



CHALMERS
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Implementation of Carpool in New House Construction

A study questioning the parking ratio regulation in Gothenburg

Master's Thesis in the Master's Programme Design and Construction Project Management

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Department of Civil and Environmental Engineering
Division of Construction Management
CHALMERS UNIVERSITY OF TECHNOLOGY
Master's Thesis BOMX02-16-152
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Examensarbete BOMX02-16-152/ Institutionen för bygg- och miljöteknik,
Chalmers tekniska högskola 2016

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ABSTRACT

Gothenburg city is today working with the challenge to develop a sustainable city and transportation system, where space and resources are used in an optimal way. This raises the discussion of new ways of designing the urban structure. A sustainable city needs to reduce car usage and integration of sustainable mobility solutions is needed already in the planning phase of new dwellings. The aim of this study has therefore been to investigate carpool as a mobility solution in new house construction.

The process has included literature research, interviews, calculation comparison and execution of a survey. During the research, it was found that implementation of carpool in new house construction, in the central part of Gothenburg, is beneficial since it contributes to the sustainable development. But it is not easy to implement because the parking ratio regulation requires a special assessment and there is no guarantee this will be approved. Also, it was discovered that the behavioural aspect plays an important role where circumstances in life and the car's anchoring in the society makes it more complex. Thereby affecting the intrinsic value and in turn the choice of owning a car versus using a carpool. In addition, the result has contributed with stronger reasons to make the actual cost of parking places visible for those who demand a parking place because this might eliminate the subsidizing and the manipulated parking demand.

The study concludes there are problems with the parking ratio regulation regarding flexibility, economical rationality and estimation of the parking demand. The recommendation is to apply flexible parking ratios based on a will-controlled approach. In addition, economic rationality and behaviour changes should be taken into consideration in the regulation.

Further studies are requested to investigate how to formulate a new regulation in order to work well. An analysis how these kinds of changes would affect people's travel behaviour and the parking demand is recommended to be done.

The contribution has been to rethink the designing of new dwellings and understand that cooperation and communication among different actors is important in order to create updated and well-functioning regulations. Hopefully this can create a debate about how create incentives in regulations to strive for a sustainable development in the built environment.

Key words: Flexible parking ratio regulation, new house construction, house developer, carpool, car ownership

Implementering av bilpool vid nyproduktion av bostäder

En studie om regleringen av parkeringstal i Göteborg

Examensarbete inom masterprogrammet Design and Construction Project
Management

EMMA STRÖMBERG

Institutionen för bygg- och miljöteknik

Avdelningen för Construction Management

Chalmers tekniska högskola

SAMMANFATTNING

Göteborg stad står idag inför utmaningen att utveckla en hållbar stad med ett transportsystem, där land och resurser används optimalt. Detta väcker en debatt om nya sätt att forma staden. En hållbar stad behöver reducera bilanvändningen och integrera hållbara mobila lösningar redan i planeringen av nya bostäder. Den här studien kommer därför utreda bilpool som mobilitetslösning i nyproducerade bostäder.

Studien har innefattat litteraturforskning, intervjuer, beräkningsjämförelse och genomförande av en enkät. Under arbetets gång konstaterades att implementering av bilpool i nyproducerade bostäder i centrala Göteborg är fördelaktigt eftersom det bidrar till en hållbar utveckling. Dock är det inte enkelt att implementera då regleringen av parkeringstal kräver en särskild utredning och det finns inga garantier att den kommer bli godkänd. Det upptäcktes även att beteendenaspekter spelar en viktig roll, där livssituation och bilens förankring i samhället gör frågan mer komplex. Varpå detta påverkar valet att äga bil eller använda bilpool. Resultatet av studien har också bidragit med starkare skäl att göra den faktiska kostnaden av parkeringsplatser synliggjord för de som efterfrågar parkeringar, eftersom det eliminerar subventioneringen och den manipulerade parkeringsefterfrågan.

Studien har kommit fram till att det är problem med regleringen av parkeringstal gällande flexibilitet, ekonomisk rationalitet och uträkning av parkeringsefterfrågan. Rekommendationen är att tillämpa flexibla parkeringstal baserat på ett viljestyrt tillvägagångssätt. Dessutom bör ekonomisk rationalitet och beteendeförändring beaktas i regleringen.

Ytterligare studier är efterfrågade för att undersöka hur en ny reglering ska formuleras för att fungera väl. En rekommendation är att analysera hur dessa förändringar påverkar människors resebeteende och parkeringsefterfrågan.

Bidraget har varit att tänka över utformningen av nya bostäder och förstå att kommunikation mellan olika aktörer är viktigt för att skapa en uppdaterad och väl fungerande reglering. Förhoppningsvis kan detta skapa en debatt om hur incitament i regleringar kan leda till en större strävan mot en hållbar utveckling i den byggda miljön.

Nyckelord: Flexibla parkeringstal, nyproduktion av bostäder, bostadsutvecklare, bilpool, bilinnehav

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Preface

This Master's thesis has been conducted at the Department of Civil and Environmental Engineering at Chalmers University of Technology, Sweden, from May to December 2016. The work with the Master's thesis has been strongly supported by several persons that should be acknowledged.

First, I would like to thank Christian Koch, Professor, at the Division of Construction Management. Your professionalism has been of great importance in my development and to strengthen my critical thinking. Thank you for the support and feedback during the process.

I would also like to give a big thanks to Anna Henriksson and Jonas Gustafson as well as all employees at Sverigehuset. Your support and feedback have been of high value for me. Thanks, you for your time and enthusiasm throughout my process.

Finally, I would like to thank all respondents of the survey at Almedals terrasser and to all interviewees who participated in this study. Thank a lot for you time and for sharing your experience and opinions.

This Master's thesis is the end of my education at Chalmers University of Technology. I like to thank the university for obtaining education at an excellent level and being an important part in my life.

Gothenburg, December 2016

Emma Strömberg

Vocabulary

City of Gothenburg	Göteborgs Stad
Construction cost	Byggkostnad
Construction cost index for multi-dwelling buildings	Faktorprisindex för flerbostadshus
Condominium	Bostadsrätt
Department of City Planning	Stadsbyggnadskontoret
Department of Traffic	Trafikkontoret
Detailed development plan	Detaljplan
Dwelling	Bostad
Greater Gothenburg	Stor-Göteborg
House developer	Bostadsutvecklare
Housing association	Bostadsrättsförening
Multi-dwelling building	Flerbostadshus
National Board of Housing, Building and Planning	Boverket
New house construction	Nyproduktion av bostäder
Resident	Boende
Parking ratio	Parkeringstal

1 Introduction

1.1 Background

The research question arose from a discussion with the house developer, *Sverigehuset*, who perceived that the parking ratio regulation in Gothenburg sometimes is insufficient when other mobility solutions, such as carpools, are considered. The parking ratio regulation in Gothenburg requires house developers to build a certain amount of parking places in new house construction projects. The combination of the parking ratio and the limited physical space in the city often force the house developer to build expensive underground garages which leads to high construction cost. Furthermore, the parking ratio does not always equal the parking demand and neither does it considering the economic rationality in projects. Because of this, problems arise where the actual cost of the parking places do not equal people's willingness to pay for it. To finance the construction of the parking the house developers need to spread out the cost on all apartments. The increased apartment prices then subsidize the cost of the required parking places. In other words, those who buy new built condominiums, and not own a car, subsidize the cost of parking places to those who own a car. Carpool construction is a good solution for a sustainable development which should be better supported in the parking ratio regulation. By implementing a carpool in new house construction there is a possibility to reduce the number of required parking places and thereby reduce the construction cost, which in turn can lower the apartment price. The house developer also argues they should have a possibility to influence the parking ratio more since they have a good insight in the parking demand. Hence, a better estimation of the parking demand could be made and the risk for over or under estimation could be reduced. Therefore, this study aim to investigate the current parking ratio regulation and its contribution to the sustainable development which have a long-term effect on the building scale.

1.2 Purpose

The study aims to investigate the reasons to implement carpool in new house construction, located in the central part of Gothenburg. If carpool is found to be beneficial it means an implementation of carpool should be eased in the parking ratio regulation when applying for building permit. Hence, it is important to understand why the house developer perceived issues when implementing carpool. Here literature study, in combination with calculations comparisons and a survey, will help to analyse the perceived issue. Further on, the study aim to investigate if this is a common problem in the building industry by interviewing other actors. It can then be concluded if an improvement is needed of the parking ratio regulation. In the end, the research can contribute with recommendations how to ease the implementation of carpool, in new house construction located in the central part of Gothenburg. Following questions will be the basis for the study:

- What are the reasons to implement carpool in new house construction?
- Do actors in the building sector perceive issues with the parking ratio regulation in Gothenburg?
- Is there a need to improve the parking policy in Gothenburg?

2 Method

In this chapter the methodology approach for the thesis will be presented, described and justified. The quality of the research, calculations comparisons and the empirical studies will in the end be discussed.

2.1.1 Research approach

The research is based on a systematic combining approach, grounded in an abductive method (Dubois & Gadde, 2002). An abductive method means the study have started with an observation and process toward explaining this in the theory. A standardized research process consists of several planned phases while an abductive method constantly confronts the empirical findings with the theory, which give the advantage to be able to expand the understanding of both theory and empirical phenomena.

In this study this means that the theoretical framework, literature research, interviews, calculation comparisons and a survey have been evolving simultaneously and this is particularly useful for development of new theories. This regular confrontation between an empirical world and a model world will successively reorient the research issue and the analytical framework (Dubois & Gadde, 2002). Because the theory will be better understood with the empirical finding and vice versa. This approach is beneficial when developing new combinations through a mixture of established models and new concepts derived from the confrontation with reality.

The research question took the basis in a more general literature review to find an interesting and debated topic connected to the construction industry and house developers. The review covered up to date literature such as article in new papers, websites connected to construction industry and governmental organizations i.e. Boverket, Fastighetsnytt, Göteborgs Posten, Sveriges byggindustrier and Byggvärlden. Several interesting topics was found and selected to be discussed during the first meeting with Sverigehuset.

During the meeting, it was found that carpool as a sustainable mobility solution in the urban planning was a very interesting topic. Arguments arouse that carpool give the possibility to reduce both the construction cost and the parking demand in residential areas. Additionally, the issue was explained with the requirements of the parking ratio regulation that have led to subsidizing of car parking. Therefore, it was decided to make further literature research connected to new house construction and carpool. It was also discussed that a calculation comparison of the construction cost and land use could be relevant to do, in order to see how much the apartment prices could be reduced.

In this step of the literature research a narrower research was made with more precise key words and phrases in databases such as the Chalmers library and Google Scholar. The literature review started to examine academic articles, books, reports and projects as well as regulative documents such as the parking policy and the parking ratio regulation in Gothenburg. The research was connected to terms such as parking places, parking ratio, urban planning, mobility development, car sharing, carpool and mobility management. In this step of the research 58 relevant sources have been found and examined. One important finding was the VINNOVA financed project *Innovativ parkering*. The project was led by Pelle Envall, CEO at Trafikutredningsbyrån who

has experience from Swedish transportation administration's biggest research and development projects within parking and urban planning. This project had reports, publications, seminars and new house development examples published at their website. In turn these publications led to other sources for example the finding of the dissertation *The Car Society: Ideology, Expertise and Rule-making in Post-War Sweden* by Per Lundin. His dissertation has made a very deep study of how the parking ratio regulation erupted in Sweden through history, due to that traffic technical experts got big influence in the political climate. These sources have been critical toward the parking ratio regulation and how it is formulated and works in today's society. The critical perspective was in line with the how the house developer perceived the parking ratio regulation. Hence, this strengthen the reason to do the study. Additionally, it was also discovered during the literature research that only two sources had investigated the construction cost of car parking and how it affected the prices of apartments in new house construction. Just one source had the basis in Sweden, however, not Gothenburg. Thereby, the calculation comparisons were reasonable to do and due to according to the conditions within Gothenburg. In addition, interviews with actors were relevant to investigate if the critical perspective the sources had on the topic was recognized, and also in order to collect data relevant for the calculation comparison.

The research question is strongly connected to social science due to that parking places are connected to people's relationship to car. To get a comprehensive view a so called mixed method research will be applied (Creswell, 2014). This is a new method within social science where a combination of quantitative data (closed-ended) and qualitative data (open-ended) are combined. Because each type of data collection has both strengths and limitations a combination of these can develop a stronger understanding of the research question than each data separately. Through a qualitative method, the research is striving to get a holistic description of people's behaviour connected to the ownership of the car and the car usage. The qualitative method is a term that encompasses several research methods (Nationalencyklopedin, A, 2016). The researcher is taking part of the social reality that is going to be analysed. The data is collected in parallel with analysis and the aim is to understand human behaviour and the reasons that govern such behaviour. For example, are interviews a common method used to generate data within this approach. The quantitative part of the work aim to collect empirical and quantified data to get a statistical basis to understand behaviour and test hypothesis (Nationalencyklopedin, B, 2016). The literature research in combination with supervision made it clear that the social and behavioural aspect of mobility is of great importance. Therefore, people's relationship to cars also needed to be covered in the literature research. Here 19 articles have been found and examined where 12 of them were selected as relevant for the study. In accordance to this a survey was interesting to do since this could give an insight of the social aspect of the study according to the mobility and urban planning conditions in Gothenburg. In conclusion, this has been the way of collecting relevant data, both quantitative and qualitative to critical examine the parking ratio regulation in Gothenburg.

2.1.2 Interviews

During the research, interviews have been conducted and all actors are compiled in the references list at p. 55. It is a method of data collection that uses people's answers as a source of data (Denscombe, 2014). Interviews focus on what people say they do,

believe and opinions they have. When people are taking part of interviews they recognize it is a formal piece of research through their agreement to be interviewed. Due to this they implicitly know they give their consent to participate in the research, their words can be used as research data and the agenda for the discussion is set by the researcher. Unless they specify they do not want the information to be used in the research.

According to Denscombe (2014) interviews are useful in research of more complex problems, in order to provide the researcher with better understanding of the issue. The purpose of the interviews is to gain more knowledge and a deeper understanding through individuals' experiences, opinion and beliefs as well as collecting data related to the scope. Interviews were required due to the complexity of the scope and that information is difficult to find by other methods. It was important to understand if the house developer's issues were perceived by other actors. It was also a way to collect data of construction cost of car parking in new house construction, since it was difficult to find studies considering Gothenburg. They have also been asked questions about the usual parking fees in new house construction. Further on, it was chosen to get an insight in other actors' opinions regarding the parking ratio regulation. A selection of the most frequently asked question can be found in *Appendix I*.

There are two important factors when choosing interviews (Denscombe, 2014). Firstly, it is important to consider people might be busy and be difficult to get in contact with and there is also a matter of authorization. During the research this was sometimes difficult when trying to get in contact with people who has an important role in an organization and had a tight schedule. However, it was surprisingly many that took time to discuss the issue, because many of them considered the scope of the research as relevant for them and therefore they wanted to contribute this by taking time for the interview. Those with limited time suggested a booked phone interview which was done. E-mail was also used when additional questions arose after the interviews or when trying to reach a person within a company that was able to answer the questions.

The degree of control during the interview will vary depending on the style of interviewing. An interview can be formed in three different types of ways; structured, unstructured and semi-structured interviews (Denscombe, 2014). In this study, semi-structured interviews have been made because it provides with the flexibility and ability to ask questions and receive answers that covers a broader span than the determined topic. Due to that the topic has a complex character, this gives a possibility for a better insight within field of study. The interviewees were aware that the proceeding and the agenda for the discussion will be controlled by the researcher. Therefore, semi-structured interviews were chosen because some questions could be sensitive and the interview process might have needed to change the question or the way of working, due to information that is a competitive advantage or be difficult to answer because it regards sharing personal opinions. This has been fully respected during the interviews and in the research.

The selection of interviewees took the basis in contacting actors connected to the house development and construction sector within Gothenburg as well as municipal organizations. The organizations have been selected due to that they are involved in ongoing projects of new house construction or have done these kinds of projects

located in the central parts of Gothenburg. It has also been selected due to that they have a business focused on building condominiums. This means interviewees have a lot of experience within the field. Also, they are selected because carpool has already been implemented in a project or is planned to be implemented. Furthermore, the Department of Traffic where interviewed since they have a good insight in the parking ratio regulation and the future plan of the traffic structure in Gothenburg.

Further on, an interview was held with the project manager for DenCity. It is a part of the VINNOVA financed project CLOSER, which is a national and neutral arena working to increase the efficiency within transportation. DenCity is a project making research about innovative solutions and services to decrease the congestion, environmental effect and increase the life quality in dense cities. In other words, they work with innovation to create sustainable attractive cities. This means they investigate sustainable and land efficient transportation solutions for dense cities. Because in cities the space is limited for vehicles and the requirements on sustainability, accessibility and attractive environment is important. They have developed and test different kind of efficient transportation solutions that results with less traffic congestion, positives environmental effects, increased life quality, new products and services. The project is already ongoing and will end 2018 and confirm the government is supporting a sustainable development and positive mobility solutions. In turn it supports research where implementation of positive mobility solutions such as carpool is examined.

2.1.3 Calculation comparison

Calculation comparisons have been conducted to investigate how construction cost, land use and private expenses would be affected by implementing or using a carpool. These are based on regulations and conditions in Gothenburg, to assimilate real multi-dwelling building projects. The first calculation compares the construction cost and land area. Statistics of the construction cost was gathered from both Sverigehuset and other interviewed companies. However, it was found out during the interviews the cost of building parking garage has been difficult for companies to estimate, due to the complexity to separate the cost of building parking from the construction cost of the whole building. According to interviews this is usually not separated since it is a part of the facility cost. Therefore, contact was made with *Parkeringsbolaget*. *Parkeringsbolaget* is steered by the municipality in Gothenburg and works to offer sustainable parking and mobility solutions as well as promote new travel habits. They coordinate the municipal parking in cooperation with other actors, works with maintenance, owns and build car parking. Because they are specialized in car parking and building parking in Gothenburg they have a good insight in the matter in question. Therefore, it can be argued that *Parkeringsbolaget* have a good overview of the construction cost of parking places in Gothenburg. *Parkeringsbolaget* provided with both an interval of the construction cost and area required for parking places. The construction cost has an interval due to that the cost might vary depending on the projects preconditions. This interval is also confirmed by estimations made by actors that have been interviewed in this study (Trafikkontoret, 2016; Sverigehuset, 2016; Wallenstam 2016 and Skanska 2016). Therefore, the cost given by *Parkeringsbolaget* will be used in the calculation. However, it is important to understand that it is complex to estimate the cost due to the preconditions and difficulties to separate it from the construction cost of the building's foundation (Magnusson, 2016; Skanska, 2016; Sverigehuset, 2016; Wallenstam, 2016). The comparison of the construction

cost and land area is limited to only consider the parking ratio for residents and exclude the number of parking places required for visitors. Because visitors might own a car and have parking places in their own residential area.

In the second calculation comparison of the private cost it was found to be difficult to get access to data over the cost to use a carpool. When asking carpool companies about members cost and driving behaviour, they could not provide this information due to the competitive market conditions. Therefore, three driving behaviours have been created to approximately calculate the monthly cost of using a carpool. The driving behaviours are based on data from Statistics of Sweden combined with a traveling survey conducted to investigate traveling behaviour among people in Gothenburg. The survey has been of great importance since the study has data over behaviour sorted for the inner city of Gothenburg. Because of this the calculation is reflecting the real driving behaviour of people living in the inner city of Gothenburg. For example, the data in the survey was of great importance since the result showed that the car usage for residents living in the inner city was much lower compared to those living in the peripheral area. Additionally, Sunfleet's recommended driving pattern for each membership was taken into consideration as well as a study over how one family used a carpool during one year.

2.1.4 Survey

A survey has been made to analyse people's preferences and attitudes toward car ownership and carpool as well as their decision-making when buying an apartment. It has been sent out through mail to 145 households living at *Almedals terrasser*. A reminder was sent through mail a week after and the survey got 53 respondents. They have been selected for the study due to that the housing association has an agreement with an electric carpool administered by the company *Moveabout*. The carpool is implemented in the housing which is the field of the study. For that reason, it is interesting to investigate how people there choose to travel and their relationship to cars.

Additionally, the survey was meant to analyse how many of them that used the carpool and if the membership had affected the travel behaviour. However, only four of the respondents were member of the carpool. Therefore, it is too few to draw any conclusion how the membership in the carpool have affected them. Furthermore, the survey wanted to get an insight in how they prioritized the car parking when buying a condominium located in the central Gothenburg where the accessibility to public transportation is regarded as good. The questions and results can be found in *Appendix II*. The survey gives a limited insight of preferences among people living in the central part of Gothenburg. On the other hand, the result has been confirmed in literature connected to behavioural economics and in studies founded during the literature research. Therefore, the survey can be argued as being relevant for the study.

2.1.5 Limitations

The research considers new housing construction of multi-dwelling houses in the inner city of Gothenburg with good public transportation. This is chosen due to that the parking ratio regulation have divided Gothenburg into different zones based on the public transportation. The aim is to create calculation comparison that mirrors real projects as much as possible. However, the study will only consider parking ratio for

the residents parking places because visitors and disabled persons might own a car. When possible data is limited for the inner city of Gothenburg, but such narrow limitation makes it sometimes difficult to find statistics. In those cases, data will be sorted for a bigger part which may affect the result. The calculation of the construction cost of car parking places only regards condominiums. Tenancy rights and condominiums differ because they are operating in two different markets in which needs and demands distinguish from each other. The limitation was made due to the complexity of the rent for a tenancy right. The same applies to the land cost which is excluded from the calculation.

3 Theoretical Framework

This chapter aims to provide the reader with underlying concepts and theory related to the scope of the thesis and respond to the research questions. The framework is divided into three sections where *Figure 1.* gives a schematic overview of the scope. The first section introduces the concept of sustainable development. The reason is to understand why it is important to consider this in the building sector and actors connected to it. This part set the basis for the discussion why house developers want to implement carpool in new house construction. The second section describes the concept of policies and regulations as well as the positive and negative aspects of these. The section tries to clarify how these impact the sustainable development, by either be supporting or counteracting, depending on how it is formulated. Thereby, the reader will understand the issues house developers perceive when implementing carpool in new house construction. The last section defines and describes the theory of behavioural economics because it affects people’s decision making process and affects the choice of transportation. It is of great importance when discussing the complexity of peoples travel behaviour and the subsequent effect on the sustainable development.

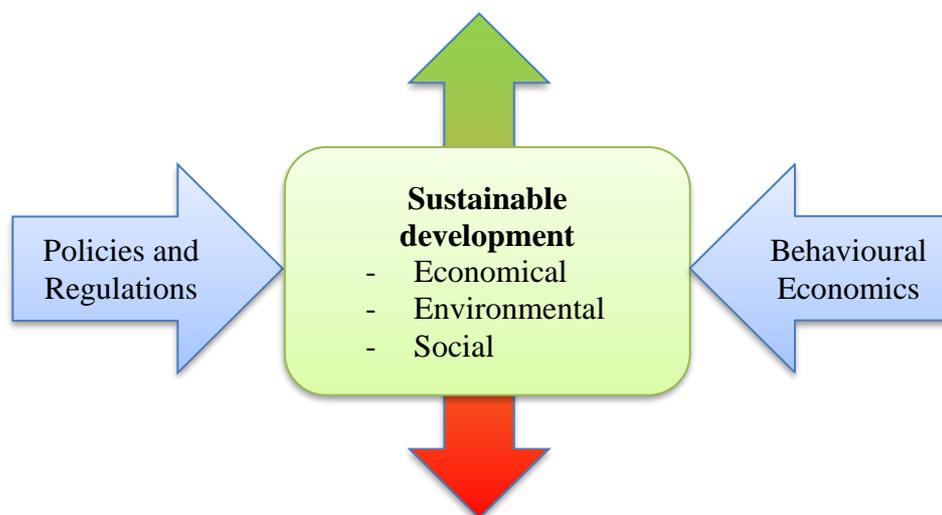


Figure 1. Schematic view of the theoretical framework.

3.1 Sustainable development

Sustainable development is a term defined in the Brundtland (1987) as:

“Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.”

The concept is extensively wide spread and there is a broad agreement that sustainable development should be the overarching goal for the development of the society both on the local and global level (Nationalencyklopedin, C, 2016). Sustainable development requires a long-term and holistic approach at a global perspective. There are very broad interpretations on the concept where for example many believe that the environmental approach sets the limits of what is sustainable,

while others believe this is a part of the approach. The other aspects in the economic growth and good living conditions for all humans on earth, which may mean that the protection of the earth's ecosystem and resources are breached. It is not set how the balance between the three dimensions: economic, ecological and social sustainability should look like and many interpretations compete with each other's. Sustainable development can be seen more of a process, where different perspectives can meet. These three dimensions are meant to reach the overall goal of developing and maintaining human welfare now and in the future (Hedenus et al., 2016).

The ecological dimension concerns sustaining the natural environment so it can keep providing humans with goods and services (Hedenus et al., 2016). This dimension can be understood as a boundary since if the earth would be damaged, through irreversible changes in the ecosystem, there is nothing to do with our money. Some degradation has been repaired but other interventions are much harder to handle. For example, emissions of carbon dioxide that will stay in the atmosphere for thousands of years. Likewise, if species are lost it cannot be restored. There is good reason to be careful with the environment because there is an uncertainty what future may come to need. For certain people are dependent on natural systems and will continue to be it in the future. The ecological dimension is therefore meant to guarantee there is a natural system in the future. However, this dimension is often threatened by the tragedy of the common which means if a common resource can be used at will it tends to get overused, for example the option of releasing emissions into the air. In order to handle the threat, new social contracts or policy measures are needed rather than new inventions.

The economic dimension of sustainable development means managing resources required to sustain human well-being now and in the future (Hedenus et al., 2016). This dimension can be divided into two parts. The first is finite natural resources such as fossil fuels, metal, and phosphorous. It is about substances extracted from the earth, which are not part of the ecological system and are not renewed. Additionally, it is a question about how to allocate the resources among people today and in the future generation. Overexploiting would put generation to come at risk of not being able to meet their needs. Therefore, resources need to be managed in a reasonable way. Conserving finite resources by keeping them in ground is not necessarily the best way to support human well-being. However, when it comes to material one solution could be to use closed systems which re-use material in the future. The second part of the dimension is monetary capital which means assets created by humans i.e. roads, buildings, factories. A sustainable economic involves managing infrastructure and questioning what societal structures are left for future generation. Basically, it is important how investment in infrastructure is made since only investing in one type, for example highways, have an impact on future generation's ability to develop new transportation solutions. The challenge is to keep the current needs along with the long-term future ones. In summary, the economic dimension of sustainable development is about finding efficient ways to manage the economy and financial resources. In addition, balance this with current and future generation in a reasonable way.

The social dimension of sustainable development means creating and sustaining social institutions and structure which are important for the human well-being (Hedenus et al., 2016). Fundamental institutions for this dimension is an efficient and functioning

state, a reliable law enforcement and judicial system as well as a good international cooperative. It also covers less formal concepts such as trust among people in the society. An institution that has a good functioning is known to promote human well-being in different ways. The rule of law and trust among people are important conditions for the economic development. A public sector that works well decreases the risk of deep economic crises and promotes collective decision-making. Except from that institutions are ideas and conceptions it is also about democracy. The development of institutions takes time and depends on the intentional plans as well as accidental occurrences. This is probably the broadest dimension and many different factors can be included such as human rights, peace, equality, fighting poverty, codeterminations etc.

The need of new housing in Sweden are today estimated to be 710 000 until 2025 where a bigger part, 440 000, are needed already 2020 which means an average annual rate about 88 000 (Boverket, 2016). The reason is the expected population growth and that the construction during the past years has not increased sufficiently to meet the housing demand. Today's housing situation and the future scenario create challenges for a long time ahead. Boverket (2016) concludes the biggest and foremost challenges. The first is the need to increase the production which will take time to change and must deal with both resources as well as the speeding up the production process. Secondly the economic and financial challenges are mentioned, where economically weak groups not directly are in need for new construction but demand efficient moving chains that new housing can generate. Further on, the volume of the new housing requires an efficient infrastructure to be well functioned in combination with attractive housing. In many cases homes are likely to be built in development areas which demand infrastructure expansion in combination with other investment such as school and services to withstand the requirements. Hence, the possibilities to build new houses increase with an improved infrastructure development. It is also essential that the housing market is characterized by long-term economic sustainability for all actors and it is of great importance when shaping the rules for the market.

3.2 Policies and regulations

Regulation can be defined as a state intervention in the private domain, which is a consequence of our imperfect reality and human limitations (Orbach, 2012). The self-interest among people causes harm to others and these imperfections and limitations are the primary motivation for regulation. The aim with regulation is to promote economic efficiency, environmental sustainability, morality, and the general welfare of the public (Orbach, 2012). However, the imperfection and limitation also means the regulation will be imperfect. Human involvement allows regulations to serve certain interest groups. Therefore, the society must acknowledge these imperfections because regulations will always be a part of the society, and therefore it is important to work to maximize its benefits and minimize its cost.

The benefit with a regulation is that it makes it is easier to plan and organize because rules and their outcome should be known (Lundin, 2008). It helps to overbridge distances and is a tool for coordination to eliminate insurance and vagueness. Similar situations are treated in similar ways which increases the efficiency. Regulations practices are therefore easier to predict compared to judgement practices where each case is evaluated. However, regulation can be criticized because the result is

inefficiently or the regulation is producing unwanted side-effects (Baldwin et al., 2012). It can also lack transparency and accountability as well as exhibit bias and unfairness. For the exposed, rules are easy to fall back on because they appear to be fair and impersonal which in turn decreases the risk for arbitrariness and partiality (Lundin, 2008). At the same time, rules have obvious back draws which affects the flexibility. Rules simplify interpretations and choices which may lead to losses of non-verbalised knowledge and skills. Further on, the formal and official character of rules makes them impersonal, rigid and slow changing. It works conserving and is therefore not a good tool for complex and fast, unexpected changes. Despite that rules are based on what happened in the past, they are also designed for another time. The result is that the vision the rule makers had in the past are conserved into today's society.

To decide what good regulations is can be discussed. If people through the government have pushed for a certain regulation and the government have achieved the result the regulators can claim the public support (Baldwin et al., 2012). Unfortunately, this is open for interpretation and the result might involve other interest from other actors. Furthermore, regulatory functions might require expert judgement. Then the decision-maker needs to consider several competing options or values and come up with a fair judgement of incomplete and shifting information. The regulatory in this case might claim support based on the expertise rather than give reasons or justifications for the decision. In other words, the regulatory can claim to only let people "trust" the expertise. Experts thus argue they will have the most appropriate decision and achieve the best results when freed from duties of explanation (Baldwin et al., 2012). A problem with this is that the public might have difficult to assess whether the decision or policies that have been applied are produced by the application of expertise. Another problem is that it cannot be assumed that experts are neutral. Their decision involves judgements that will have a political aspect and interest which affect the regulation.

The traffic congestion is partly about movement in the traffic and partly about the stationary vehicles (Lundin, 2008). This has been the case since 1930s but research has focus mostly on the moving car since car is strongly associated with movement. In more than a decade the car has been associated to freedom, individual movement and speed. While it is the vehicle that on the other hand is making noise, pollute and contribute to traffic accidents. This study focuses on the stationary vehicle. Here it should be said that a car is standing still 96 % of its life time and this requires a parking place. A city adapted to cars needs a lot of parking places and usually a common problem is the lack of parking places. Even though, this induce irritation it is such a natural part of everyday life that alternatives are rarely considered. The lack of parking places, in larger cities, during the 1940s was discovered to be difficult for people to solve by themselves.

As the Swedish economy flourished during the 1950s, more and more households could afford buying a car and Sweden reached Europe's highest car density (Lundin, 2008). The increased number of cars and traffic frequency became a significant social problem with both traffic jam and traffic accidents. Both authorities and the government got surprised and previously successful strategies and actions to cope with the car traffic suddenly appeared to be ineffective. The view of motoring was considered as something impossible to mollify. The reason for this can be explained

by some connected factors. Firstly, this was not arisen from a regulative decision and secondly there were no actors who monitored the development. Finally, the most important factor behind the fast expansion was the individual decision-making to purchase and use the car. The car was sought-after by everybody but the question about building cities adapted to cars was never questioned. Authorities and governmental powers were not prepared for this and had a hard time handling the mass motoring. The situation created possibilities for new actors, such as traffic technical experts, to enter the stage. The new actors with traffic technical expertise got dominant positions and thought the only way was to adapt to the demand and requirements of car usage. Their big influence and vision lead to regulations about how buildings, roads and urban planning should be done to adapt to the usage of cars. The parking ratio regulation became a way to transmit knowledge and experience from the traffic technical experts, who got more influence in the political climate. Lundin (2008) argues that the development and application of rules for parking can explain the extensive adaption of cars in cities and societies in Sweden. He claims the regulations formulated during this time still seem to be a part of today's urban planning, even though the political vision today wants to aim for a sustainable development.

The vision of the traffic technical expert can be found in report made by Nordqvist (1955) where the only way to handle the issue with cars in cities was to build a city for the cars. He argued that building a society adapted to the cars would eliminate the traffic congestion and traffic accidents. He also stated that a car society was not just a solution, it would provide people with comfort, material welfare and movement as well as democracy and freedom. From his perspective, the car society represented a new attractive life style and was an ideal society in an upcoming future. The solution to the problem with parking places in cities was a combination of political and market regulations (Trafikverket, 2013). Swedish cities started to take inspiration from how cities in United States handled this with minimum requirements in their parking standards for new house construction. Swedish authorities implemented requirements on e.g. house developers to build parking places that would accommodate the residents' cars and release the pressure on parking places along streets. Hence, regulation of minimum levels in new house construction was implemented in Sweden. This development took turn in the end of the 1960s when the negative consequences of a society adapted to cars become apparent (Lundin, 2008). The city was distinctly unattractive with fragmented city core to serve motoring and parking demand. The parking places that had replaced courtyards and playgrounds to free parking along the street did not solve the problem. The free street parking places were fast filled up with new cars and the issue with traffic congestion remained.

The debate about the car society took off during the environmental moment in 1970 but the resistance against the car society and its experts did not get any anchoring among the people (Lundin, 2008). The society had gone too far in the development and was already car dependent. Through the planning had the car successively been both economic and cultural integrated in people's everyday life and in many cases become an important part for work and free time. The car had become a part of people's identity and the lack of alternatives made it difficult to replace. Today the motoring is still a problem but the car also keeps its many attractive qualities. During the history, it is found a fundamental ambivalence about the car taking place in the city (Richardson et al., 2010). Private car use is constantly appearing to be a main

problem to handle, but still very few of the policy measures challenge the use in any radical sense.

Both Lundin (2008) and Shoup (1997) argue that the empirical methods used to set the parking requirements have been a simple and meagre study. Shoup (1997) argues that the planning of parking places does not consider the cost to provide parking. Also, the minimum parking requirements provide subsidies that influence the parking demand. The influenced parking demand is used as a base to set the minimum parking requirements. In other words, this means the requirements are based on a manipulated demand, which can be questioned. According to Shoup (1997), it is not surprising that the generous amount of parking places often goes unused since how they are predicted. He also claims an elimination of minimum parking requirements would reduce the cost of urban development, improve urban design, reduce car dependency, and restrain urban sprawl.

3.3 Behavioural economics

Implementation of carpool in new house construction will be affected by the residents' travel behaviour and choice of means of transportation. This can be understood when getting insight in the behavioural economics. Behavioural economics in travel studies have two aspects (Garcia-Sierra et al. 2015). The first is bounded rationality, where Prospect Theory is applied to travel time, uncertainty and interpretations of expected travel time. This gives an insight in "willingness to pay" differences when estimating value of time savings in project appraisals. Bounded rationality has special issue when it comes to travellers' habitual behaviour. Daily trips are in majority based on habitual and automatic choice with a low information processing. The second aspect is the social preferences which concerns altruism, fairness, norms, reputation and status seeking. This aspect has got more attention in studies and it has been commonly to apply social psychology to travel studies, where feeling of moral obligation, perceived social pressure and control beliefs has been analysed.

Recently behavioural economics have been applied to environmental economics to conduct studies of sustainable consumption, voluntary cooperation in public goods, environmental valuation and the implication of environmental policies (Garcia-Sierra et al. 2015). Behavioural biases, considering both bounded rationality and the social preferences, increases the understanding of complex environmental behaviour and is therefore important as a base for the policy design of such cases as parking ratio regulation. The travel behaviour is a complex environmental behaviour and individuals tend to be heuristic. The term heuristic was first mentioned by Tversky and Kahneman (1974) and it can be described as shortcuts when people make judgment under uncertainty. They describe three kinds of heuristics that often emerges unconsciously when decisions are made. Firstly, decisions are made on previous outcome (representativeness), secondly the likelihood of an event is assessed by the ease with which it can be recalled (availability) and finally people make judgment based on reference points (adjustment/anchoring). This means the individual deviate from rational agent behaviours due to imperfect information and limited calculation abilities (Garcia-Sierra et al. 2015). A valuation of the positive and negative consequences with the transportation are weighted, thereafter the choice becomes so habitual that people no longer makes any evaluation before the next trip (Johansson, 2001).

In summary, the individual choice is based on self-interest rationality and is more prioritized than the collective rationality. The choice will be influenced by how alternatives are presented because individuals tend to choose the alternative that is framed as the highest gain policies (Garcia-Sierra et al. 2015). This gives biases such as asymmetric valuation, loss aversion and probabilities being weighted as non-linearly. The result in immediate rewards due to that the individual tends to over value the present over the future and do not have a long-term consequence thinking as well as problem with self-control and habit formation. This immediate rewards are then weighted heavier than the future gains, thus denoting time inconsistent preferences. Individuals tend to show limited altruism and fairness as well as interdependency of choices due to social and self-identity concerns. Hence, the travellers' behaviour is heterogeneous and their preferences are inconsistent. Current policies aim to reduce the environmental pressure from the transportation sector, but are not fully effective since the behavioural aspects of travellers are insufficiently recognised (Garcia-Sierra et al. 2015). Behavioural economics is therefore important to consider since it gives a better understanding for people's travel behaviour and choices as well as the impact of policies. However, in the following part the study will first cover how the sustainable development is connected to the new house construction. Policies and regulation as well as the behavioural economics will be brought up later in the study.

4 Empirical findings

This chapter aims to first highlight the importance of sustainability in the urban planning and what challenges the built sector must deal with. It will be followed by a section where carpool is examined to understand its environmental, economic and social effect. The social effect is analysed by a calculation comparison and through a survey. Then it can be understood why carpool should be implemented in new house construction. The problem with implementing carpool and planning parking places will also be explained here. The last part will cover the parking ratio regulation in Gothenburg and discuss where improvements could be made in order to ease implementation and strive towards a sustainable urban planning.

4.1 Sustainability in the urban planning

Sustainable development in the built environment is of great importance since it has direct and indirect connection to the economic, ecological and social approaches of the sustainable development (Bourdeau, 1999). Urban planning is facing a lot of challenges regarding health, environmental issues, transport, land use, housing politics, and economical issues (Kittang & Thomsen 2010). All aspects are essential to give coming generation good living conditions. Our future development and transformation of our cities need to have a long-term perspective. One crucial question is how to enable cities to reduce the consumption of resources and emissions but still provide a good urban life. It is partly about affecting people's attitudes and behaviour, partly about sustainable urban planning that gives preconditions toward a more efficient and sustainable traveling (SKL & Trafikverket, 2010). Municipalities have an interest and willingness to work toward a decreased traveling demand, enhanced security and energy-efficient transport. The work can be divided in the fields such as regulations and economic policy making, technical development, physical planning and behavioural impact. It is challenging to create a sustainable development and there is a need for a new view of traffic and urban planning. It is about climate, energy and consumption of resources. Already today there are changes in the urban planning affecting our lifestyle. Therefore, the traffic and the urban planning play an important role in the context.

The mass motoring and the growth of mobility demand has reduced the quality of urban public spaces and significantly affected the environment (Papa & Fistola, 2016). The negative effects have been increased land and energy consumption, congestion, greenhouse gas emissions, air pollution, noise and road accidents. Hence, car traffic is a burden on public and private budgets as well as causes environmental and health problems. Mobility is a very critical issue as it is essential for the quality of life for citizens (European Commission 2011). Also, mobility plays an important role in economic and social development in every society. However, it has several negative consequences. This raise the discussion of new ways of designing urban form, where the future city need to develop new urban structures and transportation systems that encourage walking, cycling and the use of public transportation (Kittang and Thomsen (2010). Urban planning has therefore the potential to influence the usage of cars, and this is important to acknowledge. Structures for transportation in cities should be transformed to integrate environmental-friendly transportation in residential areas, working places and services. Furthermore, the potential and most suitable place for development of low-car housing is greater in the inner areas of larger cities (Ison et al., 2014) Because the road capacity and parking are under high

pressure, hence, low-car development is a useful tool for cities undergoing urban intensification.

At European level, it is set objectives and actions aimed at integrating adaptation to climate change and resilience into EU policies (Papa & Fistola, 2016). Among the objectives, it is stated a more strategic and long-term approach to spatial planning will be necessary, including transport (European Commission 2009). This means spatial planning should deal with transport issues in a strategic and long-term vision where mobility must be primarily environment and climate friendly. According to the European Commission (2009) there is a need to drastically reduce world greenhouse gas emissions. For this reason, the current continuous growth in private car ownership and usage is not sustainable in the long term.

The transportation is 40% of Sweden's CO₂ emissions and in Europe the cities' traffic stands for 40% of the CO₂ emissions of the road traffic (SKL & Trafikverket, 2010). To reduce the emissions, solutions are needed within the transportation sector. But sustainable development cannot only be solved by traditional building of the infrastructure were for example traffic jam is difficult to eliminate through this. Neither will new technical solutions be enough. Political measures are required to change people's behaviour. In the recent years, public governance of the society has changed. New types of instruments based on market principles and in cooperation and dialogue are getting more common. Citizens and businesses assume to be included in the planning process, creating new requirements on the house development.

Cities are playing a more important role in our life and municipalities are putting more efforts to create an attractive environment that attracts people (SKL & Trafikverket, 2010). It permeates the physical planning where the aim is to give opportunities for a better life in an attractive city. The transportation system is a big factor for how the city is perceived. Different traffic systems give different accessibility to popular activities. A changed view on the city traffic requires new working methods such as integration of sustainable traveling already in the planning of new house constructions. Besides the fact that physical planning is important to affect the mobility, there are also national goals when it comes to climate, health etc. which requires actions on the local level to be achieved (SKL & Trafikverket, 2010). Sustainable traveling is primary about sustainable means of transport such as walking, cycling and public transportation. Secondly, more efficient car usage, such as car sharing and to some extent fossil fuel free vehicles.

Sustainable urban planning aims to create environment where people can choose to travel in a sustainable and more efficient way (SKL & Trafikverket, 2010). A crucial aspect is that the urban planning and new house construction gives preconditions and supports sustainable traveling in the built environment. This requires another perspective, goals and working methods in the traffic, urban planning and new house construction. Economic instruments and regulations can strengthen the impact on behaviour and planning actions. Mostly economic instruments are taken above the municipal decision-making but for example, parking policy and parking ratio regulation are strong instruments and will have a big impact. In addition, the municipality have a possibility to decide details in the detailed development plan that may affect the demand of transportation. In the detailed development plan,

distribution of areas for different means of transportation and implementation of positive mobility solutions, such as carpool, can be done.

Our view on the mobility is one of the most important aspects in the physical planning (SKL & Trafikverket, 2010). For many people mobility is mixed up with the term accessibility. Accessibility is being able to access the work, education, culture etc. Mobility is the possibility to movement where the accessibility is the utility of the movement. The transport has a small intrinsic value. People travel to do something else i.e. recreational activities, visiting friends and family, and work meetings. In other words, the travel is more a mean to achieve something else. In economic theory people attempt to minimize the cost per gained utility. Therefore, urban planning should maximize the accessibility per movement. For example, this means shorter distances to kinder garden, stores, service, work etc. This would increase the accessibility and freedom for all groups in society and in turn the need of movement decreases. Therefore, research has shown that movement and accessibility is of great importance in physical planning of the cities. An example is when building external shopping centres outside the city. The increased distance leads to more movement but less accessibility. For the same reason congestion in traffic cannot be eliminated in the long run by building new roads. Due to this, many cities work with affecting people's traveling behaviour by improving the accessibility and in turn keeping or decreasing the need of movement. Actions are done through economic policy making, sustainable urban planning, coordination, information and communication.

In accordance to sustainability in the urban planning it has been investigate challenges in the urban planning. The discussion about high construction cost, often in relation to housing shortage and that we build too little, has been for a very long time in Sweden (Boverket, 2014). This discussion can be understood when comparing the Building Price Index (BPI), Construction Cost Index (CCI) and the Consumer Price Index (CPI) in *Figure 2*. This shows that the BPI and CCI have increased more than the CPI which could be a reason to the debate. During 2011 to 2014 has the BPI increased with 19 percent even though the CPI in principle has standing still (SCB, A, 2015).



Figure 2. BPI, CPI and CCI during 1980-2012 (Öhrn, 2013).

High construction cost affects the housing prices but another aspect of the problem is that housing prices in Swedish cities depend on the high willingness to pay (Boverket, 2015). Central location is highly valued by people in combination with the limited housing supply. High valuation of central apartments is partly about wealthy buyer but also about strong preferences. The construction costs are indeed higher in more central locations but Boverket (2015) argue the land cost is the mainly reason for this between central and peripheral location. Data compiled in *Figure 3* shows how construction and land cost has increased in Sweden during the past years (SCB, A, 2015). Especially in the cities has the land cost increased significantly. Regardless, both parameters are important to consider since they affect the total production cost and this will house developers use as a base when pricing condominiums (SCB, A, 2015). This could be an argument that the housing prices partly can be explained by the market and partly due to the increased construction and land cost.

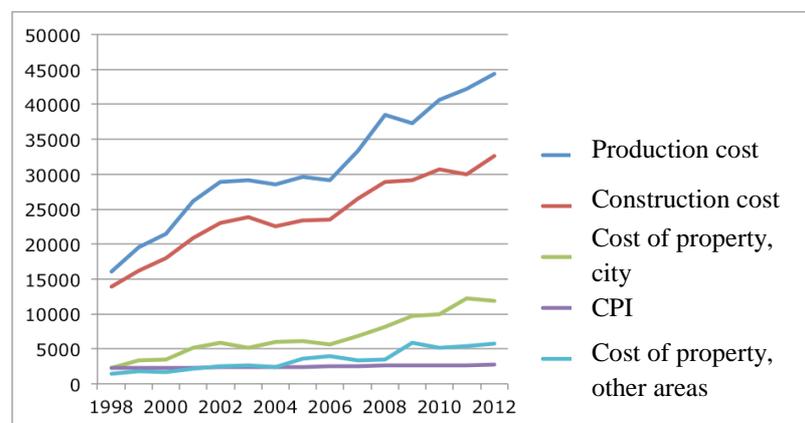


Figure 3. Cost development in the building sector (Ekonomistas, 2014).

4.2 Reasons to implement carpool in new house construction

In this part the aim is to investigate the reasons to implement carpool regarding the sustainable aspects. The first part will cover the environmental effects. The second considers the economic effects, where calculations comparison is made to analyse how an implementation could affect construction cost, land use and private expenses. The last part is regarding the social effect where a survey is conducted to get an insight of residents' interest for carpool.

In a sustainable city, the way of traveling need to change, but this is difficult to achieve, since the ability to move around with car is a natural part of peoples' lives and modern society (Kittang & Thomsen 2010). However, the trend towards a sharing economy seems to expand (Glotz-Richter, 2016). Sharing economy is defined as activities that aim to reduce the resources consumption through more efficient capacity usage of assets, such as sharing of services and goods. Nationalencyklopedin, D, 2016) This means the focus from private consumption is transferred into temporarily access to a goods or service, which means that people share underutilized assets to use them more efficiently (Trafikanalys, 2016). Sharing mobility is not a new trend but through the last couple of years the digital development has eased the possibility to share vehicles and increase co-traveling, in a bigger scale, between people who do not know each other. During the last years have new services for

shared mobility arises on the transportation market and traditional ones, such as carpools has got more users. If this development continuous it will have a great impact for the transportation political goals.

New house construction is still built with a great deal of car parking (Glotz-Richter, 2016). In central part of cities with good public transportation and good cycling conditions it makes sense to reduce the amount of parking and integrate car sharing. Those projects with integrated car sharing do not need as many car parking places as conventional developments. It creates potential for reducing costs and improving the quality of urban space. In the long run implementing carpool in new house construction may have environmental, economic and social effects. In the literature research, it is shown a car is standing still 23 hours in average per day, which clearly indicate that it could be used more efficiently (Bilpool.nu, 2016; Olwan, 2015). Carpool is one element of the sharing economy (Glotz-Richter, 2016) which offers a car at your disposal without the need of ownership and on a short-term basis (Engel-Yan & Passmore, 2013). It has therefore a potential to reduce the vehicle ownership, travel and parking demand, without reducing individual mobility (Engel-Yan & Passmore, 2013; Glotz-Richter, 2016; Åkerman & Nyblom, 2014). The number of members in carpools have increased relatively fast in Europe, however, from a low level (Åkerman & Nyblom, 2014). In Sweden, Sunfleet has the biggest part of the market shares with 21 000 customers and 700 cars in 35 cities during 2013. Another commercial carpool is Bilpool AB and except from them there are a few non-profit carpools here *Gothenburg bilkoop* is the biggest one in Sweden with around 30 cars (Åkerman & Nyblom, 2014).

An interviewed project manager for the project DenCity, said carpool seem to be one positive mobility solution that is of interest when working with new house construction, for example in the development of Frihamnen in the central part of Gothenburg. The development in Frihamnen aim to be built very dense and all projects within the area have got a lower parking ratio. To solve the mobility for people, carpool is one of many solutions that is considered since it makes people use cars more efficiently and reduces the demand of car parking.

4.2.1 Environmental effect

Gothenburg city has in the development strategy document densification as an important part towards a more sustainable society (Göteborgs Stad, A, 2014). In the strategy, a key component in the future city is accessibility of everyday commodities within walking, cycling or public transportation distances. A city planned from a holistically perspective and with a mixture of housing, business and activities will decrease the need of the car (Göteborgs Stad, A, 2014; Riksbyggen, 2016). In other words, this gives the city core life and may lead to shorter distances between workplace and homes as well as increasing the attractiveness of its environment. There is a clear connection between density and everyday commodities in Gothenburg which makes it reasonable to claim that the local market base is very important for the supply. A distance that exceeds 600 m decreases significantly the number of people who walk there. In addition, a dense city has economic driving force which generates high land values that in turn create a willingness to invest.

About the expansion plans, examples have been produced to show how one can work with improving and utilizing areas in the city core. Investing in carpools is important

to save space (Göteborgs Stad, B, 2014) Carpool can be an interesting alternative instead of owning a car, in those cases the daily traveling to work or other activities can be made by walking, cycling or public transportation (Åkerman & Nyblom, 2014). To make carpool attractive one important aspect is to provide stations close to its customers (Glotz-Richter, 2016; Vägverket, 2003). Other success factors that increase carpool usage are economic of scale, high parking fees and shortage of car parking places (Vägverket, 2003). Relatively dense cities, as Gothenburg, are therefore those with most potential for carpools usage. Additionally, it was mentioned during an interview with Sunfleet (2016) that it is also important to give people information and have complementary solutions such as good public transportation. It has been recon from the company's side that the number of members increase mostly where cars are, which is the central part of Gothenburg. This confirms the literature stating that carpool is most suitable for the central part of the city. Hence the limitation of the study to only focus on the central part is reasonable. Sunfleet has also recon that new house construction with carpool implemented, has 40 percent higher number of interest application. This gives an indication that carpool is an interesting service for condominium buyers.

It has been found in the literature that a carpool has the potential to replace around 4-7 car parking places with one car in a carpool (SKL, 2010; IEA, 2009; Trivector, 2014; bilpool.nu, 2016). Loose (2010) state that it could be 9-14 parking. As seen the literature has quite a broad span of how many car parking places a carpool can replace, and as IEA (2009) state this depends on the context. An assumption is that one carpool could replace 7 cars that is parked at street level, 84 m² could be released to other purposes (Åkerman & Nyblom, 2014). If the parking would be parking garage, which is more common in the city core, this do not occupy extra area. It can also be argued that some parking areas, connected to work, stores and service, can be reduced. Interviews with Riksbyggen (2016), Sunfleet (2016) and Envall (2016) states that there is a need to consider other aspects except from the number of parking a carpool can replace. There is a need to look to the whole living perspective and from the customers' point of view. For example, Glotz-Richter (2016) mention new housing in location with good public transport and cycling conditions make sense to reduce the amount of parking and integrate a carpool.

Gothenburg has significant problems with air pollution and traffic congestion (Göteborgs Stad, 2016). These are reasons the city wants to attract more people to choose an environmental-friendly car or choose alternative means of travels when it is possible. To share a car with others in a carpool is one concrete example how to reduce the environmental pressure. Sunfleet (2016) stated an implementation of carpool in new house construction in Gothenburg reduces the car usage with 20-30 percent. Research have shown a carpool can reduce travels with 30-60% (Vägverket, 2003) since the users plan their traveling better and do less spontaneous trips (bilpool.nu, 2016). This can be connected to the behavioural economic, because carpool will make people do an active choice before the travel have started. This helps reducing negative impacts in the city such as emission, accidents, and traffic jams (Åkerman & Nyblom, 2014). A reduction will then have a positive effect from an environmental and health perspective.

4.2.2 Economic effect

As understood from previous part, carpool can replace parking places which might affect the construction cost and land use. Today, the parking ratio requirements affect the construction cost in new house construction (SOU, 2013; Sverigehuset, 2016; Innovativ parkering, 2016). House developers are forced to build a certain amount of parking places, and this could lead to that housing projects will not be done which have a negative impact of the development and densification of the city (SOU, 2013; Sverigehuset, 2016; Innovativ parkering, 2016). Therefore, it is interesting to examine how carpool can affect the construction cost and land use.

First the cost to solve car parking will be examined, which depend on how it is chosen to go about (Malmö Stad, 2010). The construction cost for different types of parking in Gothenburg is compiled in *Table 1*. (Parkeringsbolaget, 2016). The cheapest parking type is to build car parking places at street level, with a cost around 20 000-30 000 SEK/place. But due to that the amount of land in the city core are physically limited, housing developers has a limited space available (Boverket, 2015; Glotz-Richter, 2016). So even though underground parking garage is much more expensive it is still common to build because it uses the space more efficiently (Malmö Stad, 2010). Parking places corresponds to approximately 13% of the construction cost for a normal sized three rooms and kitchen of 75 m² (Parkeringsbolaget, 2016). In Sweden, the average construction cost was 30 266 SEK per m² apartment area in a multi-dwelling house (SCB, A, 2015). In the Greater Gothenburg, this was amounted to 33 100 SEK during the same year. If the construction cost corresponds to 13 % in Greater Gothenburg this would be a cost around 322 725 SEK for an apartment of 75 m². As seen in *Table 1* this correspond to a lower price in the cost interval given by Parkeringsbolaget.

Table 1. Approximate estimation of the construction cost exclusive VAT for different parking types in Gothenburg (Parkeringsbolaget, 2016).

Type of parking	Construction cost excl. VAT (SEK/parking place)
Street parking Car parking along the street in the residential area.	20 000 - 30 000
Parking in an underground garage fl. -1 Car parking built one floor underground	300 000 - 500 000

In Gothenburg, the parking ratio regulation has different minimum requirements depending on the size of the apartment and where it is located (Göteborgs Stad, 2011). In *Table 2* the parking ratio is shown, before considering the public transportation which can reduce the ratio with 10%. Smaller apartments correspond two rooms and a kitchen or smaller size.

Table 2. Parking ratio for residents when applying for building permit of a multi-dwelling house (Göteborgs Stad, 2011).

Building permit for a multi-dwelling house	Car park places/apartment
Apartment, Inner city	0,49

Apartment, Central Gothenburg	0,54
Apartment, Other part of Gothenburg	0,65
Smaller apartments, Inner city	0,34
Smaller apartments, Central Gothenburg	0,42
Smaller apartments, Other part in Gothenburg	0,46

The house developer, Sverigehuset, has got an indication that the parking demand increases if the size of the apartments is bigger than three rooms and a kitchen (Sverigehuset, 2016). They have also seen that the parking demand decreases depending on where it is located. This corresponds to how the preconditions of the parking ratio regulation set the minimum requirements. On the other hand, the company's analysis of the parking demand for smaller apartments indicates a much lower value than in the parking ratio regulation. Their results from the analysis of the parking demand for smaller apartments, located in the inner city of Gothenburg, are closer to zero. The current parking ratio for smaller apartments is 0,34 and can be reduced to 0,31 due to good public transportation. From Sverigehuset's perspective this is too high which risks that vacancies emerge.

To understand the problems, the house developer perceives with the parking ratio regulation the study will investigate this further. First of all, are the high construction cost leading to high parking fees, but this is not expected to be paid fully by the car owner (Sverigehuset, 2016; Skanska, 2016; Malmö Stad, 2010; Envall, 2016). Because house developers know the actual construction and maintenance cost will not equal the willingness to pay for a parking place. Instead the cost is spread out over all apartments and only a smaller amount is included in the monthly fee for the car owner. This is a subsidy from neighbours who do not own a car to those who do. According to interviews has a parking place in an underground garage a fee set to around 1400 SEK incl. VAT for new house construction projects in central Gothenburg (Sverigehuset, 2016; Skanska, 2016; HSB, 2016; Veidekke, 2016). The interviewed companies mention it is difficult to set a fee corresponding to the construction and maintenance cost of an underground parking garage, due to the residents' willingness to pay.

These kind of cross subsidising is a significant problem for new house construction and the problems are greater in the outer part than centrally due to that free parking along the streets are easy to find (SOU, 2013; Sverigehuset, 2016). Even though house developers are forced to build the number required by the parking ratio. To understand the issue a calculation example follows with the construction cost set to 500 000 SEK and the other assumptions are given by Sverigehuset (2016). The expected rate of return is assumed to be 4,5% and the monthly maintenance cost is set to 75 SEK per parking place.

Rate of return set to 4,5 %:	$500\ 000 \times 0,045 = 22\ 500$ SEK
Monthly maintenance cost:	75 SEK
The yearly cost:	$75\ \text{SEK} \times 12\ \text{months} = 900$ SEK.
Yearly revenue:	$22\ 500\ \text{SEK} - 900\ \text{SEK} = 21\ 600$ SEK
Monthly revenue excl. VAT (20%):	$21\ 600 / 12 = 1\ 800$ SEK
Monthly revenue incl. VAT (20%):	$1\ 800 \times 1,2 = 2\ 160$ SEK

The result shows the actual parking fee should be approximately 2160 SEK incl. VAT. But as mentioned before there are few residents who are willing to pay this amount (Sverigehuset, 2016; Skanska 2016, HSB, 2016, Veidekke, 2016). So, the house developer sets the rent to a lower fee around 1400 SEK, to avoid vacancies in the parking garage. Vacancies would otherwise lead to a decreased revenue for the housing cooperative in the long-run and in turn they would need to increase the fixed fee on the apartments. Therefore, it is better to lower the fee to avoid these risks. Furthermore, the issue with the subsidy is shown in next calculation example. It gives an understanding for how much the parking place will be worth when the fee is set to 1400 SEK.

Parking fee (in an underground garage)	1400 SEK incl. VAT (20%).
The monthly revenue:	1120 SEK excl. VAT
The yearly revenue:	1120 SEK x 12 months = 13 440 SEK
Monthly maintenance cost:	75 SEK
The yearly cost:	75 SEK x 12 months = 900 SEK.
The yearly net revenue:	13 440 SEK – 900 SEK = 12 540 SEK.

A calculation with a rate of return set to 4.5 % gives an actual value:
 $12\,540\text{ SEK} / (4,5\%/100) = \mathbf{278\,700\text{ SEK}}$

This means that the house developer makes a deficit corresponding:

Construction cost – Actual value of car park place in a parking garage =
 $500\,000\text{ SEK} - 278\,700\text{ SEK} = \mathbf{221\,300\text{ SEK}}$

The result shows the deficit that will be included in the price of all apartments even though not all of them own a car (Malmö Stad, 2010; Sverigehuset, 2016; Skanska, 2016; Trafikutredningsbyrån, 2016). If the house developers lower the cost even more, for example to 1200 SEK, this would increase the deficit with 42 700 SEK which also would be transferred to the price of the apartments. If vacancies still would arise after all apartments have been sold, the loss of revenue will be compensated by increasing the fixed fee for all apartments in the housing cooperative. These examples show the willingness to pay for a parking place and the risk of vacancies affect all residents in a housing cooperative, even though, not all own a car.

A conclusion drawn from this is that there is an issue with the parking ratio regulation that is not only perceived but also can be confirmed in the calculations. This is an issue this study wants questions because it shows the parking ratio regulation have problems to meet the willingness to pay. Subsidizing the parking fee also gives a manipulated parking demand due to that the whole actual cost is not visible. In the literature, it has also been discovered this subsidy is something few of the residents are aware about and it seem to be a natural part of the housing project (Malmö Stad, 2010). Due to this it can be questioned if the residents would think this is a fair system.

To find out how the parking ratio regulation affect the construction cost in new house construction in central Gothenburg, an interview was held with a project manager at Skanska. She works with a multi-dwelling house project at Lindholmshamnen and for the moment they are planning the parking for the multi-dwelling house. She tells that

from the beginning the plan was to implement a carpool for all new production in the area, where other developers are involved. But the idea was not implemented in the beginning of the process. She says that if the shared carpool had got more attention from all involved developers and stakeholders it would have been more beneficial for everybody to build it. Today they are in a situation to solve the parking by them within the property area. This has led to problems because the parking ratio regulation requires 62 parking in Skanska's project and they have solved 51 parking in a one floor underground parking garage. To solve the remaining places, they need to build a garage in two levels, but it would be few places on the second floor which would not be economic rational. Therefore, they have decided to apply for a planning permission with place for two carpool cars among the 51 parking and now Skanska is waiting for an approval for from the building committee. According to the project manager is a carpool better at street level than in underground parking garage due to access and security reasons. Also, two cars in a carpool are few to work optimal. During the process, they also analysed a scenario to sell the car parking places to those who own a car. The estimated price they could take from the customer which ended up to be 480 000 SEK and that would not even hold the whole construction cost by itself. This scenario was considered unrealistic due to the willingness to pay. In the end of the interview she states that if a reduction of parking places could be done, without affecting the individual mobility among the residents, the reduced cost for this could be used for other purpose in the project in order to give a higher quality and attractive living in contrast to the car parking.

In conclusion carpool was used as a solution to compensate the remaining parking places' that would require a second floor underground. The implementation of carpool can therefore be a solution to find an economic rationality in new house construction. Hence, carpool would be beneficial from an economic point of view. On the other hand, it is not as easy to implement. As seen in the example Skanska needed to make a special application to implement two carpool places. The parking ratio regulation requires an extra parking assessment where the house developer need to prove this solution will work in the long-term. There are no guarantees those two carpool places will be approved and then the company need to find other solution or be forced to build the underground parking garage in two floors. As a summary, implementation of carpool in new house construction is not easy to do even if it is economic rational. This confirm the research made by Shoup (1997) who claim the planning of parking places do not consider the cost.

4.2.2.1 Calculation comparison - Replacing parking places with carpool in new house construction

As mentioned in the theory the economical aspect of sustainable development is of great importance. The research has shown parking places can be expensive, especially when underground parking garages are required, due to the limited space in the city core. House developer argues to ease an implementation of carpool in new house construction in order to reduce the parking ratio. Therefore, following part aims to examine how much construction cost savings could be done if all the required parking places were replaced by a carpool. Additionally, the area occupied for the required parking places will be compared with the implementation of a carpool

This case is a calculation representing today's situation for a house developer who want to build a new multi-dwelling house located in the central part of Gothenburg.

The calculation is based on the number of parking places required for a building permit, in Gothenburg, concerning 100 apartments. The availability and frequency of the public transportation system is assumed to be good, which reduce the parking ratio with 10%. The calculation is based on statistics over completed apartments in Gothenburg during 2014 (SCB, B, 2015). For smaller apartments, the average size is 40 sq. for a 1 room and kitchen and 57 sq. for 2 room and kitchen. The distribution of apartment sizes is also based these data. Therefore 53 apartments are smaller ones where 17 is 1 room and kitchen while 36 is 2 room and kitchen. The remaining 47 apartments are assumed to be 3 rooms and kitchen or more with an average size of 78 sq. The construction cost is given by Parkeringsbolaget see *Table 1* and these costs are a lump sum. Due to the span the lowest and highest construction cost are calculated.

Location:	Inner City
Good public transportation:	-10%
Number of apartments:	100 apartments
Average apartment size in Gothenburg:	66 sq. per apartment

Following calculation shows the required number of parking places according to the parking ratio for a building permit given in *Table 2*:

47 apartments x 0,49 = 23 parking places
 53 smaller apartments x 0,34 = 18 parking places
 Total: 23 + 18 - 10% = **37 parking places**

The building permit requires 37 parking places in this case. The construction cost can then be calculated according to given cost in *Table 1*:

Street parking:	37 x 20 000 SEK = 740 000 SEK 37 x 30 000 SEK = 1 110 000 SEK
Garage fl. -1	37 x 300 000 SEK = 11 100 000 SEK 37 x 500 000 SEK = 18 500 000 SEK

The calculation shows that the cost when building 37 street parking places in the residential area varies between 740 000 – 1 110 000 SEK. If this instead would be built as an underground parking garage the cost would vary between 11 100 000 – 18 500 000 SEK. For a house developer, it is therefore very important that the number of required parking are estimated as precise as possible for each project, since the accumulated cost run very high per extra parking place.

The area required for a car parking depends on which type and the preconditions (Parkeringsbolaget, 2016). A parking space has a size of 2,5 x 5 m = 12,5 m² (Teknisk handbook, 2016). But this do not include additional area needed when building parking places and to access the parking. Parkeringsbolaget (2016) estimate the required area for a street parking as 25 m²/parking and 40 m²/parking in a parking house. The area given for the parking house is assumed to be the same for an underground parking garage. The total area for each car parking type and the required number of places gives following calculation:

Street parking	37 parking places x 25 m ² /parking = 925 m²
Garage fl. -1	37 parking places x 40 m ² /parking = 1480 m²

The result shows that the difference is 555 m² between the two alternatives. In conclusion, street parking is cheaper and requires less space. But as seen when examine the literature street parking are not always possible to build due to the limited space (Malmö Stad, 2010). So even if underground parking garage is much more expensive and requires more area it is usually build. On the other hand, underground parking garage do not occupy area at the street level and the building can be places above it, which gives the house developer the possibility to aim for a more attractive environment and use the space for other purpose. However, depending on the situation an underground parking garage have certain requirements i.e. entrance and ventilation which may affect the planning (Skanska, 2016).

4.2.2.1.1 Calculation when replacing all parking places with a carpool

The next step in the comparison is to replace all these 37 parking places with a carpool. As mentioned the aim is to compare how a replacement of all parking to a carpool would affect the construction cost and area. When making a replacement, an assumption is needed about how many parking places one car in a carpool would be able to cover. In the literature, this number has a quite broad span. Therefore, interviews have been of great importance to get information about what has been approved in Gothenburg, in new house construction projects. It was found 5-6 cars per car in a carpool usually are approved (Sverigehuset, 2016; Trafikkontoret, 2016). In this case, it is assumed one carpool parking can replace 6 parking places. Hence, the number of carpool places needed to replace the 37 parking places is:

$$37 / 6 = \mathbf{6 \text{ carpool places}}$$

The construction cost for 6 carpool places:

Street parking	6x20 000 SEK/parking = 120 000 SEK
	6x30 000 SEK/parking = 180 000 SEK

Garage fl. -1:	6x300 000 SEK/parking = 1 800 000 SEK
	6x500 000 SEK/parking = 3 000 000 SEK

Area needed for the carpool:

Street parking	6 parking places x 25 m ² = 150 m²
Garage fl. -1	6 parking places x 40 m ² = 240 m²

Carpool is preferable built at street level because it will make it more convenient for external users due to problems with accessibility for external users and the security to the houses (SKANSKA, 2016). However, during interviews it was mentioned carpools is a complementary solution to get a reduced parking ratio. Therefore, it has been placed in parking garages since the garage is still built to supply the residents with private parking places as well as other functions connected to the building. The result is compiled in following to get a better overview from the calculations.

Table 3. Results compiled from the calculation.

No. of parking places	37	6
Street parking	740 000 - 1 100 000 SEK	120 000 – 180 000 SEK
Garage fl. -1	11 100 000 - 18 500 000 SEK	1 800 000 - 3 000 000 SEK
Area street parking	925 m ²	150 m ²
Area parking garage fl. -1	1480 m ²	240 m ²

The two types of parking solutions in both cases will give different outcome depending on how the replacement is made. A matrix of all outcomes for both construction cost and area are shown in *Table 4.* and *Table 5.*

Table 4. Matrix showing how the construction cost and area would be affected depending on which replacement that is done.

	6 Carpool places Street parking	6 Carpool places Parking garage
37 Street parking places	Scenario 1 - (560 000-980 000) SEK -775 m ²	Scenario 2 + 700 000-2 260 000 SEK -685 m ²
37 Parking garage places	Scenario 3 - (10 920 000-18 350 000) SEK -1330 m ²	Scenario 4 - (8 100 000-16 700 000) SEK -1240 m ²

The result of the different outcome shows that the highest reduction of construction cost and area is in *Scenario 3* where 37 parking places in garage is replaced with a carpool at street level. The reduction between 10 920 000-18 350 000 SEK divided on the 100 apartments gives a saving of 109 200-183 500 SEK per apartment. The result confirms the estimation Malmö Stad (2010) made which showed 190 000 SEK could be saved. However, Åkerman & Nyblom (2014) claim replacing car parking with a carpool convey savings in construction cost around 1,2-4,2 million SEK per car in the carpool.

The least beneficial case would be to replace 37 street parking places with 6 carpool places in a parking garage. The replacement increases the construction cost with 700 000 - 2 260 000 SEK compared to the other scenarios that reduces it. The area will be reduced with 685 m² but this is the smallest reduction of all scenarios. The problems to handle accessibility and security with a carpool in a garage would also be a fact, on the other hand, it will not occupy area at street level. Then a positive aspect is that the released 925 m² could be used for other purpose. This would probably improve the attractiveness of the surrounding which in turn may increase the utility for the residents. However, the scenario could be questioned if this would weigh up the increased construction cost.

Even though the best case, *Scenario 3*, shows that the construction cost would be lower and the space could be released, it is still of great importance to consider the customers who buy the apartments. Assume the *Scenario 1* would be the case, then the saving would be 5 600-9 800 SEK per apartment. As an apartment buyer, this may not be compelling by just looking at the reduction of the apartment price. Especially, when this is a small part of the total price where data showed the square meter price in Greater Gothenburg is 33 100 SEK. *Scenario 4* maybe more compelling where the reduction is 81 000-167 000 SEK per apartment.

In conclusion, savings can be done in 3 of 4 scenarios and the area will be reduced in all cases. So, this might be a possible way of reducing the price of the apartment and give incentives to people to change their traveling behaviour. In the literature, it is also found that a house developer benefits with being the first to create concepts for low car residential areas (WSP, 2013). This can give an advantage and leading position at the housing market before the competitors. There is also a possibility to conduct a concept to separate the cost from the price of the condominium. Both concepts can lead to a higher profit in project or the possibility to realize those projects which otherwise would not be considered, due to the high cost of parking. Moreover, buyer who does not own a car benefits by getting the possibility to buy a condominium to a lower price when the parking cost is separated from it. A prerequisite for a house developer to be able to conduct some of these concepts is support from the municipality.

On the other hand, it is not only the cost and support from the municipality that are of importance. To attract those who buy apartments to use a carpool the whole utility they get from owning a car needs to be considered. The customers are in the end those who pay for the apartment and they may have certain preferences regarding car ownership and carpools which affect the demand for parking places. Hence, their preferences and requirements of parking demand decide if the apartments will be sold. Following chapter will therefore investigate this more deeply.

4.2.2.2 Calculation comparison - The cost to own a car compared with using a carpool

If a house developer could decide to implement a carpool to reduce the construction cost and use the property more efficiently, this do not mean there is a market demand for housing without car parking. The customer's preferences are essential if the house developer would be able to sell the apartments. Despite that carpooling have many proven benefits, people associate it with several "cost" factors such as increased travel time, loss of personal flexibility, and negative psychological image (Systematics, 1977). According to Gardner & Abraham (2007) there are five motives making people continue using cars; minimizing travel time, avoiding negative travel experiences, psychological effort, creating personal space, and minimizing the financial expenditures. This motive is also underpinned by a desire to have control over the travel experience. Therefore, this part will analyse customer's preferences and economic incentives that may affect their decision making when buying an apartment. Firstly, expenses to own a car versus using a carpool will be analysed. Secondly, a survey has been conducted to investigate preferences toward car ownership and the important factors when buying apartment.

In order to compare the expenses of owning a car versus using a carpool, assumptions need to be made according to traveling behaviour. In the region of *Västra Götaland* the driving length is 12 390 km/year per car (Trafikanalys, 2015). In general, a carpool is reasonable to use when the driving length is less than 11 000 km per year (bilpool.nu, 2016; Åkerman & Nyblom, 2014). The driving length per month is then in average 916 km. *Figure 4.* is schematic showing when carpool is the best choice depending on the traveling behaviour (Åkerman & Nyblom, 2014) Therefore, the assumption is made that the driving length is up to 1 000 km per month.

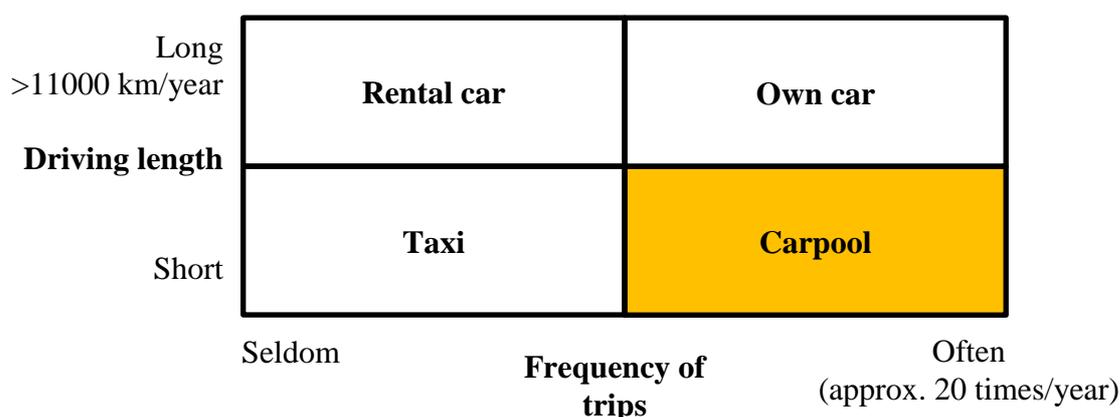


Figure 4. Schematic showing when carpool is the best choice (Åkerman & Nyblom, 2014).

The cost to use a carpool depends on the pricing model of the company. The company that have largest market shares are Sunfleet. Their pricing model, see *Table 5*, is used in the calculation. They have three types of memberships: Small, Medium and Large. Small is for those who need car seldom and Large is when a car is needed often. It cost 1-2 SEK per km including fuel and therefore the driven km has less impact on the cost. Parameters that have larger effect are which membership you choose and how many times you need to use the car as well as the type of trips is done. The choice of car model also gives an extra cost for each trip.

Table 5. Shows the pricing model for each membership Sunfleet provides.

Small	V40	V60	V70
Price per km incl. fuel	2	2	2
Price per hour	40	50	60
24 h price	439	559	679
Weekend price	519	619	819
Fixed monthly fee	169	169	169
Medium	V40	V60	V70
Price per km incl. fuel	1	1	1
Price per hour	30	40	50
24 h price	359	479	599
Weekend price	469	569	769
Fixed monthly fee	499	499	499
Large	V40	V60	V70
Price per km incl. fuel	1	1	1
Price per hour	15	25	35
24 h price	259	379	499

Weekend price	399	499	599
Fixed monthly fee	999	999	999

As seen the pricing model depends on how the members' traveling behaviour looks like. Three memberships mean they assume there are three kinds of customers with different kinds of driving behaviours. When estimating the cost to use a carpool, three driving behaviours are assumed in accordance to the membership that Sunfleet provide. These are compiled in *Table 6*. Behaviour 1 is based on a study made by Ikano (2015) where one family used carpool during a whole year. This is assumed to the driving behaviour suitable for the membership Small, which is recommended for a member who use the car seldom. Behaviour 2 is an assumed middle of Behaviour 1 and Behaviour 3 which is suitable for the membership Medium where the recommendation is that the car is used several times. Behaviour 3, is based on a traveling survey conducted by the Trafikkontoret (2015). This corresponds to a normal driving behaviour and should be suitable for membership Large where the car is used often. Important factors such as where the person lives and if the person has a job will explain differences in traveling behaviour. It was found in the survey that people in Gothenburg are in average making 3,5 trips per working day and 2,8 trips per weekend day. Summed up to a whole month, this is 92 trips. In Gothenburg 40 % of those trips are with cars. Interesting finding was that for residents living in central Gothenburg only 25% of the trips are made with car during summertime (April-September). Due to this only 23 trips are made by those living in central Gothenburg when the average is 37 trips in Gothenburg. This also gives an argument that carpool may be more reasonable for new housing project in central of Gothenburg. The average driving length is 15 km and the median driving time is 15 minutes. Therefore, most of the trips are assumed to be shorter than 3 hours for example shopping or other free-time activities.

Table 6. Three kind of driving behaviour.

	Behaviour 1	Behaviour 2	Behaviour 3
Shorter trips up to 3 h	2	10	20
Daytrips up to 12 h	0,5	1	2
Weekend trip	1	1	1
Driving length per month	600 km	800 km	1000 km
Total	4 trips	12 trips	23 trips

The research has shown that owning a new car usually cost between 5000 - 10 000 SEK per month included depreciation, fuel, insurance, taxes, maintenance and parking (bilpool.nu, 2016). Owning a smaller car may cost around 2500 - 4500 SEK (Olwan, 2015). In this study the cost to own a car is based on the website bilsvar.se where similar models to those in the carpool pricing model are used in their calculation (Bilsvar, 2016). The car expenses consider depreciation during an ownership over 5 years, driving length of 600 km, 800 km and 1000 km per month. A petrol price of 14,88 SEK per litre and fuel consumption of 5,5 litres per 100 km. As earlier mentioned in the study the parking fee in new housing construction is around 1400 SEK for an underground parking garage. Therefore, this is the assumed parking fee in this study since parking garage is often build in new housing construction located in the central of Gothenburg. All house developers interviewed also had set the cost to around 1400 SEK in their most newly projects which argument that it is reasonable. The calculation can be found in Appendix II. The result of the cost is compiled in

Table 7. In the table the cheapest alternative for each membership (driving length) is coloured.

Table 7. Cost comparison of using a carpool and owning a car.

600 km	V40	V60	V70
Carpool (Small)	2 348	2 568	2 888
Owning car from 2013	3 524	3 716	3 799
Owning car from 2016	4 508	5 441	5 533
800 km	V40	V60	V70
Carpool (Medium)	3 027	3 547	4 167
Owning car from 2013	3 688	3 880	3 963
Owning car from 2016	4 671	5 605	5 696
1000 km	V40	V60	V70
Carpool (Large)	3816	4756	5696
Owning car from 2013	3852	4043	4127
Owning car from 2016	4835	5768	5860

The result shows that carpool is the cheapest alternative when driving seldom, as Behaviour 1, and having the membership Small, regardless the model of the car. In the membership, Medium is cheaper to use a carpool when booking the V40 and V60. But if the car user required a V70 it will be cheaper to buy an older one. When comparing the membership Large with owning a car, the price for a V40 almost equal the price to own a V40 from 2013 but owning an older V60 and V70 model cost less than using a carpool. In overall, owning a car from 2016 is, not surprisingly, the most expensive alternative due to the depreciation of the new cars. But interesting is that the cost of a Large membership, in combination with Behaviour 3, gives almost the same expense as owning a V70 from 2016.

The result shows that carpool is more economical beneficial when the need is low compared to when it is high. So, if the car is required often due to circumstances in life there will still be economics incentives to own a car which in turn create a demand for parking places. Hence, it can be said that carpool from a private economical perspective is not always the best alternative. Therefore, a carpool could be a complementary solution in new house construction for residential who do not need a car often, but should be mixed up with parking places for those who requires a car more often. As the traveling survey showed from the Department of Traffic in Gothenburg (2014) residents living in central Gothenburg uses the car less seldom which also argues for that carpool might be more suitable for new housing projects in this area.

Except from the monthly cost of owning and driving the car, there are other factors that need to be considered. There will be an extra cost of building the car parking that is put on the apartment price. A deposit is usually required when purchasing a car, which requires a bigger capital (bilpool.nu, 2016). If the buyer needs to take a loan this means an interest will be added to the expenses. Another issue is handling the service of the car which may take extra time and effort.

4.2.3 Social effect

Beyond the private economical perspective, this research also wants to examine the residents' interest and attitude toward using carpool. Because the sustainable urban planning with the aim to reducing travels and car usage requires the municipality to consider how to impact people's behaviour in order to make them choose carpool (SKL & Trafikverket, 2010).

Current policies created to reduce the environmental pressure and aim for a sustainable society are not fully effective because the behavioural aspects of travellers are not sufficiently recognized (Garcia-Sierra et al. 2015). How individuals behave needs to be better captured in traditional models of economic policy. Therefore, insights from behavioural economics, which is based on economic and psychology, can contribute to a better understanding of travel behaviour and choices. Understanding behavioural economics can help to uncover the motivations, heuristics and cognitive biases behind travel behaviours (Young & Caisey, 2010). Behavioural economics in combination with social marketing builds on the premise that people will only change their behaviour if they are sufficiently motivated to do so. In turn this gives an understanding of the impact on policies. The few studies that have been done in the area show that a transition to sustainable mobility is unlikely if technological improvements and changes in the built environment are not combined with behavioural changes. Behavioural changes mean impacting peoples' travels and transportation before they have started (Boverket et al., 2015). The term includes new service concepts and carpools in cooperation with the business sector and different organizations. The purpose is to affect the attitude and behaviour to make the usage of both the physical space and infrastructure more efficient. Knowledge and awareness of the potential of actions that affect people behaviour need to be integrated during the urban planning process.

Implementing carpool in new house construction is basically seen as positive by many residents but there are misgivings that it will not work (Kupersmidt & Henriksson, 2014) The public in general is still not aware of how carpool works (Glotz-Richter, 2016). In the research made by Kupersmidt & Henriksson (2014) it is found that it is important to plan carpool nearby the resident. If the cars are parked directly outside the resident it is seen as positive from the residents, and gives an additional value. However, the study by Kupersmidt & Henriksson (2014) concluded how the residents prioritize is based on the situation and depends on circumstances in life. For example, a family with children choose to own a car when the children are young, but might be willing to sell the car when the children grow up. A 50-years old participant in the research was willing to sell the car and become a member in the carpool when she retires. In other words, a "no" from a resident today could be a "yes" tomorrow. Curiosity and interest toward mobility services such as carpool exist, especially among those without a car and among those who only uses it during the free-time (Kupersmidt & Henriksson, 2014). Experience and knowledge about carpool and other alternative mobility solutions is significantly low which reflect the uncertainty where the residents' questions if it will be working. The residents also think the management of the carpool is important and questioned how this is going to work. Therefore, actions to increase the knowledge and experience of the prospective users are important.

In the study by Kupersmidt & Henriksson (2014) it was found that parking place nearby the resident could be decisive for the habitual motorist in the choice of buying an apartment. Within this group people express that they are very satisfied with the comfort an underground parking garage in the resident offers. For example, they mention a warm car during the winter that does not need the ice scratched from the car windows, but mainly the knowledge that they have their own parking place when getting home. This means they avoid spending time to look for a vacant parking place every time they have used the car.

4.2.3.1 Survey - Condominium owners' preferences regarding purchasing a condominium, parking places, car ownership and carpool

The comparison showed there is economical beneficial for those who drive less to use a carpool. However, the potential cost saving that could be done might be weighted up by other factors, i.e. flexibility, habits, comfort and accessibility, people value higher than the economical one. Therefore, it is interesting to investigate what residents think about replacing car parking with carpool and what would make them resist this replacement. With support from Sverigehuset, a survey has been conducted and sent to residents living in Almedals terrasser, located in the central part of Gothenburg. The location counts as having good public transportation (Göteborgs Stad, 2011) and the housing cooperative has an agreement with the company Moveabout, which is a carpool with electric cars. So, the residents have access to transportation alternatives nearby, even though, all car parking places are occupied which verifies a high car ownership (Sverigehuset, 2016). What makes people who buy apartments in such central location, with close access to other transportation alternatives, still choose to own a car?

The survey where answered almost equally by women and men with the average age between 21-40 years old. The respondents are high income earners were the majority have a monthly net income over 30 000 SEK. In Sweden, the average monthly net income is 21 760 SEK (SCB, C, 2015; Ekonomifakta, 2016). A study made by Göteborgs Stad (2008) have showed the average income have a strong correlation to car ownership which is confirmed in this survey where almost 70 % owned at least one car. Even though, only 37% used it as a primary means of transportation while public transportation was most commonly used. Among those who owned a car, half of them used it primarily during their free time while 34% used it to travel to work. For example, two respondents commented the car was needed when traveling to the summerhouse. When asking those who owned a car how often they used it, the answered "on everyday basis" or "several times per week". As concluded from the cost estimation of being member in a carpool it is not private economical beneficial when using the car often. Therefore, the survey support the fact that for those who requires a car often still will prefer owning a car in front of being member in a carpool. In turn a parking place will be demanded, even though the dwelling is in the central part of Gothenburg. As a respondent commented, the car was required in work every second day and during the weekends, therefore a car parking was preferred in front of using the carpool. However, the same respondent mentioned that in few years, as a pensioner, the preferences might be different and would maybe lead to another answer.

When asking car owners how they parked their cars, parking house and parking garage was the most common way. The strongest reason was to be sure to have a

parking place when getting home, but it was also important to keep the car safe, have a low parking fee and having the car nearby. From a house developer and planner perspective this is an important factor when planning where to put parking places in new house construction. Furthermore, the apartment size in Gothenburg has a strong connection to car ownership in the central part of the city (Göteborgs Stad, 2008). This is confirmed in the survey where almost 60 % of those who owns a car lives in apartments with at least 3 room and a kitchen. This strengthen the argument that the parking demand partly can be explained by the size of apartments that is built in new housing projects. In other words, it is important to consider the apartments size when estimating the parking demand.

Regarding families, all of them lived in two rooms and a kitchen or bigger and owned at least one car. For example, one respondent commented the car was needed to drive the children to activities and school as well as driving disabled parents to health facilities. The same respondents said carpool would be preferable in 5-10 year they don't need to drive the children and parents anymore. In a study made by Kupersmidt & Henriksson (2014) the car ownership among families can be understood from interviews where for example, families with small children choose to own a car for practical reasons.

When asking the residents to grade factors for their decision-making when buying an apartment, the three important factors where; the layout of the apartment, price and fee, and the quality of materials. Other factors with high grades were good public transportation, nearness to stores and service, and car parking places. When questioned if they would be interested in buying an apartment were the car parking places, except those for visiting and disabled persons, would be replaced with a carpool 64 % said "no". Among the reasons this had to do with availability, carpool price and circumstances in life that requires owning a car. Further on, the respondents were asked to grade, on a scale 1 (not at all) to 5 (a lot), how much the decision-making would be affected if a replacement led to:

- Reduced price and fee of the condominium
- Higher quality of the condominium
- Improved public transportation
- Improved preconditions to cycle or walk
- Increased supply of shops and service nearby
- Safer and more secure city environment
- More attractive city environment
- Reduced noise from traffic

The result showed that all factors would affect the decision-making and each of them had an average grade of 3. Price, quality and public transportation had marginally higher average. Interesting about this question was that *improved public transportation* was most polarised with both most "not at all" and "very much" answers compared to the other factors. Among those who said "not at all" 50% used the car, but on the hand, 47 % those who answered "very much" did it as well. Usually argumentation for less car parking places per apartment erupt when the public transportation is regarded as good. However, it is found there is no correlation between the car ownership and the times it takes to travel with public transportation (Göteborgs Stad, 2008). This might explain the polarized answer.

Another interesting comment came from a respondent who was interested to buy an apartment where all parking places had been replaced by a carpool if this would lead to decreased price of the apartment. Though, this respondent did not have any driving licence which strengthens the reason for this prioritization. The person to not be in use of a parking place. However, this aspect interesting since recently statistic has shown young people tend to get a driving license later in life (Trafikanalys, 2012). This might affect the future parking demand among young people who is going to buy an apartment and therefore it is an important aspect when planning and building houses. Also, the interview held with HSB confirms this trend when comparing the projects in Kvillebäcken and Örgryte Torp. Kvillebäcken had in general a younger average and the parking demand was lower compared to Örgryte Torp where the average age was higher. Additionally, people moving to Örgryte had lived in houses before and had therefore using car was a habit in their everyday life.

It can be concluded from the survey that circumstances in life, such as family, work and free-time, will have a big impact on the decision making to own a car or being member in a carpool. This confirms what is found in the study by Kupersmidt & Henriksson (2014). Additionally, availability and price seem to be other aspects that affect the choice. As the cost estimation also showed it is not economical beneficial when driving often which many of the car owners do. In accordance to this the study showed that car owners prefer having a reserved parking place in a parking house or parking garage to be sure they have a place when getting home. The results are in line with the interview by the habitual motorist (Kupersmidt & Henriksson, 2014). It was important from the perspective of keeping the car save, nearby or to have a low parking fee. Since the survey only had four respondents who were member in the electric carpool, it was too few respondents to draw any conclusions from questions regarding this. Therefore, the study was not able to get any insight in how the respondents perceived being member in a carpool and how it has been working. Finally, the survey confirms statistics where the apartment size has a strong connection to car ownership, and this will in turn affect the parking demand. Hence, apartment size is an important aspect when estimating parking demand in new house construction.

4.2.3.2 Implementing carpool requires behavioural changes

Important factor when changing traveling behaviour are not only technical development, traveling, improve traveller's knowledge and travel comfort as well as values of mean of transportation (Johansson, 2001). It also requires more knowledge about how and why trips are generated in everyday life such as work, household and during free time. In behavioural economics, it is claimed the choice of means of transportation will be influenced by how alternatives are presented because individuals tend to choose the alternative that is framed as the highest gain policies (Garcia-Sierra et al. 2015).

If cities as, Gothenburg, wants to support carpool in society, awareness-raising is an absolute must (Glotz-Richter, 2016). Gothenburg can work with this by communication in regular media, using billboards and run campaigns for carpool. There is also a need to know more about how both urban planning and societal regulation affect travel planning, choice of destination and means of transportation for people (Johansson, 2001). Higher income gives better living condition for households

which increases the ownership of the car and the car traveling as well as decreases travels with public transportation. The flexibility and the possibility to choose destination favour the growth of motoring. The history behind current transport systems make it difficult and cost consuming to change. It also needs reassessment of the priority of means of transportation and transportation structure. Research has shown that when aiming for a sustainable society, technological improvements and changes in built environment need to be combined with behavioural changes.

Behaviour and people's relationship to cars seem to be an issue in the parking ratio regulation. This was discovered during an interview with HSB who works with the projects Örgryte Torp which is located nearby Gothenburg city. The parking ratio regulation was set below 1 which means there is less than one car parking per apartment. The seller of new production at HSB mentioned there has been dissatisfaction among the condominiums buyers due to the lack of parking places. Many of those who move to the area own a car and it is an important part in their everyday life. The interviewee was also responsible for the selling of apartments in Kvillebäcken. Compared to Örgryte Torp had Kvillebäcken the opposite problem since there were younger people moving into the area and they did not demand as many parking places. This give an indication that the parking demand differ between projects, even though, both are in the central part of Gothenburg. Because both projects are in the inner city, the parking ratio will not change due to the geographical location. The only parameter the parking ratio then is based on is the distribution of the size of the apartments. The seller at HSB believed there are other parameters that affect the parking demand, except from the apartment size. She mentioned factors as if the residents owned a car before, generation and circumstances in life as well as where they moved from. She believed those who moved from houses outside the city had become used to use the car, which made it more difficult to change travel behaviour. This confirms the issue with the bounded rationality in the behavioural economics theory, where daily trips are in majority based on habitual and automatic choices with low information processing.

A conclusion from this is that companies are struggling to work in accordance to the parking ratio regulation in Gothenburg. The examples show the regulation might be too simplified because in some cases the requirements are economical irrational and in other cases it do not equal the parking demand. As Lundin (2008) state regulations treat similar situations in similar ways to increase efficiency but with the consequence of being stiff an inflexible. As understood from the examples there are other factors that seem to affect the parking demand where both Lundin (2008) and Shoup (1997) argues the empirical methods used to set the parking requirements have been a simple and meagre study. There seem to be reasons to improve the parking ratio regulation and this will be presented in the next section.

4.3 Improving the parking ratio regulation

Sustainable urban planning aims to create environment where people can choose to travel in a sustainable and more efficient way (SKL & Trafikverket, 2010). A crucial aspect is that the urban planning and new house construction gives preconditions and supports sustainable traveling in the built environment. This requires another perspective, goals and working methods in the traffic, urban planning and new house construction. Economic instruments and regulations can strengthen the impact on behaviour and planning actions.

The parking ration regulation in Gothenburg, approved 2011, is based on studies made in United States during the 50th (Trafikutredningsbyrån, 2016). The parking ratio has then been reduced over time to better adapt to the Swedish society. Even though, interviewed companies still struggle with the regulation. Therefore, this study has questioned its way of working.

4.3.1 The approach of the parking ratio regulation

In Gothenburg have the municipal stated that they through the parking policy is going to support citizen in Gothenburg to choose public transportation, carpool and other environmental-friendly vehicles (Göteborgs Stad, 2009). The aim is by planning and regulation of car parking achieving the environmental quality goals and thereby support a development towards a sustainable city. When the municipality steer the urban planning, there are two approaches how to meet the future; will-controlled or forecast-driven planning (Göteborgs Stad, 2015). Forecast-driven planning is about predicting the demand and supply, meaning decisions and investments are done regarding the forecast of the future demand. For example, if the car ownership increases more parking places will be demanded. To prevent the capacity problem more parking places are built. But planning based on future prognosis risk to lead to the same problem. As seen through the history, it has been concluded, building more parking places would not be eliminate the parking problem (Lundin, 2008). The will-controlled planning aims to work proactively to develop the city in line with a vision for the city (Göteborgs Stad, 2015). In other word, the municipality work with steering the future demand in a certain direction. Traditionally Gothenburg city have work from a forecast driven perspective. On the other hand, they have a vision to be a sustainable city. This is a reason the city wants to work more and more from a will-controlled perspective.

In accordance to this the parking ratio regulation was examined and it was found it is based on a forecast-driven perspective. The building Department monitors eventual changes of the underlying variables and initiates revision when necessary (Göteborgs Stad, 2011). The monitored variables are the supply of the public transportation system and car ownership. If car ownership is changed so that there is reason to revise the forecast for future car ownership, the building Department take decision to revise the parking ratio. So, in contradiction to the cities aim to work from a will-controlled perspective this is a forecast driven perspective. This was questioned during the first interview with the Department of Traffic in Gothenburg (Trafikkontoret, 2016). They confirm the city wants to work from a more will-controlled way because they believed a parking ratio regulation based on a will-controlled approach would contribute to the city's vision to increase the investment in public transportation and reduce the car usage. However, they mention this is a complex issue and need a balance in how much steering can be done. The question how to handle the car parking is sensitive from a political point of view, since it affects people in the city. This concern about political acceptability of radical policies and resentment among the people is confirmed by Banister (1998). He claims the consequence have been to introduce policies that directly improve the attractiveness in urban areas instead of those policies that are perceived as negative, but indirectly would have a significant impact on the city's quality. Also, Kittand and Thomsen (2010) confirm the way of traveling need to change in sustainable cities, but it is difficult to achieve since the car is a natural part of peoples' lives.

4.3.2 Mobility management

The public sector needs to adapt laws and regulations to ease the development of the sharing economy (Trafikanalys, 2016). So, another way to look at carpool is that it makes it easier to steer toward a reduction of car usage without the risk to limiting people's mobility (Trafikanalys, 2016). Managing car parking through policies and strategies can support the promotion of alternatives and other sustainable means of transportation (Papa & Fistola, 2016). According to Papa and Fistola (2016) are the parking policy underestimated as a way to manage which means of transportation people choose in an urban environment. The author state car ownership depends on several conditions such as economic and social but also on the availability of a parking place near or at the dwelling. In fact, they have observed a smaller motorization in densely urban areas in larger cities due to public transport services and high real estate costs, where land is too valuable to be spent on garages. Therefore, to benefit the positive effects of carpool requires that the public-sector steer towards a sustainable transport system in the parking policy (Trafikanalys, 2016).

The development of carpool services in many cities around the world has led to a growing interest to support carpools in parking policies (Engel-Yan & Passmore, 2013). To develop a sustainable city there is a need to reduce the minimum parking requirements (WSP, 2013). The municipality might then require compensation actions from the house developer because the risk of overspill effect from parking at properties to curb parking's. Municipality will require actions from house developers to make actions, such as mobility management already in the planning phase of new construction (WSP, 2013).

Behavioural economics is important for the municipality to understand because considering behavioural changes in the design policies helps people make transport choices that are more optimal (SKL & Trafikverket, 2010). Measures done in the right way will affect people's travel behaviour and attitude toward mobility. Measures to deal with behaviour impact can be achieved through Mobility Management (MM) where information, communication, cooperation and marketing gives people knowledge and possibility to try new ways of traveling (SKL & Trafikverket, 2010).

For example, mobility management actions could be to give personal advice to people how to reduce their car usage and marketing the benefits with a carpool in the residential areas to forgo the purchase of a car. In the literature research, it was found the City of Bremen revised its parking requirements for new house construction (Glotz-Richter, 2016). The new regulation gives the house developer a choice to provide parking or offering other mobility options such as car pools. Thus, it is possible to implement carpools to reduce the number of parking spaces.

4.3.3 Flexible parking ratio regulation

Traditionally increased parking demand was addressed by enlarging the parking supply. However, in the last few years several cities all over the world have set the goal of reducing private traffic and increasing public transport, especially in metropolitan areas (Papa & Fistola, 2016). Formal rules and policy-making is of great importance in order to clarify and legitimize environmental goals. If the regulation and policies are insufficiently formulated, such as inconsistent regulation at different levels, it can constrain the environmental integration. Mostly economic instruments

are taken above the municipal decision-making but for example, parking policy and parking ratio regulation are strong instruments with big impact (SKL & Trafikverket, 2010).

In Sweden, the parking ratio regulation in Sweden is steered by the Planning and Building Act where it is written there should be reasonable with space for car parking (Trafikverket, 2013). The municipality should in the detailed development plan decide what is reasonable and it is common municipalities steers this with minimum requirements, but important to notice is that the PBA do not require minimum levels from the municipality. Glotz-Richter (2016) state that a reduction of parking spaces leads to lower construction cost which in turn can give more incentives for usage of other alternatives, supplemented by a carpool. A change in the regulation therefore helps to limit the car traffic generated by new developments. Another benefit is that the users don't have to pay for the neighbours parking place and instead have access to a carpool.

The access and the cost of a car parking affects the number of cars in a new build residential area (SOU, 2013). Current minimum requirements of parking places put high pressure on house developers to provide parking places. If these requirements increase, it will lead to increased car usage but also indirectly give a more fragmented city. The space would be needed for parking instead of building structures or using it for other purposes. As Shoup (1997) argues the empirical methods used to set parking requirements have been a simple and meagre study. The report also states that the planning of parking places does not consider the cost to provide parking. Information about the cost of parking is often missing because the municipality is not the direct actor in the financing of the parking places and therefore this issue is considered to not be needed to take a position to (Trafikutredningsbyrå, 2014). When costs are mentioned in other municipalities' parking policies it often expressed as the responsibility of the house developer to handle the costs. When examine the parking ratio regulation in Gothenburg there are no terms as such as "cost" or "price" in the document (Göteborg Stad, 2011).

Minimum parking requirements provide subsidies that influence the parking demand Shoup (1997). Then the influenced parking demand is used to set the minimum parking requirements. Shoup (1997) claims that an elimination of minimum parking requirements would reduce the cost of urban development, improve urban design, reduce car dependency, and restrain urban sprawl. A reduced parking ratio for house developers who implement a carpool program in new house construction, has potential to reduce construction cost (Engel-Yan & Passmore, 2013; Glotz-Richter, 2016; SOU, 2013). In turn incentives can be offered to support the choice of walking, cycling and public transportation in combination with carpool (Glotz-Richter, 2016). The new regulation helps to mollify the car traffic, that otherwise would be generated in new built areas. For the residents, it is also beneficial since they do not have to pay for a parking place but still have access to a car. This subvention makes it more difficult for other means of transportation to have a fair competitiveness (Trafikutredningsbyrå, 2013). The effect contradicts both implementation of effective mobility solutions and economical rational incentives for long-term sustainable choices.

Carpool companies could benefit by being supported by house developers for the service to help achieve a parking reduction. In accordance with this, house developers could market it as providing a convenient carpool. Engel-Yan & Passmore (2013) state that the access to a carpool creates incentives for residents to forgo the purchase of a vehicle or sell the car, which helps to reduce the vehicle ownership and the personal transportation costs. A reduction of car ownership also reduces the parking demand and it encourages the proliferation of carpool services.

The parking ratio regulation in Gothenburg do not quantify amount of parking places an implementation of carpool in new housing construction could replace (Göteborg Stad, 2011). Instead, the parking question turn into an assessment case where the house developer needs to prove that the project's specific parking requirements persist over time. This will be processed by administrators at the Department of City Planning and Department of traffic in Gothenburg and in the end assessed by the Building Committee. However, there are studies for example made by Trivector (2014) that argues a carpool can replace five to seven cars. However, a literature research shows that the estimated amount has a broad span. In accordance to this an interview held with a project manager from Riksbyggen states that the parking regulation should be careful to steer the amount of parking places a carpool can replace. He argues that it more depends more on the context and other parameters i.e. nearness to service, store and alternative of mobility solutions. Therefore, he argues that is it better to look to the whole context because this will affect people's everyday life and their demand of car and parking. Jakle & Sculle (2005) confirmed this in the book *Lots of parking* where the authors argue that if the distance to shopping is nearby the need for shorter and frequent trips are eliminated. In addition, the project manager at Riksbyggen claimed it is better when implementing a carpool to work from a functional perspective, where the carpool is working according to the context rather the replacing a certain amount of parking places. The report made by Trivector (2014) also shows that a well functioned carpool reduces the car ownership per household in average from 0,4 to 0,1. This supports the argument to make an assessment of the context and if the carpool is well functioned.

Municipalities with older policies tend to be stiffer and have a more general parking ratio for the whole municipality (Trafikutredningsbyrå, 2014). Recently accepted policies take into consideration the access to public transportation. The flexibility of parking ratio varies between municipalities. Many of them have a vision aiming for sustainable transportation and carpool is one alternative with a clear connection to reduction of parking ratio. There are few who supports other alternatives such as information about mobility when moving in but this do not reduce the parking ratio. Alternatives i.e. cycle pools, discounted cards for public transportation, intelligent service boxes for delivery, have not been found among the policies in the region. Today there seem to be a new trend to implement flexible parking ratio (Hasselgren, 2016). A flexible parking ratio means that the municipality can give house developers building permits for new house construction with a lower amount or more flexible parking ratio (SKL & Trafikverket, 2010, Trafikutredningsbyrå, 2014). For example, if the house developer can provide positive mobility services, such as implementation of carpools in new house construction, the municipality will give a reduction on the parking ratio (Trafikkontoret, 2011, Trafikutredningsbyrå, 2014). The solutions are meant to increase the residential mobility and decrease both the need and interest to own a car. The benefit with the flexible parking ratio is that economical resources are

used more efficiently and saves money due that fewer costly underground parking garage needs to be built. The saving could then be spent elsewhere i.e. to increase the mobility or put on actions to decrease number of trips, such as solutions for home delivery.

Svensson & Wetterstrand (2011) recon the support to public transportation and cycle roads can be ineffectual without changes of incentives for parking. The municipal minimum requirements and manipulated parking fees is therefore a subvention that worsen the economic and environment. Parking should therefore, as far as possible, be grounded in market conditions. Letting the market demand decide could lead to that the owner of the car who need a parking place pays the actual cost of the parking (Trafikutredningsbyrån, 2014). In turn, subsidizing could be avoided due to that the actual cost is revealed which probably make people start to consider alternatives and push the toward a changed travel behaviour. Therefore, it is interesting to have a more flexible parking policy for house developers that provide place for carpool (Engel-Yan & Passmore, 2013).

A flexible parking ratio is a concept that means the municipality gives the house developers the possibility to influence the number of parking places required when building new residents (Kupersmidt & Henriksson, 2014). With flexible parking ratios is the house developer able to negotiate to get a reduced parking ratio when providing so called positive mobility solutions or services such as carpool, delivery boxes or marketing. In order to create a flexible parking ratio regulation, the jurisdictions to define appropriate reduction for the local context is needed (Engel-Yan & Passmore, 2013). There are three policy recommendations for developing an appropriate parking reduction. Firstly, any flexible provisions should be tailored based on the existing parking requirements and current market conditions. Secondly, there should be a connection between the parking reduction ratio and the size of the residential. Finally, other implementation factors should be considered, such as agreements with carpools companies, carpool visibility, and marketing.

5 Discussion

This chapter will discuss the analysis of the empirical finding and theoretical framework to answer the research questions.

5.1 Reasons to implement carpool in new house construction

This study aimed to investigate implementation of a carpool in new house construction and questions the effect of the parking ratio regulation. Gothenburg city is striving toward a sustainable development and implementing carpool in new house construction would support the development. Carpool has namely the benefit to reduce the vehicle ownership, travel and parking demand, without reducing individual mobility. Therefore, there are reasons to support carpool in the parking ratio regulation.

Implementation of a carpool has the potential to reduce the construction cost. In the comparison, when all parking places required by the parking ratio regulation were replaced with a carpool, the result ended up with four scenarios. The scenario with the biggest saving would be to replace an underground garage with a carpool placed at street level. The saving would be between 10,9-18,4 Million SEK which in turn means a reduction on the apartment price with 110 000 – 184 000 SEK. From a land use perspective, it would be negative since the carpool occupies 150 m² at street level. On the other hand, it can be argued that the potential reduction of construction cost might be worth it.

It needs to be questioned how this would affect people and their mobility. Especially, for those who want to buy a new built condominium. Due to this, it was interesting to investigate if residents have incentive to become a member in carpool instead of owning a car. When comparing the expenses to own a car with a membership the result showed that carpool reduces the cost when driving seldom but when driving often owning, an older car was more economic rational. The conclusion can be draw that parking places still will be demanded from individuals who need to use the car often. In accordance to this, a survey was conducted to investigate peoples' point of view about replacing all parking places with a carpool. The result where quite surprisingly since it became very clear that owning a car has a strong intrinsic value regarding i.e. accessibility and flexibility than was thought before the study. It seems to be a very sensitive question since people do not want to be limited regarding their mobility. This shows that owning a car have an intrinsic value and this might be higher than the value of the cost reduction when using a carpool. Additionally, the survey showed that other factors such as family, economic situation, free time activities and work affect the choice. In conclusion, circumstances in life and intrinsic value will have a big impact on the choice to own a car or being member in a carpool. This indicates that parking places will be demanded which argues for that new housing construction still should have parking places.

However, both literature and the survey shows there is an interest of a carpool, especially for those who do not require a car often. From the study, it is understood that technological improvements and changes in built environment needs to be combined with behavioural changes. When owning a car, daily trips are in majority

based on habitual and automatic choices with a low information processing. A carpool has the positive effect to reduce the number of trips with 30-60% because a valuation of the positive and negative consequences with the transportation is weighted for each usage. This makes people more conscious about their behaviour which in turn reduces trips or makes them choose another mean of transportation. Therefore, carpool is positive from both an environmental and health perspective since it reduces CO₂-emission, pollution and traffic congestion.

Even though implementing carpool in new house construction would support a sustainable development. Companies are struggling with the parking ratio regulation in order to do so. The parking ratio regulation in Gothenburg seems to need improvements. Parameters such as economic rationality and behaviour changes make it questionable. However, it is still a complex issue because cars have become a natural part of peoples' life.

5.2 Why questioning the parking ratio regulation?

Gothenburg and other cities is facing big challenges to densify and use the land more efficiently as well as working with sustainability in new house construction, where economic, social and environmental factors are considered. Additionally, there are a heated debate about housing shortage, high construction cost, land prices and a too slow building process which in turn affects the apartment prices. In accordance to this, house developers work toward speeding up the pace and provide the market with affordable homes that contribute to sustainability.

The research question arose from a discussion with the house developer, *Sverigehuset*, who found that the parking ratio regulation in Gothenburg is too generalized, stiff and does not consider the economic rationality in new housing projects. Further on, it is difficult to implement positive mobility solutions such as carpool since the regulation do not quantify the number of parking places a carpool can replace. Instead this turns into an assessment case where the house developer need to prove that the project's specific parking requirements persist over time. But this does not guarantee they get a lower parking ratio because the municipality can have another view on the matter. This contradicts the work toward the city's vision of a sustainable development, where the regulation should ease and give incentives for house developer to implement positive mobility solutions. Therefore, this study wants to question if the parking policy is well formed, from an economic, social and environmental perspective.

From the beginning, parking ratio regulation was implemented to handle the mass motoring development in Sweden. The parking ratio regulation was aimed to mollify the pressure on street parking by forcing house developers to make place for car parking within the property. However, the consequence of building a city adapted to cars was never questioned. It was discovered more lately when the negative consequences became apparent. The city had become unattractive, fragmented and the free street parking places were quickly filled up with new cars. The significant problem with traffic congestion, traffic accidents and parking problems remained. Even though, there were and still are problems with cars, it has become a natural part of society and a habit in many peoples' life which makes it difficult for people to think about alternatives. The regulation formulated during this time is still a part of today's urban planning, whereupon the view has changed and the development has

gone forward. As Shoup (1997) also stated the parking ratio regulation relying on meagre research, even if it has been revised through the years. Unfortunately, regulations overall have the drawback to conserve norms and the societal context of the time it has been conducted. Hence, it is questioned if the parking ratio regulation is suitable for today's society and Gothenburg city's aim to strive toward a sustainable development.

It can be claimed regulations is too simplified and should make place for a better flexibility since the projects might have different parking demand. The argument to have a more flexible parking ratio seems to be supported. A flexible ratio would consider mentioned parameters such as the economic rationality of the parking places and how the expected parking demand is expected to be. If the regulation is too stiff and generalize all projects in the same way, as the example shows, it can lead to either vacancies or shortage of parking places which in the end will affect the cost for the residential. It may be difficult to estimate the parking demand but as house developers it might be easier because they have a better insight of the buyer preferences compared to the municipality.

Gothenburg city have a vision to build a sustainable and closer city. They want to work with a will-controlled approach because this supports a development in line with the vision. However, it is found out the parking ratio regulation have not applied this approach and is instead based on a forecast-driven perspective. It seems to be a difficult decision from a political point of view since it affects people in the society. A conclusion from this is that even if they have an intention to aim for a sustainable development, the way of working toward sustainability is not applied and communicated in the parking ratio regulation. This can be questioned because, even though it is a complex question, applying a will-controlled approach might be necessary in order to reach the vision of having a sustainable development. Hence, the study wants to argue for applying a will-controlled approach on the parking ratio regulation.

According to Lundin (2008) and Shoup (1997) is the parking ratio based on meagre research and therefore it can be questioned if it is adapted for today's context and contribute to our aim for a sustainable development. The sustainable development is an important focus for the municipality but maybe this should be better applied and communicated in the parking ratio regulation. The municipality wants to work from a will-controlled perspective but the regulation is based on forecast-driven perspective which contradicts to this. Both construction sector and governmental organization finds the regulation as stiff and rigid. A change to a more flexible parking ratio seems to be a trend among other municipalities which could be a recommendation for the municipality in Gothenburg. Finally, the overview that is going to be made by Trafikutredningsbyrån is needed.

During an interview with Trafikkontoret (2016) they stated the parking ratio regulation in Gothenburg is insufficient according to flexibility and innovation, which is one of the reasons Trafikutredningsbyrån have got the mission to make a review and create a draft by the end of the year.

5.3 Key factors for a successful implementation of carpool

From the economic perspective, it should be expected that the parking ratio regulation considers the price a car owner pay for a parking or the construction cost of providing parking places. When the regulation was examined, nothing was found about this. Therefore, this study aimed to investigate the economic issue with the regulation and the cost of building parking places as well as the effect on the parking fee. The result showed that when a house developer applies for a building permit for 100 apartments, 37 parking places is required in the inner city of Gothenburg. The construction cost to solve a parking place in an underground garage depend on the preconditions, but in general it lies between 300 000-500 000 SEK per place. In total this gives a construction cost around 11 100 000-18 500 000 SEK for 37 parking places. The problem is that the market value, or willingness to pay, for a parking place in Gothenburg does not equal the actual value of the construction cost. If the construction cost per parking place was 500 000 SEK this means the monthly cost should be around 2200 SEK per month but this do not correspond the willingness to pay. Especially this will be a consequence in peripheral areas where the parking ratio requires more parking places and the willingness to pay decrease. Regardless, the house developers are forced to build the required parking places. To handle the issue with the willingness to pay, the construction cost is spread out on all apartments. Each apartment will therefore have a higher price corresponding to 111 000-185 000 SEK and the fee is set to around 1400 SEK. Comparing this with an estimation by Malmö Stad, who ended up with 190 000 SEK, it seems reasonable and is probably closer to 185 000 SEK. This is a way of subsidizing the required parking places by increasing the price on the apartments, which few people are aware about. So, the actual cost is partly hidden whereupon the throwback is a manipulated parking demand. Further on, the manipulated parking demand set the basis for the parking ratio regulation, due to that it is forecast-driven. This insight has led to questioning if this is fair effect of how the regulation works. Hence, it can be understood that house developers interviewed during the study experience the regulation and decision taken by the municipality sometimes is economical irrational.

5.4 Flexible parking ratios

This study came to the insight that it is better to mix parking places and carpool in new house construction, because it will support the sustainable development without affecting people or limiting their mobility. Due to the conclusion to mix parking places and carpool it is recommended to make the parking ratio regulation more flexible, since the house developer probably has a better insight in people preferences and how to meet the parking demand. Flexible parking ratios mean the house developer gets the opportunity to negotiate for a lower parking ratio if other positive mobility services, such as carpool, are provided. In other words, it opens up for a better estimation of parking places and strengthens the incentives for positive mobility solutions. During the study, it has also been discovered that flexible parking ratios is a trend established among other municipalities in Sweden, which indicate it might be better adapted for today's context and strive toward a sustainable development.

5.5 Should there be a parking ratio regulation at all?

A question that has been living throughout the whole study is if the parking ratio regulation should exist at all. On the one hand, the house developer could reduce the price of the apartment by reducing the number of parking places, especially when

building underground parking garage in central locations. On the other hand, they also want to be able to sell the apartments and some people would not buy apartments without a parking place. It was speculated if this would be self-regulated or if this would lead to no parking places at all. Further on, it was discussed if parking places could be sold on a free market to the actual cost plus maintenance, similar as condominiums. This would make the actual cost for car parking fully visible and the construction of parking places would be economical rational. Probably the insight of the actual cost to buy a parking place would indirectly result in a more sustainable development. The choice would definitely be affected, since the utility to own a car would be weighed against the construction cost around 300 000 - 500 000 SEK per parking place plus expenses to buy and maintain the car. The total cost may not be worth it and be much less interesting if there were a carpool alternative. This could lead to big changes in cities and probably increase travels through walking, cycling and public transportation as well as increase the demand of other mobility solution. Also, the requirements for how cities are planned would be questioned but this recommended for further studies.

6 Conclusion

A sustainable city needs to reduce car usage, and integration of sustainable mobility solutions is needed already in the planning phase of new dwellings. The aim with the study has therefore been to investigate carpool as a mobility solution in new house construction.

It was found carpool is beneficial in order to reduce the vehicle ownership, travel and parking demand. It can also reduce the construction cost and land use which is suitable for new house construction in the central part of the city. Due to that the city of Gothenburg has the vision to strive toward a sustainable development it is reasonable to create incentives and ease implementation of carpool in the parking ratio regulation.

However, the result of the study showed circumstances in life and the car's anchoring in the society makes it to a more complex question. These factors affect the residents' choice of owning a car or using a carpool, and the result showed carpool is not preferable for everybody. A conclusion is that a mix of parking places and carpool is recommended for new house construction.

Further on the study has concluded that carpool is not easy to implement and requires a special assessment, which needs to be approved in order to get a reduced parking ratio. In addition, house developers struggle with the current regulation regarding flexibility, economical rationality and estimation of the parking demand. A consequence has been that parking places needs to be subsidized by increased prices on condominiums, which in turn have led to a manipulated parking demand.

It is concluded an improvement of the regulation is needed where the study has come up with the recommendation to apply flexible parking ratios based on a will-controlled approach. This will give house developers the opportunity to negotiate for a lower parking ratio if other positive mobility services, such as carpool, are provided. A better estimation of the parking demand would also give the opportunity to make the actual cost of parking places visible in order to eliminate the subsidizing and the manipulated parking demand. It is also recommended the regulation considers behavioural impact through mobility management. Because this affects people's travel behaviour which makes the implementation of carpool more successful.

The contribution has been to rethink the designing of new dwellings and understand that communication among different actors is important in order to create updated and well-functioning regulations. Hopefully this can create a debate about how create incentives in regulations to strive for a sustainable development in the built environment.

6.1 Suggestion for further research

This study came to the insight that it is better to mix parking places and carpool in new house construction. Further studies are requested about how to distribute places between those alternatives, without limiting the mobility of the residents. Furthermore, it would be interesting to compare carpool with other positive mobility solutions that could be integrated in new house construction.

Due to the recommendation to make the actual cost of car parking visible it is interesting to see how the revealed cost of the parking places would affect the car ownership among people in the central part of the city. If parking places also would

be separated from the price of the condominium it is also interesting to evaluate how a lowered price of the condominium would affect the interest for the apartment. Therefore, it is suggested to make further studies within this field.

Another suggestion is to investigate how to formulate the parking ratio regulation, as well as other regulations, in order to be well-functioning and steer toward a sustainable development. Because changes in the regulation will have a long-term impact in the society which makes it of great importance.

Finally, the study has raised more questions about how urban planning and infrastructure could affect residents' everyday life and their need of cars. Building a society where walking, cycling and public transportation are prioritized would probably affect people's choice of means of transportation and the need to use car at all.

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Phoneinterviews

Anders Johansson (Project manager of Brf Viva, Riksbyggen) Interviewed by the author 29th August 2016

Karin Pollak (Seller, HSB) Interviewed by the author 29th August 2016

Magnus Thölén (Sales director region west, Veidekke) Interviewed by the author 29th August 2016

Maria Stenström (CEO, Parkeringsbolaget) Interviewed by the author 21th September 2016

Pelle Envall (CEO, Trafikutredningsbyrån) Interviewed by the author 14th of September 2016

Olof Holmgren (Business developer manager, Sunfleet) Interviewed by the author 5th of September 2016

Interviews

Alexander Sjöberg (Project manager sustainable mobility, Göteborgs Stads Trafikontoret) & David Backelin (Project manager sustainable mobility, Göteborgs Stads Trafikontoret) interview by the author 1st of September 2016

Elin Chytraeus (Project manager, Skanska) Interview by the author 2nd of September 2016

Jonas Gustafson (CEO, Sverigehuset) & Anna Henriksson (Deputy CEO/Legal Counsel, Sverigehuset) meetings with author during the whole study process.

Lina Olsson (Project manager, CLOSER) Interview by the author 9th of September 2016

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Appendix I – Commonly used interview questions

- Do you work with ongoing projects or have done projects where carpool has been implemented? How have the process worked out?
- How much does a car parking cost?
- Street parking
- Parking in an underground garage?
- What is the parking fee set to in new house construction?
- How many parking places have been replaced by the carpool?
- What do you think about implementing carpool in new house construction?
- What effect would an implementation of carpool in new house construction has?
- How do you perceive the parking policy and the parking ratio regulation?
- Do you think the policy and regulation need to be improved?
- Have you recon some characteristics of people who require a car parking compared to those who not require one?

Appendix II - Calculation of private expenses to own a car and use a carpool

Volvo v40

Behaviour 1	small	h	Trips	
Price per km incl. fuel	2			1200
Price per hour	40	3	2	240
24 h price	439		1	220
Weekend price	519		1	519
Fixed monthly fee	169			169
Total				2348
Behaviour 2	medium	h	Trips	
Price per km incl. fuel	1			800
Price per hour	30	3	10	900
24 h price	359		1	359
Weekend price	469		1	469
Fixed monthly fee	499			499
Total				3027
Behaviour 3	large	h	Trips	
Price per km incl. fuel	1		1000	1000
			km	
Price per hour	15	3	20	900
24 h price	259		2	518
Weekend price	399		1	399
Fixed monthly fee	999			999
Total				3816

Volvo v60

	small	h	trips	
Price per km incl. fuel	2			1200
Price per hour	50	3	2	300
24 h price	559		1	280
Weekend price	619		1	619
Fixed monthly fee	169			169
Total				2568
	medium	h	trips	
Price per km incl. fuel	1			800
Price per hour	40	3	10	1200
24 h price	479		1	479
Weekend price	569		1	569
Fixed monthly fee	499			499
Total				3547
	large	h	trips	
Price per km incl. fuel	1			1000
Price per hour	25	3	20	1500

<i>24 h price</i>	379	2	758
<i>Weekend price</i>	499	1	499
<i>Fixed monthly fee</i>	999		999
Total			4756

Volvo v70

	small	h	trips	
<i>Price per km incl. fuel</i>	2			1200
<i>Price per hour</i>	60	3	2	360
<i>24 h price</i>	679		1	340
<i>Weekend price</i>	819		1	819
<i>Fixed monthly fee</i>	169			169
Total				2888
	medium	h	trips	800
<i>Price per km incl. fuel</i>	1			800
<i>Price per hour</i>	50	3	10	1500
<i>24 h price</i>	599		1	599
<i>Weekend price</i>	769		1	769
<i>Fixed monthly fee</i>	499			499
Total				4167
	large	h	trips	
<i>Price per km incl. fuel</i>	1			1000
<i>Price per hour</i>	35	3	20	2100
<i>24 h price</i>	499		2	998
<i>Weekend price</i>	599		1	599
<i>Fixed monthly fee</i>	999			999
Total				5696

Appendix III - Survey questions

1. Välj det alternativ som stämmer in på dig
Man
Kvinna
Annat
2. Hur gammal är du?
Under 20 år
21-30 år
31-40 år
41 - 50 år
51 - 60 år
61 år eller mer
3. Vad är din månadsinkomst?
Under 10 000 kr
10 000 - 15 000 kr
15 000 - 20 000 kr
20 000 - 30 000 kr
30 000 - 40 000 kr
40 000 eller mer
4. Hur många personer är ni i hushållet?
Vuxnast
Barnst
5. Hur stor lägenhet bor ni i?
1 rok
2 rok
3 rok
4 rok
5 rok
6. Hur viktigt är följande vid köp av bostadsrätt? (1-inte alls, 6-mycket viktigt)
Planlösning
1 2 3 4 5 6
Kvalité på material i bostaden
1 2 3 4 5 6
Pris och avgift
1 2 3 4 5 6
Nära till butik och service
1 2 3 4 5 6
Nära till arbetet
1 2 3 4 5 6
Nära till arbetet
1 2 3 4 5 6
Nära till skola

- | | | | | | | |
|--|----------------------------------|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | Nära till familj/vänner | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | Nära till park- och naturområden | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | Bilparkering | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | God kollektivtrafik | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | Bra cykelvägar och cykelförråd | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
7. Vilket transportsätt använder du främst i din vardag?
 - Kollektivtrafik
 - Bil
 - Cykel
 - Gång
 - Annat
 8. Har du körkort?
 - Ja
 - Nej
 9. Äger du en bil?
 - Ja, en bil
 - Ja två bilar eller fler
 - Nej
 - Nej, men har möjlighet att låna av familj/vänner
 10. Planerar du att skaffa bil de närmaste året?
 - Nej
 - Ja, om det kommer att finnas fler parkeringsmöjligheter
 - Ja, har bara valt bort bilen tillfälligt
 - Vet ej
 - Ja, på grund av...
 11. Hur ofta använder du bilen?
 - Dagligen
 - Flera gånger i veckan
 - Enstaka gång per vecka
 - Enstaka gång per månad
 - Enstaka gång per år
 12. Vilket är det främsta ändamålet bilen används till?
 - Har behov av bil i mitt arbete
 - Har behov av bil till och från arbetet
 - Har behov av bil på fritiden
 - Har behov av bil för annat
 13. Hur parkerar du din bil idag?
 - I P-hus

- På garageplats inom kvarteret
 - På garageplats utanför kvarteret
 - På markparkering
 - På gatan
 - Annan plats
14. Varför har du valt denna parkeringsform?
- För att ha så låg parkeringskostnad som möjligt
 - För att ha så nära bilen som möjligt
 - För att skydd bilen, minska risk för inbrott, åverkan osv.
 - Ogillar att parkera i källare/parkeringshus
 - För att kunn ha uppsikt över bilen
 - För att vara säker på att ha en plats när jag är hemma
 - Det var den enda möjligheten som erbjöds
 - Annan orsak
15. Är du medlem i elbilpoolen?
- Ja
 - Nej
 - Är medlem i annan bilpool.....
16. Hur ofta använder du bilpoolen?
- Någon gång i veckan
 - Någon gång i månaden
 - Vid mer enstaka tillfällen
 - Har inte använt den än
17. Hur har medlemskapet påverkat följande
(1-minskat mycket, 3 ingen förändring, 5 ökat mycket)
- Transportkostnader
 - 1 2 3 4 5
 - Antal gånger jag använder bil
 - 1 2 3 4 5
 - Antal körda mil
 - 1 2 3 4 5
18. Skulle du kunna tänka dig att köpa en bostadsrätt där bilpool ersatt alla parkeringar, förutom besöks- och handikapparkering?
- Ja
 - Nej
 - Beror på...
19. Hur mycket skulle ditt val av bostad påverkas om en bilpool som ersatte bilparkeringar ledde till (1-inte alls, 5 väldigt mycket)
- Sänkt pris och avgift på bostadsrätten
 - 1 2 3 4 5
 - Högre kvalité på bostaden
 - 1 2 3 4 5
 - Bättre kollektivtrafik
 - 1 2 3 4 5

Bättre förutsättningar att cykla eller gå

1 2 3 4 5

Bättre utbud av butiker och service i närheten

1 2 3 4 5

Tryggare och säkrare stadsmiljö

1 2 3 4 5

Attraktivare stadsmiljö

1 2 3 4 5

Minskat buller

1 2 3 4 5

20. Finns det något annat som skulle kunna få dig att köpa en bostad i ett område med bara bilpool?

Appendix III - Interview result

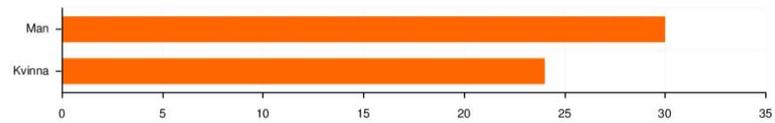
1. Välj det alternativ som stämmer in på dig *

Antal deltagare: 53

30 (56.6%): Man

24 (45.3%): Kvinna

- (0.0%): Annat



2. Hur gammal är du? *

Antal deltagare: 53

- (0.0%): under 20 år

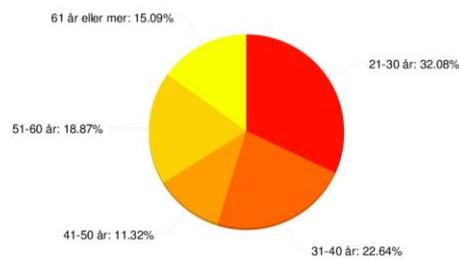
17 (32.1%): 21-30 år

12 (22.6%): 31-40 år

6 (11.3%): 41-50 år

10 (18.9%): 51-60 år

8 (15.1%): 61 år eller mer



3. Vad är din månadsinkomst? *

Antal deltagare: 53

3 (5.7%): under 10 000 kr

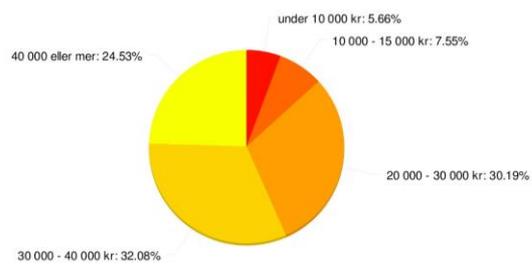
4 (7.5%): 10 000 - 15 000 kr

- (0.0%): 15 000 - 20 000 kr

16 (30.2%): 20 000 - 30 000 kr

17 (32.1%): 30 000 - 40 000 kr

13 (24.5%): 40 000 eller mer



4. Hur många personer är ni i hushållet? *

Antal deltagare: 53

	Antal	
	Σ	Ø
Vuxna	78,00	1,47
Barn (under 18 år)	11,00	0,21

5. Hur stor lägenhet bor ni i? *

Antal deltagare: 53

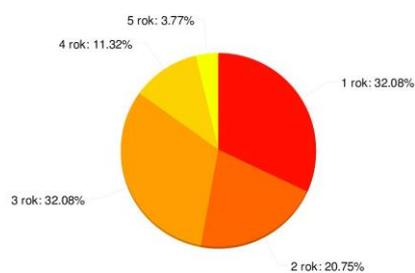
17 (32.1%): 1 rok

11 (20.8%): 2 rok

17 (32.1%): 3 rok

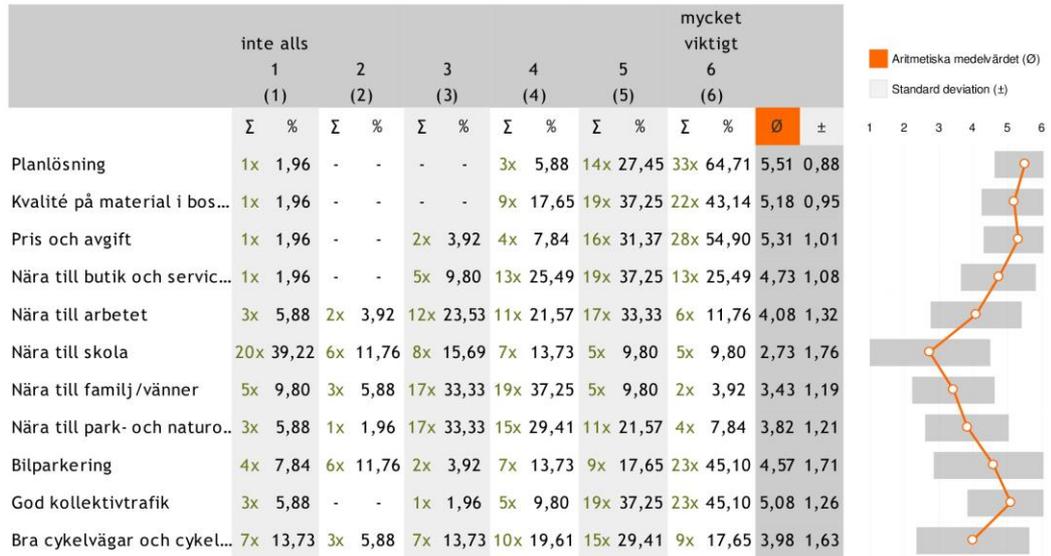
6 (11.3%): 4 rok

2 (3.8%): 5 rok



6. Hur viktigt är följande vid köp av bostadsrätt? *

Antal deltagare: 51



7. Vilket transportsätt använder du främst i din vardag? *

Antal deltagare: 51

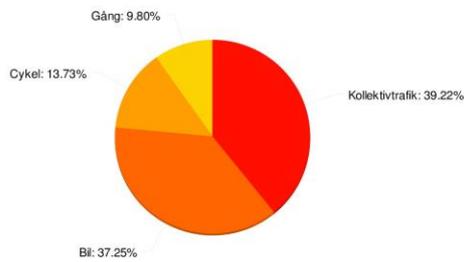
20 (39.2%): Kollektivtrafik

19 (37.3%): Bil

7 (13.7%): Cykel

5 (9.8%): Gång

- (0.0%): Annat

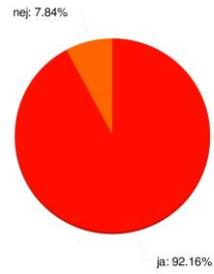


8. Har du körkort? *

Antal deltagare: 51

47 (92.2%): ja

4 (7.8%): nej



9. Äger du en bil? *

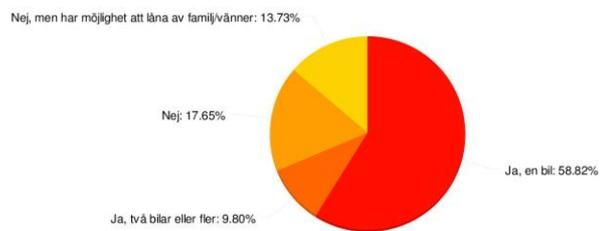
Antal deltagare: 51

30 (58.8%): Ja, en bil

5 (9.8%): Ja, två bilar eller fler

9 (17.6%): Nej

7 (13.7%): Nej, men har möjlighet att låna av familj/vänner



10. Planerar du att skaffa bil de närmaste året?

Antal deltagare: 16

13 (81.3%): nej

1 (6.3%): ja, om det kommer att finnas fler parkeringsmöjligheter

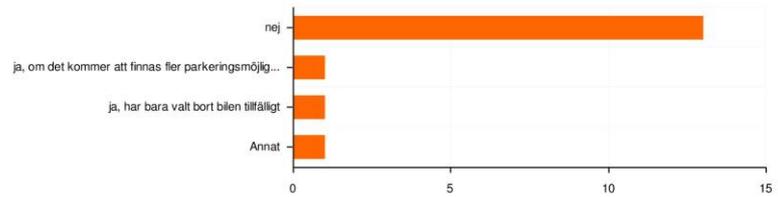
1 (6.3%): ja, har bara valt bort bilen tillfälligt

- (0.0%): Vet ej

1 (6.3%): Annat

Svar från det tillagda fältet:

- Barn.



11. Hur ofta använder du bilen?

Antal deltagare: 34

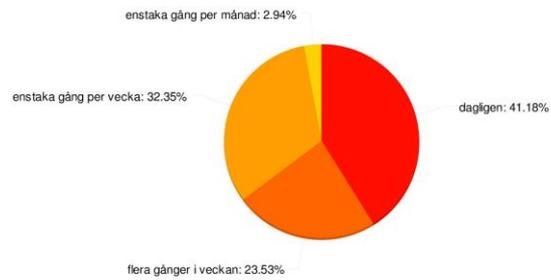
14 (41.2%): dagligen

8 (23.5%): flera gånger i veckan

11 (32.4%): enstaka gång per vecka

1 (2.9%): enstaka gång per månad

- (0.0%): enstaka gång per år



12. Vilket är det främsta ändamålet bilen används till?

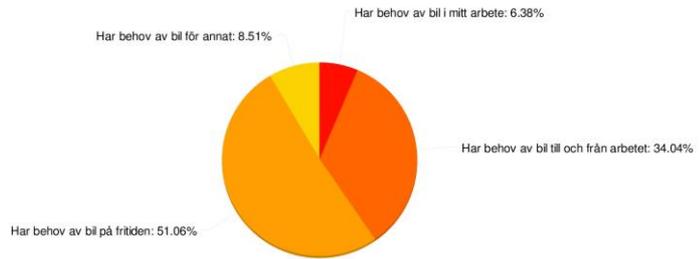
Antal deltagare: 47

3 (6.4%): Har behov av bil i mitt arbete

16 (34.0%): Har behov av bil till och från arbetet

24 (51.1%): Har behov av bil på fritiden

4 (8.5%): Har behov av bil för annat



13. Hur parkerar du din bil idag?

Antal deltagare: 34

9 (26.5%): i P-hus

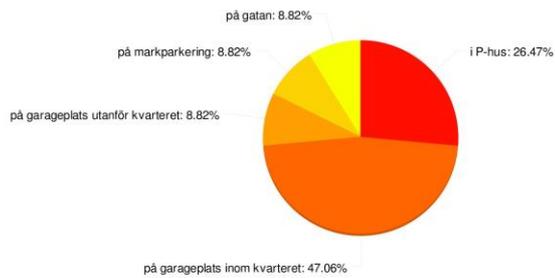
16 (47.1%): på garageplats inom kvarteret

3 (8.8%): på garageplats utanför kvarteret

3 (8.8%): på markparkering

3 (8.8%): på gatan

- (0.0%): annan plats



14. Varför har du valt denna parkeringsform?

Antal deltagare: 46

6 (13.0%): för att ha så låg parkeringskostnad som möjligt

6 (13.0%): för att ha så nära till bilen som möjligt

6 (13.0%): för att skydda bilen, minska risk för inbrott, åverkan osv.

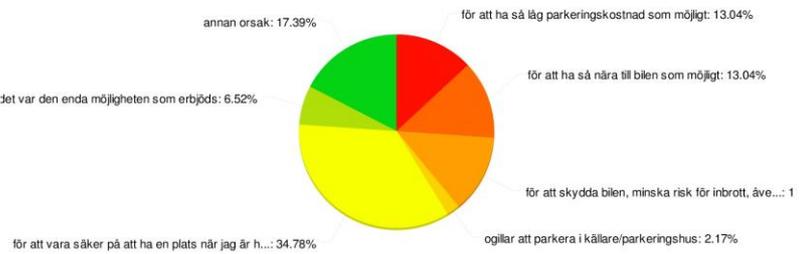
1 (2.2%): ogillar att parkera i källare/parkeringshus

- (0.0%): för att kunna ha uppsikt över bilen

16 (34.8%): för att vara säker på att ha en plats när jag är hemma

3 (6.5%): det var den enda möjligheten som erbjöds

8 (17.4%): annan orsak



15. Är du medlem i elbilpoolen?

Antal deltagare: 49

4 (8.2%): Ja

45 (91.8%): Nej

- (0.0%): Annat



16. Hur ofta använder du bilpoolen?

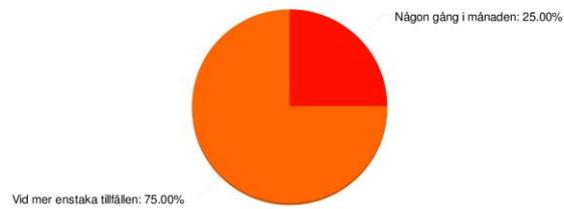
Antal deltagare: 4

- (0.0%): Någon gång i veckan

1 (25.0%): Någon gång i månaden

3 (75.0%): Vid mer enstaka tillfällen

- (0.0%): Har inte använt den än



17. Hur har medlemskapet påverkat följande

Antal deltagare: 24



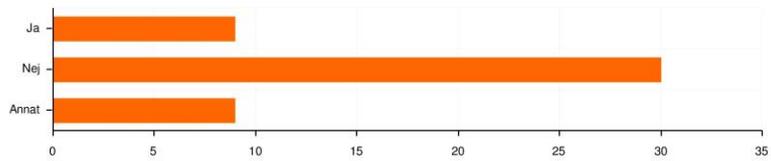
18. Skulle du kunna tänka dig att köpa en bostadsrätt där bilpool ersatt alla parkeringar, förutom besöks- och handikapparkering? *

Antal deltagare: 47

9 (19.1%): Ja

30 (63.8%): Nej

9 (19.1%): Annat



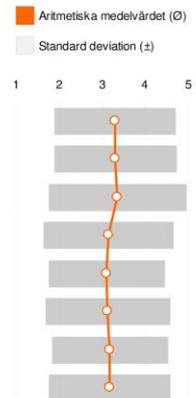
Svar från det tillagda fältet:

- tillgängligheten av bilar
- Bilpool priser
- Om priserna på bilpoolen är såpass förmånliga att det blir lönsamt, samt att det nästan går en bil per lgh, lite mindre.
- Måste ha bil då jag arbetar på annan ort, annars hade jag självklart använt bilpoolen som är en jättebra idé.
- Om jag har eller kommer skaffa en bil nej
- om jag har behov av egen bil. Isåfall vill jag ha egen parkering nära bostaden
- om jag är beroende av bil elelr inte
- bilpool kostnad
- tillgänglighet och kostnaden

19. Hur mycket skulle ditt val av bostad påverkas om en bilpool som ersatte bilparkeringar ledde till

Antal deltagare: 44

	inte alls				väldigt mycket					Ø	±	1	2	3	4	5	
	1	2	3	4	5												
	(1)	(2)	(3)	(4)	(5)												
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%							
Sänkt pris och avgift på b...	8x	18,60	3x	6,98	10x	23,26	12x	27,91	10x	23,26	3,30	1,41					
Högre kvalitet på bostaden	7x	16,28	6x	13,95	8x	18,60	11x	25,58	11x	25,58	3,30	1,42					
Bättre kollektivtrafik	11x	25,58	1x	2,33	8x	18,60	8x	18,60	15x	34,88	3,35	1,60					
Bättre förutsättningar at...	10x	23,81	4x	9,52	8x	19,05	10x	23,81	10x	23,81	3,14	1,51					
Bättre utbud av butiker o...	8x	19,05	4x	9,52	13x	30,95	10x	23,81	7x	16,67	3,10	1,34					
Tryggare och säkrare sta...	9x	21,43	5x	11,90	9x	21,43	10x	23,81	9x	21,43	3,12	1,45					
Attraktivare stadsmiljö	7x	16,67	5x	11,90	12x	28,57	10x	23,81	8x	19,05	3,17	1,34					
Minskat buller	9x	21,43	3x	7,14	10x	23,81	12x	28,57	8x	19,05	3,17	1,41					



20. Finns det något annat som skulle kunna få dig att köpa en bostad i ett område med bara bilpool?

Antal deltagare: 11

- i och med att jag under några år framåt har en bil så måste jag ha den någonstans, och då spelar p-möjlighet större roll än bilpool. Men om några år, som pensionär, kanske jag tycker annorlunda.
- Absolut inte. Skulle aldrig få för mig att göra något så korkat
- Absolut inget! Skulle inte vara intresserad då vi har sommarhus som gör att vi behöver bil!
- I dagsläget behöver jag bil för skjuts av barn till skolor och aktiviteter, samt skjuts av handikappade föräldrar till olika vårdinstanser. Kan INTE tänka mig att bo någonstans där jag inte har bestämt parkeringsplats.
Dock vill jag tillägga att den dagen jag inte behöver skjutsa barn och föräldrar (inom 5-10 år) skulle jag mycket gärna välja bilpool framför egen bil och då hade svaren på dina frågor blivit helt annorlunda!
Så jag tror inte på enbart bilpool, det finns för många av oss som faktiskt måste ha egen bil och egen parkering, i alla fall under vissa faser i livet.
Lycka till!
- nej
- Om jag har garanterad åtkomst till bil när jag vill och till ett väldigt billigt pris kan det vara värt att överväga. Min vardag ställer höga krav på tillgänglighet till bil och behöva boka upp dagar eller timmar i förväg är inget alternativ.
- Har inget körkort - om priset därför blir lägre eftersom att det är färre parkeringar är det ett stort plus.
- Jag är inte intresserad av bara bilpool. Vår familj behöver bil för att komma till vårt lantställe och skulle aldrig köpa med bara bilpool. Vi använder cykel och kollektivtrafiken då det är möjligt och vill använda bil när så behövs.
- Måste ha en bil bära anslutning till bostaden då jag använder den varannan dag i jobbet samt på helg. Föredrar garageplats men P-plats fungerar också.

Trevlig dag!

- Nej
- Nej.