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The effects of and attitudes toward mobility- and parking measures in Gothenburg

A case study of two municipally owned properties that implemented mobility measures in order to decrease their parking number

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DEPARTMENT OF SPACE, EARTH AND ENVIRONMENT

Chalmers University of Technology
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Physical Resource Theory
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Abstract

The increase of carbon emissions from transportation is a challenge that must be met to address the climate crisis, underscoring the importance to analyse strategies to reduce car ownership. As supported by previous research, implementation of mobility- and parking measures can be an effective strategy for reducing car ownership and usage, based on the observed relationship between these factors. The City of Gothenburg has introduced the concept of mobility agreements. The agreement enables property developers to build less parking in exchange for the implementation of alternative mobility measures such as car- or bicycle sharing. Yet evaluations of implemented measures and attitudes towards them remain limited.

This report aims to evaluate the effectiveness of implemented of mobility- and parking measures, along with residential and professional attitudes towards them. A case study was conducted in two housing properties with mobility measures implemented, utilizing surveys and interviews. Interviews were also conducted with two city officials involved in the planning process of parking and mobility measures. Residents generally expressed positive attitudes toward mobility measures, however the study identified several issues in the implementation of them. The main finding was that the interest and use of the measures was quite low in both properties. Residents stated that there was a lack of information on how and what had been implemented. In terms of car ownership, the study concludes no significant correlation between the implementation of mobility measures and a decrease in car ownership in the studied properties. At last, it was concluded that when aspiring to decrease car ownership it is important to have a holistic approach and include all aspects which affect a resident's travel habits.

Keywords: Mobility measures, Parking measures, MPR, Public transportation, Car sharing, Bicycle sharing, City development, Sustainable transportation, Mandolingatan, Nya Kvibergshuset

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Firstly, thank you to our supervisor Devon McAslan for supporting us throughout the project and dedicating many hours to meet us and reading our work. Your time, knowledge and feedback was greatly appreciated and helpful in our process. Thank you to our examiner Frances Sprei for enabling us to conduct this study and introducing us to the area of research. Additionally, Joa Ivarsson at Framtiden Byggutveckling AB and David Backelin at Exploateringsförvaltningen, deserve appreciation for agreeing to meeting with us (multiple times!) and participating in interviews. They provided us with many useful insights from the city official perspective and talked passionately about the topic. We also want to thank all survey respondents for taking the time to participate in our study, especially the seven residents who agreed to be interviewed.

Lastly, a huge cheer for ourselves. We have done a great job, and learned a lot during this journey. Keep rollin'

Julia Borgsten, Pontus Crafoord, Edvard Edsgård, Hanna Ekvall, Sofia Fredriksson, Jakob Westerback

Gothenburg, May 2024

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1
Introduction

The increase of carbon emissions from transportation is a challenge that must be met to address the climate crisis. In Sweden, the transport sector is one of the largest emitters of greenhouse gases (Statistics Sweden, 2023), where notably, 61% of these emissions are from passenger vehicles (Naturvårdsverket, n.d.). Simultaneously, the demand for passenger vehicles is expected to grow globally, potentially generating even higher rates of emissions (Mingardo et al., 2015). This underscores the importance of exploring alternative sustainable transportation modes and finding ways to decrease reliance on cars in order to lower the net emissions. Sustainable transportation refers to modes of transport that are energy-efficient, generate minimal or no emissions, and are economically viable. This includes e.g. car sharing, bike sharing and public transport (Etukudoh et al., 2024).

Previous research has concluded that there is a relationship between car ownership, car use and availability of parking in housing areas. Furthermore, there is also research showing relations between availability of workplace parking and car usage, as well as the pricing of parking as a factor (Sprei et al., 2020). More specifically, reducing the amount of parking is one way to reduce car ownership (McAslan & Sprei, 2023). Another way could be to increase the options of alternative mobility measures such as bicycle- and car sharing. In addition, studies have shown that improving the availability of public transportation can promote sustainable transportation (Vega-Gonzalo et al., 2024) (Yao et al., 2021).

There are several different sustainability strategies and agreements aiming to provide common goals and guidelines in order to decrease the emission rate. In the EU, the member states have consigned on the *Fit for 55* strategy, which is legally binding. The specifics of the strategy include a 55% reduction of CO2 emissions by 2030, and a net-zero goal by 2050, in alignment with the Paris Agreement (Europeiska rådet, 2024). To achieve these targets set for 2030, Sweden must reduce emissions from domestic transportation by 70% compared to 2010 levels. As of the end of 2022, domestic transport emissions had been reduced by approximately 34%, indicating that a further reduction of 1 million tonnes per year is necessary to meet these objectives (Naturvårdsverket, n.d.).

In Gothenburg, the transition towards a more sustainable future is reflected in the City of Gothenburg's transport strategy, dictating aims and goals for future transportation within the city (Hellberg et al., 2014). According to this strategy, the goal is to reach 35% of journeys within the City of Gothenburg being taken by foot or

by bicycle, and at least 55% of motorised journeys being made by public transport in 2035. These targets imply a doubling of journeys on foot or by bicycle, as well as by public transport. At the same time, the amount of car journeys will have to decrease by 25% (Hellberg et al., 2014).

One strategy to reach the goals for 2035 is through the City of Gothenburg's mobility agreements initiative, which enables for property developers to build less residential parking. In order to do this, alternative mobility measures such as bicycle- and car sharing must be implemented (Göteborgs Stad, 2021). As of the end of 2023, 113 properties in Gothenburg had adopted these agreements, but few evaluations have been done on the use of the different mobility measures implemented (McAslan, 2024). This bachelor's thesis will focus on studying and evaluating these mobility measures, incorporated into two recently constructed rental properties in Gothenburg and examining their effectiveness and influence on sustainable transportation behaviors.

1.1 Aim of this study

The aim of this study is to evaluate the effectiveness of implemented mobility- and parking measures, along with residents' attitudes towards them. The study will primarily focus on the mobility measures, car sharing and bicycle sharing, and parking measures such as reduced parking availability and increased parking costs. The goal is to understand how residents use and value different mobility measures and how the price of parking can affect the will to own a car. The result will lead to an increased understanding of the impact of implemented mobility measures and if they can have a positive effect in terms of increased usage of sustainable transportation, and decreased usage of private car transportation.

1.1.1 Research questions

In order to reach the aim of this study, the following research questions will be answered:

- **To what extent are the implemented mobility measures used by the residents?**
  Looking to see how, and if, the implemented mobility measures actually are used by residents.
- **What are the experiences of, and attitudes toward mobility measures?**
  Looking to evaluate the residents' experiences of the mobility measures they have access to.
- **Do mobility measures impact residents' car ownership and car use?**
  Looking to see if mobility measures can have an impact on car usage and car ownership. This includes self-estimated price sensitivity to parking prices.

- **How do city actors and building actors view the mobility measures?** Looking to understand how actors that are central to the development of the City of Gothenburg view mobility, parking, mobility measures and the mobility agreement.
- **Are there any mobility measures - not currently implemented - that actors and residents believe would reduce car usage?** Looking to see how residents and actors view the potential of mobility measures to decrease car usage.

This study will provide new knowledge and insights that can be used to apply mobility measures more efficiently in future projects connected to parking and mobility in the City of Gothenburg.

1.2 (De)limitations

It is important to note that there are certain limitations to this study. To begin with, the study only considers two residential areas in Gothenburg. This means that the results are restricted to these areas and also the limited amount of residents in each area, which may not be entirely representative for the entire Gothenburg area or other cities. In addition, both properties are developed and maintained by the same company, which might further confine the study in both which mobility measures have been chosen and how they have been implemented and maintained.

Due to the spatial and quantitative limitation of the study, qualitative interviews were held as a way to triangulate and improve the quality o the results (Flick et al., 2004). However, the number of resident interviewees was also limited, primarily by the population of residents in each property, as well as the likelihood that not all respondents wished to participate. Two officials, one from the City of Gothenburg and another from Framtiden Byggutveckling AB, of which Poseidon AB is a part of, were also interviewed to gain insights into their current approaches to mobility measures and to provide a broader perspective on the topic.

This study has a core focus on car- and bike sharing as well as accessibility for public transport. This means that some mobility measures were excluded although they exist in the properties that are studied

2
Background

The following chapter presents foundational material vital for comprehending the subject area. It includes a synthesis of previous research in the field, comprehensive reviews of relevant policies, and the identification of research gaps.

2.1 Parking regulations

The parking regulation in Europe is overall homogeneous, despite differences in characteristics between the countries (Mingardo et al., 2015). Studies done within the field shows that the development of parking regulation tend to follow a certain pattern, which can be divided into three phases. The first phase aims to address the absence of regulation by implementing basic means such as prohibiting parking in certain areas and utilizing time restrictions. Moving to the second phase, the focus is on managing the prices as a tool to shift the demand for parking. This is often done by zoning, meaning different prices for different areas. The third phase integrates the use of parking regulations in the goals and aims for the city, such as taking consideration into sustainability, social factors and effective land use (Mingardo et al., 2015).

2.1.1 Minimum parking requirements (MPR)

In many cities minimum parking requirements (MPR) is a common tool used to manage parking (Sprei et al., 2020). Minimum parking requirements represents the least amount of parking spaces that need to be built in connection with e.g. the construction of a new housing area (McAslan & Sprei, 2023). The MPR is normally decided by the city and can be dependent on factors such as accessibility, infrastructure and population density. Reducing the minimum parking requirements can be a pathway to more sustainable mobility solutions (Sprei et al., 2020). Sprei et al. have investigated sixteen housing developments with low MPR across five different countries. They observed that individuals in areas with lower MPR tend to use more sustainable transportation modes compared to individuals living in nearby housing areas with higher MPR (Sprei et al., 2020). However it is important to note that if parking is reduced and other options of mobility are not implemented it might imply less accessibility for the people living in the area (Sprei et al., 2020)(Leibling, 2014).

Minimum parking requirements have been widely accepted as a standard method to decide on parking, but there are also studies that emphasize the negative effects of using MPR. A prominent person in this field of research is the American engineer and professor, Donald Shoup. In the report *The High Cost of Free Parking* written by Shoup, there is an indication that urban planners establishes MPR in order to meet peak demand, without taking into account the actual cost of providing the required parking space or the price the drivers needs to pay for it (Shoup, 1997). Furthermore, it is discussed that the MPR are lowering the market price of parking, leading to an increased parking demand. This demand is then used to justify the establishment of even higher minimum parking requirements (MPR). MPR can significantly increase the housing development costs. According to Shoup, by removing the MPR this would decrease the expenses associated with urban development, enhance urban design, reduce reliance on automobiles, and restrain urban sprawl (Shoup, 1999).

2.1.2 Considerations of parking regulations

Further studies also highlight the importance of considering multiple factors when restricting parking. According to Antonsson et al (2017), a lowering of the parking numbers does not significantly affect the spatial parking patterns, car usage, and car ownership if it's only implemented by itself. It is not only restricted parking requirements that influence car usage, therefore it is important to have a holistic approach. Alongside restrictions in the number of parking spaces, it is also essential to increase parking prices, reduce the number of public parking spaces, and coordinate other urban planning functions with parking planning efforts (Antonson et al., 2017). Furthermore, Johansson et al (2019) emphasize that changes in car ownership and travel behaviors are influenced by various factors beyond just parking policies or mobility services, including family situations and employment status (Johansson et al., 2019).

According to Greg Marsden, there are several factors in travel behaviour which needs to be addressed when analysing the use of parking policies. Marsden states that out-of-pocket costs including fees and walking time, have a more significant impact on drivers than in-vehicle costs (Marsden, 2006). Although drivers have a sensitivity to increased walking time, there is evidence suggesting unexpectedly long walks for free parking spaces. This phenomenon indicates that unless restrictions are implemented across a broad area, parking problems will likely start occurring elsewhere. Additionally, policies that enforce restrictions in urban city centers while maintaining parking standards in the outskirts of cities can challenge the effectiveness of city center policies (Marsden, 2006). Furthermore, a study conducted in New York City revealed that there is a significant correlation between having guaranteed parking at home and an increased use of cars for commuting to work, even when public transit options are easily available for the route (Weinberger, 2012). This means that in areas with ample on-site parking, trips are disproportionately made by car, regardless off accessibility to public transit.

2.2 The cost of parking

As mentioned, the actual cost of providing parking is not regarded when deciding the minimum parking requirements. The cost is instead integrated to the overall cost of development, thereby affecting the rent long term (Shoup, 1999). Studies done by Shoup, analysing the actual cost of construction of parking in the USA, indicates that the average cost is $24,000 per parking space in above ground parking garages, while underground parking reaches $34,000 per space. This is excluding the potential land costs (Shoup, 2016). Similar to the prices estimated by Shoup in the USA, there are studies done in Stockholm, Sweden (price variations might occur between cities), estimating the prices within the same span (Naturskyddsföreningen et al., 2020). The estimated prices for constructing each type of parking in Sweden can be found in table 2.1. The estimated prices does not take into consideration that there are others costs affecting the actual total cost for parking e.g land cost, alternative cost and maintenance costs. This implies that the cost presented below is most likely an underestimate compared to the real cost of parking (Shoup, 2018).

Parking Type	**Cost Range (SEK/space)**
Paved area	10,000 - 15,000
Parking deck	50,000 - 100,000
Above-ground parking garage	100,000 - 300,000
Underground garage	350,000 - 450,000

Table 2.1: Construction costs for different parking types in Sweden (Naturskyddsföreningen et al., 2020)

Research indicates that the willingness to pay for parking falls significantly short of its actual cost (Kerttu, 2014). In order to maintain parking costs at a socially acceptable level, substantial subsidies are necessary. For instance, analyses conducted for the *Framtiden för parkering och nya bostäder* report, including cases like Norra Djurgårdsstaden in Stockholm, reveal that direct subsidies exceeding 50% are employed to align with the accepted market price (Naturskyddsföreningen et al., 2020). Consequently, these costs are distributed among all residents, leading to increased expenses irrespective of car ownership status.

2.3 Mobility in urban planning

Cars typically spend just one hour per day on the road, with the remaining 23 hours spent parked (Katona & Juhasz, 2020). Yet, urban areas often allocate disproportionate space to accommodate car traffic. For instance, in Graz, Austria, cars constitute only 47% of transportation mode share but occupy 92% of urban space designated for stationary traffic. In contrast, cyclists and pedestrians, comprising 33% of mode share, receive only 5% of urban space for amenities like benches and bicycle racks (Rye Tom et al., 2022). Another study, discusses micromobility, the

use of small-scale devices such as bicycle and scooters (Silva et al., 2021). The study emphasizes micromobility's ability to fill critical mobility gaps within the transport network, and its impact on the parking spaces. Research findings indicate that a transition from car usage to micromobility reduces the environmental impact. Also the demand for car parking can decrease, as shown by this case, with a 36% decrease, thereby freeing up urban space (Silva et al., 2021).

There are several research studies that have conclusively shown a reduction on the amount of cars owned by private households after introducing car sharing as an alternative mode of transport. It shows that in general, people also tend to reduce their car-ownership level while shifting towards more public transportation, not as much research have been made on the effects of bike sharing (Becker et al., 2018) (Klincevicius et al., 2014). Furthermore, various studies have accounted for behavioral variations between urban and suburban residents. Most of these studies have highlighted a greater inclination towards reducing car ownership among urban residents (Vega-Gonzalo et al., 2024). Additionally, research findings indicate that users of car sharing services are more likely to be in relationships, have children, lack access to a private vehicle, and live in transit-friendly neighborhoods (Mouratidis, 2022). On the other hand, Mouratidis also discovered that bike-sharing users tend to be younger, male, single, environmentally conscious, and reside in densely populated areas with convenient access to public transportation.

2.4 Accessibility

In the development of new residential areas and the regulation of parking, numerous studies highlight the correlation and significance of proximity to local amenities such as shopping, food, retail outlets, and public transportation (Ibraeva et al., 2023) (Ewing et al., 2017) (Olsen et al., 2024). Research demonstrates that increased access to these amenities effectively reduces car ownership rates and reliance on automobiles for transportation. Instead, individuals tend to opt for bicycles, public transit, or walking as preferred modes of travel (Olsen et al., 2024).

It's increasingly common for cities to strive toward developing suburbs, regions, or districts that prioritize local self-sufficiency, thereby reducing the necessity for extensive travel beyond their boundaries. Vital to achieving this goal is the provision of a stable and accessible public transportation system located within reasonable walking distance, along with the availability of essential amenities for residents in the area(Ewing et al., 2017). A type of developing strategy is Transit Oriented Development (TOD). This is based around creating thriving and dynamical areas around hubs of public transportation. A key principle of TOD is that it uses mixed-use development. This means mixing commercial, residential and other leisure areas in order to provide higher accessibility for residents and increase the use of sustainable transport modes and behaviours (Ibraeva et al., 2023).

2.5 City planning in Gothenburg

The national government in Sweden underscores the objective of achieving sustainable development in cities through the commitments outlined in Agenda 2030 and the sustainable development goals (SDG) set by the United Nations. Regarding sustainable city planning, the specific goal 11 - *Sustainable cites and communities*, is highlighted as guidance (Dahlgren Camacho & Simonsen, 2020). The goal aims to ensure affordable housing with access to basic services, while at the same time aiming to reduce the overall environmental impact of cities, by promoting sustainable urbanization and sustainable transportation (UN General Assembly, 2015).

In Sweden, the municipality has the overall responsibility over the planning of parking (Dahlgren Camacho & Simonsen, 2020). According to the Planning and Building Act (PBA), the municipality must ensure that the design of the built environment aligns with the urban or landscape aesthetics, preserves natural and cultural values, and makes sure that the overall result maintains a good standard (SFS nr: 2010:900, 2010). Furthermore, the act, §8.9.4 states, "there is suitable space on the site or in its vicinity to a reasonable extent for parking, loading and unloading of vehicles" i.e there needs to exist available parking. In addition, it is also stated that different groups of road users, such as cyclists and pedestrians should also be considered, not only the drivers. The entire traffic network should be designed in an appropriate manner and the environment should be designed for people with reduced mobility or orientation (SFS nr: 2010:900, 2010). According to PBA, the responsibility to meet the needs for private parking for residents falls on the property owner, as assessed by the municipality based on the property's use. However, when the municipality is a property owner itself, they have the responsibility over parking, for example parking close to schools, preschools, and residential facilities (SFS nr: 2010:900, 2010).

2.5.1 The parking policy in Gothenburg

In order for the City of Gothenburg to be able to achieve the requirements decided by the PBA, the city has their own parking policy (Göteborgs Stad, 2009). With regard to the goals of reducing car use by 25% in the city and increase the use of walking and cycling, the City of Gothenburg highlights three main focus areas. The areas are: good accessibility, low environmental impact, and attractive urban environments, which are interlocked with each other, see Figure 2.1. The City of Gothenburg (2009) mentions in the parking policy that accessibility is essential for the city's functionality. Improved environmental conditions including good air and minimal noise pollution are also necessary for the city's long-term sustainability. It is important that Gothenburg remains an attractive destination for both residents and businesses. To do so, according to the parking policy, the city must offer an appealing urban environment, have good environmental conditions, and good accessibility, if Gothenburg is to continue to develop as a city. A development must take place in balance ensuring that no special interest offset the others (Göteborgs Stad, 2009).

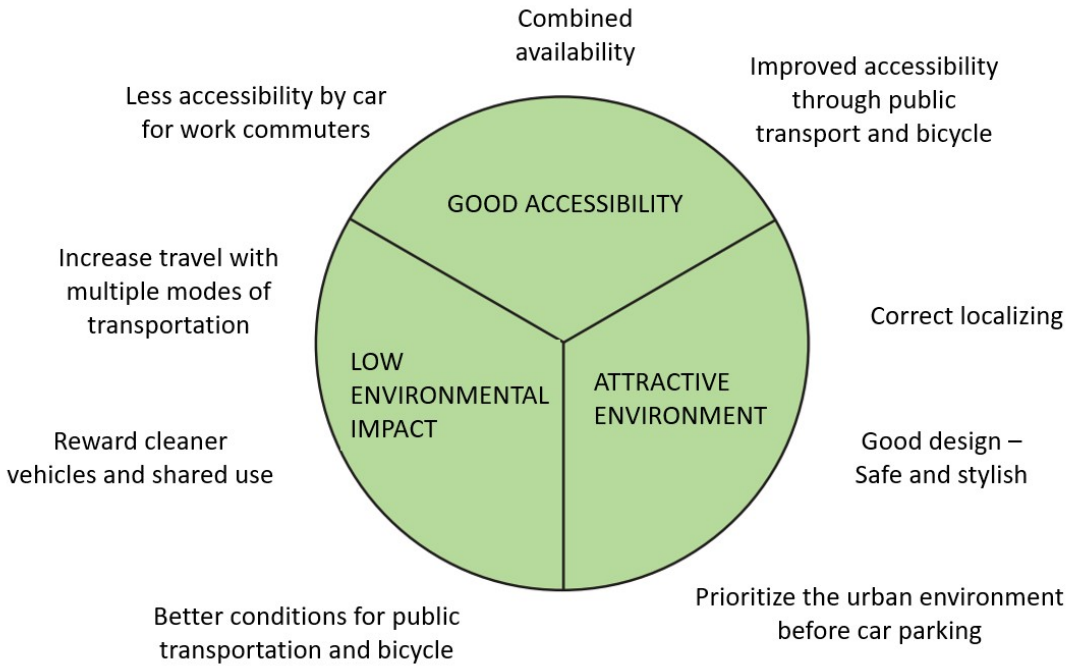

Figure 2.1: The three parts are connected: Good accessibility, low environmental impact, and an attractive urban environment. Figure retrieved from (Göteborgs Stad, 2009) and modified with permission.

Ground parking or simpler temporary parking is the most common parking facilities in Gothenburg, and it is a relatively cheap service compared to other types of parking facilities such as a parking garages (Göteborgs Stad, 2009). The problem with under-priced public parking on the street in Gothenburg is also explained in the parking policy. Similarly, studies show that if the parking on the street is much cheaper compared to residential parking, the residents will utilize street parking instead of using the residential parking provided (Eliasson & Börjesson, 2022). Different measures can be implemented in order to decrease the use of street parking as an option to residential parking, including pricing and limitation in parking time.

Residents should have access to a 24-hour parking space, according to the parking policy (Göteborgs Stad, 2009). However, it is not stated that the car park must be located directly next to the residential area. The 24-hour parking should be well integrated, secure, and adapted for the residents. Furthermore, the policy describes that the walking distance from home to a public transportation stop, and car parking should be coordinated. It should be roughly the same distance or shorter to a public transportation stop as to a parking spot. It is also stated in the parking policy that the city should encourage a shared use of cars, since sharing cars leads to a reduced amount of cars and the need for land used for car parking decreases. To encourage citizens to use car sharing services, they should be available in attractive locations in the city, both on municipal- and property land (Göteborgs Stad, 2009).

2.5.2 Guidelines for mobility and parking in Gothenburg

In order to enable property developers to use a wide range of mobility measures, the City of Gothenburg has developed a report which is called *Riktlinjer för mobilitet och parkering i Göteborgs Stad* (2018). This report intends to provide guidance for the City of Gothenburg regarding parking and mobility aspects of the planning and building permit process. The objective of these guidelines is to ensure consistent management of mobility and parking. The guidelines state that a parking- and mobility investigation has to be conducted before receiving a building permit. The assessment of parking demand, and therefore parking numbers is divided into four steps, see Figure 2.2.

However, mobility measures are an optional part if the property developer is interested in reducing their parking number even further. Also, the parking numbers and requirements will vary from each project based on factors such as the project's location in the city, its specific conditions, and agreed mobility measures. These factors will influence the assessment of appropriate space for parking (Göteborgs Stad, 2018).

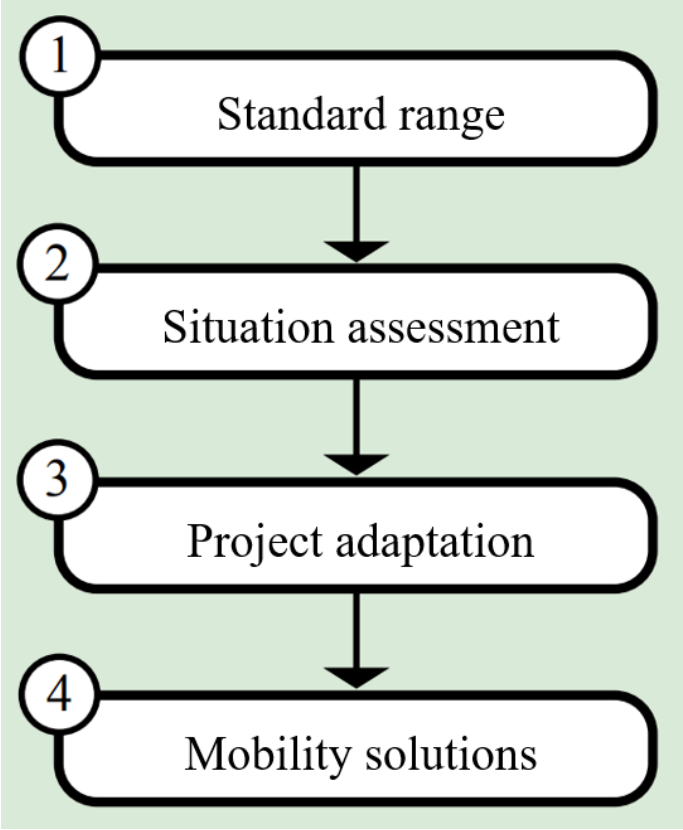

Figure 2.2: The parking number is based on these four steps: Normal span, situation assessment, project adaption and mobility solutions. Figure retrieved from (Göteborgs Stad, 2018) and modified with permission.

The first step is to assess in which parking zone the property is located in order to determine the standard range for the parking number. The municipality of Gothenburg is divided into five zones (A-E) with a standard range for parking numbers for apartment buildings, see Figure 2.3. The inner city including Älvstaden is part of area A together with the extended inner city and strategic hubs. Area B includes areas that are prioritized for the development of the middle city, and area C contains the middle city in general. Other parts of Gothenburg's mainland are in area D and archipelago with no physical connection to the mainland is part of area E (Göteborgs Stad, 2018). The different zones are the basis for the assessment of the appropriate parking number for cars in the area. The parking number is defined by the standard range and describes the amount of parking spaces per residence or per Gross Floor Area (GFA), *Bruttoarea* in Swedish. GFA represents the total floor area and is limited by the outer boundaries of the building structure, according to the guidelines(Göteborgs Stad, 2018). Typically, the final parking number in the area A-E should end up within the range in Figure 2.3. The higher value in the standard range of parking is the starting point for the project specific assessment of mobility and parking, as seen in Figure 2.4. Note that this value includes parking spots for visitors.

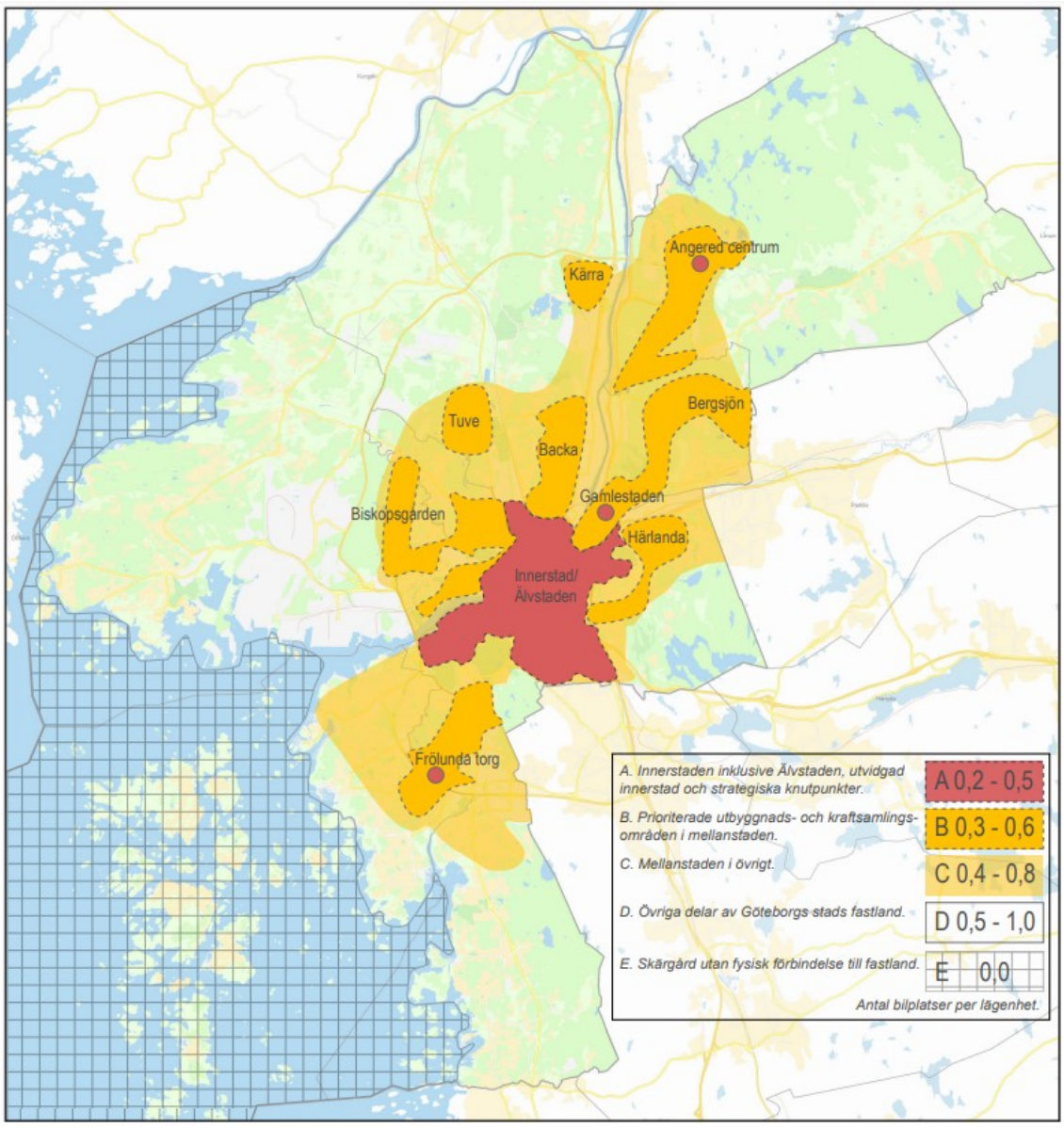

Figure 2.3: Standard range for parking number for apartment buildings, number of parking spaces per apartment in different zones. Figure retrieved from (Göteborgs Stad, 2018) with permission.

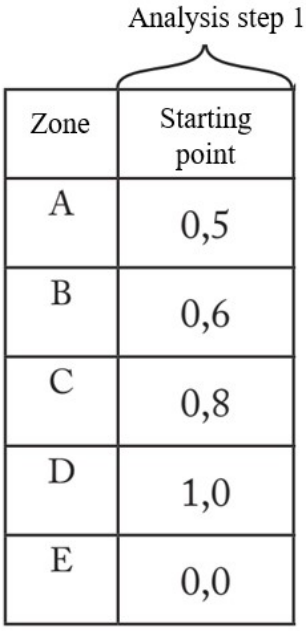

Figure 2.4: Starting values for parking numbers in the different zones for analysis step 1 - The normal range, for apartment buildings. Figure retrieved from (Göteborgs Stad, 2021) and modified with permission.

The second step is the situation assessment. In this step, the specific location is analyzed in more detail together with its overall accessibility. The area is evaluated in terms of proximity to public transportation, bicycle infrastructure, and proximity to other services and societal functions. If found to be adequate, the parking number will be lowered compared to the starting point (Göteborgs Stad, 2018). In zone A and B, a reduction of the parking number with 0.05 is be applied if the overall accessibility is good, and in zone C and D a reduction of 0.1 is applied. If zone C and D is in direct proximity to a large district center, a reduction of 0.05 is recommended in zone C and a 0.1 reduction in zone D. The possible parking number reductions are shown in Figure 2.5.

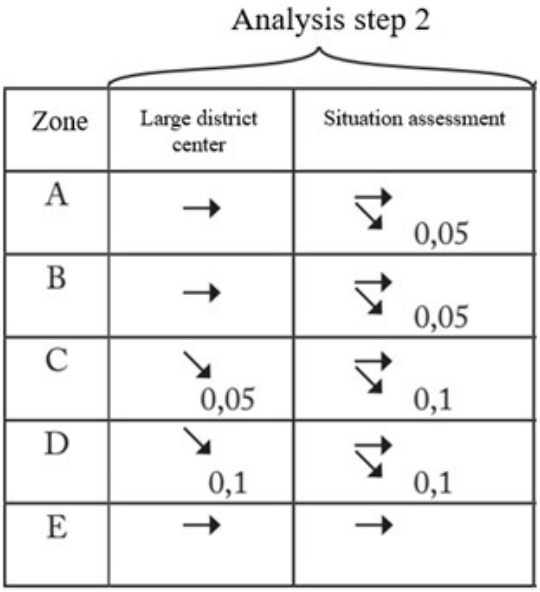

Figure 2.5: Based on the situation assessment the reduction of parking spaces for apartment buildings differs depending on what zone the project is located in. Figure retrieved from (Göteborgs Stad, 2021) and modified with permission.

In step three, project adaption, the project's specific conditions are evaluated. This includes aspects like the intended types of apartments or the opportunities for shared use of vehicles. The number of parking spaces can be reduced or increased depending on the result of the project assessment (Göteborgs Stad, 2018). For example, if 75 percent of the apartments are mainly small, at most 50 square meters, the parking number can be reduced. Furthermore, if the opportunities for shared car spaces or other project-specific conditions in the area are good, a further reduction can be made. However, if the property consist of more than 25 percent large apartments with at least 4 rooms and/or the opportunities for shared car spaces is poor, the parking number can be increased. Figure 2.6 shows the possible parking number reduction or increase for each zone.

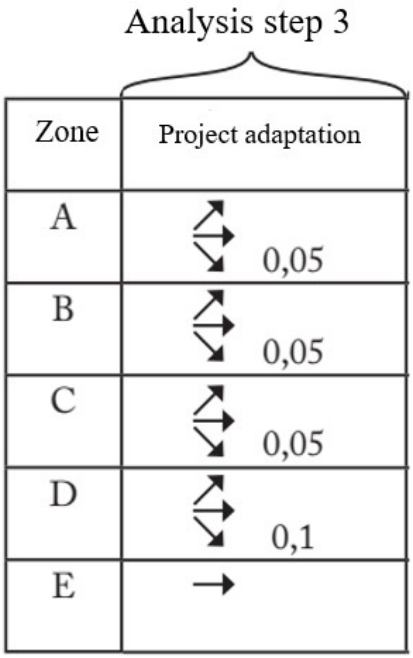

Figure 2.6: The analysis step 3- Project adaption gives different reductions/increases depending on the zone in which the project is located in. Figure retrieved from (Göteborgs Stad, 2021) and modified with permission.

2.5.3 The City of Gothenburg's mobility agreements

The fourth and last step of the assessment is the mobility solutions, which is the focus of this bachelor thesis. Mobility solutions, or measures, are a voluntary offer to reduce the parking number even more after step 1–3 is completed (Göteborgs Stad, 2021). A mobility agreement between the municipality and the property owner can be established which covers a period of at least ten years. The aim of the mobility agreement is to enable property owners to decrease the parking number by implementing mobility measures. The goal is to offer residents more sustainable, accessible, and easy use transportation modes than the car. This is intended to lead to reduced dependency of private cars. Furthermore, these measures aim to contribute to a good economic viability for the property owners and creates a more appealing urban environment.

How great the reduction of parking spots will be can be calculated using a model, commonly visualized by a pyramid, see Figure 2.7. Every tier of this pyramid is a set of measures that, if implemented together, will reduce the MPR by some additional factor. The property developer can achieve anywhere from a 0.05 to 0.2 reduction, using this process.

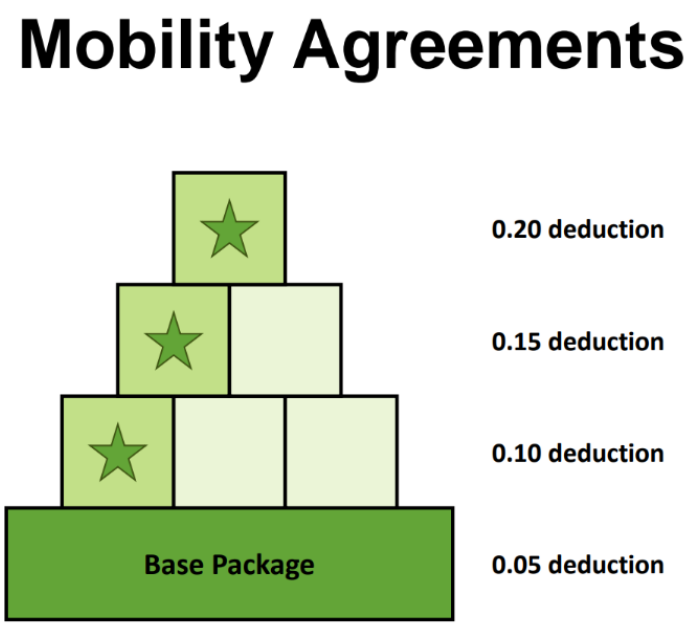

Figure 2.7: The mobility agreements model of the City of Gothenburg. Figure retrieved from (Göteborgs Stad, 2021) and modified with permission.

Here follows a list of every possible measure to on the. If the resident owner manages to do all steps, is it not possible to reduce the MPR further.

1. The first step is to complete the base package which is achieved by implementing all the measures noted on Figure 2.8. Doing that will lead to a deduction of 0.05 parking spaces per apartment.

2. The next step (deduction of 0.10 parking spaces per apartment) is achieved by implementing three of the measures from the list in Figure 2.9 one of which has to be marked with a star.

3. If two more measures are implemented, one of which with a star, MPR can be reduced by 0.15 parking spaces per apartment.

4. The last step is to implement one more measure, marked with a star. That will lead to a deduction of 0.20 parking spaces per apartment.

Additionally, the guidelines mention the importance to evaluate how the mobility measures work in practice in order to increase the knowledge how different measures can decrease the demand for car parking (Göteborgs Stad, 2021).

Category	Measure
Information	**Starter package for new movers**
	Current information about mobility
Public transport	**Free public transport ticket 30 days**
Bike	**Extra good bicycle parking**
	Cargo bike parking (2018-2021)
Car	**Limitation of fixed car parking spaces**
	The car parking rental is reported separately
	Car share spaces
Other	**Mobility manager**

Figure 2.8: Mobility measures that resident owners need to implement in order to achieve the base package. Figure retrieved from (Göteborgs Stad, 2021) and modified with permission.

Category	Measure	Stars
Information	**Annual mobility activity**	
Public transport	**Real-time boards for public transport**	
	Free public transport ticket 90 days (previously 1-year free option)	*
Bike	**Area for bicycle service**	
	Bike share with special **/ Cargo bikes**	*
Car	**Limit on fixed parking (extended)**	
	Discount on car sharing (previously membership)	
	Car sharing vehicles (became * in 2021)	*
	Collective car parking facilities	*
Other	Reduce travel **/ Delivery services / Shared offices**	
	Digital service for mobility (2021)	*
	Open mobility solutions (2021)	*
	The property owner's own proposal	(*)

Figure 2.9: Mobility measures that resident owners need to implement in order to achieve the star packages i.e. the top three layers of the pyramid. Figure retrieved from (Göteborgs Stad, 2021) and modified with permission.

2.6 Research gap

As presented in this chapter, significant advancements have been made in research concerning parking regulation, alternative mobility measures, and other factors that impact car ownership and usage. However, there are still several research gaps identified.

According to Gillmen and Gräsberg, who have conducted research specifically on parking standards in Gothenburg, it is important to conduct further studies on the actual outcome of the implementation of new parking standards (Gillmén & Gräsberg, 2014). In addition, Marsden highlights an issue in understanding how citizens react to parking policies. He states that this lack of understanding can impact the effectiveness of implemented parking- and mobility policies and regulations. as well as the consequences in these reactions also have a clear statement (Marsden, 2006). Accordning to Marsden, Understanding these factors is crucial for developing future urban transportation strategies and policies.

Furthermore, existing literature primarily focuses on the impact of car sharing on vehicle ownership levels and consistently finds a significant reduction in car ownership associated with these services. However, further research is needed to explore the influence of other shared mobility options such as scooter-sharing and bike-sharing, as well as the collective impact of all shared mobility services as a comprehensive system (Vega-Gonzalo et al., 2024). Moreover, Gillmen and Gräsberg also propose that the attitudes towards shared mobility measures should be further investigated (Gillmén & Gräsberg, 2014). This research gap puts the following study in context, which aims to evaluate mobility measures and parking solutions.

3
Method

The following chapter describes the methodology of the project, with incorporate both quantitative as well as qualitative methods to achieve the objectives. The methods utilized include a survey, interviews, statistical data analysis and a case study. Literature studies have been conducted throughout the whole project to further develop our understanding of previous research, different policies in the City of Gothenburg, and the areas where the surveyed properties are located.

3.1 Literature review

The project started with a literature review of previous research in the area of parking- and mobility. This also included a review of policy documents from the City of Gothenburg. The knowledge from the literature review was used to help identify a reasonable entry for the aim and scope of this project. Additionally, the previous research was used to construct an informative background and introduction to the subject. Furthermore, it served as a tool to deepen our understanding of mobility- and parking measures, and how such has been studied in the past. Identifying relevant previous research was made partly with help from our supervisor who presented a plethora of available research within mainly the topics of parking- and mobility measures. Previous research was also found by using the Research Rabbit tool, and by reading research papers published by e.g. Francis Sprei in order to find other similar papers that may support the report. Other platforms such as Google Scholar was also used to find suitable research papers by searching with keywords such as; "parking policy", "minimum parking requirements", "MPR", "mobility solutions", "mobility agreements", etc.

Throughout the duration of the project, documents from the City of Gothenburg have been reviewed, in addition to scientific research papers. This includes documentation on parking- and mobility. Especially *Riktlinjer för mobilitet och parkering i Göteborgs Stad* (2021) where the guidelines for mobility and parking are stated, and explained as a part of the city planning (Göteborgs Stad, 2021). For the area descriptions, information was primarily sourced from the parking- and mobility investigations for Mandolingatan and Nya Kvibergshuset (Framtiden Byggutveckling AB, 2017)(Bostads AB Poseidon et al., 2018).

3.2 The Survey

The main data collection was done through a survey that was distributed to the residents of Mandolingatan and Nya Kvibergshuset. The aim of the survey was to understand the travel behaviour of the residents, and to evaluate how well the mobility measures have been implemented and the residents attitudes towards them. The residents were also asked questions about other possible mobility measures than those currently implemented.

3.2.1 Survey Design

The survey was created in *Microsoft Forms* and all respondents were required to answer it online. The survey was tested multiple times in order to ensure its' feasibility and to make sure the time it took to answer was reasonable. After testing and evaluating, the survey was reviewed again and a final version was decided upon.

The survey is divided into six different sections:

1. Questions about socio-demographics and general travel behavior
2. Questions for residents that has a car
3. Questions for residents without a car
4. Questions about the car sharing service
5. Questions about the bicycle sharing service
6. Questions about the attractiveness of mobility measures.

The survey begins by mapping the respondents socio-demographics with questions about: age, gender, occupation, household size and household income, together with their general travel behaviour for several types of transportation. Residents who have their own car got to answer questions about when and how they use their car, how much they pay for parking and how much they would be willing to pay for parking before they consider getting rid of their car. Residents without their own car got to answer questions about why they do not have one.

The main focus of the survey was to understand the usage of, and attitudes toward, the mobility measures implemented in the respondent's property. This part of the survey focused particularly on the car- and bicycle sharing. Lastly, the survey contained questions about the attractiveness of mobility measures and if the residents had any other mobility measures that they though could decrease their car dependence. At the final stage, residents who wanted to participate in an interview were encouraged to leave their contact information. All respondents were anonymous, and no information that can connect answers to specific respondents is stored in the data collection. Further information on the survey questions can be found in Appendix A.4.

3.2.2 Integrity and managing personal information

Evaluation on how to execute the survey in terms of participant integrity has been done. The survey contained questions concerning participants age, occupation and income in relation to their mobility habits. Therefore, all participants remained anonymous in their answers and participation was voluntary. When distributing the surveys, the first plan was to do so through email with the help of Poseidon AB. However, in conversations with representatives from the company, it was concluded that email distribution would be difficult in terms of *GDPR* and handling personal information. Therefore, *Poseidon AB* instead provided access to the properties and surveys were handed out directly to participants and left in mailboxes.

3.2.3 Survey Distribution

Permission to distribute the survey was received by personnel at Poseidon, and the content of the survey was approved as well.

An informative flyer was created. The flyer contained information about the project and the reason why we wanted answers from the residents. The flyer contained a QR-code and a URL-link, that linked to the online survey. The first flyer was only in Swedish, and the second version distributed included information in Swedish on one side, and English on the other side. Two separate survey links were created, one for *Mandolingatan*, and one for *Nya Kvibergshuset*. This way, it was possible to keep track of the amount of responses from the different properties, as well as allowing us to compare the responses between the properties.

In order to distribute the survey, two strategies were used. Firstly, we visited both areas to put flyers in mailboxes. In order to access the entrance and mailboxes, the property managers allowed us to borrow keys. Flyers were distributed in all mailboxes of both properties. Secondly, we also used an intercept survey approach by standing outside entrances handing out flyers, and asking residents to answer the survey directly with us. Together these strategies ensured that the information and the flyers only reached out the the residents of the selected properties. Furthermore, residents were actively encouraged on site to answer the survey within the second approach. If they did, they got candy or soda in exchange for showing us that they submitted the survey. This proved to be a fairly effective strategy in order to collect answers.

The procedure described was executed two times per property. Mandolingatan was visited the first time 2024-03-21 and the second time 2024-04-15. Nya Kvibergshuset was visited the first time 2024-03-26 and the second time 2024-04-17. The survey was closed on 2024-04-24.

3.3 Interviews

In order to deepen our understanding of parking and mobility issues, in-depth interviews were conducted with seven residents and two city officials.

3.3.1 Interviews with residents

Interviews were conducted with seven residents. Four of whom reside at Nya Kvibergshuset, and three whom reside at Mandolingatan. The interviewees were from three different age groups, were both male and female, had different household sizes, and consisted of both car owners and non car owners. Therefore, the interviewees can be assumed to represent a good sample of the residents in the two properties. Regarding the amount of interviews, there is no need for a specific number in order to be representative, since the purpose of the interviews differs from the survey. The interviews are used to further understand experiences and circumstances within the area studied.

Interviewees were contacted through email or text message and asked to reply with a date, a time and a method that would suit them. Interviewees could choose between an interview through telephone or a video-call through *Zoom* or *Microsoft Teams*. Each interview was conducted by at least two group members and were approximately 20-30 minutes long. Each interview aimed to thoroughly investigate the travel behaviour of the interviewee in greater detail, and to discuss their opinions and thoughts on the mobility measures implemented in their property. All interviewees were assured their answers will remain anonymous. All interviewees gave consent for us to voice-record the interview. The interview questions can be found in Appendix A.1.

3.3.2 Interviews with city officials

In order to understand how the City of Gothenburg views and works with the mobility agreements in practice, interviews were conducted with two people. The first was Joa Ivarsson, Head of Sustainability at Framtiden Byggutveckling AB. Framtiden Byggutveckling AB is a municipally owned company that initiates, develops, and produces housing for for the citizens of Gothenburg. The second interview was with David Backelin, Project Manager in Sustainable Mobility at Exploateringsförvaltningen, which is an administrative unit in the City of Gothenburg. Its primary task and responsibility is to exploit the municipally owned land in order to develop the City of Gothenburg in a sustainable way.

These interviews aimed to create an understanding of how leading actors in the city view and work with mobility agreements, parking, and mobility solutions. The interviews also investigated the overall perception these two actors have of the implemented measures, their learning's from working with them for the past few years, and how they view the process going forward. Both participants were asked whether they consider the mobility agreements to be an effective solution for promoting sus-

tainable travel, or if there are alternative methods or business models that should be explored further. The interview questions can be found in Appendix A.2, and Appendix A.3.

3.4 Analysis

To achieve the project's objectives, information was derived from statistics of the residential areas, the survey and the interviews. This was put together as the results of the project. The results were then analyzed in order to create the discussion and conclusion of the project.

3.4.1 Analyzing the residential areas

Statistics from SCB and the City of Gothenburg were analyzed to get an understanding of the residential areas in which the two studied properties are located. Factors looked at were of a socio-demographic matter. This was done in order to have underlying data that could be compared to the collected survey data. Furthermore, building permits and mobility investigations for both properties were studied in order to gain an understanding of the parking situation and implementation of mobility services.

3.4.2 Analyzing the survey results

Upon the conclusion of the survey, the collected data was analyzed. The primary objective of the analysis was to identify common themes among residents' responses and to compare them with the area-specific data. Using factors such car ownership, parking availability and travel behaviors, possible statistical correlations were studied. Since the survey answers and collected data was in Swedish, careful considerations have been made when translating and analyzing the result, in order to do it in an unbiased way.

The statistical analysis of the survey in this study utilized a confidence level of 95% and a margin of error of 10%. The sample size was determined based on these parameters, calculated from the total population size. To achieve a 95% confidence level and a margin of error of 10%, a sample size of approximately 86 individuals was calculated using the standard statistical formula:

$$n = \frac{(Z_{\text{score}})^2 \times p \times (1-p)}{E^2}$$

To apply finite population correction, the corrected sample size n' is:

$$n' = \frac{n}{1 + \frac{(Z_{\text{score}})^2 \times p \times (1-p)}{E^2} \times N}$$

Where:

- Z_{score} is the Z-score corresponding to the desired confidence level.
- p is the estimated population proportion.

- E is the margin of error.
- N is the population size.

This sample size ensures that the sample used, is likely to represent the true population values within the specified margin of error.

3.4.3 Analyzing the interviews made with residents

The primary objective in analyzing the interviews with residents was to compare and expand/complement the survey with further insights. The findings from the seven conducted interviews were set side by side, in order to identify common opinions. The interviews are presented both individually and as prevalent key findings.

3.4.4 Analyzing the interviews made with city officials

The findings from the survey and interviews with residents were compared to those from the interviews with Framtiden Byggutveckling AB and Exploateringsforvälatningen, in order to see whether the involved actors share similar thoughts and experiences, or not.

4

Area descriptions

The areas chosen for evaluation are the two finished housing properties Mandolingatan and Nya Kvibergshuset, located in the areas marked with red in figure 4.1. Both properties were developed by Framtiden Byggutveckling AB which is owned by the city of Gothenburg.(Bostads AB Poseidon, 2022a) The properties are owned and administered by Bostads AB Poseidon which is also a part of Framtiden AB. The properties were chosen for this study due to the fact that they both are built with a green profile and aim to promote sustainable living (Bostads AB Poseidon, 2021, 2022b). Specifically, both properties have implemented several mobility measures in order to encourage residents to more sustainable means of transportation. By implementing a car- and bike sharing, both properties have been able to decrease their parking number in accordance with the city's guidelines (Göteborgs Stad, 2011) (Bostads AB Poseidon et al., 2018) (Framtiden Byggutveckling AB, 2017).

The following chapter provides an overview of the two properties where the study was conducted. Statistics regarding demographics are presented as well as information about the parking situation and implemented mobility measures in each area. The aim of this is to establish an understanding of the characteristics and differences of the two selected locations.

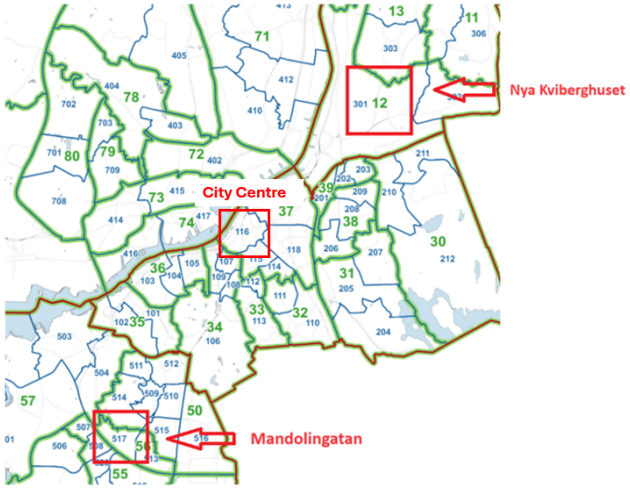

Figure 4.1: Map over parts of Gothenburg. The areas marked in red indicate the areas for evaluation. Image: Göteborgs stadsledningskontor.

4.1 Statistical overview

As seen in figure 4.1, the areas of study differ geographically. However, there are also demographic differences. The city of Gothenburg has divided the city into different regions, in order to organize statistics. Mandolingatan is located in the area: 03 Southwest, 56 Frölunda-Tofta, 517 Frölunda Torg. Nya Kvibergshuset is located on Beväringsgatan, in area: 01 Northeast, 12 Gamlestaden-Utby, 301 Gamlestaden as seen in figure 4.1. (Stadsledningskontoret, n.d.). All statistics presented below are collected from the statistical database, provided by the City of Gothenburg. The information found in the database is compiled by Statistiska Centralbyrån (SCB) in between 2021-2022, depending on the specific category of statistics (Statistik och Analys stadsledningskontoret Göteborgs Stad, n.d.). All statistics used are the most recent to be published and aims to give a brief overview of the residents in the area and their characteristics. It is also important to note that this statistical analysis does not include data specific to the evaluated properties, Mandolingatan and Nya Kvibergshuset, but only regarding the larger areas in which they are located. This is important to regard when compering the statistical area data to the survey responses.

The main demographic difference between the two areas is ethnicity and country of birth as seen in Figure 4.2 and 4.3. Gamlestaden has a slightly higher amount of citizens with a foreign background than Gothenburg in general. Furthermore, Frölunda Torg has the highest percentage of citizens with foreign backgrounds and a foreign country of birth, in comparison with both Gamlestaden and Gothenburg in general.

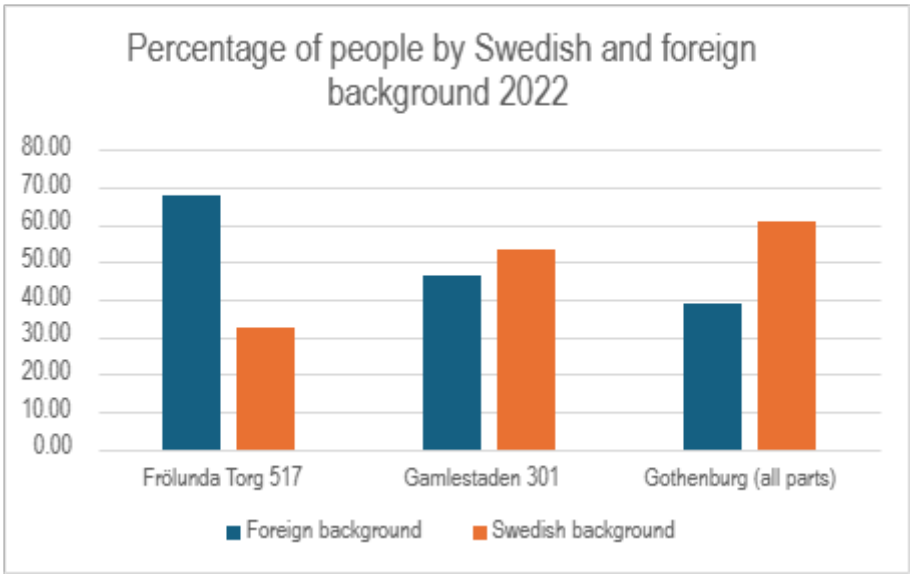

Figure 4.2: Percentage of people by Swedish and foreign background for the compared areas 2022.

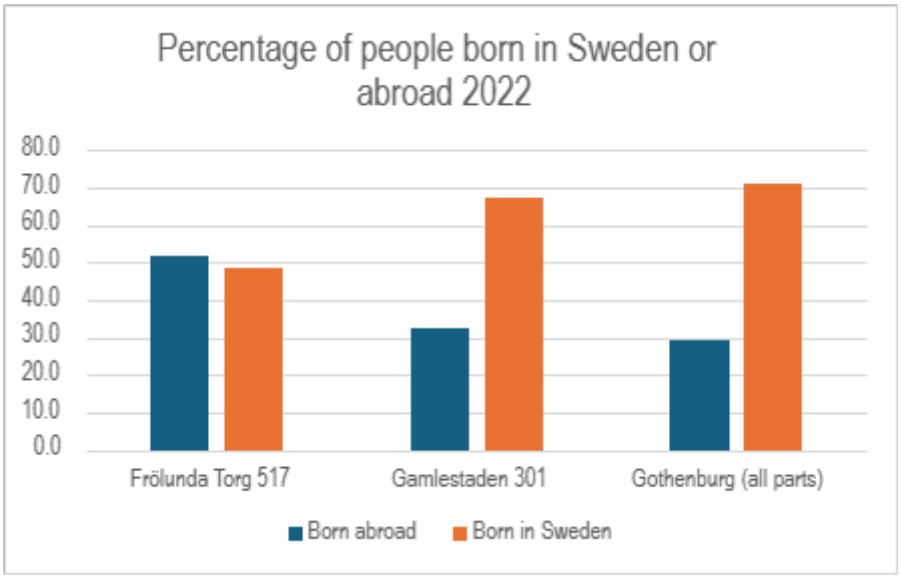

Figure 4.3: Percentage of people born in Sweden or abroad for the compared areas 2022. Data source (Statistik och Analys stadsledningskontoret Göteborgs Stad, n.d.).

Other demographic differences of the two areas are income, occupation and age, as displayed in figures 4.4, 4.5 and 4.6. Gamlestaden has a slightly lower median and average income than Gothenburg in general. Frölunda Torg has the lowest median and average income of the areas studied. Furthermore, the main source of income for all citizens over the age of 18 years is displayed in figure 4.5. It is apparent that Gamlestaden has a higher rate of students than both Frölunda Torg and Gothenburg in general as well as a lower rate of age pensioners. This correlates with the data displayed in figure 4.6 which shows Gamlestaden to have the highest rate of people in the ages 18-44 as well as the lowest in the ranges 45-80+. It is also noted in figure 4.5 that Frölunda Torg has more citizens in the categories; missing income, financial assistance, labor marker policy measure, unemployed and early retiree.

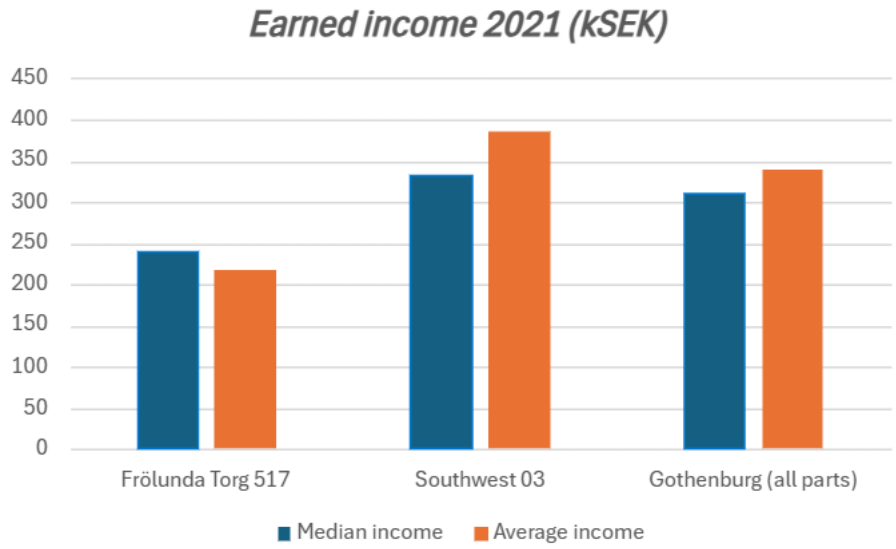

Figure 4.4: Earned income 2021, regardless of education levels and gender. Data source (Statistik och Analys stadsledningskontoret Göteborgs Stad, n.d.).

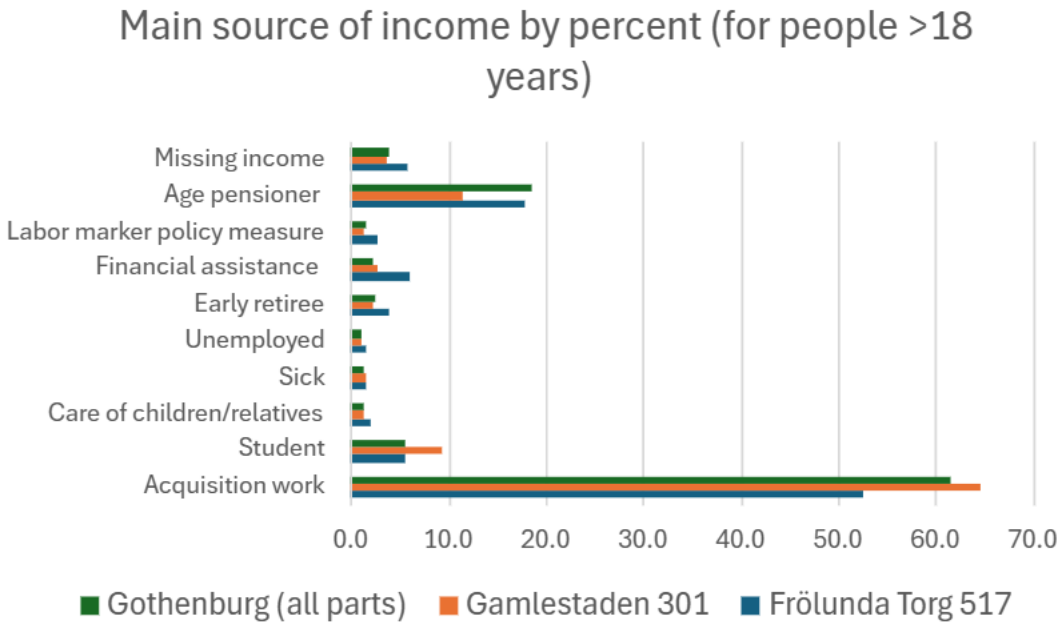

Figure 4.5: Main source of income for all groups of people over 18 years living in the areas. Data source (Statistik och Analys stadsledningskontoret Göteborgs Stad, n.d.).

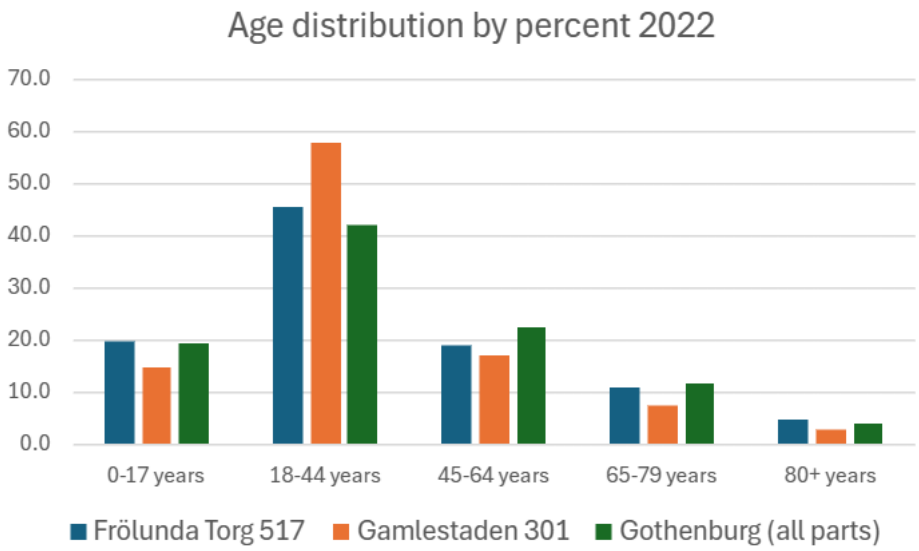

Figure 4.6: Age distribution of the population in the areas. The numbers are presented by % of the full population for each area. Data source (Statistik och Analys stadsledningskontoret Göteborgs Stad, n.d.).

Lastly, Figure 4.1 illustrates the ratio between population and car ownership in each area as well as Gothenburg in general. It is noted that there is a small difference in cars per person in the two studied areas. Frölunda Torg has a slightly lower rate of car ownership than Gamlestaden, both areas are lower in comparison to Gothenburg in general.

Area	Population	Number of cars	Cars/person
Gothenburg (ll parts)	596841	165964	0,278
Gamlestaden 301	11816	2648	0,224
Frölunda torg 517	7875	1427	0,181

Table 4.1: The population, number of cars (owned by natural persons), as well as the calculated cars/person, in each area. Data source (Statistik och Analys stadsledningskontoret Göteborgs Stad, n.d.).

4.2 Mandolingatan

Mandolingatan is a newly built residential area located in the district of Västra Frölunda, an area situated within the southwest district of Gothenburg municipality as seen in 4.1. According to the City of Gothenburg, Frölunda is selected as a strategic area for development, with the goal of making it an even stronger core region of the city, thereby giving rise to even further development regarding accessibility in the future (Ekström Finskud, n.d.). The new residential area, which can be seen in figure 4.7, consists of four blocks with a total of 528 apartments for rent. The apartments come in various sizes, from 1 RoK to 4 RoK, providing a possible diversity in tenants. The prices for rent ranges from around 6 000 - 14 000 SEK/-

month, depending on size (Framtiden Byggutveckling AB, 2022). In addition to the apartments for rent, there are also other premises for rent, such as offices and retail spaces, located on the ground floor of the buildings (Framtiden Byggutveckling AB, 2022). The blocks were built between 2019-2023, by the contractors: Skanska Sverige AB, Veidekke Entreprenad AB and Byggnads AB Tornstaden (Bostads AB Poseidon, 2021). A fifth block with 38 apartments is also planned (Framtiden Byggutveckling AB, n.d.).

Figure 4.7: Aerial view of Mandolingatan and its surroundings. Areas marked in yellow are already completed properties and the area marked in red is planned construction as part of the project. Image: Lantmäteriet.

4.2.1 The area and its surroundings

The area in which Mandolingatan is located, together with and adjacent areas, provides good access to service- and societal functions, as well as closeness to nature and sports. The area is close to multiple major transport connections, both regarding public transport, as well as roads. The good accessibility makes the area well-suited for its purpose (Framtiden Byggutveckling AB, 2017). Within the distance of one kilometer, residents have access to services such as healthcare, pharmacies, insurance and tax offices, schools and preschools, supermarkets, banks, shopping and sports in diverse forms. The service and societal functions can be seen in figure 4.8. Within the larger radius, 3-4 kilometers, there is also several outdoor baths in the sea, which can be reached either by public transport or other means of transportation (Bordier, 2017).

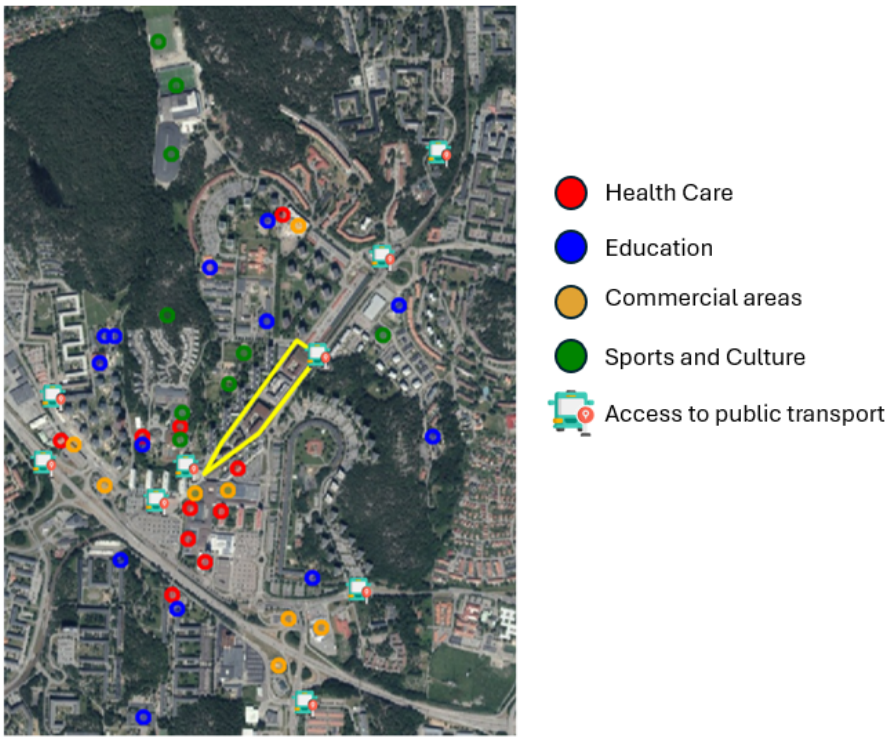

Figure 4.8: Service- and societal functions close to Mandolingatan, marked with yellow. The functions are divided into different categories, in order to give a clear picture of the area and its accessibility. Image: Lantmäteriet.

The area is classified as an area with "fairly good access to public transport". According to the guidelines set by the city of Gothenburg this makes it possible to get deductions in MPR (Framtiden Byggutveckling AB, 2017). As seen in figure 4.8 there are several public transport stops in close proximity to the residential area. The closest stops are frequented by both trams and busses, all with frequent departures. There are currently 3 tramlines in the area, all with various end-locations around Gothenburg. By tram, the estimated time to reach the central station in Gothenburg is approximately 20 minutes. In addition to the trams, there are also 22 bus lines, routing to and from the area (Västtraffik, 2024). The two stops located the closest are named Frölunda Torg and Positivgatan, both located within 400 meters from the most central point of the four apartment complexes (Framtiden Byggutveckling AB, 2017).

In addition to the different means of public transportation, there is also a good infrastructure regarding alternative green travel options, such as walking and cycling. As seen in figure 4.9, there are several bicycle lanes that lead from the area toward the more central parts of the city. Along the paths there is access to both pumping stations and the municipal bicycle sharing service: Styr & Ställ. According to the bicycle planning tool provided by Trafiken.nu, the quickest route from Frölunda Torg to the central station is approximately 30 minutes (Trafiken.nu, 2024).

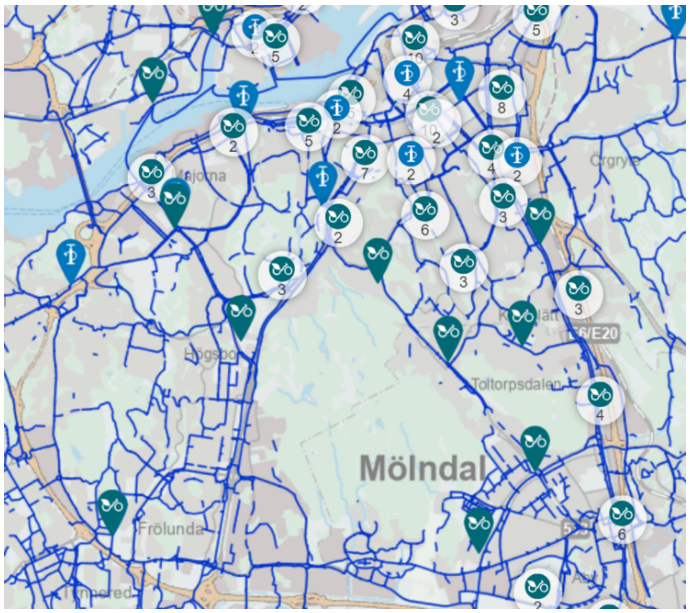

Figure 4.9: Map showing the infrastructure for bicycling in Gothenburg. Image: Trafiken.nu.

4.2.2 Parking situation

The ground on which the new complex, Mandolingatan, is built, was previously used as parking, holding 490 parking spaces for tenants living in the already pre-existing neighbourhood (Framtiden Byggutveckling AB, 2017). Before the construction, the existing parking lot had a vacancy rate of 30%. The previous parking was accounted for in the production of the new complex, which provides parking within the new buildings, both as parking decks and underground parking.

The area is located within parking zone A, regarding the standard range for parking numbers (described in section 2.5.2), which sets the foundation for the calculation of required parking within the area (Göteborgs Stad, 2021). As part of the detailed plan for the construction of the complex, a parking investigation was conducted. The investigation includes calculations regarding the legal regulations for parking, including parking for apartments, both new and existing, as well as for other premises.

The required parking is calculated with the factor 0.46 for smaller apartments (1-2 RoK), 0.65 for bigger apartments (3-5 RoK) and 0.07 as factor for visitor parking. Regarding parking for bicycles the factors 2.5 and 3 is used respectively. Table 4.2 shows a summary of the total parking calculated with these reductions, according to the the mobility investigation (Framtiden Byggutveckling AB, 2022). Furthermore, the final parking required is also regulated by deductions for mobility measures (see specifics in section 2.5.2) and access to public transport. Further reductions are possible for the implementation of mobility measures as well as proximity to public transportation. According to the mobility agreement, the amount of parking can be reduced by 20% for mobility measures and an additional 5% for the access to public transport (Framtiden Byggutveckling AB, 2017). The final parking requirements,

including the further reductions, are also presented in Table 4.2. Final amount of parking is calculated to 690 parking spots for cars.

Category	**Number of Apartments**	**Parking spots required (Cars)**	**Parking spots required (Bicycles)**
New construction			
1 RoK	165	$165 \times 0.46 + 165 \times 0.07 = 87.45$	$165 \times 2.5 = 412.5$
2 RoK	269	$269 \times 0.46 + 269 \times 0.07 = 142.57$	$269 \times 2.5 = 672.5$
3 RoK	107	$107 \times 0.65 + 107 \times 0.07 = 77.04$	$107 \times 3 = 321$
4 RoK	25	$25 \times 0.65 + 25 \times 0.07 = 18$	$25 \times 3 = 75$
Total	**566**	**325.06**	**1481**
Pre - existing			
1-2 RoK	420	$420 \times 0.46 + 420 \times 0.07 = 222.6$	$420 \times 2.5 = 1050$
3-5 RoK	360	$360 \times 0.65 + 360 \times 0.07 = 259.2$	$360 \times 3 = 1080$
New 1-2 RoK	100	$100 \times 0.46 + 100 \times 0.07 = 53$	$100 \times 2.5 = 250$
Other Premises		48.29	20.3
Total	**880**	**583.09**	**2400.3**
Total overall	**1446**	**908.15**	**3881.3**
Including further reductions		$908.15 \times 0.95 \times 0.8 =$ **690**	

Table 4.2: Summary of required parking (cars and bicycle) for Mandolingatan. The factors used are according to the regulations set by the City of Gothenburg. The calculations are derived from the mobility investigation (Framtiden Byggutveckling AB, 2017).

Bostads AB Poseidon offers the tenants a set of residential parking with different prices and different options. The new complex itself has 675 parking spaces available (with restriction for the spaces reserved for the car sharing), these are divided into 50 outdoor parking spaces and 625 parking spaces in a parking garage above ground level, located centrally in the area (Bostads AB Poseidon, 2021). It is apparent that a there is a slight shortage of parking, as the calculated requirement is 15 parking spots higher than what is built. In addition to the parking offered by the property owner, there are several other parking options available in the neighbourhood, these are marked on the map in figure 4.10. A summary of the closest complementary parking options and their prices can be found in table 4.3.

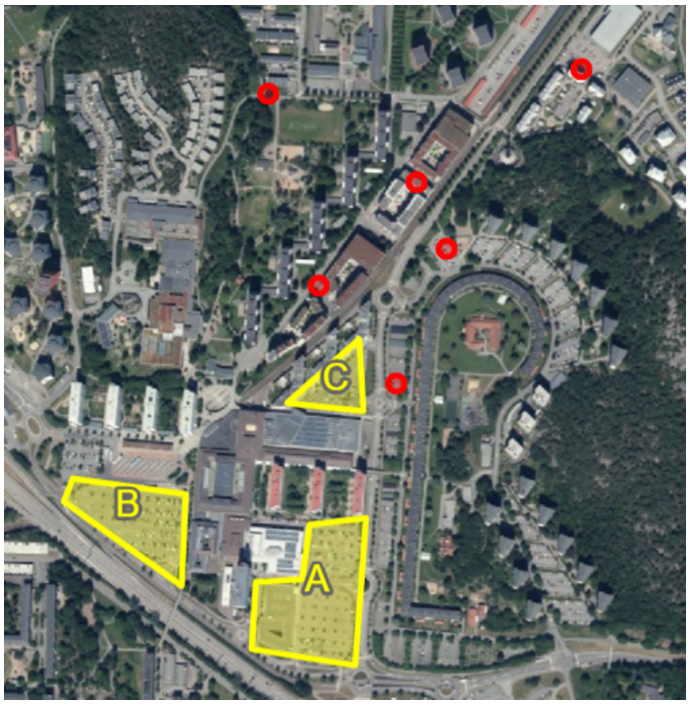

Figure 4.10: Location of the complementary parking options in the immediate area. Yellow markings indicate parking provided by APCOA and red markings indicate parking provided by the City of Gothenburg. Image: Lantmäteriet.

Location	**Provider**	**Price of parking**
Frölunda Torg	APCOA	30 SEK/h, first 3h free (max. 300 SEK/day). Parking area A & C: 22:30-06:00 - Price: 7 SEK/h. Parking area B: 21:00-06:00 - Price: 7 SEK/h.
Mandolingatan 80-124	Gothenburg City Parking	10 SEK/h all days between 08:00-22:00, 2 SEK/h all other hours.
Mandolingatan 40-62	Gothenburg City Parking	10 SEK/h all days between 08:00-22:00, 2 SEK/h all other hours.
Norra Dragspels-gatan 2-18	Gothenburg City Parking	7 SEK/h all days between 08:00-22:00, 2 SEK/h all other hours.
Pianogatan 2-44	Gothenburg City Parking	7 SEK/h all days between 08:00-22:00, 2 SEK/h all other hours.
Trumgatan 2	Gothenburg City Parking	7 SEK/h all days between 08:00-22:00, 2 SEK/h all other hours.
Transistorgatan	Gothenburg City Parking	7 SEK/h all days between 08:00-22:00, 2 SEK/h all other hours.

Table 4.3: Information about the complementary parking options, and their current pricing, in the immediate area (Framtiden Byggutveckling AB, 2017).

4.2.3 Mobility measures

Mandolingatan is built with the vision of creating a sustainable society for the future. Both the developer Framtiden Byggutveckling and the property owner Poseidon have high ambitions in providing different mobility solutions in order to provide and encourage sustainable travel options for tenants, and thereby minimise the need for private owned cars. In relation to this, the mobility solutions aim to reduce the MPR, as well as functioning as part of the main goal to reach economic, ecological and social sustainability (Bordier, 2017).

As part of the detailed plan for the construction, a mobility investigation was conducted, in order to analyse different possible mobility measures. The investigation was used as basis for the agreement between the property owner and the Traffic Administration office of the City of Gothenburg, allowing the 20% deduction on MPR. As part of the agreement, Poseidon is obligated to provide and maintain the agreed-on measures for at least 10 years from the date of the final clearance (Göteborgs kommun & Bostads AB Poseidon, 2020).

The agreement is built on two levels, the first including mobility measures that fulfils the base-package for deduction on MPR and the second part with additional measures that adds up to a total of 20% deduction on MPR. The mobility measures include a car- and bicycle-sharing, weather protected bicycle rooms etcetera. (Göteborgs kommun & Bostads AB Poseidon, 2020). An account of all mobility measures included in the agreement, for both levels, can be found displayed in table 4.4.

Mobility Measure	Package Type	Information
Fixed parking limitations	Base-package	The number of parking spaces fixed/personal cannot exceed 75%.
Appealing bicycle storage facilities	Base-package	50% of bicycle storage should be weatherproof. Parking must be accessible, safe, theftproof, and near a bicycle pump.
Parking for cargo bicycles	Base-package	A minimum of 4 parking spaces per 100 apartments.
Attractive and accessible planning area	Base-package	Good accessibility to bicycle- and pedestrian pathways in the area.
Car sharing parking	Base-package	Minimum of 2 designated parking spaces for car sharing vehicles for the first 200 apartments. Additional 1 parking space per 200 apartments beyond these regulations.
Mobility starter-pack (new tenants)	Base-package	A package encouraging green travel options. Includes gifts such as an umbrella, bicycle lights, reflexes, etc.
Ongoing information about mobility	Base-package	Sustaining the sustainable travel perspective with emails/flyers.
Free public transport card for 30 days (new tenants)	Base-package	1 card for 1 RoK, 2 cards for 2-5 RoK.
Rental costs for parking should be separate	Base-package	Parking rent is not included in the apartment rent.
Real-time information boards for public transport	Additional package	Information about departures nearby, in stairwells/entrances.
Bicycle service room	Additional package	Provides opportunities to wash, maintain, and repair private-owned bicycles. 1 room per 100 apartments.
Bicycle sharing with special bicycles	Additional package	Free membership, access to electric bicycles, cargo bicycles, etc. 3 bicycles per 100 apartments.
Additional limitations on fixed parking	Additional package	Maximum of 25% of all parking allowed to be fixed.
Additional proximity and accessibility	Additional package	The plan area must be densely populated and have access to schools, shops, leisure activities, etc.
Yearly mobility activity	Additional package	The property owner should have a yearly activity encouraging mobility solutions, at least providing free bicycle service.

Table 4.4: A summary of the mobility agreement between Bostads AB Poseidon and The Traffic Administration office. The summary includes all mobility measures that affect MPR for Mandolingatan.

4.3 Nya Kvibergshuset

Nya Kvibergshuset is one of Poseidon's new apartment houses which was completed in 2022 (Bostads AB Poseidon, 2022b). The property is located at Beväringsgatan in the area of Kviberg in the northeast of central Gothenburg and includes an apartment building with 250 apartments for rental. The project was built by Framtiden Byggutveckling AB together with Tuve bygg.

4.3.1 The area and its' surroundings

The area has relatively good access to service- and societal functions as seen in figure 4.11. There are preschools and schools in close proximity to the property, as well as many places for sport activities. However, there is a lack of general service and shopping functions as well as healthcare in the vicinity. In terms of public transport, there are good connections both by bus and tram in the area. The closest tramlines stops at Beväringsgatan which is located 75-150 meters from the property (Bostads AB Poseidon et al., 2018). There is also another public transport stop accessible by bus at Nymånegatan, north of the property as seen in figure 4.11. With these options of public transport, residents are able to access services and societal functions further from the property.

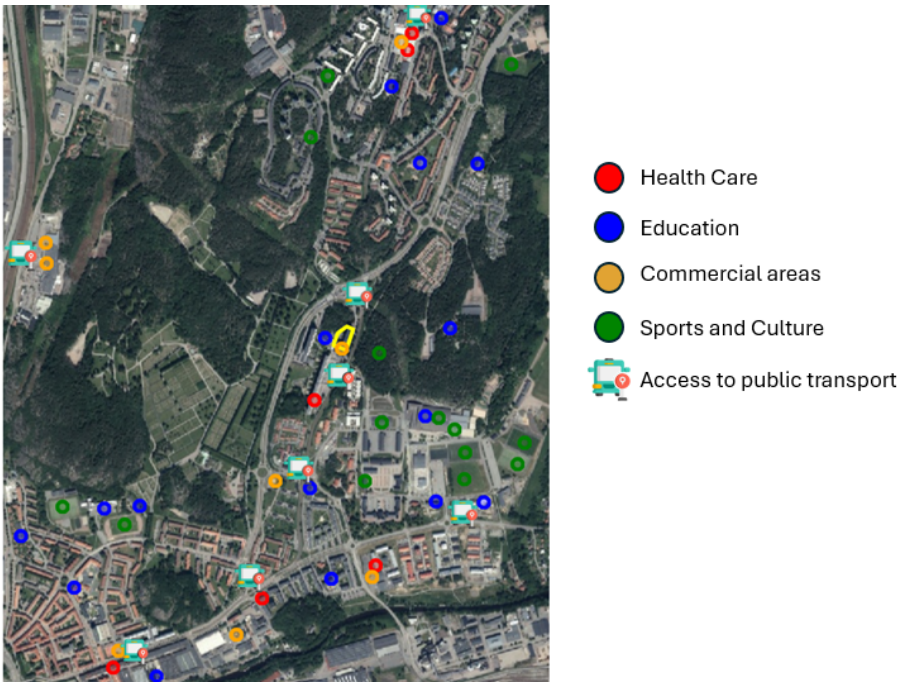

Figure 4.11: Service- and societal functions close to Nya Kvibergshuset, marked with yellow. The functions are divided into different categories, in order to give a clear picture of the area and its accessibility. Image: Lantmäteriet.

The area has fairly good accessibility to bicycle infrastructure which is illustrated in figure 4.12. Bike lanes and roads are marked with blue, the green bicycle markers state where the municipal bike sharing, "Styr och ställ" is located. As seen in figure 4.12 there are no "Styr och ställ" bikes in close proximity to the property. According to the travel-tool at Trafiken.nu. Cycling from Beväringsgatan (Nya Kvibergshuset) to the central station would take approximately 20 minutes.

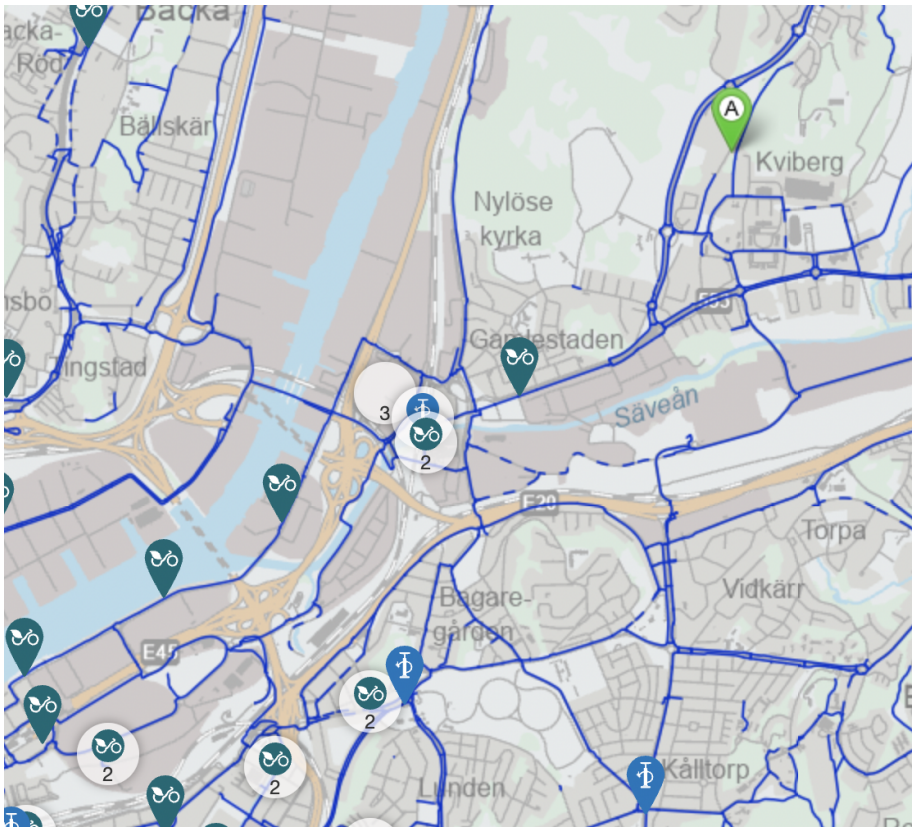

Figure 4.12: Map showing the infrastructure for bicycling in Gothenburg. Nya Kvibergshuset is marked as "A" on the map. Image: Trafiken.nu.

4.3.2 Parking situation

A parking investigation was executed in the planning process of the project in order to determine how to provide parking for the new building. Beforehand, there were a total of 280 rental parking spaces as well as 37 visiting parking spaces in the area (Bostads AB Poseidon et al., 2018). To make space for Nya Kvibergshuset, 85 of these parking spaces were demolished. The current occupied and utilized parking spaces were compared to the theoretical demand calculated with the new parking number (Bostads AB Poseidon et al., 2018). The area in which the property is located is classed as "övriga Göteborg" according to the city's guidelines for parking numbers (Göteborgs Stad, 2011) and the initial parking numbers were decided accordingly as 0.46 for small apartments, 0.65 for larger apartments and 0.07 for visitors. The new parking numbers in the area were additionally decreased by 10%

due to good accessibility to public transport in accordance with the same guidelines. The implementation of a mobility solutions enabled a further reduction of the parking number by 16% (Bostads AB Poseidon et al., 2018). To ensure that the calculated parking number would meet the parking demand in the area, thorough analysis of the current occupancy and use of existing parking spaces was carried out. It was decided that the implementation of a car sharing as well as the construction of a new parking garage would supply existing and new inhabitants of the area with sufficient parking. To account for the residents in Nya Kvibergshuset, an additional 96 garage parking places as well as 28 ground parking places were built (Bostads AB Poseidon et al., 2018). Four of these parking places, two inside and two outside, were designated to the car sharing service. The final calculated parking numbers are displayed in table 4.5.

Type of accommodation	**Initial Parking number**	**Reduction 1 (public transport)**	**Reduction 2 (mobility measures)**	**Final parking number**
Apt (small)	0.46	10%	16%	0.348 parking spots/apt
Apt (larger)	0.65	10%	16%	0.491 parking spots/apt
Apt (visitors)	0.07	10%	16%	0.053 parking spots/apt

Table 4.5: All reductions and the final calculated parking number for each apartment (Apt) type in the property Nya Kvibergshuset (Bostads AB Poseidon et al., 2018).

4.3.3 Implemented mobility measures

In order to account for the additional 16 % reduction of the parking number, the developer adapted several mobility measures. The implemented measures mentioned in the agreement between Sunfleet car sharing and Framtiden Byggutveckling AB are represented below.

- A car sharing with 4 vehicles.
- A bicycle sharing with two electric cargo bikes.
- Bicycle workshops / service rooms.
- Up to 10% discount on journeys with taxi.
- Discount agreements on travel by rental car (Sunfleet Carsharing, 2017).

At the time of planning this project, the City of Gothenburg had not yet developed the mobility agreements previously mentioned in section 2.5.2. As there was not an existing framework of how to calculate reductions of the parking number when adapting mobility solutions, the extent of the reduction was decided by a comparison of policies in Gothenburg, Malmö and Stockholm (Bostads AB Poseidon et al.,

2018). A calculation of the efficiency of a car sharing was also performed which stated that a car sharing service would compensate for the reduced amount of parking places (Edoff, 2017). Framtiden Byggutveckling AB chose Volvo's car sharing company *Sunfleet* to provide these mobility solutions (Sunfleet Carsharing, 2017). The agreement covered five years starting at the time when at least 50% of the apartments in Nya Kvibergshuset were occupied. In 2018, *Sunfleet* was integrated into the larger initiative *M* which is owned by Volvo Car mobility (Volvo Cars Media Relations, 2018). *M* underwent an additional makeover in 2022 and the service was renamed *Volvo on Demand* (Volvo Cars Media Relations, 2022).

The main objective of the agreement between Sunfleet and Framtiden Byggutveckling AB was the implementation of a car sharing service (Sunfleet Carsharing, 2017). The car sharing service was to include four vehicles, two of which are parked in the new garage and the other two on the ground parking lot. It was agreed that Framtiden Byggutveckling AB would pay a monthly car sharing fee for each apartment in accordance with Sunfleet's current pricing (Sunfleet Carsharing, 2017). Sunfleet agreed to sign user agreements, free of cost, with all residents of Nya Kvibergshuset who are eligible for the service. All users would be provided with a key card to use when unlocking and locking the vehicles. Furthermore, the agreement emphasizes the importance of communication and marketing in order for the car sharing to reach full potential. Both parties pledged to market the car sharing and encourage residents to utilize it. Sunfleet also pledged to produce and distribute informational brochures to all residents in Nya Kvibergshuset. (Sunfleet Carsharing, 2017). The car sharing would be integrated in Sunfleet's larger network of rental vehicles. Therefore, the car sharing in Nya Kvibergshuset is not exclusive to its' residents but open to all of Sunfleet's users. Likewise, the residents of Nya Kvibergshuset who sign user agreements also have access to all of Sunfleet's car sharing vehicles in the city(Sunfleet Carsharing, 2017).

5
Results

The following chapter illustrates and highlights the results of this project. The results consist of data collected through surveys, through interviews with residents, and through interviews with professionals in relevant fields.

5.1 Survey answers

Survey responses were collected from 54 out of 528 households (10.2%) at Mandolingatan and 31 out of 250 (12.4%) in Nya Kvibergshuset. The survey respondents were 85 in total and a brief summary of their demographics is concluded in Table 5.1. The survey questions can be found in Appendix A.4.

		Mandolin-gatan	Kvibergs-huset	All
Gender	Man	23	13	36
	Woman	31	16	47
	Other	0	2	2
Age	19-29 y/o	24	11	35
	30-39 y/o	15	9	24
	40-49 y/o	10	3	13
	50-59 y/o	4	3	7
	60-69 y/o	0	4	4
	70+ y/o	1	1	2
Occupation	Employed	31	19	50
	Student	18	5	23
	Self-employed	1	0	1
	Other	3	1	4
	Retired	1	6	7
Household size	Single person	18	19	37
	Two person	20	11	31
	Family with children	16	1	17
Household Income	0 - 20 tkr	7	6	13
	20 - 40 tkr	18	16	34
	40 - 60 tkr	17	3	20
	60 - 80 tkr	7	3	10
	80+ tkr	5	0	5
	No answer	0	3	3
Mobility	Owns a car	20	10	30
	Used car sharing	4	8	12
	Used bicycle sharing	2	1	3

Table 5.1: Summary of survey respondents demographics.

5.2 Respondents' travel behaviour

In order to understand the travel behaviour of the respondents, they had to answer a question regarding how many days a week they use certain means of transportation during an ordinary week. The survey required an answer for each alternative listed. The results can be seen in Figure 5.1.

- It can be seen that public transportation and walking are, by far, the two most used means of transportation, followed by private cars use.
- Looking at car travel, 16% of all respondents use their own car 4 days a week or more. 30% use it at least one day a week.
- The corresponding numbers for usage of bicycle or private electric scooter are 10% and 21%.

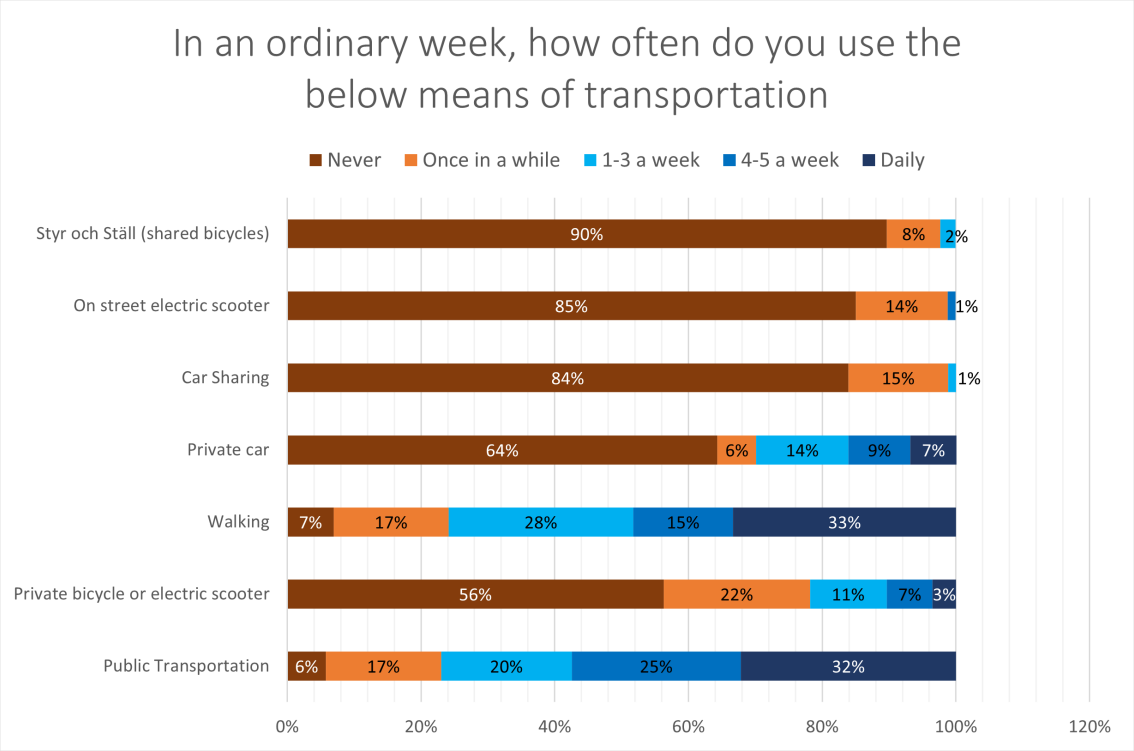

Figure 5.1: Survey respondents on how many days a week they use the listed means of transportation during an ordinary week. The question was obligatory and answers was required for every mode of transportation

5.3 Correlations

This section aims to look at correlations between different characteristics of the respondents, and their use of, and attitudes towards, different mobility measures, car ownership and parking.

When looking at the following graphs in this section, it is important to keep a few in mind:

- The amount of answers were not equally distributed between the two properties. For every Figure or graph in this chapter, the number of respondents that have answered the question will be presented.
- If there were no interesting differences between the two properties, only one Figure with the all collected data will be presented. This is the general case, since for almost all questions, there were no distinct differences in the distribution of answers between the two properties.
- If a bar chart has a fractional number on top, for example 8/21, it means that 8 out of 21 respondents in that category have answered *Yes* to that alternative.

5.3.1 Car ownership

Overall, 30 out of the 85 respondents or households own a car, or 35.3%. In Mandolingatan 20 households (37%) owns a car, according to our survey, respectively 10 households at Nya Kvibergshuset (32%), see Figure 5.2. This means that only these 30 respondents have answered the questions concerning car ownership. For the Figures in this section, car ownership will be compared to occupation, household size, household income, and the respondents' age groups.

The respondents' total car ownership of today, was compared to before they moved into the properties. At Mandolingatan, fewer households owns a car today (20 out of 54 households), compared to before they moved in (26 out of 54 households). For the respondents in Nya Kvibergshuset, the total car ownership have increased a little. From 9 out of 31 households before moving, to 10 out of 31 today. See Figure 5.2 for the results.

From the survey data, it was found that 11 of the respondents that do not own a car today, did own a car before moving to Mandolingatan or Nya Kvibergshuset, i.e. 11 of the respondents have gotten rid of their car after moving. The total number of households that owns a car today has not decreased by the same number, meaning that some respondents have bought a car after moving.

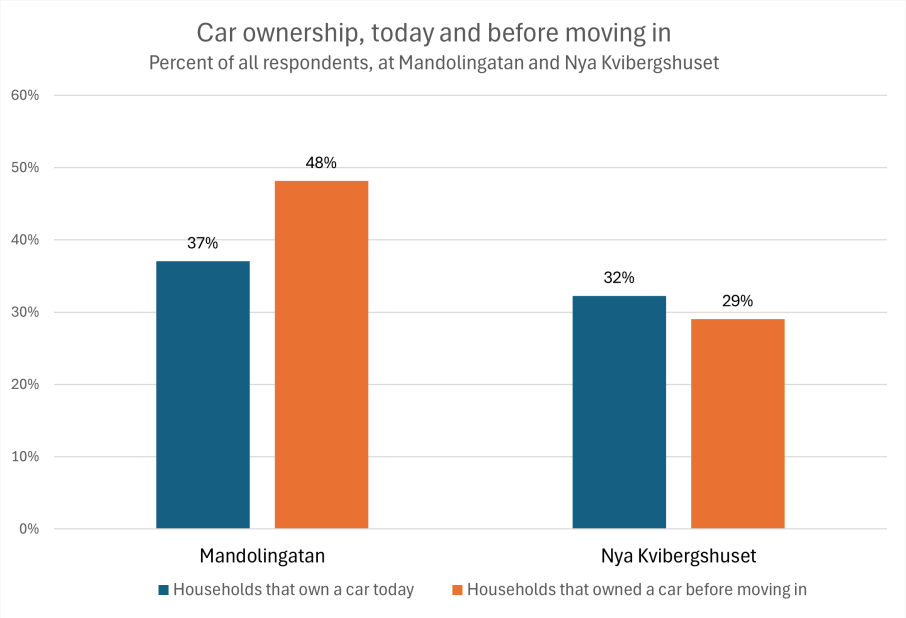

Figure 5.2: Percent of respondents that own a car today, and the percent that owned a car before moving.

Employed respondents have the highest percentage of car ownership, followed by students, retired people, and lastly the category *Other* which can constitute of occupations such as unemployment, sick leave, parental leave etc, see Figure 5.3. There was only one of the 85 respondents that chose *Self-employed* as occupation. This respondent owns a car. This response was added to the category *Employed*.

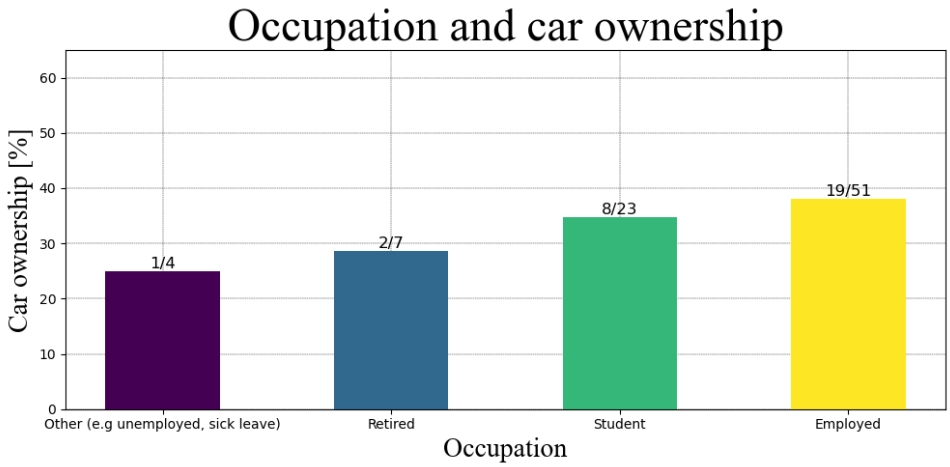

Figure 5.3: The percent of people in every occupation group that has at least one car per household. The data is for both properties combined.

The car ownership of the respondents increases with the size of the household, see Figure 5.4. This is clearly seen by looking at the households consisting of 1-3 people. The more people in a household, the higher percentage of car ownership. There is an exception, since none of the five households with 4 people in it own a car. The one household with 5 people has a car, which results in 100% car ownership for this group.

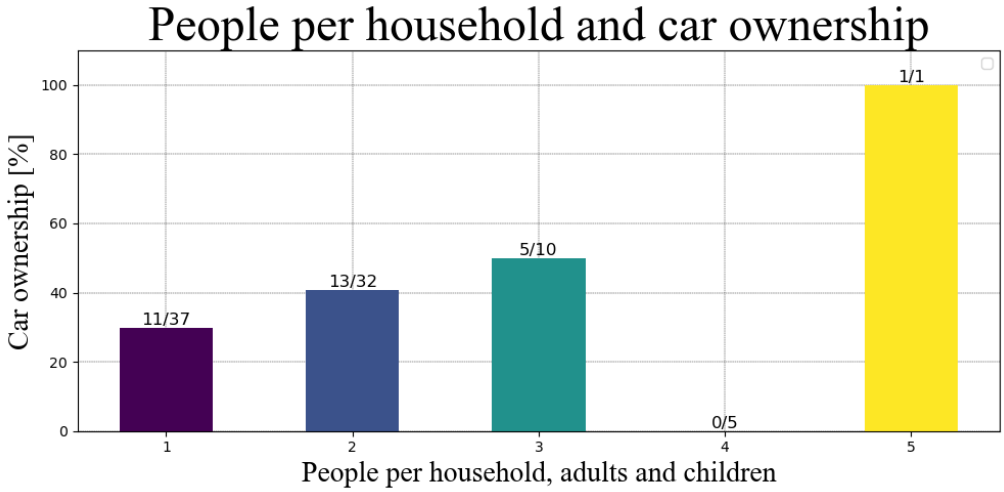

Figure 5.4: The correlation between the amount of people in apartment and car ownership for both properties combined.

The car ownership of the respondents increases steeply with household income until an income of $40 - 60$ kSEK per month, where it tops at 50%. Car ownership then decrease a bit, and stabilize on 40% for the households with a household income larger than that. The results are shown in Figure 5.5.

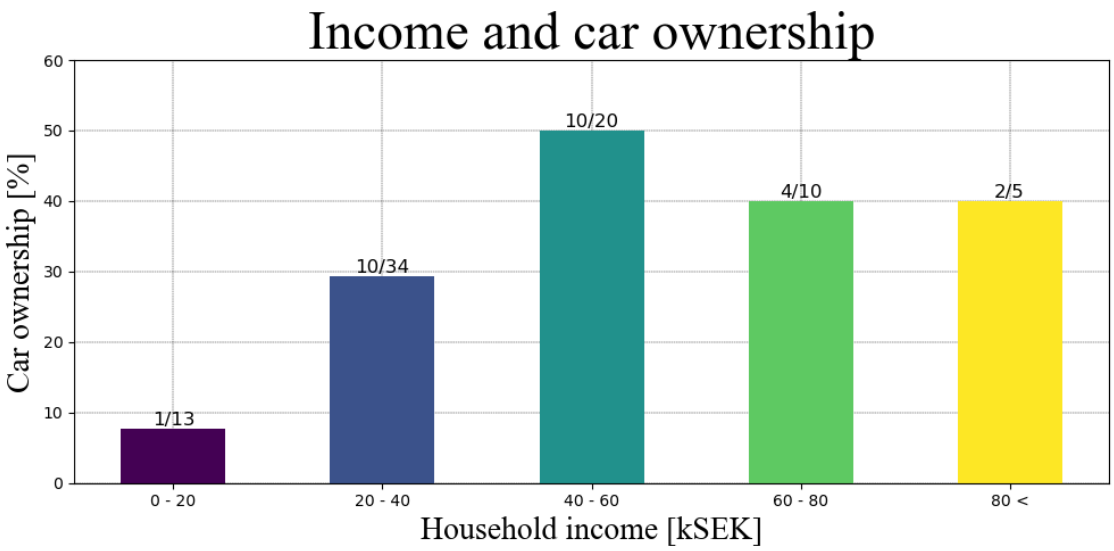

Figure 5.5: The percent of households in different income groups that has at least one car per household. The data is for both properties combined.

The car ownership of the different age groups varies between approximately 30−50%. There is no clear trend telling us that car ownership varies with age in any significant way. However, respondents in the age group of *40-49 years of age* have the highest percentage of car ownership, about 54%. Results are shown in Figure 5.6.

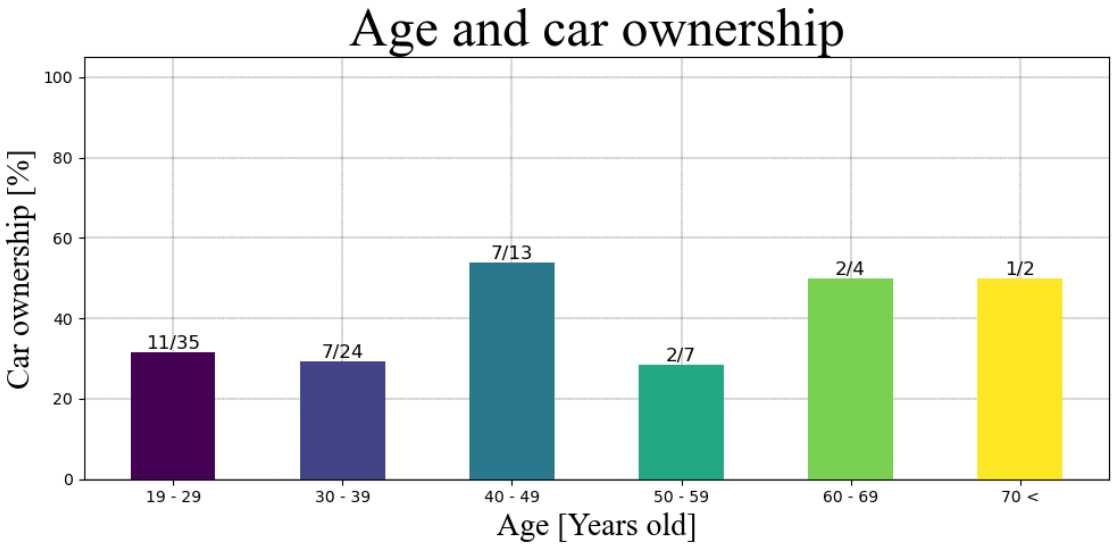

Figure 5.6: The percent of people in different age groups that has at least one car per household. The data is for both properties combined.

5.3.2 Parking

To evaluate how the car owning respondents view and value parking, the 30 respondents that own a car got to answer questions on this matter.

The average monthly cost of residential parking for the different income groups are shown in Figure 5.7. To calculate and visualize the data, assumptions had to be made about the actual cost for parking. Since the answers were given by intervals and not fixed numbers, the value in the middle of the interval was used. For example, for the interval *401 - 600 SEK* the value *500 SEK* was used. For the last option, *1201 SEK or more*, the value *1500 SEK* was used as an estimated average cost of parking. The number on the top of the bar chart is the calculated monthly parking cost in SEK. Using these approximations, the total average cost for parking was found to be *1100 SEK* per month. It can also be seen that the cost for residential parking does not vary much between the different income groups, as it appear to be roughly the same.

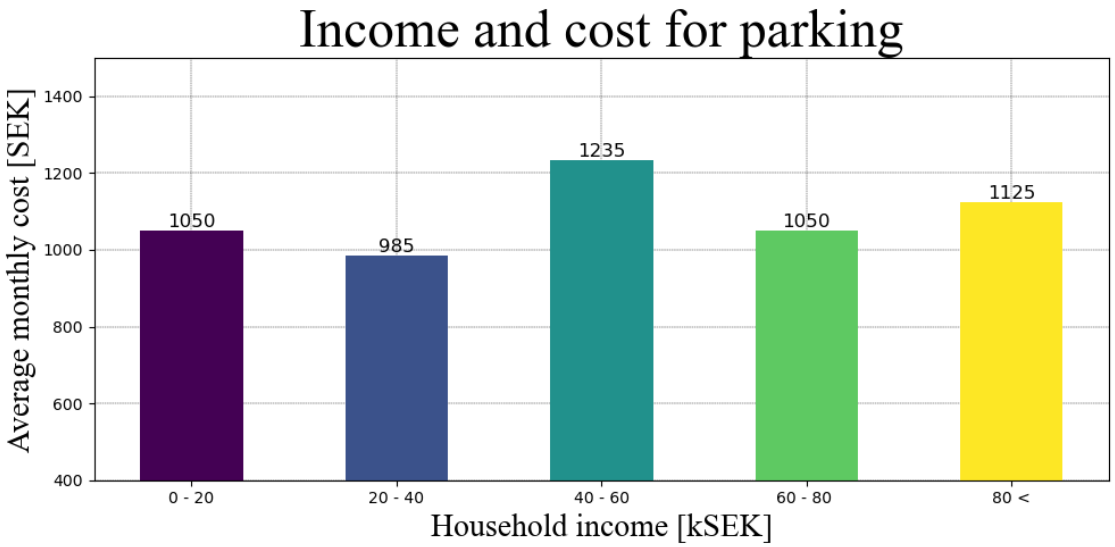

Figure 5.7: The average price that people from different income groups spend per month on parking. The data is for both properties combined.

A large majority, 84%, of the car owning respondents pay *900 SEK* or more for residential parking per month. None of the respondents pays less than *400 SEK* per month. See Figure 5.8 for full information.

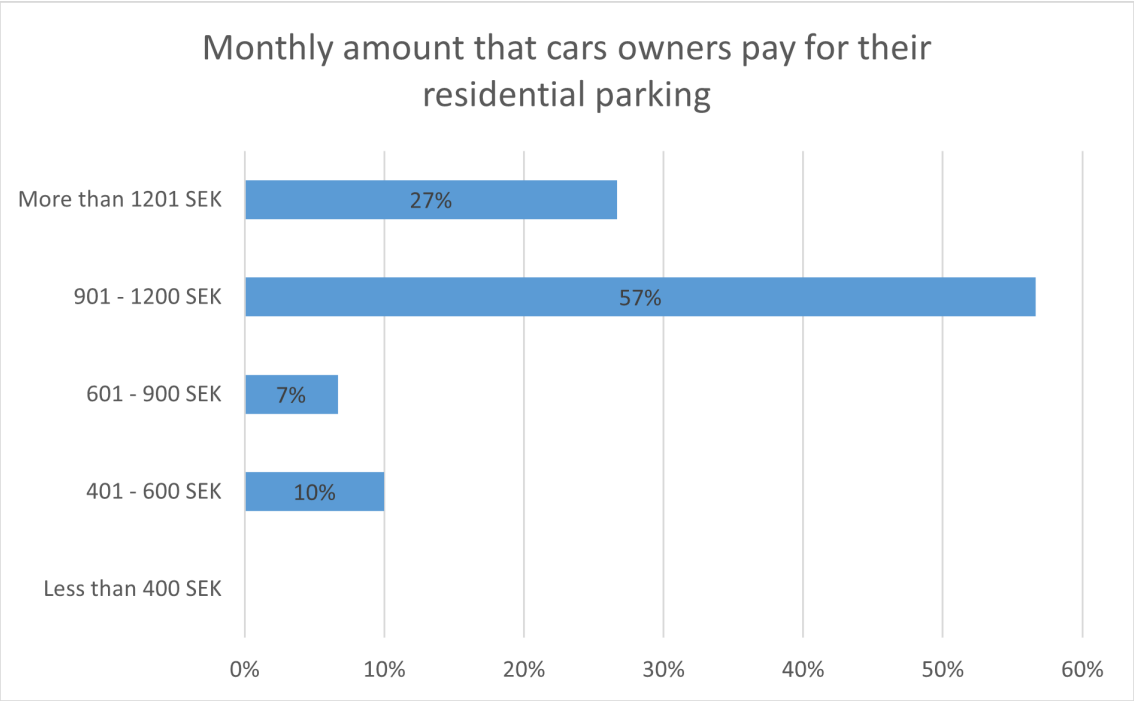

Figure 5.8: How much the respondents pay monthly for residential parking.

In order to understand the willingness to pay for residential parking, the car owners were asked how much they would maximum be willing to pay each month before they would start considering giving up their car. Using the information displayed in Figure 5.9 the following can be identified:

- It is 46% that would be willing to pay more than the current average price that was calculated to be *1100 SEK* per month.
- Only 19% would be willing to pay more than 1800 SEK per month.
- Only 6% states they would be willing to pay more than 2500 SEK per month.

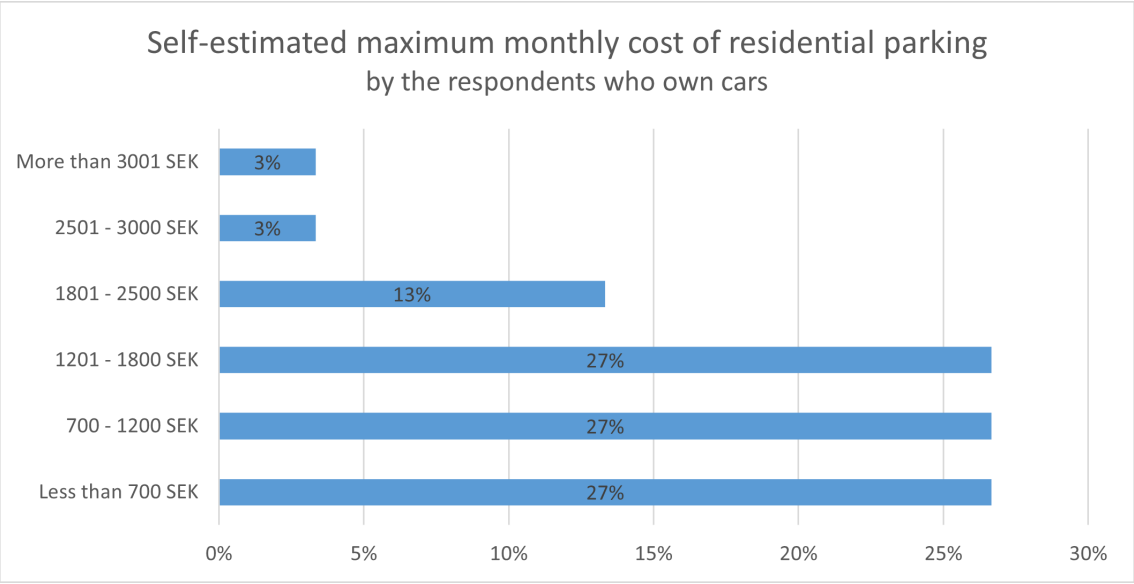

Figure 5.9: Self-estimated maximum monthly cost for residential parking.

The parameters, household income and self-estimated maximum monthly cost were compared to each other in order to see whether the respondents' household income had any effect on the willingness to pay for residential parking. The number of car owning respondents in each income group can be seen in Table 5.2 below, while Figure 5.10 shows the results of the comparison.

- The percent willing to pay more than 1800 SEK inceases at higher income levels. When factoring the willingness to pay more than 1201 SEK the percentage is 50%. Overall, it can be seen that the distribution of the willingness to pay for parking is fairly similar for most of the income groups.

- For the two households with a monthly income of more than 80 kSEK, one of them would only be willing to pay the the price of the lowest interval, while the other would be willing to pay the price of the highest interval.

- For the income groups ranging between 20 to 80 kSEK, some respondents are only willing to pay the price of the lowest interval, while other respondents would be willing to pay the price of the highest interval, with some respondents willing to pay something in between. This indicate a similar pattern, regardless of the income within this span.

- In addition, the two groups *Don't want to answer* and *0-20000 SEK* differ from the pattern above.

Household income	**Car owners**
Don't want to answer	3
More than 80 000 SEK	2
60 000 - 80 000 SEK	4
40 000 - 60 000 SEK	10
20 000 - 40 000 SEK	10
0 - 20 000 SEK	1

Table 5.2: The number of respondents that are car owners, and their household income. This is the sample size for Figure 5.10.

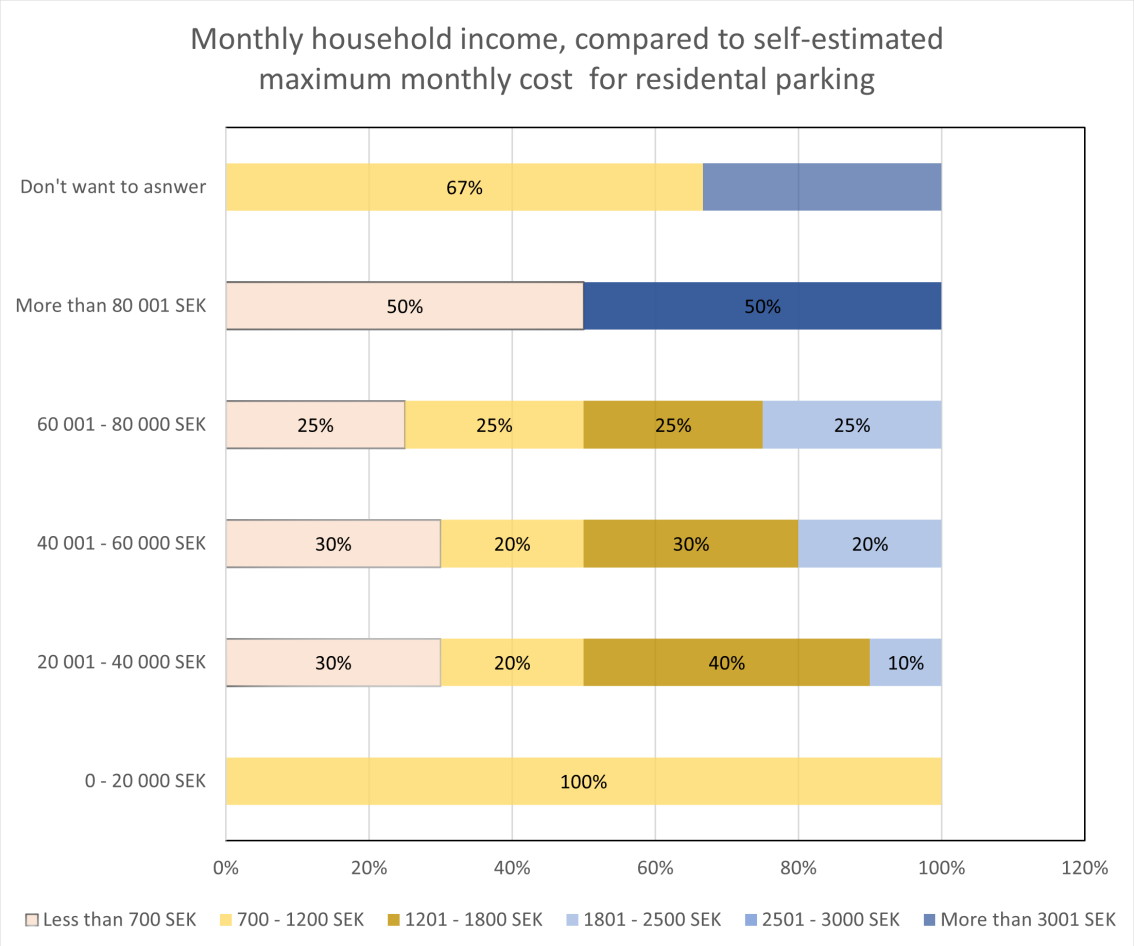

Figure 5.10: Monthly household income compared to self-estimated maximum cost for residential parking.

The property owner is responsible for providing residential parking (SFS nr: 2010:900, 2010). That is one reason behind the system with MPR, which forces property developers to build a certain amount of parking spaces per apartment. A known issue is that residents can park elsewhere, and that was something this project aimed to look into. A significant proportion of the respondents that are car owners do not park their car on property land, see Table 5.3.

Property	**Parked in property garage**	**Parked elsewhere**	**Percent parked elsewhere**
Mandolingatan	15	5	25%
Nya Kvibergshuset	5	5	50%

Table 5.3: Amount of car owners that are parked, and are not parked, in the garage provided by the property owners.

5.3.3 Not owning a car

Out of all 85 respondents, 55 of them do not own a car (64.7%). The project wanted to look into the reasons on why people do not have a car. Each respondent could chose up to three alternatives. The results can be seen in Figure 5.11.

- The cost of owning a car, and the cost of parking received many answers, together with the answer that a respondent has no need for a car.
- None have answered that the availability of parking was a reason why they do not own a car.
- A couple of self-written answers under the alternative *Other* were that the respondent did not have a driver's license.

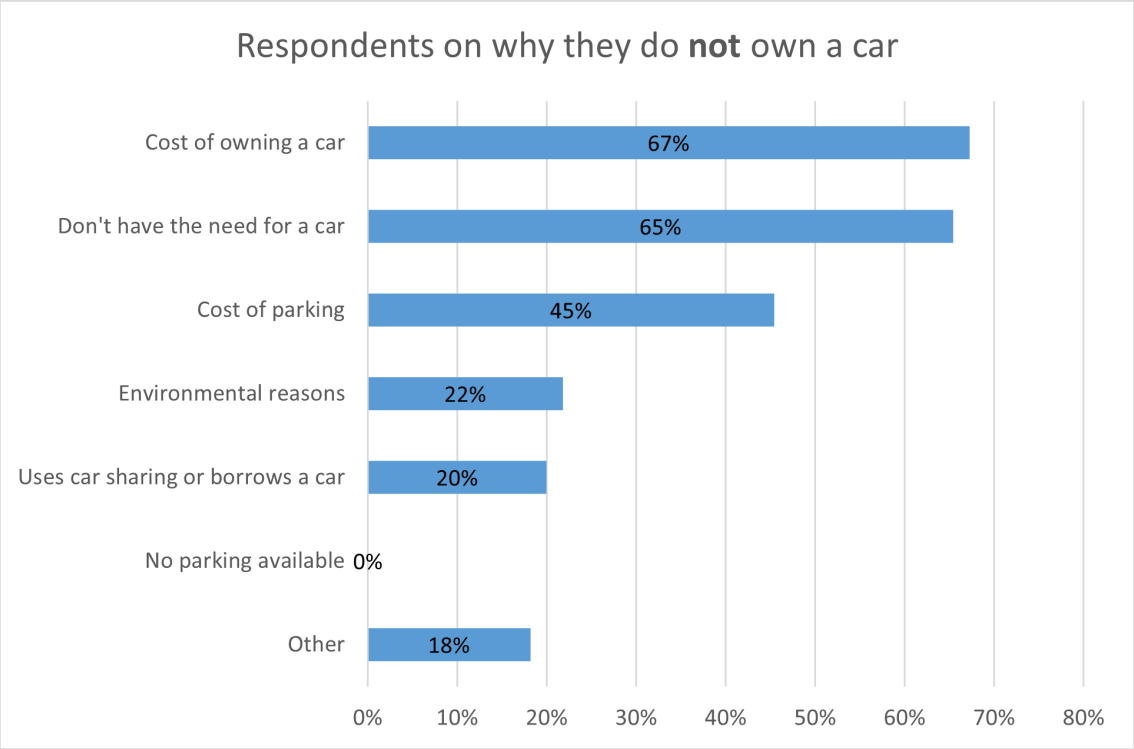

Figure 5.11: Survey respondents who does not own a car, on why they do not own a car. 55 respondents.

5.3.4 Attractiveness of mobility measures

If mobility measures are attractive, they are more likely to be used. This sections aims to evaluate how attracted the respondents were to the fact that mobility measures were implemented in their respective properties. In the study, 12 out of the 31 respondents (39%) in Nya Kvibergshuset states that the mobility measures implemented in the property were something that attracted them to move there, see Figure 5.12.

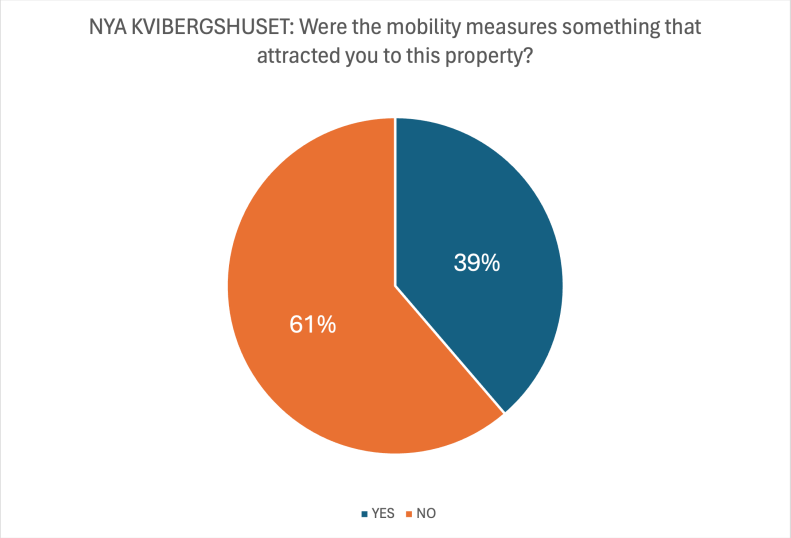

Figure 5.12: Respondents on if the implemented mobility measures were something that attracted them to move to Nya Kvibergshuset. In total 31 residents responded.

At Mandolingatan, 14 out of the 54 respondents (26%) states that the mobility measures implemented in the property were something that attracted them to move there, see Figure 5.13.

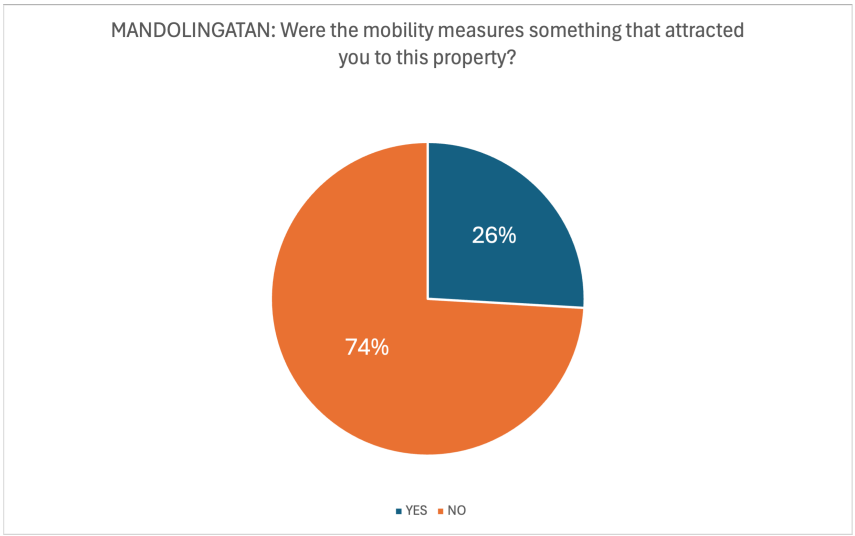

Figure 5.13: Respondents on if the implemented mobility measures were something that attracted them to move to Mandolingatan. In total 54 residents responded.

5.3.5 Car sharing

The car sharing service have been used by 8 out of 31 respondents (25.8%) in Nya Kvibergshuset, and 4 out of 54 respondents (7.4%) at Mandolingatan. Of the total 12 respondents that have used the car sharing service, 75% of them do not own a car today. At Nya Kvibergshuset, 7 out of the 8 car sharing users do not own a car. From the survey data, it was found that 11 of respondents that do not own a car today, did own a car before moving to Mandolingatan or Nya Kvibergshuset. Of these 11 respondents, only one have used the car sharing service. Five of these 11 respondents have listed *Student* as their primary occupation.

Among the respondents, the youngest age group have used car sharing the most, in absolute numbers. Percentage-wise, the group consisting of *50-59 years of age* have used car sharing the most. Worth to note is that only 7 respondents are categorized into this age group. Results are shown in Figure 5.14.

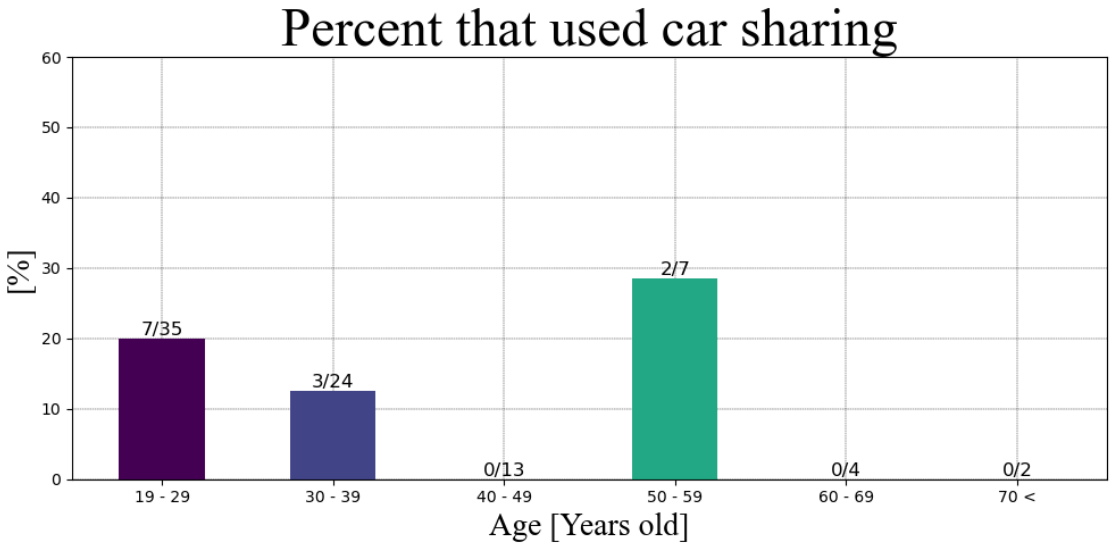

Figure 5.14: The percent of people in different age groups that have used the car sharing service. The data is for both properties combined.

Among the respondents, people living in households with higher income seems more prone to use the car sharing service. Zero of the 13 households with the lowest income have used car sharing, while six out of the ten households claiming to have a monthly household income of $60 - 80$ kSEK have used the car sharing service. Results are shown in Figure 5.15.

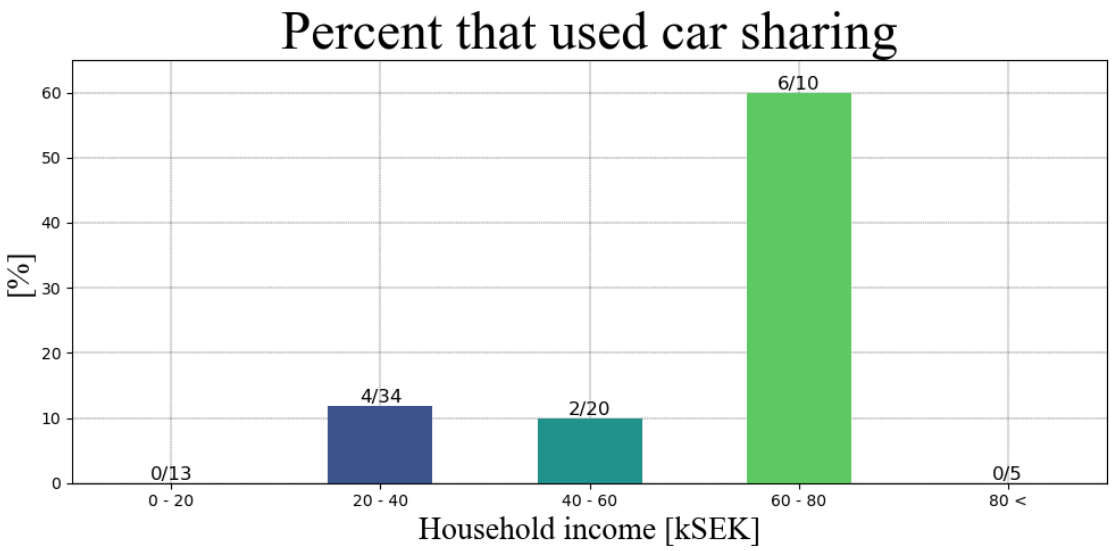

Figure 5.15: The percent of people in different income groups that have used the car sharing service. The data is for both properties combined.

The 12 respondents that have used the car sharing service are overall satisfied with it, indicated by the mean value being 4.2 of the overall experience. The respondents got to rate their experience in each category, giving a grade between 1 and 5. Where 1 is the lowest, meaning very unsatisfied, and 5 is the highest, meaning very satisfied. Noteworthy is that the category that received the lowest rating was the affordability of the car sharing service. See Table 5.4 for full information.

Category	Mean value
Overall experience	4.2
Price/Affordability	3.6
Availability of cars	4.0
User friendliness	4.3
Car was in a pleasant condition	4.0
The available information	4.4

Table 5.4: Ratings of the car sharing experience.

In order to understand why the car sharing service might not have been used, all respondents that answered they have not used car sharing got to answer a question on why they have not. Each respondent could chose up to three alternatives. The results can be seen in Figure 5.16.

- A quarter of these respondents states that the cost of using the car sharing service is a reason to why they have not used it.
- Only one respondent thinks that low availability of cars in the car sharing service is a reason to why they have not used it.
- 15% of the respondents that have not used car sharing states that a reason to why, is that they did not know the service existed.

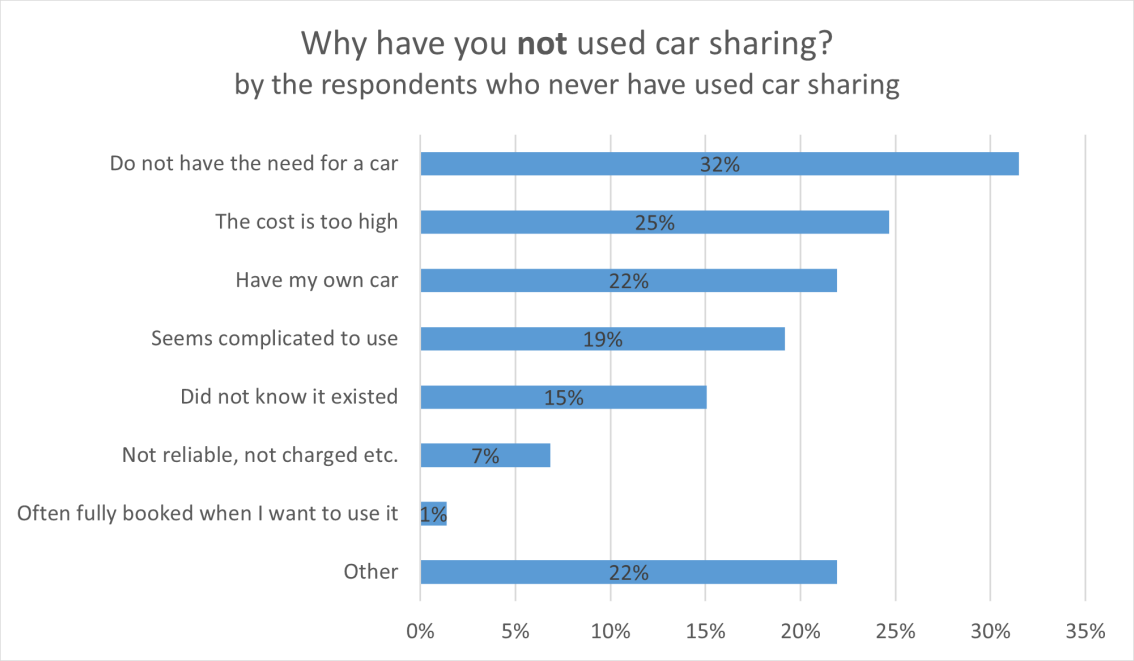

Figure 5.16: Survey respondents that have not used car sharing, on why they have not used it. In total 73 residents responded.

5.3.6 Bicycle sharing

Only 3 out of the 85 survey respondents have used, or tried to use, the bicycle sharing service that is implemented in Nya Kvibergshuset and at Mandolingatan. This corresponds to a mere 4% of respondents. See Figure 5.17.

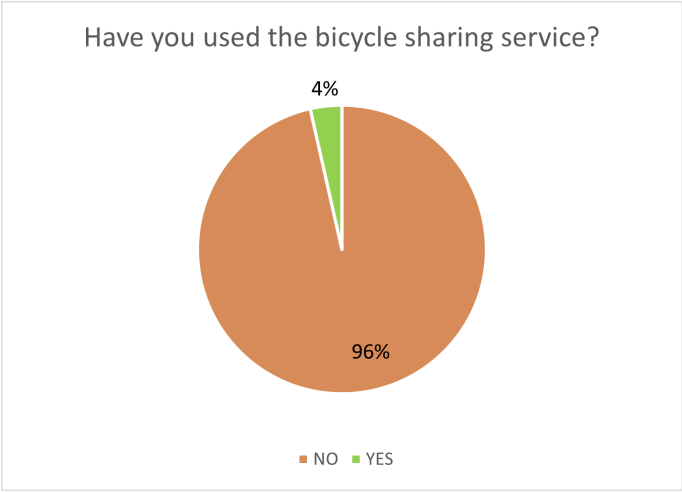

Figure 5.17: Percent of survey respondents that have used the bicycle sharing service.

In order to understand why the bicycle sharing service might not have been used, all respondents that answered they have not used bicycle sharing got to answer a

question on why they have not. Each respondent could chose up to three alternatives. The results can be seen in Figure 5.18

- 44% of the respondents states that they have not used bicycle sharing because they own their own bicycle.
- 38% of the respondents states that they do not have the need for using a bicycle.
- Not a single respondent thinks that low availability of bicycles in the bicycle sharing service is a reason to why they have not used it.
- 15% of the respondents states that one reason to why they have not used bicycle sharing is because they did not know the service existed.

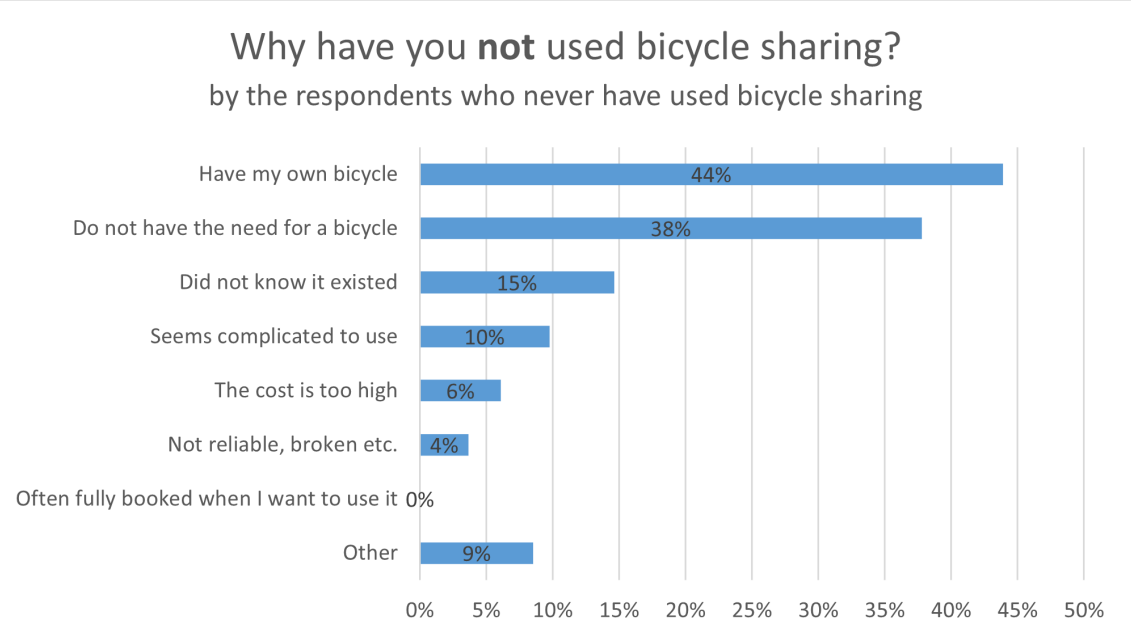

Figure 5.18: Survey respondents that have not used bicycle sharing service, on why they have not used it. 82 respondents.

5.3.7 Which measures could decrease the use of cars

To understand the attitudes toward a large set of mobility measures, all respondents got to answer a question on which measures they though could decrease society's general need for using cars. A maximum of three options could be chosen by each respondent. Figure 5.19 shows how the respondents answered.

- It can be seen that cheaper public transportation is the most popular answer, followed by increased amount of departures for public transportation.
- Interestingly, 27% thinks that improved information about the existing measure could be a way to decrease car use in general.
- 15 % answered that shared electric bicycles was a measure with potential to reduce the need for cars.

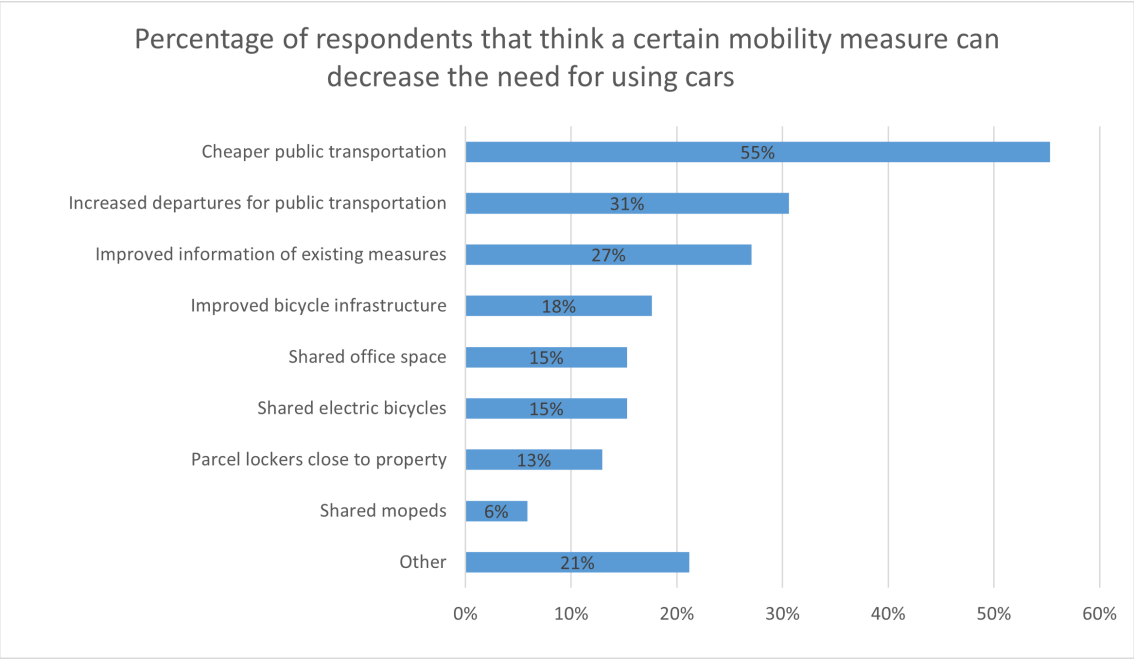

Figure 5.19: Which mobility measures can decrease the need of using cars, in general. 85 respondents.

In order to see whether the respondents that are car owners have different views on which mobility measures can decrease the need of using cars, the data displayed in Figure 5.19 was filtered to only show the answers of respondents that are car owners. The result is shown in in Figure 5.20.

- Compared to the results from all respondents, the car owners are slightly more positive to cheaper public transportation as a way of decreasing car use.
- The same goes for having shared office space as a measure.
- Other than that, the car owners are less positive, or equally positive to all other mobility measures potential to decrease car usage.

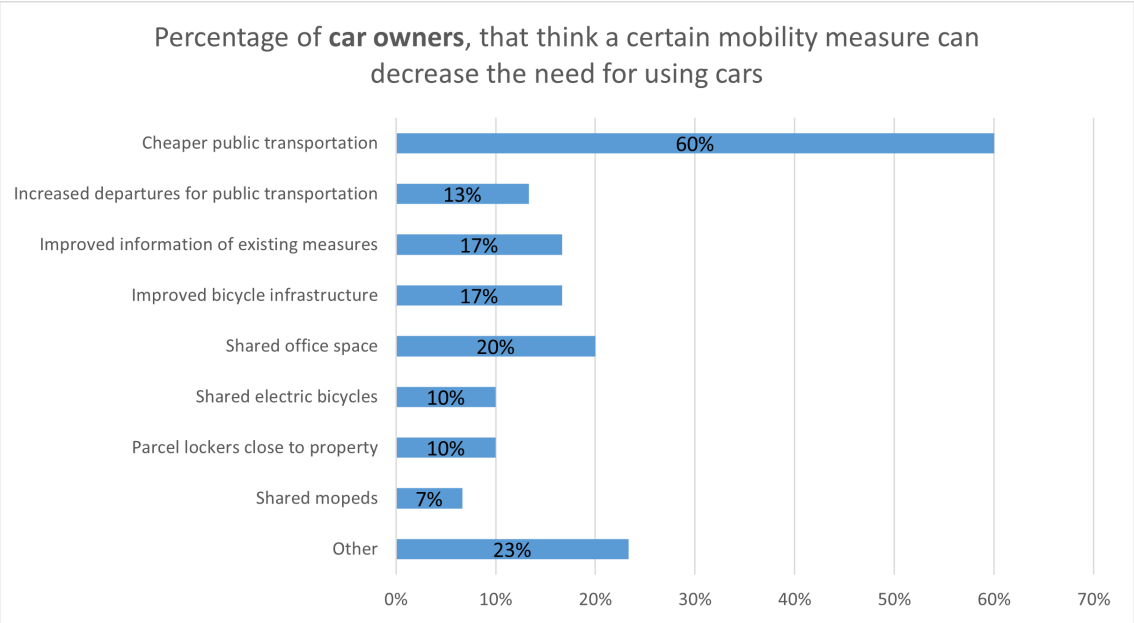

Figure 5.20: The car-owning survey respondents, on which mobility measures they think can decrease the need of using cars, in general. 30 respondents.

5.4 Interviews with residents

For the interviews with residents, there were a total of seven participants. The participants were almost evenly distributed between the two properties with four residents from Nya Kvibergshuset and three residents from Mandolingatan. Basic information about each resident is displayed in table 5.5 and 5.6. Interview questions for the residents can be found in Appendix A.1.

Interviewee	Age	Occupation	Number of residents in household	Owns a car
A	19-29	Student	2 adults	Yes
B	30-39	Employed	1 adult	Yes
C	19-29	Student	2 adults	No
D	30-39	Employed	1 adult	No

Table 5.5: Information about interviewees from Nya Kvibergsgatan, derived from the interviews.

Interviewee	Age	Occupation	Number of residents in household	Owns a car
E	19-29	Employed	2 adults	No
F	40-49	Employed	2 adults, 1 child	Yes
G	30-39	Self-employed	2 adults, 1 child	Yes

Table 5.6: Information about interviewees from Mandolingatan, derived from the interviews.

5.4.1 Key findings

Below are key findings from the interviews with residents.

- More or less all interviewees states that the price of public transportation single-tickets is too expensive. Interviewees owning a car argues that it is cheaper to take the car and pay for parking, instead of paying singe-tickets.
- A common take on public transportation is the wish for increased comfort, primarily solved by increasing the frequency of departures during rush hour in order to reduce the amount of over-crowded vehicles.
- The interviewees are positive to the idea of mobility measures, but only a few have used car sharing service, and none of them have used bicycle sharing nor the bicycle service rooms.
- All interviewees are positive to the targets the City of Gothenburg has to reduce traffic and to increase trips made by sustainable means of transportation. Some thinks a lot more efforts should be put in to the city's sustainable development. While others, primarily the car owners, are frustrated by the fact that the city makes it harder for people to use their car, especially since the alternatives are not improved.

5.4.2 Interviewee A

Interviewee A is female in her late twenties. She is a full time student, but also works part time, remotely, from home. She lives together with her partner in Nya Kvibergshuset. They own a small car together, and it is parked in the garage underneath the property. They pay approximately 1000 SEK per month for that parking spot.

She uses public transportation when going to her educational institution, and when going to activities in the city centre. She uses the car when going to activities elsewhere, i.e. not the city centre. One example is that she uses the car to make a short journey, a couple of kilometers, to a sports club where she is a coach.

At least twice a month she takes the car to her parents house, which is located in *Västtrafik Zone C*. This trip takes approximately 45 minutes by car, and would take a lot longer with public transportation.

She claims to be environmentally-conscious, but states that she is not always acting in the most eco-friendly way.

The states that the main reasons for owning and using a car, are that it is more time efficient to travel by car in genreal, and that it is cheaper than paying for public transport for the trips to outside of Gothenburg, especially if two or more people use the car at the same time, which often is the case. She travels to outside of Gothenburg often enough to view the car as the cheaper option.

She thinks the public transport within *Västtrafik Zone A*, works well in genreal, and that she can travel within the whole of Gothenburg with maximum one change of transportation vehicle. But busses and trams can be very crowded during rush hours which can make her take the car instead.

She thinks that the cost of monthly tickets of public transportation is good value for money if you live a in single household. But as soon as there are two or more persons in a household, it makes more sense economically own a car. The car makes her life more comfortable, and that is of great value to her.

She thinks the parking price of 1000 SEK per month is really expensive. But since she can share the cost with her partner, it is fine.

She has used the car sharing service, *Volvo On Demand* several times. Mostly before she and her partner got their own car, but they still use it once in a while. For example if they need to buy things like furniture that are too big to fit in their own car. She thinks the car sharing service for works great, and is decent value for money for shorter trips. But it is not an option to use it for longer trips, like going to visit family over the weekend, since it the fee is charged hourly.

She is positive to targets that the City of Gothenburg has to reduce traffic, and

increase trips made by sustainable means of transportation, but she thinks that the city currently are trying to drive this change faster then it can handle. She thinks it is frustrating that the city makes it harder and harder for people to own and use their cars, especially since the alternatives are not improved, the public transportation is not made better nor cheaper. The city fails to create good substations for owning a car.

Her own thoughts on improved mobility in Gothenburg are lowered prices on public transportation, and more frequent departures during rush hours.

5.4.3 Interviewee B

Interviewee B is male, in his mid thirties. He is employed full time and work in an area not too far away from his home. He lives in a single household in Nya Kvibergshuset. He does not have a car.

Sustainability is not important when it comes to his choice of transportation. The most important factor is the time it takes to get to the destination, and he thinks that travelling by car is not much faster than public transportation.

> *In a larger city you don't benefit that much (timewise) from having your on car, since moving about with public transportation is pretty fast*
> - Interviewee B, Author's own translation

His main means of transportation is public transportation during the colder months, and public transportation and bicycle during the warmer months. During the colder months, he purchases monthly tickets for public transportation.

His workplace is located a couple of kilometers from his home, and most of his activities are within central Gothenburg. Therefore, he does not feel the need of owning a car.

His parents live in Gothenburg as well. If he needs, he can borrow their car. Sometimes they take the car and go shopping together. He borrows their car about two times a month, in order to go somewhere outside of Gothenburg for recreational purposes.

He has tried to use the cargo bikes from the bicycle sharing service once. But there was no battery available. He has not tried to use it again.

He has informed himself on how to use the car sharing service *Volvo On Demand*, but has not used it since he can borrow a car from his parents if needed.

He has visited the bicycle service room. He is positive to the idea, but his experience was that it was not fully functional when he was there. He also has his own tools for his bicycle.

He is positive to the targets that the City of Gothenburg has to reduce traffic, and increase trips made by sustainable means of transportation. He wishes that the central parts of the city were more bicycle-friendly, and less car-centered.

His main thought on improved mobility in Gothenburg is improved bicycle infrastructure. He would like the paving of the bicycle lanes to be improved. Poor paving take away the joy of riding the bicycle he states.

5.4.4 Interviewee C

Interviewee C is female in her mid twenties. She is a full time student, and she works occasionally. She lives together with her partner in Nya Kvibergshuset. Her partner is employed. They do not have a car.

Sustainability is not important when it comes to her choice of transportation. The most important factor is the cost, and the second is comfort. She thinks she would own a car if it was cheaper.

Her main mean of transportation is public transportation. She uses her bicycle sometimes in the summer. Her most frequent trips are to the campus were she studies, and to the workplace where she works once in a while.

The reason why they do not own a car is the cost. It is too expensive in comparison to how much they would use it. Therefore, she thinks that the cost of parking is of great importance when it comes to owning a car. The higher the cost, the less beneficial it is to own a car.

She and her partner have used the car sharing *Volvo On Demand* several times. Mainly for shopping purposes. She thinks the car sharing service is easy to use, cars are almost always available, and the cost is affordable. She adds that it is convenient that she can use *Volvo On Demand* car sharing at all locations, not just the one outside the property.

She is positive to targets that the City of Gothenburg has to reduce traffic, and increase trips made by sustainable means of transportation, but says they got a long way to go. First and foremost, one needs to be able to travel everywhere within the city, with public transportation, she says.

Her main thoughts on improved mobility in Gothenburg is improved bicycle infrastructure and cheaper public transportation. She says that she sometimes feel unsafe when riding her bicycle. Mainly on a personal safety level, but she also thinks that traffic safety for cyclist could be improved.

5.4.5 Interviewee D

Interviewee D is female in her mid thirties. She is employed full time, works remotely from home three days a week, and at the office two days a week. She lives in a single household in Nya Kvibergshuset. She has a dog. She does not have a car.

Sustainability is important when it comes to her choice of transportation. Cost and sustainability are the most important factors. She thinks that the public transportation system works well enough for her lifestyle, and therefore she does not see the need for owning a car.

Her main means of transportation is public transportation. She uses her bicycle sometimes in the summer. Her most frequent trips are to the office, to the gym, to the city centre, to her partner, and to local supermarkets. More or less all these trips are made with public transportation. Sometimes she walks in order to get more exercise.

She started using the car sharing service *Volvo On Demand* about one year ago. She uses it approximately once a month, to visit friends outside of Gothenburg, or to go shopping. She thinks it is easy to use, and is affordable.

She does not use the bicycle sharing service since she has her own bicycle. She recently found out that the bicycle service room existed, which was a pleasant surprise.

She is positive to targets that the City of Gothenburg has to reduce traffic, and increase trips made by sustainable means of transportation.

Her main thoughts on improved mobility in Gothenburg is improved public transportation. She thinks that the trams can be way too crowded, especially during rush hours. Sometimes she waits for the next tram to arrive, hoping that it will be less crowded.

She states that traveling is about comfort and time efficiency. This has to be considered when developing the city.

5.4.6 Interviewee E

Interviewee E is female, in her mid twenties. She is employed full time. She lives together with her partner at Mandolingatan. They do not have a car.

Sustainability is important when it comes to her choice of transportation, but time efficiency is what she values the most. If having a car would have saved her a lot of time, she might have had one.

The locations she regularly visits are located nearby her home. This makes it possible for her to walk or ride her bicycle to these places. Other trips within Gothenburg

are made with public transportation or by bicycle. This is made easy by the fact that she lives close to both tram stops and bus stops that are trafficked with high frequency.

She has not used the car sharing service nor the bicycle sharing service, since she does not feel she has a need to. She is positive to the fact that the measures exist and thinks it is great that they are implemented for those who needs them.

She is positive to targets that the City of Gothenburg has to reduce traffic, and increase trips made by sustainable means of transportation. She thinks the city needs to put a larger effort into sustainability overall.

Her main thoughts on improved mobility in Gothenburg are improved bicycle infrastructure, less crowded public transportation and less delays in public transport.

5.4.7 Interviewee F

Interviewee F is male, in his late forties. He is married and has a child. Both he and his wife are employed full time, and both work in the city centre. They live at Mandolingatan. They own a car, and it is parked in the above-ground parking garage that belongs to the property. They pay approximately $1500 - 1600$ SEK per month for that parking spot.

Both adults use public transportation when going to work. Most of their other trips are made with their car.

Sustainability is a fairly important factor when it comes to his choice of transportation, but time efficiency and comfort is what he values the most.

He states, that as the situation is today, the car is superior to all other means of transportation, since almost all trips are made easier with car compared to the alternatives. This is especially true for trips made outside of Gothenburg. Therefore, the family feels they need to own a car, since it will makes their life easier to live.

He has not used any of the mobility measures implemented in the property. He does not need the car sharing service nor the bicycle sharing service, since he has an own car and bicycle. He has his own tools and know how to fix his own bike, therefore, he is not in need of the bicycle service room either.

He states that the high cost of using the car sharing service disqualify it from being an alternative to owning a car.

The interviewee has many opinions on the parking situation. He thinks the parking price of $1500 - 1600$ SEK per month is extremely expensive. He thinks the price is unreasonably high. The price is similar to renting a parking spot in the very central

parts of Gothenburg, he states.

He thinks it is annoying to not have a permanent spot in the parking garage. As the situation is today, he sometimes needs to search for the car, since he might not know where it was parked last time.

The distance to the parking spot is not a factor that affects his will to own a car. Before the garage was finished, they had their car parked about $1km$ away. It was frustrating, but not owning a car was still not an option, he states.

He is frustrated by the fact that there are no chargers for electric vehicles in the parking garage. If residents had electric cars instead of fossil fueled ones, it could have a large positive impact on the environment, he states.

> *They have just built a new parking garage, with no EV-chargers installed. If you live in a rental apartment, you cannot have an electric car, as the situation is today.*
> - Interviewee F, Author's own translation

About the public transportation in Gothenburg, he thinks that monthly tickets are good value for money, but single tickets are way too expensive. As a family it is cheaper to go by car instead of paying two or three single tickets for a journey. He states that it often is cheaper to travel alone by car as well.

He is positive to targets that the City of Gothenburg has to reduce traffic, and increase trips made by sustainable means of transportation, if that means that they make it more attractive to use public transportation and bicycle by making these alternatives more attractive.

As of today, he thinks it is frustrating that the city makes it harder and harder for people to own and use their cars, especially since the alternatives are not improved.

On top of that, he thinks that it is unfair that the ones who are the most affected are people living in rental properties, since their parking costs will be raised. Compared to house owners whose parking at home always is free.

His main thought on improved mobility in Gothenburg is improved public transportation. He thinks that is has to be less crowded during rush hours, the vehicles needs to be more comfortable, and the price of single journey tickets needs to be cheaper.

5.4.8 Interviewee G

Interviewee G is male, in his thirties. He lives with his partner and his child. He is self-employed and works all over the city. They live at Mandolingatan. They own a car, and it is parked in the above ground parking garage that belongs to the

property. They pay approximately 1200 SEK per month for a parking spot.

Sustainability is important when it comes to his choice of transportation, but time efficiency is what he values the most. He is car dependent, both because he needs it during the work days, but also to go shopping, drive his son to activities and so on.

He states that many of the trips he is doing would take twice as much time if done with public transportation instead of car. The same goes for his son. Therefore, he feels like he has not got the possibility to act and travel sustainable in his current situation.

He thinks it is frustrating that owning and using a car is expensive and unsustainable. He looked into the car sharing service, but it is way too expensive to use, especially for him who needs a car every day for work. He states that he would like to be a part of some kind of car sharing service in order to get the costs down, but there are no viable alternatives at the moment.

He thinks the parking price of 1200 SEK per month is expensive. But he does not have the option of not owning a car, so he has to pay up.

He is positive to targets that the City of Gothenburg has to reduce traffic, and increase trips made by sustainable means of transportation. He hopes the goals will be achieved, but as of today, he has not experienced any improvements.

His main thoughts on improved mobility in Gothenburg are more and cheaper car sharing services, and more public transportation routes without needed connections in order to reach the destination.

5.5 Interview with David Backelin at Exploateringsförvaltningen, Göteborgs stad

David Backelin is an environmental scientist and has worked with the City of Gothenburg for 10 years. Throughout his professional life until now he has been working with tasks revolving around sustainable transport, parking, and city planning. He was part of the team who developed the mobility agreements. Now he is working at the division *Projekt Söder* trying to connect city planning with traffic and mobility questions.

The foundation of the mobility agreements, according to him, is to make it possible to affect the mobility habits of newly moved residents. By planning the housing area and the surroundings for sustainable transportation, this can become the obvious choice instead of a privately owned car.

Exploateringsförvaltningen, where Backelin is employed, is responsible for exploita-

tion projects in the city. It's a big division with several hundred employees, many who are specialized professionals. Backelin's special function is to develop governing documents and make sure that they are followed properly. Therefore he did not work specifically with the sites (Mandolingatan and Nya Kvibershuset) that are studied in this thesis, but he assisted colleagues who were developing the detailed plans for the buildings.

When asked about how successful the implementation of mobility measure in Nya Kvibergshuset and Mandolingatan have been for residents, he responded that he is not sure. There has not been any extensive follow up from the residents perspective, but Backelin mentions that there are surveys carried out currently. He has heard that there is a high vacancy rate in the parking garage at Mandolingatan. The reason, he said, can be low car ownership or that the cars are parked in other places. They do not have a routine of analyzing why parking spots are empty, since that falls on the responsibility of the property owner. The property owners do not want empty parking spots either, since it is an investment they expect to gain revenue on.

In 2017, the mobility agreement started to be developed as a part of the project *Bostad 2021*. This project aimed to build 7000 more units of housing than the normal pace, to reduce the building costs, and at the same time increase sustainable transportation. The idea of the possibility to lower parking numbers started to take form. That is when Backelin and his colleagues together with the property developers invented the model for mobility agreements with deduction on parking number.

They did not have a specific source of inspiration when developing the mobility agreement, but the department has learned a lot by looking at how other successful European cities have managed similar issues.

They had a very tight deadline since the detailed development plans and building permit for the housing areas were handled at the same time. They also needed to go through all steps to set a parking number and to ensure the apartments were built by 2021. Parallel with this, the guidelines for mobility and parking in Gothenburg, were constructed and published 2018.

Since then, the document has been updated and improved in dialogue with the property owners and developers. As things moved forward, different issues were solved in order to make the process of mobility agreements easier. In the beginning, property developers, wanted clear structure and guidelines. They wanted to know exactly which measures to implement and how to do it. Nowadays, they want more freedom to be able to adapt the mobility measures based on the characteristics of the area where the property is being built. Communication has improved and they have a better collaboration today than they had before. Since the constructions that started being built in 2017 just moved in 1-2 years ago, it's a bit too early to say if the measures have been successful or not. Considering this, the development of the mobility agreements might even go too fast. In the end, the goal is not

necessarily to match the supply with demand, but to find a balanced way to regulate parking numbers and prices, as well as efficiently implement mobility measures.

A recent political proposal has been made to lower the parking number in central and semi-central Gothenburg. This mission aims to shift the parking number to be more based on accessibility in the area and will be decided upon this summer or early fall 2024.

When asked about how well he thinks the mobility agreement is at facilitating sustainable transportation he replies that he feels confident with this work. He feels satisfied with the job and said that the project has been thoroughly thought through.

One way that Backelin sees as a possibility to create more acceptance for less and more expensive parking, is increased information about the true cost of parking. As it is today, no one pays the full price for their parking spot, he states. For property owners to get coverage for their expenses, the cost of parking will be added to the rent for all residents. Meaning that residents without cars subsidies the parking spaces for the car owners.

> *I think most people will accept the principle of that if you want something, you will have to pay for it*
> - David Backelin, talking about parking prices. Author's own translation.

Today, the car has too many benefits. To increase the amount of sustainable mobility in the city, the measures that are good need to be further improved, but actions need to be taken to make the car less advantageous. A lot of research proves this, states Backelin.

It is easier for the politicians to work with improvements and develop new measures. It is harder for them to take actions that take away things people want, even if these things are not beneficial to the city as a whole.

One important part of the mobility agreement is that it is voluntary to sign. If there is a will to reduce the amount of parking, then the option is there. It is not desirable to force this change but rather try to make it as beneficial as possible.

The mobility agreement contains many different measures that are possible to implement, in order to lower the parking number. The hope is that this will encourage property developers to implement the measures they think will have the largest impact for the residents, and for residents to be encouraged to travel more sustainable. Interview questions for David Backelin, Exploateringsförvaltningen, can be found in Appendix A.3.

5.6 Interview with Joa Ivarsson at Framtiden Byggutveckling AB

Joa Ivarsson is the sustainability manager at the company Framtiden Byggutveckling AB, where she primarily works with mobility and parking issues within the City of Gothenburg. The company utilizes and develops its own land and modifies existing infrastructure in the areas. Framtiden Byggutveckling focuses on the new production of housing and the use of sustainable materials, but also addresses the travel habits of existing tenants. The interview questions can be found in Appendix A.2.

5.6.1 The mobility agreement and its' implementation

In regards to the mobility agreement, Ivarsson is positive and states that it is advantageous to have flexible parking numbers and enable developers to lower the parking number with the help of mobility measures. However, she states that there are several factors that need to be addressed in order to get the best effect. Ivarsson believes that an important stepping stone in the implementation of mobility measures is proximity to public transport as well as properly regulated parking pricing in the area. She also believes that there is a lack of research in the effectiveness of certain mobility measures. Developers and property owners often choose to implement the mobility measures that are the most effective, in terms of cost and effort. Consequently, the chosen mobility services for a property may not be optimal for the respective areas and their residents. Ivarsson admits that a thorough evaluation on which mobility measures to implement, in terms of resident usage, might be difficult today. She states that urban planning is an ongoing process, and the city is still in the early stages of implementing and evaluating the mobility agreements.

Ivarsson sees communication as an area of improvement in the implementation of mobility measures. She wishes that new residential areas that have mobility measures and a decreased parking number, would be marketed as such at an early stage, in order to make future residents fully aware. Ivarsson emphasizes the importance of *influencing the decisions* of potential residents. She mentions Litteraturgatan in Gothenburg as an example. This is a project with the aim of zero as the parking number, this means that there will be no residential parking built for the property. The aim of a car free and climate smart residential area will be marketed to future residents with the hope of promoting sustainable living.

5.6.2 Challenges in the planning of parking

Ivarsson agrees that the price of parking is an effective way of changing citizens' travel behaviour. She highlights the impact of price of parking both at home and at the destination. This applies to all types of trips, to work, to hobbies and leisure trips, to the grocery store, and so on. Ivarsson emphasizes the importance of a better, and more consistent, regulation of parking prices. She wishes for the City of

Gothenburg to review how they regulate parking within the city. Ivarsson specifically describes an issue regarding the pricing of street parking. She recognizes a common issue, that residents are likely to use street parking in their residential area, instead of using the parking built on property land. The same goes for parking at other destinations in the city. This causes a large amount of the residential parking spots, which the developer has to build according to the law, to stay empty. As long as the city is not on board and improves the regulation of parking, the number of car sharing services or the quality of bicycle storage will have little effect. Additionally, transitioning to permit parking, rather than assigning a designated parking space for each vehicle, is essential. Permit parking facilitates the sharing of parking spaces throughout the day, accommodating varying parking needs at different times.

Ivarsson was involved in the projects developing Nya Kvibergshuset and Mandolingatan, where she coordinated parking and mobility. When building the new housing area at Mandolingatan, a major part of all existing ground parking was removed together with the one-story garages. Residential buildings and a multistory parking facility were built on this land instead. When planning new developments without accounting for existing housing, a replacement parking assessment becomes necessary. Ivarsson states than an issue with decisions regarding replacement parking is the uncertainty of the actual parking demand today and in the demand in the future, combined with the fact that the new property might cause a change in the demand of parking. It is essential to recognize that the demand for parking may vary following more redevelopments and/or change over the years to come. However, this is difficult to accurately take into consideration while doing the calculations. Ivarsson exemplifies with Mandolingatan, where there are many empty residential parking spaces in the over-ground garage. This is could be a consequence of the parking number being set to high, by the City of Gothenburg, and because the residential parking is expensive, therefore, the resident might find cheaper parking elsewhere in the neighborhood.

Lastly, Ivarsson emphasizes the importance of addressing the proper use of land. Framtiden Byggutveckling AB would like to find better use of the land and properties currently used for parking. In a perfect world, the land used for parking today would be used for housing or recreational areas instead. Ivarsson believes that enabling the property developers to build less parking and more housing would not only benefit them economically but also the city in general.

5.7 Site observations

When distributing the surveys at the two residential areas we had access to all bicycle garages, service rooms and car parking garages in the facilities. Without knowing exactly what to look for we made some observations that will be presented below.

5.7.1 Mandolingatan

Mandolingatan was visited two times in the afternoon on weekdays. Both parking garages seemed to have a lot of empty spaces, especially on the higher levels. To enter one of them you needed a key, but the other one was open since it also contained costumer parking for the small shop nearby. No electric chargers for electric vehicles were observed in any of them. There were dedicated spaces both inside and outside for the MABI car sharing service, but they were occupied by other residents cars. No cars from the car sharing service was observed.

The bikes in the cargo bike sharing service were always available when we were there. Next to the bikes there were signs displaying prices and instructions on how to use them.

The bike garages were used but far from full. Some rooms were labeled *bicycle service room* and worked as a storage but with extra space. In these premises there were no tools to facilitate any repair job, residents were expected to bring their own tools.

5.7.2 Nya Kvibergshuset

Nya Kvibergshuset was visited two times to distribute surveys on weekdays, one early morning and one afternoon. It was also visited on a weekend one time at an early stage of the project to get a first impression of the area. On the weekdays the car sharing service usually had three out of four cars parked in their spots. But on the weekend there was only one car available. As the cars were just outside the house they were almost impossible to miss. Furthermore, there were two levels of parking garage both with access to electric chargers for electric vehicles.

The bicycles in the bicycle sharing service were always available when we were there. Next to the bikes were signs displaying prices and instructions on how to use them. There were both a cargo bike and regular e-bikes, see Figure 5.21. Since the door to the bicycles were locked it seemed safe to store a bike there, but at two occasions we saw people bringing their electric bikes into the elevator to their apartment. It looked like the spacious bicycle garages could fit many more bikes.

Figure 5.21: The bicycles from the bicycle sharing found available at Nya Kvibergshuset

The bicycle service station was outside and had a bike holder, a pump with manometer and tools attached to the station with wires, see Figure 5.22. There is also a QR code that links to videos that shows how to do basic repairing jobs.

Figure 5.22: The bicycle service station at Nya Kvibergshuset. It includes a pump, tools and a place to hang the bike.

6
Discussion

The following chapter highlights the results presented and discusses them in the context of the area of study. Resident responses from the survey as well as interviews are analysed and compared to previous research. The same is done with the interviews conducted with Joa Ivarsson, Framtiden Byggutveckling AB, and David Backelin, Exploateringsförvaltningen.

6.1 Analysis of Car ownership and Parking demand

By using the survey answers, it is possible to compare the value of cars/person from the survey to the value of cars/person for the whole area, based on data from SCB. Mentioned in section 5.3.1, 10 out of 31 respondents in Nya Kvibergshuset, and 20 out of 54 in Mandolingatan, own cars. The survey answers gave us the total number of residents in each household. Adding them together, the amount of residents in the households of the respondents are 112 at Mandolingatan and 44 in Nya Kvibergshuset. Assuming that a respondent represents a hosuehold, and that none of the households have more than one car, the cars/person ratio can be found by dividing the total amount of respondents owning a car, with the total amount of residents. This results in a 0.227 cars/person ration in Nya Kvibergshuset ($\frac{10}{44}$), and 0.178 cars/person ratio at Mandolingatan ($\frac{20}{112}$). This corresponds well with the value for the whole area, calculated in chapter 4, section 4.1 to 0.224 cars/person in Gamlestaden (Nya Kvibergshuset) and 0.181 in Frölunda Torg (Mandolingatan). These values are represented in Table 6.1.

	(Gamlestaden 301) Nya Kviberghuset	(Frölunda Torg 517) Mandolingatan
Cars/person (Survey)	0.227	0.178
Cars/person (SCB)	0.224	0.181

Table 6.1: The ratio of cars/person in both properties, derived from the survey result and the area statistics from chapter 4, section 4.1.

When developing both properties, the MPR together with area specific deductions was used to calculate the respective parking number (dedicated parking spot per apartment). By comparing this with the actual car/apartment ratio, we can estimate

if this number has been over- or under estimated. As mentioned in subsection 5.3.1 the number of cars per apartment of the survey respondents was calculated to be 32% for Nya Kvibergshuset and 37% for Mandolingatan, responding to the parking numbers of 0.32 and 0.37. The parking number used by the developer is 0.348 for Nya Kviberghuset and 0.3496 for Mandolingatan. These numbers are presented in Table 6.2.

	Nya Kvibergshuset	Mandolingatan
Cars/apartment (Survey)	0.32	0.37
Parking number (Poseidon)	0.348	0.3496

Table 6.2: Parking number in both properties calculated with the survey results and the parking investigations.

In Nya Kvibergshuset, the survey estimate is lower than the reduced parking number. However, at Mandolingatan, the survey estimate is higher than the reduced parking number. This would imply a slight shortage of parking in the area of Mandolingatan. On the other hand, Figure 5.11 shows how none of the respondents state that they refrain from owning a car due to limited availability of parking. The same result was derived from the interviews, where several residents on both properties expressed that they had no issue finding available parking spots. Furthermore, when visiting Mandolingatan it was observed that the both parking garages had a considerable amount of empty parking spots. In interviews with David Backelin (Exploateringsförvaltningen) and Joa Ivarsson (Framtiden Byggutveckling AB) in section 5.5 and 5.6 it was also discussed that the low occupancy of the parking garages in Mandolingatan is a known issue.

A possible explanation to the difference in estimated and theoretical parking demands, as well as resident experience, could be the utilization of other parking lots. As discussed in the interview with Joa Ivarsson, a large issue when planning parking is the regulation of municipal parking prices in the area. In this case, as seen in Table 5.3, 25% of residents at Mandolingatan as well as 50% in Nya Kvibergshuset utilize other car parks than the residential parking garages. This could account for the low occupancy of the parking garage at Mandolingatan as well as the variation in estimated parking demand on both properties. Residents may choose to park their vehicle on a municipal parking spot somewhere in the area that is cheaper. Several residents expressed in interviews that they would be willing to walk a further distance to their parking spot if it was cheaper than the geographically closest alternative to their home. The same results were found by Johan Kerttu whilst conducting a similar study in Lund, Sweden (Kerttu, 2014). Similarly to ours, Kerttu's study concluded that most residents would consider parking further away if the price increased on their nearest parking spot. Another researcher who came to the same conclusion is Greg Marsden, who also found that residents were willing to walk long distances to save money on parking (Marsden, 2006).

The parking numbers in both Mandolingatan and Nya Kvibergshuset are fairly similar, as indicated in Table 6.2. This is unexpected considering that the two areas are situated in different zones. Mandolingatan is located in zone A, considered as a strategic area for development and Nya Kvibergshuset is situated in zone B, as seen in Figure 2.3, (Göteborgs Stad, 2021). A parking investigation was conducted at Mandolingatan, and the property signed a mobility agreement. However, Nya Kvibergshuset does not have an official mobility agreement. Instead they looked at similar areas in other cities in Sweden to find a suitable amount of parking spots (Edoff, 2017). This might be the reason why the properties resulted in almost the same parking numbers even though they are not located in the same zone. Since Mandolingatan has a relatively high parking vacancy rate according to our interviews and observations this suggests that there may still be room for improvement in the guidelines when it comes to calculating a suitable parking number.

6.2 The cost of parking, from a resident and developer perspective

The cost of parking is a factor which affects residents mode of transportation. As seen in Figure 5.11, a relatively large percentage of respondents say that the cost of parking and cost of owning a car are reasons they refrain from owning a car. According to survey responses and resident interviews, the average cost of parking amongst respondents is 1100 SEK per month. As the price of parking is fixed, it does not vary amongst income groups as seen in seen in Figure 5.7. When asked about a theoretical maximum parking price, there was no clear correlation to income. As seen in Figure 5.10, the different income groups have similar responses. It is noted that the highest income group has one respondent willing to pay more than 3001 SEK, however this makes little impact on the overall trend. A study in Lund, Sweden, has the same results and concludes that income does not have a clear correlation to willingness to pay for parking (Kerttu, 2014). It is obvious by looking at Figure 5.9 that 1800 SEK is generally the maximum price residents would pay for parking before giving up their car.

An interesting finding is that around 50% of car owners state that they would consider giving up their car at a parking price similar to, or lower, than the current average price 5.9. This proves that residents are sensitive to the price of parking. The same attitude was found in several interviews where interviewees expressed that the price they currently pay is too high. However, previous research shows that the actual price of parking is much higher (Shoup, 2018). Furthermore, David Backelin also agrees that the current cost of residential parking is much lower than the cost of construction, maintenance and profit on investment. Counter-intuitively, the survey respondents think the cost of residential parking already is too high, while the property owners cannot run a parking facility at break even, without forcing all residents to subsidize the total parking cost. Implying that if parking was free the cost would be distributed among all residents, resulting in higher rents for everyone. Additionally, both Ivarsson 5.6 and Backelin 5.5 touch on the topic of

proper use of land. It would be more economically beneficial for property owners to build more housing instead of areas of parking. As of today, they are forced to build a certain amount of parking spaces, needed or not, due to the system of MPR. In the end, it is difficult to refrain from the financial perspective of parking policies. Both residents and property owners seem to think it is too expensive from their perspective.

6.2.1 Car ownership, today and before moving in at Mandolingatan and Nya Kvibergshuset

Statistics from the survey illustrates a change in the amount of car owners before and after residents moved in to Mandolingatan and Nya Kvibergshuset. Looking at Figure 5.2, there is a tendency for lower car ownership rates at Mandolingatan compared to previous numbers. On the contrary, the opposite is shown for Nya Kvibergshuset, where the tendency to own a car is slightly higher after moving there. Delving deeper into the data, it was found that there was a total of 11 households who sold their cars after moving into one of the two areas. In order to analyse the reason behind this change, respondent answers were compared to if they had utilized the car sharing service or not. It was found that only one of the 11 households had utilized the car sharing service. This implies that the implementation of car sharing as a mobility measure, is not the main reason a resident refrains from owning a car. It is worth noting that five out of these 11 households marked student as their occupation, which could also have influenced their decision. A study conducted by Johansson et al (2019) aligns with our findings, indicating that various factors beyond mobility services and parking policies influence people's travel behaviour and car ownership. For instance, family situation and employment status were identified as a significant factors affecting these decisions (Johansson et al., 2019). Therefore, while mobility measures play a role, other factors should also be considered when analysing changes in car ownership and travel behaviour.

An explanation to the difference in the change of car ownership between the two properties could be varying proximity to services and societal functions. The proximity of Frölunda Torg, a shopping center and public transportation junction, to Mandolingatan could be one reason to why respondents, to a larger extent, gave up their car when moving. With all kinds of stores, restaurants and supermarkets available at the shopping center, residents may find it convenient to walk there for they daily needs, reducing their reliance on cars or other forms of transportation. Additionally, the availability of several tram lines with frequent trips throughout the day provides easy access to other parts from the city from Mandolingatan. On the other hand, Nya Kvibergshuset is located further away from services and societal functions. This may require residents to travel longer distances for their daily needs and could result in a higher reliance on personal vehicles or public transportation for commuting to essential destinations such as shopping centers or restaurants. Overall, the accessibility of amenities and services within walking distance can signif-

icantly impact residents' travel behaviour, influencing their choice of transportation and potentially reducing the demand for private vehicles. This is also shown in previous research, see Section 2.4. For instance Olsen et al (2024) and Ibraeva et al (2023) conducted in their study that residents who lives nearby services and societal functions tend to use more sustainable modes of transportation such as walking, biking or using public transportation because they have everything they need close-by (Olsen et al., 2024) (Ibraeva et al., 2023).

6.3 Respondents' view on public transportation

The survey data indicates that the majority of residents in Nya Kvibergshuset and Mandolingatan use public transportation on a daily basis or at least 4-5 days a week, in addition to walking, see Figure 5.1. Furthermore, the majority of interviewees stated that they rely on public transportation when traveling to the city center, work or school, viewing it as a reliable mode of daily transport. However, residents also acknowledged that for trips outside of Gothenburg, taking the car is often more convenient and time efficient (Interviewee A. 5.4.2 and Interviewee F, 5.4.7). One interviewee emphasized that owning a car in a large city does not offer significant time benefits (Interviewee B, 5.4.3), while another respondent disagreed, stating that traveling by car is generally more time efficient (Interviewee A. 5.4.2). A large proportion of the respondents have concerns about the high cost of public transportation, especially for one-way tickets. Additionally, overcrowding on trams during rush hours is a common issue, leading to a desire for more frequent departures and improved comfort during trips. One interviewee stated that she sometimes rather take her car than stand on a crowded tram (Interviewee A, 5.4.2), which becomes a problem. Another interviewee said that she sometimes waits for the next tram to arrive, hoping it will be less crowded. The above is reflected in the data, see Figure 5.19 which shows a perception that reduced cost of public transportation and improved service frequency could act as a factor in reducing the car use in general.

In summary, people utilize different transportation modes depending on their activities, often combining public transportation with walking, or cycling. While public transportation is valued for daily commuting, there is still room for improvement to encourage more residents to choose it over cars, particularly for trips outside the city center. This could involve further development of public transportation infrastructure and services to enhance convenience, affordability and comfort for users.

6.4 The usage of mobility measures and attitudes towards them

According to the survey 39% of the respondents in Nya Kvibergshuset and 26% at Mandolingatan states that the mobility measures were something that attracted

them when moving into the apartment building. Surprisingly, the actual number of persons using the mobility measures are a lot lower. For instance, only 4% of all respondents have used the bicycle sharing service 5.17, and 14% of have used the car sharing service. It appears that people do not prioritize or use the implemented mobility measures to such a large extent. Many residents also agreed on that the information of existing mobility measures needs to be improved, see Figure 5.19.

6.4.1 The impact of bicycle sharing and service rooms

The usage of the bicycle sharing and service rooms is almost non existing. Only two people at Mandolingatan, and one person in Nya Kvibergshuset had tried the bicycle sharing service, see Figure 5.17. This may indicate that these measures are quite ineffective and may not be optimal for the residents.

The main reason residents do not use this mobility service is that most people have their own bicycle and prefer to use it, see Figure 5.18. Some residents also do not have a need for a bicycle, or think the information about the bicycle sharing service is unclear. Some survey respondents expressed a desire for electric bicycle sharing services, see Figure 5.19. On the other hand, Nya Kvibergshuset already has at least two electric bicycles according to our observations, see Figure 5.21. This reveals the issue of residents being unaware of the existing mobility measures, highlighting the importance of better information regarding the mobility measures. Furthermore, instead of having internal bicycle sharing services, it might be a good solution to install more *Styr och Ställ* stations and connect the residential areas to the already existing bicycle sharing grid of Gothenburg.

6.4.2 The impact of car sharing

According to our survey, see section 5.3.5, 7.4% and 25.8% of respondents have tried the car sharing service in Mandolingatan and Nya Kvibergshuset respectively. This implies that the service is more successful at Nya Kviberghuset. A reason for this could be that Nya Kvibergshuset is further away from societal service and supermarkets, making the car, and the car sharing service, more useful compared to Mandolingatan. that has close proximity to Frölunda Torg.

Looking at Figure 5.6, there are three age groups with lower car ownership. Comparing this to Figure 5.14, we see that the same three age groups are more likely to try the car sharing service. This could imply that persons that do not own cars are more likely to try the service. This pattern is evident in both properties where the study was conducted. Our data shows that only 25% of the people who tried the car sharing service were car owners. A similar result was found in a study by Mouratidis, who also concluded that there was a correlation between the use of car sharing services and the lack of a private owned vehicle (Mouratidis, 2022).

Overall, those who have used the car sharing service are satisfied with it, rating

their overall experience at 4.2 on a scale of 5, see Table 5.4. User friendliness, and the available information of the service, were the categories that received the highest ratings. The category that received the lowest rating, 3.6 on a scale of 5, was the affordability of the service. This shows that the cost of using car sharing is viewed as somewhat of a shortcoming by the users of the service.

The majority of residents in both properties have not utilized the car sharing service. As seen in Figure 5.16, the main reason is that residents express no need for a car. The second most frequent answer, answered by a quarter of the respondents, is that the cost of the service is too high. The survey revealed that certain demographics, particularly those with lower income levels, face barriers in accessing the car sharing service. The aspect of income in relation to the use of car sharing is illustrated in Figure 5.15. 60% of respondents with a household income of $60 - 80$ kSEK/month had used the car sharing service, in comparison with only 10%, 12% and 0% of the groups with lower incomes. The data implies that residents with a higher income are more likely to use the car sharing service. Furthermore, two respondents commented in the survey that their income level make them ineligible for the car sharing service. It was found that *Volvo On Demand* imposes an income threshold of 150 000 SEK annually, as stated on their website (Volvo On Demand, 2024). Both respondents expressed a desire to utilize the service for occasional tasks but found themselves excluded due to their income status.

Furthermore, residents have responded that the car sharing service seems complicated to use or did not know it existed. The lack of information and communication in the implementation of mobility measures seems to be a reoccurring theme in both properties. Several residents expressed an interest in trying the car sharing service but were unsure of its availability. Observations on site also confirm that the car sharing service might not have been properly implemented at Mandolingatan. Both times the area was visited, privately owned cars were parked on the parking spots designated to the *MABI* car sharing service. There were not any *MABI* cars observed in the area at all, although they might have been occupied elsewhere at the time.

As previously mentioned, our data implies that the car sharing service might not be an effective way of encouraging residents to give up their car. However, studies show that in other countries car sharing have worked well. Both Becker in Switzerland and Klincevicius in Canada has seen a decrease in car ownership when implementing car sharing services (Becker et al., 2018) (Klincevicius et al., 2014). Also, Vega & Gonzalo got the same result in their study, when they found out that car sharing services had an impact on the vehicle ownership levels. They saw that a significant reduction in car ownership where associated with this service (Vega-Gonzalo et al., 2024). In resident interviews, it was determined that car sharing services are not always a complete substitute for owning a car. For instance, Interviewee G 5.4.8, is car dependent due to a need for using a car in his occupation and therefore, cannot replace his car with the car sharing service. If

people use the car frequently in their daily lives, it is not be economically justifiable to only rely on car sharing services. Interviewee G emphasizes that a car sharing service is beneficial when going on shorter trips, but not for someone like him, who needs the car the whole workday. The cost of using car sharing services quickly adds up, making car ownership a more cost-effective option. This pattern was evident in resident interviews in general, where the residents who only needed a car occasionally were more positive towards the car sharing service.

6.5 Which are the "right" mobility measures?

When planning for mobility measures, property developers need to evaluate which services are most cost effective. This is indirectly decided due to how the City of Gothenburg value the different mobility measures and how large parking reduction each measure is equivalent to. Since the implementation of mobility measures as a tool to reduce parking is relatively new there are some research gaps, especially of follow-up studies. According to David Backelin (5.5) there is not sufficient information regarding the use and actual effectiveness of different mobility measures since most residents in the these areas have only lived there for up to three years, which is not enough time to properly evaluate the mobility measures. This also goes in line with what Joa Ivarsson (5.6) said, that there are some issues in making sure property developers choose the *right* measures for mobility, since they often prioritize cost-effective and easy-to-implement solutions, without necessarily taking other factors into consideration such as area-specific characteristics.

The survey data indicates that the majority of residents in Nya Kvibergshuset and Mandolingatan utilize public transportation on a daily basis or at least several times a week, see Figure 5.1. However, residents acknowledged that when they need to travel outside the city centre it is more convenient and time-efficient to use a car instead. A large proportion of the respondents are not satisfied with the high cost of public transportation, especially for one-way tickets. This is also seen in Figure 5.19 and 5.20 indicating that most respondents believe that cheaper public transportation fares could potentially reduce car usage. At Mandolingatan a free 30-day public transport pass for new residents, as well as real-time arrival information is already in effect. However, there is room for improvement in both areas, especially in the aspects of more frequently departures during rush hours and enhancing overall passenger comfort. According to residents, improving the public transportation network could be an effective strategy to reduce car dependency, as it is a familiar concept to them.

6.6 Limitations and areas of improvement

One of the main issues encountered during the project, possibly limiting the results, was the language barrier. It was decided early on to perform the survey in Swedish. However, as the statistics show in section 4.1, a large quantity of the

residents at Mandolingatan have foreign backgrounds. This was also something we observed as we were handing out flyers for the survey. Foreign names on mailboxes were common and several of the residents we encountered had difficulties in understanding Swedish. The flyer was reviewed and translated before distributing the survey the second time, in an effort to account for non-Swedish speakers. When visiting Mandolingatan the second time to distribute surveys, we also brought an iPad which enabled us to translate the survey in person for residents. The possibility of using auto translation to other languages was also available for the residents when conducting the survey on their own, but no instructions of how to use the translation tool was not included. Whilst we cannot know for certain if the amount of answers were affected by language barriers, it is an aspect that should be evaluated and planned for when conducting further research in the area. Furthermore, the survey was an online service, which might have been the reason for excluding some people, such as elderly with less technological know-how. This topic has been studied previously where digital exclusion was considered an issue prominent to elders (Lu et al., 2022). Perhaps more respondents of an older age could have been reached more efficiently in another way.

As mentioned in the methods, the statistics from the survey used a confidence level of 95% and a margin of error of 10%, and the sample size was determined based on these parameters. This indicate that the results presented above can be seen as representative for the true population of the areas within the specified margin of error. However, it is important to highlight the limitations in making a direct relation to the rest of the city, or other cities for that matter. As presented in the section 4.1 several demographics differ between the analysed area compared to the average of all parts of Gothenburg. If conducting the same study in other areas, the result thereby might differ.

Previous research identifies and discusses common difficulties in the utilization of data (Sprei, et.al, 2020). This problem was also identified in this report, for example in regard of data related to car ownership in the city. The statistics used, provided by the City of Gothenburg, concludes that the number of cars in Gothenburg (all parts) are 0.278 cars per person. Similar data can be found in the report *Minimum parking requirements and car ownership: An analysis of Swedish municipalities* by Sprei and McAslan, but with the additional information that this number only represent total cars per 1000 natural persons. The data is still valuable to this study despite the lack in documentation, but highlights the importance of evaluating the data and mention its limitations. In addition to the difficulties with the data mentioned above, there is also a lack of data on specific travel behaviors. This might have an influence on the possibility to analyze certain of our questions in comparison to previous research and thereby affect the result.

7
Conclusion

The aim of this study was to investigate the effectiveness of implemented mobility- and parking measures, as well as general attitudes towards them. In order to achieve this, the experiences and attitudes of residents were collected through a survey as well as through interviews. Interviews with actors in the area served to further investigate the correlation between implementation and user experience. Generally, it was found that there are several areas of improvement in terms of the mobility measures effectiveness.

The main finding of this study is that the majority of the responding residents in the studied properties, where measures like car- and bicycle sharing have been implemented, do not use them. In general, there was a positive attitude towards the measures and a willingness to try them. For instance, several residents expressed an interest in utilizing the car sharing service but saw obstacles in terms of cost and unclear instructions of use. In terms of the properties' bicycle sharing services, there were barely any respondents who had used them. On the other hand many respondents saw bicycle sharing as an attractive measure to implement. A lack of information about the services is clear, as residents are not utilizing the services simply because they do not know they are available to them. In general, residents express a need for more information about already existing mobility measures in order to decrease the need for using cars. It was concluded that there is a gap in communication between property owner and resident in regards to the mobility services, which causes a low degree of utilization amongst residents.

In terms of car ownership, the study concludes no significant correlation between the implementation of mobility measures and a decrease in car ownership in the studied properties. There were some non car owners who expressed a smaller need for a private car due to the available car sharing, however these respondents also stated cost as their main reason of not owning a car. This proves that, in the studied properties, the implemented measures themselves were ineffective in terms of directly decreasing car ownership. Regarding the price of parking, residents expressed that their current price was too high and that an increased price might make them give up their car. It was also concluded that the price of parking was more important than the distance to the parking spot. It seems that increasing the price of parking may be a more effective way to decrease car ownership than the implementation of mobility services.

The mobility measures are positively viewed by the actors who were interviewed,

but it is clear that they may not be optimal at this time. It is difficult to evaluate how well the measures are implemented, especially as they are fairly new. Overall, they are a great tool to start the conversation of sustainable transport and enable property developers to encourage residents to decrease their use of private owned cars. Residents mostly emphasized the need to improve the current public transport network, in order to increase overall mobility. As this is a familiar mode of transportation, it could be the best area of focus in order to decrease car ownership. Building actors themselves are unsure what other services could impact resident travel behaviour more than the measures in the mobility agreement.

Conclusively, it seems that the mobility measures implemented are not as effective as they could have been. Improvements are necessary regarding distribution of information, as well as ensuring that implemented measures match residents' needs. It is important to address the difficulty in finding the "right" mobility measures. Moving forwards, when aspiring to decrease car ownership it is important to have a holistic approach and also evaluate the impact of other factors than availability of parking and mobility measures. Future research on the subject should take into account additional factors which affect residents preferred mode of transportation, such as proximity to societal functions or area specific preferences. If an area and its residents' needs are studied in detail, perhaps it is possible to find the most effective mobility measures to implement.

Bibliography

Antonson, H., Hrelja, R., & Henriksson, P. (2017). People and parking requirements: Residential attitudes and day-to-day consequences of a land use policy shift towards sustainable mobility. *Land Use Policy*, *62*, 213–222. https://doi.org/10.1016/j.landusepol.2016.12.022

Becker, H., Ciari, F., & Axhausen, K. W. (2018). Measuring the car ownership impact of free-floating car-sharing – A case study in Basel, Switzerland. *Transportation Research Part D: Transport and Environment*, *65*, 51–62. https://doi.org/10.1016/J.TRD.2018.08.003

Bordier, J. (2017). *Detaljplan för bostäder och verksamheter vid Mandolingatan* (tech. rep.). Göteborgs Stad. www.goteborg.se/planochbyggprojekt

Bostads AB Poseidon. (2021). Mandolingatan.

Bostads AB Poseidon. (2022a). *Årsredovisning 2022* (tech. rep.).

Bostads AB Poseidon. (2022b). Nya Kvibergshuset. https://nyabostader.poseidon.goteborg.se/nya-kviberghuset/

Bostads AB Poseidon, Framtiden byggutveckling, ÅF Infrastructure AB, & Sigma Civil AB. (2018, July). *Parkeringsutredning Nya Kvibergshuset* (tech. rep.).

Dahlgren Camacho, C., & Simonsen, F. (2020). *Frameworks for sustainable development in the city of Gothenburg* [Doctoral dissertation, Chalmers University of Technology].

Edoff, J. (2017). *Parkeringsutredning Beväringsgatan Möjlighet till bil-och cykelparkering för nya bostäder och förskola* (tech. rep.).

Ekström Finskud, L. (n.d.). Program för Frölunda. https://goteborg.se/wps/portal/start/goteborg-vaxer/hitta-projekt/stadsomrade-sydvast/frolunda---hogsbo/program-for-frolunda

Eliasson, J., & Börjesson, M. (2022). Costs and benefits of parking charges in residential areas. *Transportation Research Part B: Methodological*, *166*, 95–109. https://doi.org/https://doi.org/10.1016/j.trb.2022.10.012

Etukudoh, E., Adefemi, A., Ilojianya, V., Umoh, A., Ibekwe, K., & Nwokediegwu, Z. (2024). A Review of sustainable transportation solutions: Innovations, challenges, and future directions. *World Journal of Advanced Research and Reviews*, *21*, 1440–1452. https://doi.org/10.30574/wjarr.2024.21.1.0173

Europeiska rådet. (2024, March). fit for 55. https://www.consilium.europa.eu/sv/policies/green-deal/

Ewing, R., Tian, G., Lyons, T., & Terzano, K. (2017). Trip and parking generation at transit-oriented developments: Five US case studies. *Landscape and Urban Planning*, *160*, 69–78. https://doi.org/https://doi.org/10.1016/j.landurbplan.2016.12.002

Flick, U., von Kardorff, E., & Steinke, I. (2004). *A Companion to Qualitative Research*. SAGE Publications.

Framtiden Byggutveckling AB. (n.d.). Mandolingatan kv G, Frölunda.

Framtiden Byggutveckling AB. (2017). *16012-16 Mandolingatan Mobilitetsutredning* (tech. rep.). www.framtiden.se

Framtiden Byggutveckling AB. (2022). PL Parkeringsbehov Mandolingatan.

Gillmén, K., & Gräsberg, H. (2014). *The parking standard in Gothenburg A comparison between theory and reality* [Doctoral dissertation].

Göteborgs kommun & Bostads AB Poseidon. (2020). Mobilitetsavtal 2017-09-25.

Göteborgs Stad. (2009). *Parkeringspolicy för Göteborgs Stad* (tech. rep.). https://goteborg.se/wps/wcm/connect/4d6c6191-662e-4087-ad91-7d9a8bbc805d/Parkeringspolicy_091008.pdf?MOD=AJPERES

Göteborgs Stad. (2011). Vägledning till perkeringstal vid detaljplaner och bygglov.

Göteborgs Stad. (2018). *Riktlinjer för mobilitet och parkering i Göteborgs Stad* (tech. rep.). https://goteborg.se/wps/wcm/connect/71cb268c-0391-4964-bb7b-e0f2a56fe073/Riktlinjer+mobilitet+och+parkering+SLUTVERSION.pdf?MOD=AJPERES

Göteborgs Stad. (2021). *Riktlinjer för mobilitet och parkering i Göteborgs Stad* (tech. rep.). https://goteborg.se/wps/wcm/connect/fbf6ef6f-fc85-4b65-a6a2-832e72232afb/Anvisningar+till+riktlinjer+f%C3%B6r+mobilitet+och+parkering+i+G%C3%B6teborgs+Stad+version+1.2.pdf?MOD=AJPERES

Hellberg, S., Bergström Jonsson, P., Jäderberg, M., Sunnemar, M., & Arby, H. (2014). *Gothenburg 2035 transport strategy for a close-knit city.* (tech. rep.).

Ibraeva, A., Correia, G. H. d. A., Silva, C., & Pais Antunes, A. (2023). Impacts of transit-oriented development on car use over a 10-year period in Porto, Portugal: From macro- to micro-analysis. *International Journal of Sustainable Transportation*, *17*(11), 1195–1206. https://doi.org/10.1080/15568318.2022.2160284

Johansson, F., Henriksson, G., & Envall, P. (2019). Moving to private-car-restricted and mobility-served neighborhoods: The unspectacular workings of a progressive mobility plan. *Sustainability (Switzerland)*, *11*(22). https://doi.org/10.3390/su11226208

Katona, G., & Juhasz, J. (2020). The History of the Transport System Development and Future with Sharing and Autonomous Systems. *Communications - Scientific letters of the University of Zilina*, *22*, 25–34. https://doi.org/10.26552/com.C.2020.1.25-34

Kerttu, J. (2014, August). *Parkering vid bostaden* [Doctoral dissertation].

Klincevicius, M. G. Y., Morency, C., & Trépanier, M. (2014). Assessing Impact of Carsharing on Household Car Ownership in Montreal, Quebec, Canada.

Leibling, D. (2014). Parking supply and demand in London. *Transport and Sustainability*, *5*, 259–289. https://doi.org/10.1108/S2044-994120140000005013

Lu, X., Yao, Y., & Jin, Y. (2022). Digital exclusion and functional dependence in older people: Findings from five longitudinal cohort studies. *eClinicalMedicine*, *54*, 101708. https://doi.org/10.1016/j.eclinm.2022.101708

Marsden, G. (2006). The evidence base for parking policies-a review. *Transport Policy*, *13*(6), 447–457. https://doi.org/10.1016/j.tranpol.2006.05.009

McAslan, D., & Sprei, F. (2023). Minimum parking requirements and car ownership: An analysis of Swedish municipalities. *Transport Policy*, *135*, 45–58. https://doi.org/10.1016/j.tranpol.2023.03.003

Mingardo, G., van Wee, B., & Rye, T. (2015). Urban parking policy in Europe: A conceptualization of past and possible future trends. file:///C:/Users/PC/AppData/Local/Temp/MicrosoftEdgeDownloads/ed0eeb1d-67aa-45ce-85fa-64ea214ce387/Mingardo,%20van%20Wee,%20Rye%202015%20-%20urban%20parking%20policy%20in%20europe%20-%20a%20conceptualization%20of%20past%20and%20possible%20future%20trends.pdf

Mouratidis, K. (2022). Bike-sharing, car-sharing, e-scooters, and Uber: Who are the shared mobility users and where do they live? *Sustainable Cities and Society*, *86*, 104161. https://doi.org/10.1016/J.SCS.2022.104161

Naturskyddsföreningen, Hyresgästföreningen, & Fastighetsägarna. (2020). *Framtiden för parkering och nya bostäder* (tech. rep.).

Naturvårdsverket. (n.d.). Inrikes transporter, utsläpp av växthusgaser.

Olsen, J. R., Nicholls, N., Whitley, E., & Mitchell, R. (2024). Association between local amenities, travel behaviours and urban planning: A spatial analysis of a nationwide UK household panel study. *Journal of Transport & Health*, *36*, 101784. https://doi.org/https://doi.org/10.1016/j.jth.2024.101784

Rye Tom, Tully Susan, Godin Glenn, Schmalholz Niklas, & Hertel Martina. (2022). Parking and SUMP. Using parking management to achieve your SUMP objectives effectively and sustainably.

SFS nr: 2010:900. (2010). Plan- och bygglag (2010:900).

Shoup, D. (1997). The High Cost of Free Parking. *Journal of Planning Education and Research*, *17*, 3–20.

Shoup, D. (1999). *The trouble with minimum parking requirements* (tech. rep.). University of California. Los Angeles. www.elsevier.com/locate/tra

Shoup, D. (2016). Cutting the Cost of Parking Requirements. *ACCESS*, *Volume 48*, 26.

Shoup, D. (2018, April). The High Cost of Parking Requirements. https://doi.org/10.4324/9781351019668-5

Silva, D., Foldes, D., & Csiszar, C. (2021). The effect of modal shift to micromobility upon the parking demand. *2021 Smart City Symposium Prague, SCSP 2021*. https://doi.org/10.1109/SCSP52043.2021.9447396

Sprei, F., Hult, C., Hult, Å., & Roth, A. (2020). Review of the effects of developments with low parking requirements. *Sustainability (Switzerland)*, *12*(5). https://doi.org/10.3390/su12051744

Stadsledningskontoret. (n.d.). Göteborgs områdesindelning. https://goteborg.se/wps/portal/enhetssida/statistik-och-analys/geografi/omradesindelningar

Statistics Sweden. (2023). Utsläpp av växthusgaser.

Statistik och Analys stadsledningskontoret Göteborgs Stad. (n.d.). Statistikdatabas Göteborgs Stad. https://statistikdatabas.goteborg.se/pxweb/sv/

Sunfleet Carsharing. (2017, August). Bilpoolsavtal.

Trafiken.nu. (2024). Göteborg Cykelreseplanerare.

UN General Assembly. (2015). Transforming our world : the 2030 Agenda for Sustainable Development. *A/RES/70/1*.

Västtraffik. (2024). Reseplaneraren.

Vega-Gonzalo, M., Gomez, J., Christidis, P., & Manuel Vassallo, J. (2024). The role of shared mobility in reducing perceived private car dependency. *Transportation Research Part D: Transport and Environment*, *126*, 104023. https://doi.org/10.1016/J.TRD.2023.104023

Volvo Cars Media Relations. (2018, July). Volvo Car Mobility launches mobility brand M. https://www.media.volvocars.com/global/en-gb/media/pressreleases/234576/volvo-car-mobility-launches-mobility-brand-m

Volvo Cars Media Relations. (2022, August). Volvo On Demand to continue reshaping how people think about mobility and car ownership. https://www.media.volvocars.com/global/en-gb/media/pressreleases/303466/volvo-on-demand-to-continue-reshaping-how-people-think-about-mobility-and-car-ownership

Volvo On Demand. (2024). Hur funkar kreditupplysningen? https://help.on-demand.volvocars.com/sv/articles/4923250-hur-funkar-kreditupplysningen

Weinberger, R. (2012). Death by a thousand curb-cuts. *Transport Policy*, *20*, 93–102.

Yao, D., Xu, L., Zhang, C., & Li, J. (2021). Revisiting the interactions between bus service quality, car ownership and mode use: A case study in Changzhou, China. *Transportation Research Part A: Policy and Practice*, *154*, 329–344. https://doi.org/https://doi.org/10.1016/j.tra.2021.10.017

A

Appendix 1 - Interview questions

All interviews were conducted in Swedish. The questions presented below are translated by the author.

A.1 Interview questions for residents

Introductory questions (asked to all interviewees regardless of their answers):

- Can you tell us a little about yourself? Family situation, need for a car, everyday travelling etc.
- What are the most common journeys for you?
- What means of transport do you use for them?
- Why do you choose each mode of transport?
- What is most important when choosing a means of transport: environment, economy, or just how practical it is?

If the person has answered that they <u>own</u> a car:

- What is it in your particular life situation that makes you feel you need access to a privately owned car?
- Is there anything that could have been done in the area to make it easier for you to travel by means other than the car?
- Would any of these measures be decisive for you to change your main means of transport?

If the person has answered that he/she <u>doesn't</u> own a car:

- What is it that makes you not need a car?
- Are your usual destinations close by? Well adapted for cycling? Good public transport?
- Is there anything that could have been done in the area to make your travelling easier?
- Have the mobility solutions here influenced the way you travel?

General questions on mobility solutions (for all): Now we will move on to a few questions regarding mobility solutions. As we described in the survey, the building you live in, both in the construction phase and through continued management, has invested in a number of mobility solutions to facilitate sustainable travel.

- Did you previously know what mobility solutions have been invested in this building?

- How did you find out about these mobility solutions? Where did the information come from? (Poseidon, neighbour, searched yourself, our survey)
- How do you feel about the information about these services? Has it been clear and appealing?
- Have you tried any of the services?
  - If yes: How was your experience?
  - item If no: What are the main reasons why you did not try?
- Have these measures influenced your views on car ownership and use?
- Have you had the price reduced?
- How do you feel about the parking situation in your neighbourhood? Is the availability of parking sufficient and functional for you?
- How does the cost of parking influence your decision to use/consider sustainable mobility options?

Final questions The City of Gothenburg aims to reduce traffic and make it easier and more attractive to travel by bike and public transport.

- Do you think this development is desirable?
- Do you have any suggestions for appropriate measures in the City of Gothenburg that could be implemented in connection with this development?

A.2 Interview questions to Framtiden Byggutveckling AB

Questions:
Can you tell us about yourself, what you do, what experience you have with mobility issues.

How does Framtiden Byggutveckling work with mobility in general?

Can you describe how you see the mobility issue has developed from the time the City of Gothenburg introduced the possibility of mobility agreements until today 2024?

How do you want it to develop in the future? Future opportunities and constraints.

Is there any interaction between Framtiden Byggutveckling and the municipality that affects how the contracts are developed?

Have you been involved in the construction of New Kvibergshuset or Mandolingatan? If so, how?

Is your perception that they have been successful? If yes, how? What are the challenges?

We talked last time about mobility hubs as the future of mobility in GBG - please describe this a bit again, and why you think it would be good?

What business models/forms do you think are needed to further increase sustainable mobility?

Are there any mobility measures you miss and could be particularly useful?

Do you think that all actors are developing at the same pace or is one party slowing down the other in some way? Who is slowing down development the most, the City of Gothenburg, the companies that provide mobility services or the residents?

A.3 Interview questions for Exploateringsförvaltningen

Questions:
Please tell us about yourself and your role as an employee of the City of Gothenburg, what experience do you have of mobility measures
What does your department do?
What do you do as project manager for sustainable mobility?
How were you involved in the construction of the New Kviberg House?
Why did you invest more than necessary in sustainable mobility here?

Have you been involved in other developments since, with similar ambitions around mobility beyond this project? If so, what lessons did you learn from the New Kvibergshuset?

Can you describe how you see the mobility issue has developed from the time the City of Gothenburg introduced the possibility of mobility agreements, until today 2024? What lessons have been learnt in this development?

Do you work differently today? How do you work today? (how do you apply the lessons/insights)

Do you think mobility contracts are a good solution to promote sustainable travel opportunities or are there any other methods/business models that should be further explored?

How do you want it to develop further in the future? What is the next step in the development? What future opportunities and limitations exist?

Do you think they both develop at the same pace or does one party slow down the other in any way? Is public attitude changing at a desirable rate?

What do you believe are the biggest shortcomings of today's mobility situation?

Is the City of Gothenburg investing enough to achieve the goals set for 2030?

How do you view the development of mobility in the city as a whole?

Conclusion:
Do you have anything else you would like to add that you believe is relevant for us to consider moving forward that we have not discussed?

A.4 Survey questions

Profile questions regarding age, occupancy etc.

- What is your age
- What is your gender
- What is your main occupancy?
- How many people over 18 live in your household?
- How many people below 18 live in your household?
- What is the approximate income for the entire household, pre tax?

Questions regarding the choice of transportation, parking and use of mobility measures

How often do you use the following means of transport during a typical week, for example to get to work, service, shops, activities, friends and more? (multiple choice question)

Does your household use their own car? (for example: owns, privately leases, has own company car)
If yes:

- What do you primarily use the car for?
- What type of residential parking do you have?
- How much do you pay for parking each month?
- What is the maximum you would be willing to pay for residential parking per month, before you start consider not having your own car?

If no:

- How come your household doesn't have its own car? (multiple choice question)

Have you used the car sharing service?
If yes:

- How was your general experience using it?
- How often do you use it?
- How did you experience the; price, availability, ease of use, cleanliness and information.
- Additional comment on the car sharing service

If no:

- Why did you not use it? (multiple choice question)

- Additional comment on the car sharing service

Have you used the bicycle sharing service?
If yes:

- How was your general experience using it?
- How often do you use it?
- How did you experience the; price, availability, ease of use, cleanliness/functionality and information.
- Additional comment on the bicycle sharing service

If no:

- Why did you not use it? (multiple choice question)
- Additional comment on the bicycle sharing service

Did you have your own car before moving to Mandolingatan/Nya Kvibergshuset?

Was the availability of mobility measures a factor in deciding to move here?

Mobility solutions often aim to reduce traveling with one's own car. Should any of the below alternatives contribute to reducing the need for a car? (multiple choice question)

Voluntary, do you have any additional comments?

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