogue were held by students rather than professionals, made the whole process less stressful and more playful. It created a safe environment where stakeholders felt comfortable to express themselves and experiment with ideas. These circumstances enable learning, facilitate network building and plant the seeds of possible future collaborations. One of the participant stated in the dialogue, that in his/her housing company, they are very effective in building property but going out of their offices and meet others, like they did in our dialogue is not something that they are used to. In short, we have identified participants' interest about testing projects, collaboration and network building activities like the dialogue that we conducted.

Indeed, our thesis contributed to this direction by providing a protected space for dialogue and bringing together actors that ordinarily do not meet. However, this thesis is a time-limited project that can only be seen as an instantiation of what should happen in a niche-level and not as a niche-level activity on its own. There is need for continuity in these processes in order to facilitate the transition to the collaborative scenario. Therefore, an environment which can facilitate networking, dialogue, experimentation and the establishment of a common vision

should be created. Similar findings exist in other case studies in Gothenburg. Actors involved in the field of mobility request more pilot projects where new ideas will be tested for shorter periods of time and they either succeed or change (Sarasini & Langeland, 2017). They ask policymakers to act proactively by fostering openness and bringing all players together: *"Everyone wants to be the best, and everyone is trying to attract the same customer. […] It would be for the best if all players could connect to a single ecosystem according to their own needs. […] If I was a politician, then I'd invite all the different players, try to get the conversation going".* Thus, it is not surprising that similar attitude characterises the stakeholders that took part in our thesis. This allows us to talk about a general need for communication and networking.

Networking beyond Gothenburg's bounds

As we have already make it clear, our research shows that within Gothenburg there is need to move towards a more collaborative scenario. However, it would be beneficial for the transition process if these types of networks extended beyond city's bounds into broader coalitions such as European MaaS Alliance. The need for an entity which would have a helicopter perspective to define what the framework of MaaS should be in a European level gave birth to European MaaS Alliance in 2015. It is a public-private partnership consisting of four working groups which focus on: ① MaaS single market deployment, ② user needs, ③ regulatory issues and ④ technology (The MaaS Alliance, 2015). MaaS Alliance aspires to link niche-level activities to an emergent community of frontrunners who want to bring about regime change. It is open to everyone who would like to be part of developing the MaaS framework in Europe (ERTICO ITS Europe, 2016a). It can also be a platform where investigation on how market and non-market strategies can bring legitimation to new business models, takes place.

The Ertico - ITS Europe is a public-private partnership consisting of more than one hundred partners across eight different sectors (vehicle manufacturers, mobile network operators, public authorities, research, service providers, suppliers, traffic and transport industry and users), all working together to develop and deploy intelligent transport systems in Europe. To reach coalition's goals which are to strengthen the competitiveness of the industry and optimize services for the user, the Ertico partnership aims to marry the interests of public and private stakeholders (ERTICO ITS Europe, 2016a). Every year it organises either an ITS World Congress which rotates between Europe, the Asia Pacific and the Americas or an ITS European Congress. According to the congresses hosts, participants have the ideal opportunity to network, be part of initiatives and develop their own business after being informed for the state of the art ITS solutions (ERTICO ITS Europe, 2016b). The Managing director of CUBIC ITMS, Chris Bax claims that "*Being an Ertico partner gives us real strong access to the political makers and the opportunity to tell them how we can help to make people's journey simpler"* (ERTICO ITS Europe, 2016a).

In the case of housing companies, which consider rules and regulation to be the most important barrier (section 4.2.3) to a transition towards the collaborative scenario, the abovementioned statement can be a stimulus for taking part in a transition arena like MaaS Alliance or Ertico. According to dialogue participants, "legal aspects are blocking the advance"

and these are the main limits and restrictions that they identify in their everyday life as professionals. As one of them wrote: "I do what I am obliged to. I can do what I am allowed to". To join a coalition is something proactive and innovative but not radical in the sense that contradicts one's business role and limits. Housing companies should be part of a mobility transitions and therefore join with other stakeholders to co-define the desired future and work for it.

Uncertainties and limitations

As mentioned in the method part, we conducted a semi-structured interview with 12 professionals from housing companies, mobility providers, consultancies, research institutes and academia. Half of them joined our dialogue together with other four stakeholders, who we have met earlier in the process but never conducted an appropriate interview. In total, we managed to get input from 16 people. We recognize that this is a small sample group and we suggest that the reader should not extrapolate for a larger population of managers or researchers. Moreover, this thesis focuses on housing companies and therefore most of the stakeholders were property developers, managers or responsible for strategic planning of their company. On the other hand, the role of legislation and the barriers that the regulation creates were topics that came up many times. For this reason, we unsuccessfully tried many times to approach the urban transport administration of Gothenburg, but lack of interest or time constraints of their behalf impeded this collaboration. We consider that their participation would add value to our thesis and their absence is an important limitation that should be taken under consideration.

Another noteworthy point to acknowledge during the communication with stakeholders is the assumption that they fully expressed their perspectives on the discussed issues. We rely on the fact that we are students who tried to create a safe and open environment, and always assured stakeholders of their anonymity. As neither their names nor their company's or organisation's name are mentioned, we take as granted that they expressed their frank opinions and they did not embellish the current situation or exaggerate about their willingness to take part in a transition towards a more sustainable future. However, we are not experienced in taking interviews and conducting workshops. A more skilled or experienced interviewer may have managed to acquire more information. Related to this, the interviews were conducted in English, no one's native language. This may have hindered the communication or prevented complete disclosure of participants' points of view.

Finally, there are two other important limitations concerning the scope of this thesis. The first is the focus on Gothenburg. All the stakeholders that we communicated with, the survey that we conducted and the regulations that we studied pertain to Gothenburg and to city's citizens. For example, only people from one neighbourhood answered the survey and we cannot hypothesise that answers would be the same in other areas or cities. The outcome of this thesis relies on local conditions and cannot freely be extrapolated for other cities. Moreover, the focus of the thesis is on residential parking and the role of housing companies. Other types of parking, such as municipal curb parking, public garages, parking in malls and commercial centres as well as parking in the workplace and the role of employers were slight touched upon. The reason behind this decision was our intention to delve into housing

companies' potential to stimulate a transition towards sustainable mobility solutions and do a more targeted research. Nevertheless, a future study which will include more factors and actors in the parking equation can have a valuable contribution to parking and mobility related challenges.

6. Conclusions and Implications for Governance

This thesis sought to address the following research questions: How housing companies can stimulate a transition towards sustainable mobility solutions. The findings show that sociotechnical systems of transportation and the related to that, parking system are robust with stabilisation characteristics and resistant to changes. The most important barriers to change according to this study's participants are: ① rules and regulations which block advance, ② lack of common mindset and vision amongst stakeholders, ③ shared beliefs such as the fixation to car ownership and the consideration of cheap parking almost as a civil right and ④ hesitation to take initiatives because of the risks that ignorance about customers', competitors' and state's reaction bears. Even though there is not a common vision about how a sustainable transportation system and a residential parking practice look like in a desired future, participants do agree that we are between a *Business as Usual* and *Hybrid scenario* (section 4.3) and they aspire to move towards a more collaborative scenario.

The contribution of this thesis is that it has identified niche level activities that could and probably should happen in order to move towards the *collaborative* scenario. Rather than being general in terms of who is responsible to do what, we focus on housing companies and their potential to act proactively. We account them as change agents, willing to take part in the governance of a transition towards sustainable mobility solutions. Thus, in order this transition to take place there is need for certain steps/prerequisites/conditions/ initiatives/ measures etc.

- First, there is the need for a **common vision**. Housing companies should articulate a common idea and set the criteria for their mobility strategy since expectations and visions offer direction and guidance to the internal innovation activities. The more participatory the procedure of creating the vision is, the easier they will tackle the challenge of different mindsets and misalignment amongst their employees (see barriers in section 4.2.3). However, a common vision will be stronger if it is co-created by stakeholder beyond company's limits. For this kind of process, broader networks and alliances are necessary (we refer to them further below).
- Secondly, housing companies should start acting proactively and **experiment** with new concepts and trialability programs. Low risk trials will give tenants the opportunity to try and decide themselves for the mobility services which suit them best. According t (Strömberg, et al., 2016), travel behaviour changes can be supported by trial enabling as long as the trzials are carefully designed to guide the participants through the whole process from testing to adoption. Housing companies should ponder over important aspects such as the duration of the trial, the type of support offered and the recruitment criteria (Strömberg, et al., 2016). However, participants from housing companies are discouraged by the uncertainty and lack of research that can ensure the success of different measures. Innovative practices are accompanied by uncertainty but if they are "supported by more actors and receive more resources, they have

higher degrees of momentum" (Geels, 2012), p.475. This leads us to the next recommendation, the need for broad networks and coalitions.

- Niche level activities, like the ones suggested, can be better served and supported within **broader networks** and transition arenas. Participants in our dialogue expressed the need for discussions and network-building activities like this. Transition arenas and alliances can act as incubators for new collaborations and innovative projects for housing companies. Moreover, especially networks that include powerful actors add legitimacy and bring more resources to niches. This way, housing companies have more chances to affect policy-making process and bring about a change in institutional level. Thus, their participation in local, European or global coalitions is suggested. Examples of such coalitions are given in the discussion part (section 5).

Finally, housing companies should guarantee a continuity for the procedures mentioned above, such as adjustment of their vision, demonstration programs and building of networks. Development will be brought gradually, therefore housing companies' vision and practice should be "periodically adjusted in development rounds" and reassessed at regular intervals (Rotmans, et al., 2001). As a researcher argued "there is a lot action without research and a lot research without action". Monitoring, evaluation and reflection of housing companies niche level activities is something that should happen systematically in order to facilitate double loop learning and guarantee the benefits stemming from it.

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Appendix

A1 Table of interviewees

Interviewee	**Role**	**Company**	**Date of the interview**
Interviewee No1	Operations developer	Housing company No1	14/03/2017
Interviewee No2	Property development coordinator	Housing company No2	22/03/2017
Interviewee No3	Project director 1	Property mgmnt company No1	23/03/2017
Interviewee No4	Expert in housing & city development	Umbrella housing company	30/03/2017
Interviewee No5	Owner	Bike pool	4/04/2017
Interviewee No6	Architect & Research strategist	Property mgmnt company No2	7/03/2017
Interviewee No7	Traffic consultant	Consultancy	12/04/2017
Interviewee No8	Project director 2	Property mgmnt company No1	12/04/2017
Interviewee No9	Project Manager	Property mgmnt company No3	13/04/2017
Interviewee No10	Project director	Housing company No4	18/04/2017
Interviewee No11	Strategic Business developer	Parking company	19/04/2017
Interviewee No12	International business developer	Car pool company	20/04/2017

A2 Interview Questions

1. Please give a brief overview of your organisation, its operations and your role within it.

- How many apartments do you own?
- How many registered members / tenants do you have? Try to understand the future. Parking problem or solution

2. What would you characterise as your main product or service?

- How important is the provision of parking space/service for your business (model)?
- Bike parkings?
- How important is a sustainable profile for your business and your customers? Is it a priority?
- What is your current business model looking like now? (e.g. provision of physical parking space or access to a parking).
- What kind of parkings do you have (underground parkings, heated parkings, private parking lots,etc.)? Why?

3. What types of customers or users currently use your parking lots/ parking services?

- Households, businesses/firms, both?

4. How do you define the parking prices?

- What is the average price for building and maintaining a parking lot?
- How this cost is allocated (car owners/users, other tenants, future users etc)
- Do you think that users pay the marketing cost (real cost) of their parking?
- What are your main costs and revenue streams in parking area/business? (cost structure)
- Behaviour change is recognized as one of the most important barriers. Do you aim at moving towards real-cost/ marketing parking prices? If yes, how are you going to do this, if people think that they are overcharged?

5. How do you think a change in residential parking prices will affect car ownership and attractiveness of alternative mobility services? (enquire the scenario of lower parking rates and price raise).

6. Would you be interested in partnering with an alternative mobility provider (car sharing company, a bike pool provider or MaaS provider)?
(Would you be interested in partnering with a house company?)

- Have you done it already?
- Do you plan to do in the future?
- What are the most important barriers and drivers for a collaboration like that?
-

7. How do existing policies and regulations affect the way property developers build parking lots within new residential buildings?

- How do they influence travel behaviour amongst individuals?

8.In your opinion, what are the most important barriers and drivers for lower parking rates. (regulation, attitudes,etc)

- In what ways do you think that the lower parking requirements benefit the urban development?
- What are your thoughts about removing minimum parking requirements? Do you see any benefits/problems? What are the main barriers/ drivers?

9. What do you think Gothenburg's municipality can/should do in order to promote sustainable mobility solutions?

- How can the parking policy act as a leverage point towards this direction?
- How the municipal parking regulation can facilitate a collaboration between property developers/housing companies and mobility providers?

10. How do you think that sustainable mobility technologies, like BEVs, HEVs and biofuel will affect the parking landscape?

- Are you prepared for e-vehicles diffusion?
- How could you better prepare yourselves in terms of infrastructure?
- Do you see any beneficial collaborate on with energy sector for example?

A3 Interview guide on parking policies

Introduction to study
This study is performed as part of our Master's Degree thesis project conducted in Challenge Lab (Click here for more information) in Chalmers University of Technology.

In this thesis, we will carry out an analysis of two key areas: mobility services and parking regulations with a focus on the city of Gothenburg. We will research factors that influence the development and application of parking policies which foster a less car-dependent future.

This study is designed to generate knowledge regarding the following research aim: What is the role of P-regulation in stimulating a transition towards sustainable mobility solutions.

Car-sharing initiatives and other innovative business models are already disrupting the transport sector. Urban developers in Gothenburg try to face the shortage of land in order to respond to the increasing demand for housing. Simultaneously, a new more flexible parking policy is currently on referral. The project will carry out interviews with relevant stakeholders (housing companies, mobility providers and policy makers) and benchmark against other cities aiming to examine ways to substitute parking spaces while stimulating a transition towards sustainable mobility solutions. This will enable the development of business model innovations and identification of drivers and barriers of this transition.

More specifically, the anticipated results of the thesis project are a parking policy proposal for interested housing companies. This thesis will also help policymakers to facilitate a change in the parking landscape. The whole thesis will be publicly available through Chalmers library, during summer 2017.

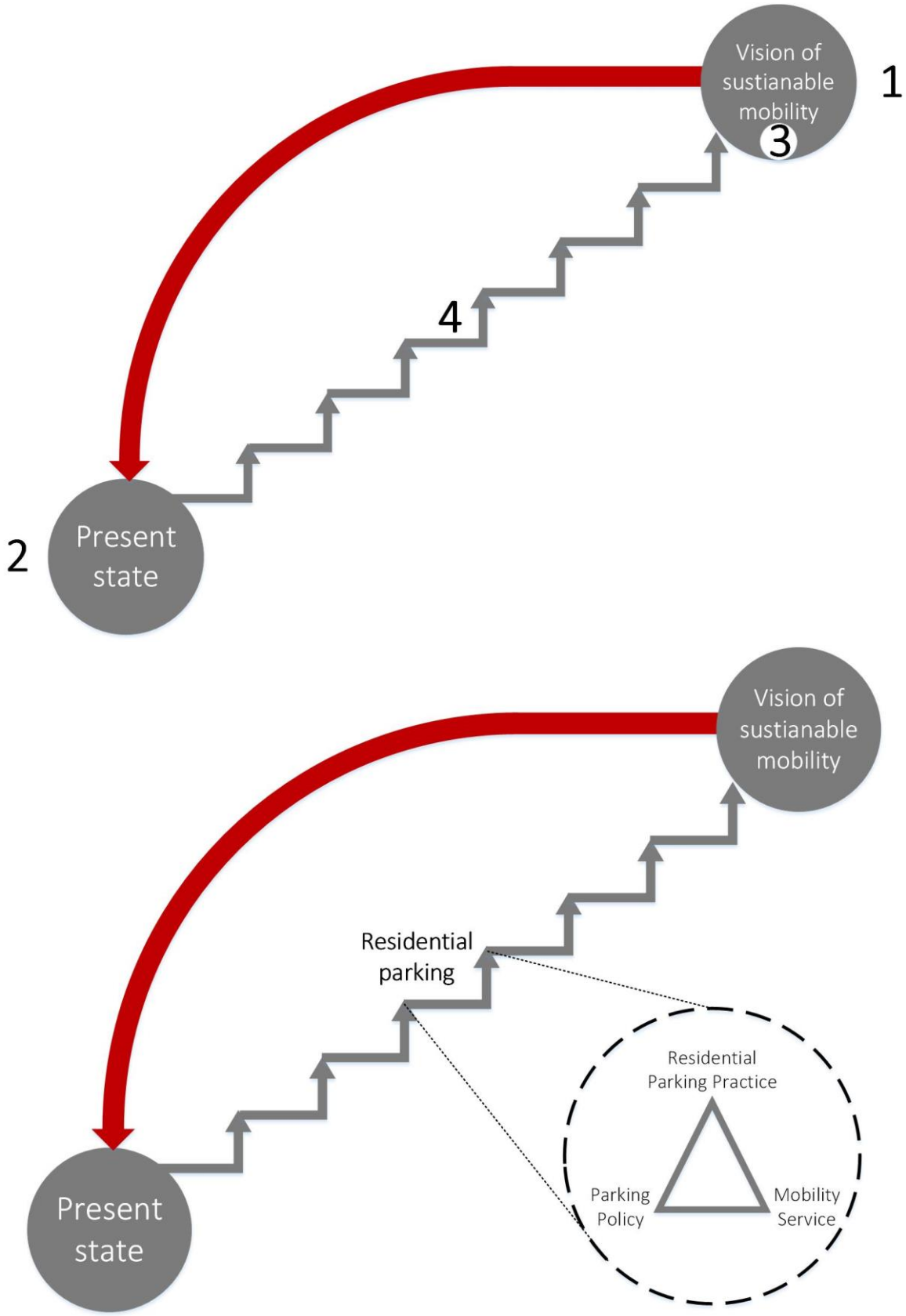
Methodological ethics and guidelines:
The project will be conducted in accordance with the code of ethics for international social science research. All data and information collected will be treated confidentially and we will anonymise the identities of all respondents and companies in any published materials.

Our study aims to address the following research questions:
What is the role of P-regulation in stimulating a transition towards sustainable mobility solutions?

- How can P-regulation impact or enhance sustainable transitions in urban mobility and decrease car ownership and car use?
- What are the drivers and barriers to a transition towards a parking practice with lower parking rates?

A4 Visualisation of the backcasting methodology

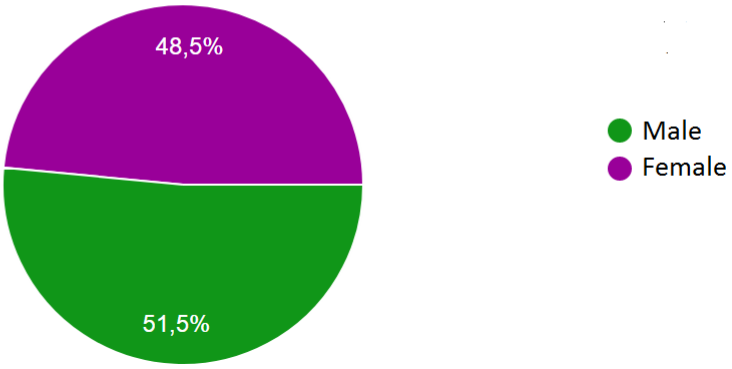
Presented in the beginning of each interview.



B Survey

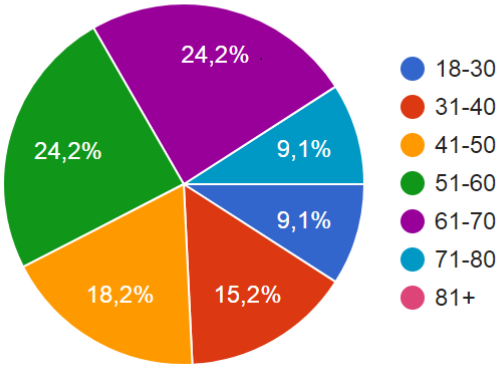
What is your sex?

33 svar



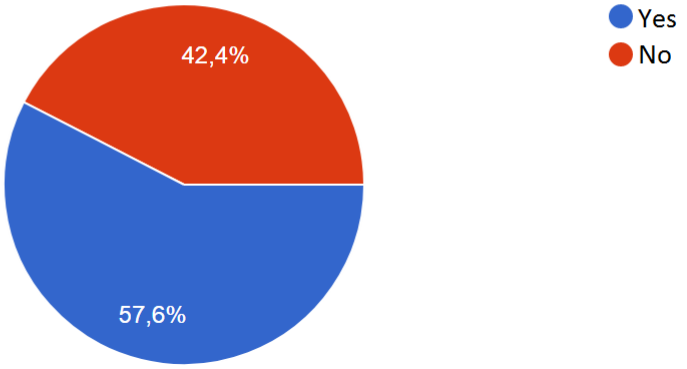
How old are you?

33 svar

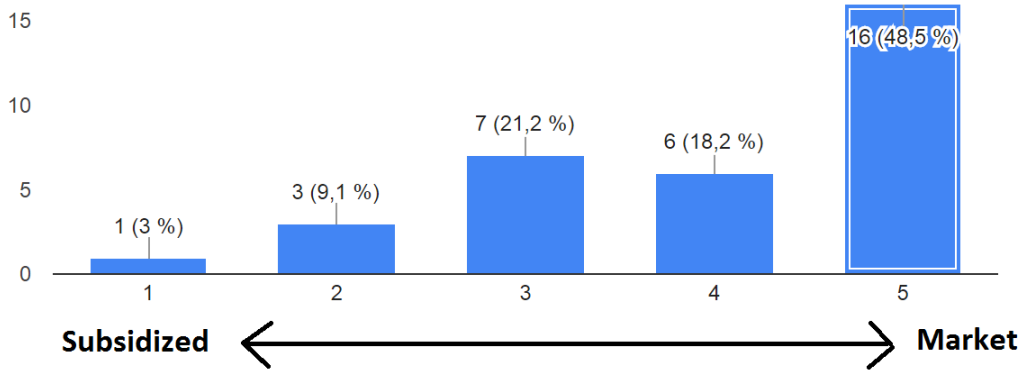


Do you own a car?

33 svar

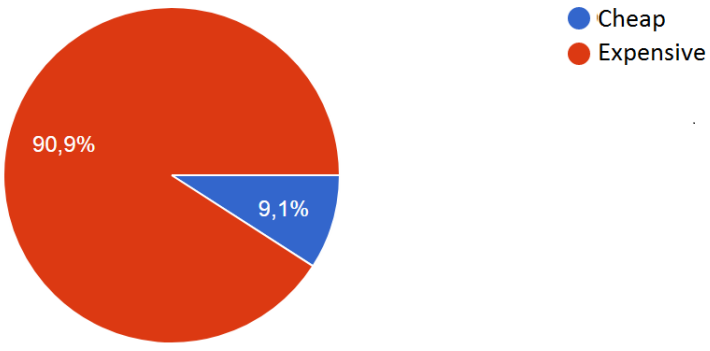


Do you think that the price for parking is subsidized or defined by the market?



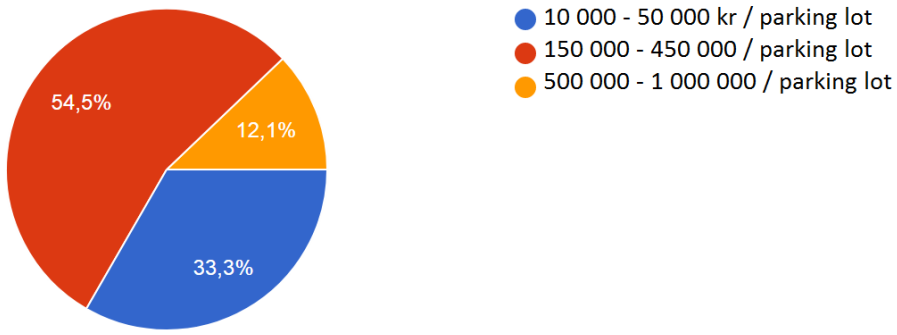
Do you regard the price for residential parking in Gothenburg is cheap or expensive?

33 svar



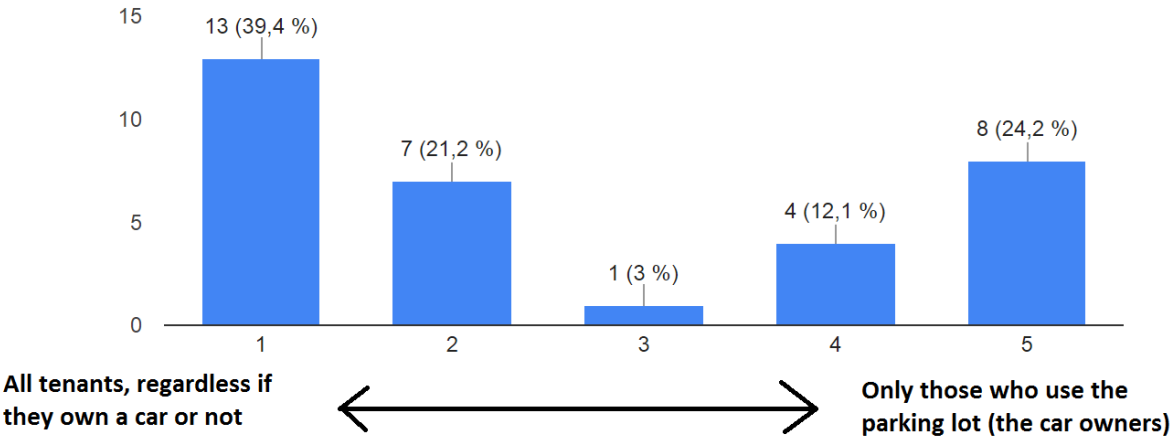
What do you think that the average cost is for construcing a residential parking lot in Gothenburg?

33 svar



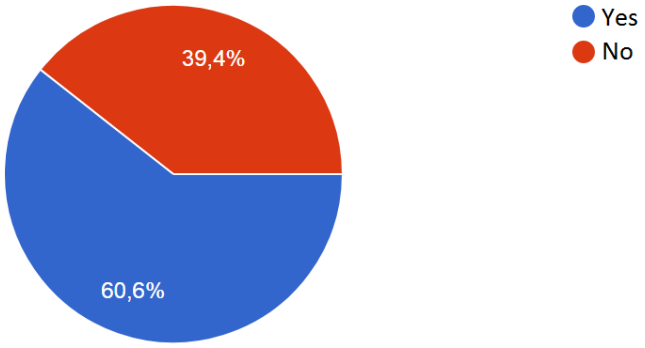
Who do you think is paying the cost for the construction of residential parking?

33 svar



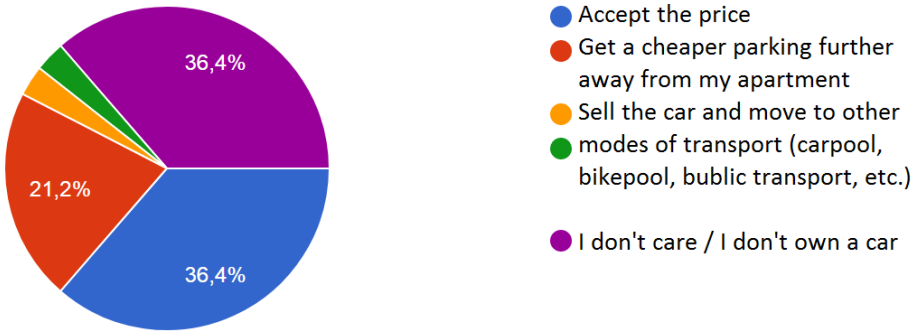
Is the residential parking price something which affects your choice of owning a car or not?

33 svar



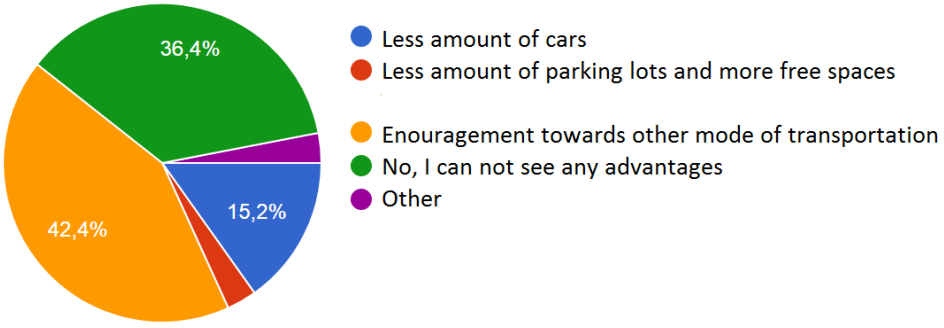
How would you react on a price increase for residential parking?

33 svar



Can you seeany advantages with an increase in rent for residential parking?

33 svar



C Survey-questions in Swedish

Kön

- ○ Man
- ○ Kvinna
- ○ Annat

Ålder *

- ○ 18-30
- ○ 31-40
- ○ 41-50
- ○ 51-60
- ○ 61-70
- ○ 71-80
- ○ 81+

Äger du en bil? *

- ○ Ja
- ○ Nej

Tror du att priset för parkeringsplatser är marknadsmässigt eller subventionerat? *

	1	2	3	4	5	
Subventionerat	○	○	○	○	○	Marknadsmässigt

Anser du att priset för en bostadsparkering i Göteborg är billigt eller dyrt? *

- ○ Billigt
- ○ Dyrt

Vad tror du att den genomsnittliga kostnaden ligger på för att bygga en bostadsparkering i Göteborg?

- ○ 10 000 - 50 000 kr / parkeringsruta
- ○ 150 000 - 450 000 kr / parkeringsruta
- ○ 500 000 - 1 000 000 kr / parkeringsruta

Vem tror du betalar kostnaden av att bygga en bostadsparkering? *

	1	2	3	4	5	
Alla hyresgäster, oberoende av om dom äger bil eller ej	○	○	○	○	○	Endast den som använder parkeringsplatsen (bilägaren)

Är priset för en bostadsparkerings något som påverkar om du vill äga en bil eller ej?

- ○ Ja
- ○ Nej

Hur skulle du reagera på en prisökning för bostadsparkering? *

- ○ Acceptera priset
- ○ Skaffa en ny billigare parkering längre ifrån min bostad
- ○ Flytta till ett nytt område
- ○ Sälja bilen och gå över till andra transportlösningar (bilpool, cykelpool, kollektivtrafik etc.)
- ○ Jag bryr mig inte / Jag har ingen bil

Kan du se någon fördel med en ökad parkeringsavgift för bostadsparkering? *

- ○ Färre antal bilar
- ○ Färre antal parkeringplatser och mer fria ytor
- ○ Uppmuntran till andra transportsätt
- ○ Nej, jag kan inte se några fördelar
- ○ Övrigt ...

D Life Scenarios for Exercise one - Dialogue

Exercise 1: (15 minutes)

The Svenssons

Svenson Family: John and Hanna have twins, Lovisa and Gun. Hanna works at Chalmers as a professor and John is chef at the Student Union ‘s restaurant. The girls are six years old and next year they will go to elementary school. Soon they will move to Doktor Allards Gata 25.

Needs:

The twins attend karate classes every Monday and Wednesday in the city center.

Hanna plays beach volley in Kviberg’s sport center every Wednesday.

John just bought a cello and he has cello class every Tuesday. He is the responsible for the grocery shopping.

Every weekend the whole family visits grandparents in Kungsbaka.

Questions:

- What should they do with their Volvo? Should they take it with them to their new appartment?
- What needs to be in place in order Svenson family to sell its Volvo? (See the toolkit)
- How they will handle/address their transportation needs then?
- How it will affect their budget?

Exercise 1:(15 minutes)

Elvis is alive!

Niklas Axelsson (Elvis for his friends) is a middle-aged singer who sings in a rock n' roll pub in andra långgatan. He lives alone in Hjälbovägen 40 in Hamarkullen and his girlfriend, Helena, lives in Borås. He is a vinyl collector and he exercises a lot.

Needs:

Commuting to the rock n' roll pub three days the week????

At least twice a week, he tries to meet Helena, either in Gothenburg or in Borås.

Often during the weekends, he goes to Majorna to his favourite record store to "fish" new vinyl disks.

Questions:

- What should he do with his old cadillac? Keep it or sell it?
- What needs to be in place in order Niklas to sell his Cadillac? (See the toolkit)
- How he will handle/address his transportation needs then?
- How will it affect his budget?

Exercise 1 (15 minutes)

Life starts after retirement!

Peter and Ula is a young in soul couple! They live in a four room apartment in Askim with their evil cat. They have three children who live on their own and they recently discovered salsa, wine tasting and the endless possibilities of internet!

Needs:

Going to salsa and wine tasting classes at Majorna every weekend.

Going to the city centre for shopping during the week days.

Visiting their children every now and then.

Going Drakoumel (the cat) to the veterinarian twice a month.

Questions:

- What needs to be in place in order Peter and Ula to give their Volvo to their children? (See the toolkit)
- How they will limit/handle/address their transportation needs then?
- How it will affect their budget?