1 SUSTAINABLE URBAN TRANSPORT TO MEET SDG 11.2 & COMBAT CLIMATE CHANGE

Increasing active transport in Sundbyberg city

MOHAMED MUSE

School of Business, Society and Engineering
Course: Degree project in environmental engineering
Course code: MTK343
Credits: 30
Program: Master's program in environmental engineering for sustainable development

Supervisor: Bozena Guziana
Examinor: Eva Thorin
Costumer: Sunbyberg city/municipality
Date: 2022-05-24
*Email:*muse.mohamedabdi.88@gmail.com

ABSTRACT

Aim: The aim of this degree project is to investigate the current condition of sustainable infrastructure in Sundbyberg City and how the city can encourage and increase active transport. **Method:** The methods used are interviews with politicians and a transport expert within the city of Sundbyberg as primary data collection. The other methods are secondary survey data provided by Sundbyberg City that provides the transport modes of the participants of the city in late 2022 and the third method is a site visit to the city center where many different modes of transport interact daily. **Results:** The findings indicate that the city is in need of improving the infrastructure for active transport. The usage of cars increased in the city since 2019 and this could possibly be due to the coronavirus pandemic that forced people to isolate and take their cars. Gender plays also a role in the choice of transport as more women tend to drive in Sundbyberg and walk less. Studies indicate a safer and better active infrastructure could encourage women to turn to active transport. The positive findings are that the interviews have shed light on new setts of policies that will help reduce the usage of cars and increase active transport. In particular, during the summer of 2023, two famous streets will be closed to cars and only walking and cycling will be allowed. Furthermore, many parking spaces will be turned into parks to reduce the usage of cars and encourage people to turn to more sustainable modes of transport. **Conclusion:** Sundbyberg city needs to improve the infrastructure for active transport by building wider lanes, separated from cars and if possible colored to highlight it for the users because that could have a positive impact on the residents and most likely encourage many to start walking and cycling. The importance of increase in active transport is improvement in the health of the public while also reduce the usage of cars. The politician and the transport experts in the city seem to be aware of the importance of better infrastructure for active transport and the importance of reducing the usage of cars as that will reduce emissions and air pollution. However, the cost seems to be a crucial factor that stands in the way of many projects. On the other hand, new policies such as closing streets from car traffic, removing parking spaces with green areas, and encouraging people to cycle even during the winter by providing salted and maintained lanes might prove to be equally important to better infrastructure and increase the city's goal of becoming a more sustainable transport city.

Keywords: [Sustainable transport, active transport, cycling, walking, driving, gender, culture, health, air pollution, noise pollution, climate change, global warming, greenhouse gases]

PREFACE

This degree project was done by Mohamed Muse during spring semester 2023. The degree project was done through the faculty of Business, Society and Engineering at the Mälardalen University in Sweden and contains 30 credits.

I would like to thank all the people that helped make this degree project. Primarly I would like to thank my supervisor Bozena Guziana for all the support and consultation throughout the degree project.

I would also like to thank Sundbyberg municipality for giving me access to the latest survey on transportation modes choices of the residents.

I would like to thank Jessica Elmgren for all the support and information she provided and for participating in the interview. I would also like to thank Martin Solberg for participating in the interview.

Sweden/Stockholm in May/24 2023

Mohamed Muse

SUMMARY

The aim of this degree project was to investigate the status of sustainable transport and in particular active transport in Sundbyberg city. The purpose was to examine the present infrastructure in the city, the principles that govern the current design, and the future of the city in terms of building new active transport infrastructure and thereby increasing walking and cycling.

The importance of the study is to fight climate change and global warming by highlighting the significance of active transport such as walking and cycling which has also been linked with improving the health of people. Furthermore, the replacement of cars with more sustainable modes of transport such as walking and cycling helps in reducing the harmful emissions that cars release, the noise pollution and is overall better for the planet.

The methods used to gather data for this degree project were both qualitative and quantitative. The qualitative method was through semi-structured interviews with policymakers and transport experts. This method was very important in order to understand how the city is working towards sustainable infrastructure and the factors that affect the future goals and ambitions of the city. The other method used was secondary data in the form of a survey provided by Sundbyberg City. This data included the residents and their choices of transport within the city and is done every 3 years and the one used for this degree project was done in late 2022. Using SPSS statistical analysis raw data was used to analyse the factors that affect the choice of transport for the resident's choose.

The results from the interview shed light on how the policymakers and transport export are working with the available modes of transport that exist in the city. The findings point towards a need for infrastructure improvement however, the interview revealed that improving the infrastructure is often limited by the cost and that the city tries to prioritize building more active transport instead of building few upgraded active transport roads that are wider and separated from cars but cost much more.

The results from SPSS statistical software analyses revealed that gender plays a role in the choice of transport in Sundbyberg City. Male and female participants seem to prefer different modes of transport as males tend to walk more and females tend to cycle and drive more. Several studies have been mentioned in Chapter 3 that indicate important factors that cause the difference between the genders such as cultural barriers, household responsibilities, and safety of the infrastructure. Important for this degree project is infrastructure as wider and

In order to increase sustainable transport Sundbyberg city has currently implemented several new policies that aim to increase cycling and walking while reducing the usage of cars. These policies have been implemented after the latest data from the survey revealed an increase in the usage of cars and a slight drop in cycling and walking. In the summer of 2023, two important streets in Sundbyberg will be closed to car traffic, and only walking and cycling will be permitted in order to showcase to the residents the benefits of active transport in terms of socializing, health, and safety for both people and children. This along with other initiatives such as turning parking spaces into green areas and building more cycle-sharing services the city is hopeful it will increase sustainable transport and meet its targets for 2030.

Furthermore, the city has chosen key areas that have importance and have a high flow rate to upgrade and will slowly look to improving others in accordance with the given yearly budget for construction. Walking and cycling is the two primary modes of transport that Sundbyberg City focuses on right followed by public transport according to the findings from the interview.

CONTENT

LIST OF FIGUREES

LIST OF TABLES

Abbreviation	Description
[GHG]	[Greenhouse Gases.]
[SDG]	[Sustainable development goals]
[NO2]	[Nitrogen Dioxide]
[CO2]	[Sulfur Dioxide]
[PM 2.5]	[Particular Matter 2.5]
[FMC/TMC/TMC]	Fifteen Min City/Tweenty min city/Thirty min city
EU	European union

DEFINITIONS

Definition	Description
[Indoor air]	[Air in the building]
[Outdoor air]	[Air in the surroundings.]

2 INTRODUCTION

2.1 Background

Half the world's population lives in cities and in the coming years, a significant increase is expected. It was reported by the United Nations (2012) that currently, the population of people living in urban cities is greater than half the world's total population, and this number by the year 2050 will reach two-thirds. The huge influx of people to cities for better working and living opportunities is the driving force behind this increase in the urban population. However, this has resulted in several problems such as traffic congestion, noise pollution, and air pollution which are all direct consequences of the emissions that come from gasoline-burning vehicles on the roads. Worldwide, in 2014 transport as a whole was responsible for 23% of total CO2 emissions from fuel combustion and road transport was responsible for 20% (International Energy Agency, 2016). The overall usage of fossil fuels makes up 75% of the global energy resources use and is also responsible for 70% of global greenhouse gas (GHG) emissions while accounting for approximately 5% of the planet's total landmass (Shahidehpour et al., 2018).

The increase in emissions from the transport sector has led to an increase in the generation of greenhouse gases that led to a further increase in global warming and the climate crises the world is facing. Surprisingly many studies have recently shown that during the coronavirus pandemic with the restrictions imposed such as lockdowns, modes of transport such as driving decreased, and this led to significant improvements in terms of emissions which in turn led to improved air quality. Air pollution is one of the biggest threats to the environment and human health states (Georgelis et al., 2021) and can be linked to premature death even at low concentrations according to the latest research as presented in WHO's updated guidelines for air, it appears that there is no minimum level during which air pollution is harmless. Generally expected life expectancy is estimated to be shortened by six months and 200-300 people annually suffer from lung cancer due to air pollution (Georgelis et al., 2021).

The pandemic caused severe losses in economic prosperity and human lives, but on the other hand, it also brought with it some positive impacts on the environment (Jevtic et al., 2021). The lockdown caused restricted mobility, and much lesser traffic on the roads and as a result led to improved air quality especially in urban settings while also bringing about a decrease in chronic diseases, such as heart and lung disorders (Jevtic et al., 2021). It is, therefore, very critical that more sustainable modes of transport such as cycling, and walking are invested in for the sake of both the planet and human lives. However, a lot of sacrifices will have to be made to bring about this change and this would create structural tension as stated by Eric Dahmen (Blomkvist & Johansson, 2016) since there are still skeptics and those that refuse to stop using fossil fuel for financial gains. Some are path dependent as stated by (Blomkvist &

Johansson, 2016) because they favor doing things the same way they have always been done and are resistant to change.

In Sundbyberg a municipality in Stockholm, Sweden there is a rapid population growth which can be linked to the municipality being located in a central area with many offices, restaurants, and other various services as well as the construction of many new buildings. This has meant Sundbyberg municipality must maintain a large number of people both on foot and by car. The municipality aims to define goals and guidelines for mobility in the new city center and the idea is that different actors should be able to meet in a joint effort toward the overall goal of reaching a high proportion of sustainable means of transport by 200 (Odhage et al., 2022). However, to reach the target set a lot needs to change, both in infrastructure and policy within Sundbyberg Stad. There is also a need for spreading awareness of the consequences of driving fossil fuel-based cars, as many people are not aware of the link between emissions from cars and air pollution particularly people with little or no formal education.

Urban planners have been trying to find different solutions to build cities that would require less usage of cars and one particular concept that is getting very popular is the 15 min city also called 20 min and 30 min city concepts. The goal of this concept is to decrease the reliance on cars and encourage people to walk or cycle within the city. The concepts propose solutions and policies that would cut down on all activities that produce these harmful emissions or find renewable replacements for them. The policy aims to promote an increase in micro-mobility, and a reduction in travel distances to meet basic needs, which are all necessary to manage increased CO_2 and carbon emissions and improve air quality.

2.2 Purpose/Aim

The purpose of this degree project is to assess the current status of active transport in Sundbyberg city by looking at the available infrastructure and gathering information from policymakers. Then to examine the underlying cause of why certain people choose driving over cycling and walking and if deemed necessary suggest possible solutions to increasing cycling and walking instead of driving to improve air quality, decrease noise pollution and improve people's overall health.

2.3 Research questions

1. What are the factors that make the residents in Sundbyberg city choose between cycling/walking versus driving?
2. How could the city of Sundbyberg meet its strategic goal of increasing sustainable journeys on foot and by bicycle?
3. Can Sundyberg city increase sustainable transport infrastructure to encourage residents to use active transport?

2.4 Delimitation

The degree project will not investigate social class as a factor for choice of transport between the residents. The exact level of improvements for air pollution and noise pollution will also not be presented but because of the anticipated decrease in cars it is expected that air quality will improve, and noise pollutions will drop. When suggesting gender as a factor for choice of transport, different cultures and norms are not looked at but will be mentioned when possible.

3 METHOD

The methods used on this degree project is based on literature study and case study of Sundbyberg city. The case study will be based on data such as interviews of policymakers such as politicians and transport experts within Sundbyberg city which is presented on chapter 2.2.1.

3.1 Literature study

3.1.1 Research

The research includes peer reviewed articles on topics related to this degree project such as sustainable transport, air pollution, noise pollution, factors that affect choice of transportation, gender, infrastructure, active transport such as cycling and walking.

3.2 Case study

The case study is focused on Sundbyberg a city in Stockholm, Sweden. The case study investigates how Sundbyberg city is currently in terms of Sustainable transport and how it plans to move towards a more sustainable city in the future. The infrastructure of the city, the policies that govern transport and design documents will be examined.

Furthermore, the cities goals to reducing cars on the roads while increasing active transport such cycling and walking will be explored.

3.2.1 Data

The data used is primary data in the form of interviews and partly collected secondary data in the form of surveys provided by Sundbyberg City. The primary data is collected through interviews with politicians and sustainable transport experts that work in Sundbyberg City. The interview will help with gathering data and information about the city while at the same time helping in answering the research question "How could the city of Sundbyberg meet its strategic goal of increasing sustainable journeys on foot and by bicycle by the year 2030?"

The secondary data is in the form of a survey which is done every three years by Sundbyberg city and for this survey the focus will be on the latest survey that was done in autumn 2022. This method will help in answering the research question "What are the factors that make the residents in Sundbyberg city choose between cycling/walking versus driving?".

The last method employed is a site visit/observation to central Sundbyberg to get a good visual observation of the most congested parts of the city during the morning peak hours. The benefit of observations is that it allows for the gathering of information in situ using the senses: vision, hearing, touch, and smell (Paradis et al., 2016).

3.2.1.1. Research ethics

1. In order to protect the rights of the participants the following research ethics were followed.
2. The interviewees were contacted and the aim the degree project was explained to them and thereafter they were asked for participation of the interview.
3. They were asked if they could do the interview in English because of the degree project being written in English and if they had difficulty with English then Swedish was used instead.
4. They were given the interview questions a head of time so they could prepare.
5. The time during of the interview was told to them beforehand so they would not feel stressed or in a rush.
6. Permission was taken from them before recording the interview with a mobile phone.
7. They were asked for permission to reveal their names and roles within Sundbyberg city.

3.2.1.2. Primary data: Interviews with policy maker and sustainable transport expert

Using interviews is an ideal method when documenting participants' accounts, perceptions, or stories about attitudes toward and responses to certain situations or phenomena (Paradis et al., 2016). The majority of research questions that surveys can provide answers for can also be answered through interview claims (Paradis et al., 2016), but interviews will generally produce richer, and more in-depth data in comparison to surveys. The type of interview that will be used in order to achieve the aim of this thesis is semi-structured interviews with a predetermined list of questions however, the advantage is that the order of the questions can change as well certain questions can raise more interest than others during the interview. Semi-structured interviews help the researcher get information from the interviewee in a conversation-like setup.

Therefore, the qualitative method of collecting primary data will be done by interviewing politicians and experts to understand the policies that lie behind the design of Sundbyberg city roads and how they plan to meet the SDG goals for 2030. Furthermore, the secondary survey data will also be used to ask the politician about the residents' viewpoints, requests, and opinions on the city. Other important questions that will be raised are also how the city currently is doing in terms of sustainable transport and if they plan on prioritizing cycling and walking over driving within the city.

3.2.1.3. The interviewees

The first participant is called Martin Solberg and is vice major for transportation & chairman of the committee for the urban environment in Sundbyberg city and has had the position since October 2022. Martin represents miljöpartiet (Green party) in Sundbyberg city and his title is currently municipal councilor for the Green party and has worked in politics and policy for the past 6 years.

The second participant is Jessica Elmgren who works with sustainable traveling in Sundbyberg city. Jessica has many years of experience working with sustainable transportation. She has worked with mobility management for the past 20 years and has produced the mobility program for Sundbyberg city and is responsible for requirements for mobility management during construction for the past 7 years.

Tabell 1. Participants background information and positions.

Name	Position/Role
Martin Solberg, Politician/miljöpartiet (Green party)	Vice major for transportation & chairman of committee for urban environment in Sundbyberg city
Jessica Elmgren	Transport expert/Project manager for Mobility program

3.2.1.4. The interview guide

Before the interview was carried out, the questions were prepared beforehand. The questions were prepared by examining Sundbyberg city design and requirements documentation. The survey data from 2019 and 2022 were also examined to see the changes that occurred during those three years. Based on the information gained the interview guide was created and is attached in the appendix. The questions were emailed a week ahead of the scheduled interview to allow the participants/interviewees to know what kind of questions they are expected to answer. The questions as they are listed in the interview guide were not completely followed during the interview due to the interview being semi-structured.

The interview with the politician was conducted in English while the interview with the sustainable transport expert was conducted in Swedish and then translated. However, both

interviews were voice recorded with the permission of the participants. The time the interviews took varied between 40 minutes and 30 minutes.

The location was at the headquarters for Sundbyberg municipality in Hallonberge, Stockholm. It is important to mention that the interviewer is a project manager that also works at Sundbyberg municipality and therefore has some insight into projects and project plans at Sundbyberg city. This helped ask questions regarding ongoing and planned projects during the interview.

3.2.1.5. Secondary survey data

For this degree project, secondary raw data provided by Sundbyberg City from a survey was used to understand the resident's different choices in terms of transport. The Survey is called "Travel modes research of the residents in Sundbyberg City" and is done every three years. The latest survey was done in the autumn of 2022 and the questions contained different sections, one section with background questions (age, gender, access to various means of transport, etc.), another section on attitudes, and a travel diary where the respondents had to fill in which trips, they had completed during the previous weekday (Sundbyberg stad, 2022).

The survey was offered in the languages English and Arabic in addition to Swedish. The different languages were only available in the web version of the survey, the postal survey was only available in Swedish.

The participants are all residents of Sundbyberg city aged 15–84 living in ten areas in Sundbyberg: Brotorp, Central Sundbyberg, Duvbo, Hallonbergen, Lilla Alby, Lilla Ursvik, Rissne, Stora Ursvik, Storskogen and Ör (Sundbyberg stad, 2022) as shown in Figure 1.

3.2.1.6. Site visit/observation

A site visit to Sundbyberg Central was done because it is probably one of the busiest areas within Sundbyberg and different modes of transport such as driving, cycling, walking, and trams all share the same space. The site visit was done during the early morning hours since it is peak traffic hours due to people going to work and since the subway is located there as well as many offices it gets very crowded. The goal was to take pictures and get a real feel of the condition of the Sundbyberg Central and to get a first-hand experience of the different transportation modes and how they coexist.

Figure 1-Central Sundbyberg next to the subway entrance showing the walking/cycling space as well as the road and tram.

3.2.1.7. Document analysis

Documentations such as design requirements and project plans have been studied to get a better understanding of the principles that govern how the construction works in Sundbyberg is planned and executed as shown in table 1. These documents are the blueprint for how the city looks and will look in the future.

Table 1-The documents used in Sundbyberg city.

Title	Content	Usage
Technical handbook	Design requirements in all stages of a project.	Used to as instruction during construction of roads, pavements etc.
Project plan	Description of the project, current situation, goals, and targets etc.	Is drafted before a project is initiated and is available for all stakeholders if they want to understand the purpose of the project.

Design

For the design of the city roads and infrastructure, Sundbyberg City uses the technical handbook that clearly states the requirements that need to be fulfilled during construction. The handbook is a tool that ensures the quality of deliveries and provides guidelines during the planning, design, and execution phases of the projects. It also gives advice on what is the best practice in areas that are not covered by the requirements. Some requirements are incorporated from Trafikverket which is Sweden's road and transport authorities.

Project plans

The project plans are drafted during the initiation phase of each project. These documents contain information about the project, the current situation, the goal, and the expected results. The project plan also outlines the stakeholders, clients, and project schedule. Often the content and the details in the project plans vary depending on the project manager leading the project and their experience. However, the project plan should be available to all stakeholders and should explain in detail why a project is being executed and what results the project will give to the public in the city.

3.2.2 Data analysis

Table 2.Data analysis methods.

Interviews	Statistics reporting	Independent T-test
Once the interview was done, the immediate thoughts were written down. Thereafter, the recording was played again in order to verify that all the questions were asked and that the answers were clear and that they addressed the question asked. The last step was to transcribe the interview audio into writing using online software that way the verification of the content was completed.	Frequencies and bar charts will be generated using the statistical software SPSS. Furthermore, a t-test is going to be used in order to analyse the collected data for the difference between the two group means of interest in order to compare and draw conclusions from the comparison.	An independent T test will be used to compare the means between female and male residents and the modes of transport such as walking, cycling, and driving. This is to see whether gender plays a role in choice of transport.

3.2.3 Research question and data collection

What are the factors that make the residents in Sundbyberg City choose between cycling/walking versus driving?
The interviews as well as the secondary survey data will help in getting a better understanding of this research question.

How could the city of Sundbyberg meet its strategic goal of increasing sustainable journeys on foot and by bicycle by the year 2030?
This research question will partially be answered by the survey results along with an alternative design that will be purposed. Furthermore, the interviews with the policymaker and sustainable transport expert will be key.

Can Sundbyberg City increase sustainable transport by improving the infrastructure to encourage residents to use active transport?
To answer this question data provided by Sundbyberg City such as the mobility program will be used. Furthermore, questions directly related to sustainable infrastructure will be asked during the interview of the participants.

4 THEORETICAL FRAMEWORK/ LITERATURE STUDY/RELATED WORK (WHAT OTHERS HAVE DONE/GAPS/WHAT YOU CAN INCLUDE)

4.1 Sustainable transport

Across the world urban planners are facing a big challenge in promoting and increasing the usage of sustainable modes of transport such as cycling, walking, and using more public transport in comparison to driving cars. The impacts caused by fossil fuel-burning cars are major and range from effects on human health through air pollution and noise pollution to safety problems for pedestrians and those that use modes of transport such as cycling. Sustainable transport policy covers many associated but also different aspects, like climate, air quality, security, traffic safety, and health (Eliasson & Proost, 2015).

According to Kraus and Proff (2021), car traffic alone is responsible for almost 11% of all GHG emissions in Europe. This demonstrates how society's prevailing car dependency contributes significantly to high GHG emission rates. The promotion of sustainable transportation concepts is of vital importance argues Kraus and Proff (2021) in order to

maintain mobility, while at the same time managing transportation in an environmentally sound, socially acceptable, and economically efficient manner.

The interest in active modes (i.e., walking and cycling) according to Ton et al. (2019) has significantly increased, as a high share of active modes in terms of the number of trips has many potential benefits both at the individual level as it can provide health benefits due to increased activity levels, as well at the network level since it might reduce traffic and emissions by replacing the car. However, it's equally important to understand which determinants influence the choice of an active mode as it can serve as valuable input for these policies Ton et al. (2019). Lanzendorf & Busch-Geertsema, (2014) argues from another perspective and believes many countries are struggling with increasing sustainable transport despite the advantages of cycling compared to other modes of transport due to the historic development of countries and cities. This might be the case since cycling and walking are seen through different lenses based on the cultural and social backgrounds of people.

4.1.1 Active transport (walking and cycling)

To be able to move about freely is very important and this is evident in the different choices available to people such as driving, walking, cycling, or taking public transport such as busses and trains. However, though each mode of transport is suitable and gets people from A to B not all these modes of transport are good for the collective and this has become more evident in recent years due to the climate change across the planet accelerated by emissions from fossil fuel burning cars. Therefore, out of the available popular modes of transport, many city planners and policymakers are pushing to restrict some and promote others for the benefit of the collective rather than the individual. One method of reducing emissions is carbon taxation as it has developed as a method in numerous policy proposals one of them being the EU Green Deal (Carattini et al. 2019). However, since policies vary from country to country with some countries banning completely old diesel cars while others apply a tax system on those driving such cars, it is clear that across the globe there is unity in promoting more sustainable modes of transport such as cycling and walking at the expenses of the traditional modes such as driving.

Yet there is a significant difference in the phase at which cycling and walking are being accepted by people and this differs from country to country which is primarily due to social, cultural, and behavioural characteristics but also safety. Research has shown that socio-demographic characteristics do indeed have a significant relation to cycling, particularly gender, income, and age (Handy et al., 2014).

The way forward has to be a balanced approach since many are path dependent and a sudden change from the norm would not be possible, and this degree project intends to understand the residents of Sundbyberg city and what views they hold in regards to active transport. A very important point raised by Banister (2007) is that it should not be on the agenda the banning of using cars since that would be against the concept of freedom of choice but rather to design and build cities that would not require the usage of cars. This is a viewpoint this degree project supports and intends to highlight.

4.1.2 Parameters that impact active transport

4.1.2.1. Culture

Lanzendorf & Busch-Geertsema (2014) points out that in North America & Australia, the bicycle is considered a recreational mode only and is used for sports and other leisure activities. While the bicycle is a travel mode routinely used for daily activities in many European and Asian cities and therefore plays a completely different role in perspective (Lanzendorf & Busch-Geertsema, 2014).

According to Kraus and Proff (2021), behavior parameters that influence a person is the mindset of an individual such as the philosophy towards life as this impacts decision-making. While social parameters that influence people include general welfare as it has the tendency to act as a source of welfare for the greater good and well-being of mankind. The cultural parameters that affect the choice of active transport include gender disparity which is when genders are defined to not be equal and in return, this affects individuals' life choices.

4.1.2.2. Social class

According to Stoffers (2011), it is not only the mental attitude of individuals that has a big role in why people cycle but also culture and politics. Stoffers (2011) take Germany as an example and mentions that the bicycle was popular for its speed as well as an instrument for the emancipation of specific social groups during the nineteenth century by middle-class groups and then the working-class group during the beginning of the twentieth century onwards. But as soon as the car became popular and offered more speed the upper class, upper middle class, and the working class abandoned the bicycle.

On the other hand, in the Netherlands, the bicycle plays a huge importance and is a national identity which the Holland was already well known for before the Second World War claims (Stoffers, 2011). The Bicycle was promoted by the ANWB as a way of becoming familiar with the whole country and all its diversity. The ANWB association was formed in 1883 and

according to Stoffers (2011) played a decisive part in scattering a rather different image of the bicycle by presenting it as an instrument to discipline and educate the masses, and impress civilized and national values on them even after the car became available.

4.1.2.3. Safety and Health

Ek et al. (2021) argue that the choice to walk or cycle is linked to health considerations and environmental concerns. The Distance to work or school is also an important factor in making the choice to walk or cycle. Furthermore, men tend to be more prone to choose active transport, and so do respondents with lower income but Ton et al. (2019) do not agree that is the case in every country. A very important finding in Ek et al. (2021) research is that the availability of safe routes for walking and cycling is important for the choice to walk or cycle. Between the genders women seem to be more risk-averse than men and thereby, tend to perceive negative consequences of sharing roads with vehicular traffic more than men do (Emond et al., 2009).

Ton et al. (2019) takes the Netherlands as an example where more kilometers are cycled nevertheless the fatality and accident rates are significantly lower in comparison to the cycling-poor countries, which points to a very safe cycling environment. To have a safe cycling environment demands a good cycling infrastructure that prevents cyclists from danger in traffic and that encourages many more people to cycle.

4.1.2.4. Infrastructure

Other research such as the one done by (Daley & Rissel, 2011) argues that although cycling has very significant benefits to both health and the environment there are still barriers that are either due to lack of physical infrastructure, as well as perceptual or psychological. The argument Daley & Rissel (2011) present is that some non-riders have reported being afraid of cycling due to sharing the road with cars while others fear appearing inept or embarrassed on a bicycle.

4.2 Negative impact of cars

4.2.1 Global warming

Ever since the industrial revolution emission caused by humans has been on the increase and global warming was on the rise. The burning of fossil fuels to produce energy has changed the world as it opened the door for many new inventions. However, this came with a great price

in the form of global warming and humans are struggling to deal with it. Since the industrial revolution period, it has been noticed that the earth's temperature has been on the rise and this is what has been causing the melting of polar ice raising sea levels as well as the major forest fires in Australia, USA (California) and Portugal causing loss of lives. At this rate earth's average surface temperature will continue to rise as humans continue their environmentally harmful activities in particular the burning of fossil fuel (Al-Ghussain, 2019).

The way forward presents only three strategies argue Al-Ghussain (2019) and that is to do nothing and continue to increase the amount of greenhouse gases in the atmosphere, which will eventually mean the extinction of life on Earth. The second strategy is to combat climate change by reducing the amount of human-caused greenhouse gases and the last and final strategy is the adjustment to climate change by developing techniques and methods that will reduce the impact of climate change.

4.2.2 Pollution (Air & Noise)

The transport sector has been responsible for large amounts of harmful emissions that have caused serious damage to both the environment and the health of humans across the globe. According to research by Johansson et al (2017) road vehicle emissions are one of the most crucial causes of human exposure to air pollution. Depending on the pollutant, mode of travel, and travel distance, the exposure while commuting all through rush hours on very heavily trafficked roads may create a significant portion of the sum of daily exposure.

Air pollutants are considered to contain particulate and gases such as carbon dioxide, monoxide, sulfur dioxide nitrogen oxide, etc. Particulate matter is those (PM 2.5 & PM 10) with sizes less than 2.5 μm in diameter and those that have sizes up to 10. According to a study done by Perez and Reyes (2002), exposure to high concentrations of PM10 in the atmosphere is strongly associated with several health problems. There has been a significant correlation between exposure to PM10 and hospital check-ins for lower respiratory symptoms mainly in children and older groups symptoms in upper respiratory.

Within Europe, air pollution causes premature deaths and diseases and is considered the single largest environmental health causing more than 400 000 premature deaths every year (Jevtic et al., 2021). According to studies done by (Georgelis et al., 2017), the outdoor air quality in Stockholm city as a whole had improved significantly in recent years. The environmental quality standards for particles (PM10 and PM2.5) were met in the whole of Stockholm city. However, there were areas where the standards were exceeded, and those areas were located along the major roads (for example E4 and E18) and along roads in urban

areas with buildings on both sides (Georgelis et al., 2017). The study also revealed that Soot and ultrafine particles decreased drastically and in 2017 were at record low levels (Georgelis et al., 2017).

On the other hand, due to the increase in the proportion of diesel-powered cars and light trucks, the reduction in the level of nitrogen dioxide leveled off (Georgelis et al., 2017). As a result, the environmental quality target for NO2 was exceeded at all Stockholm city measuring stations in the street environment (Georgelis et al., 2017). The research by (Georgelis et al., 2017) states that a total of 142,000 people (6.5 percent) in Stockholm County are estimated to be exposed to concentrations of PM10 that exceed the target value in the environmental objective Fresh air, and 61,000 people (2.8 percent) are estimated to be exposed to concentrations of nitrogen dioxide (NO2) that exceed the target value. The estimate had been made for a population of 2,191,991 people, which corresponds to the number of inhabitants in Stockholm County on 31 December 2014 (Statistikmyndigheten SCB, 2014).

When focused on only Sundbyberg municipality the results showed that among the people living in Stockholm, Solna and Sundbyberg have the lowest air quality, with the proportion reporting poor air quality being between 6 and 17 percent, compared to between 1 and 5 percent in the county's other municipalities (Georgelis et al., 2017). The study done by (Georgelis et al., 2017) concludes that the single biggest cause of air pollution problems is due to emissions from road traffic which affects almost 8.2 percent of the population in the municipality. The children's environmental health survey shows that nearly 70 percent of twelve-year-olds in Stockholm County spend 30 minutes or more daily in traffic which causes the highest exposure to air pollution (Georgelis et al., 2021).

Another major issue that came with the boom in urbanization and increased usage of cars is noise pollution. Noise on it is own is not a problem, however, above certain levels, noise becomes a serious health issue that causes stress, sleeping problems, and even deafness. Both indoor and outdoor noise pollution is classed as serious health hazard with increasing adverse effects on fetuses, infants, children, adolescents, and adults Gupta et al. (2018). Old cars, machinery, and increasing traffic affect all age groups argues Gupta et al. (2018) but those most vulnerable are pregnant women, fetuses, newborns, and infants. The World Health Organization (WHO) has setup limits for noise and the recommended noise limits for the community environment is 55 dBA (Leq) during the day and 45 dBA (Leq) during the night.

These values are in harmony with the acceptable noise levels in Sweden which are 30dB(A) indoors, 45 dB(A) outdoors, and in close approximate to railways 55 dB(A) (TDOK

2014:1021). yet, according to a study done by Andersson et al. (2020), the levels of air pollutants such as nitrogen oxides have decreased in Sweden during the past decades, but on the other hand exposure to traffic noise has increased. This means that even though measures are being taken in Sweden to reduce both air and noise pollution the results are still not positive. Noise barriers are one of the measures used to reduce noise pollution in Sweden and many other European countries however, based on the results from the study done by Andersson et al. (2020) traffic noise is still increasing.

In Stockholm, the highest proportion of homes exposed to noise (over 30 percent) is found in the metropolitan municipalities such as Sundbybergs city and Solna as well as Järfälla, and the lowest proportion (less than 15 percent) is found in Värmdö, Ekerö, and Tyresö municipalities as shown in Figure 6, (Georgelis et al., 2017). Most of the noise pollution is experienced in densely built-up areas such as Sundbyberg municipality and this is due to the increasing urbanization that forces people to move closer to the noise areas. In addition, the lack of unused land and the need for more permissive guidelines means new buildings are built in locations already exposed to noise.

The total number of people exposed to traffic noise has increased strongly in Stockholm for all types of traffic from the 1990s onwards to today, mainly due to population growth (Georgelis et al., 2021). The proportion of people exposed to noise pollution has also increased claims (Georgelis et al., 2021), especially noise from road traffic, with over 40 percent of the population estimated to be exposed to traffic noise levels above rising WHO guideline values. Furthermore, it is expected that the number of people exposed to noise pollution risks increasing, primarily because of the continued urbanization, densification of buildings, and increasing transport (Georgelis et al., 2021).

4.3 Solution

4.3.1 Reducing air and noise pollution

In terms of air pollution mitigations in recent years many have suggested replacing traditional cars with electric cars in order to reduce air pollution since they don't rely on combustion and therefore release few emissions. India being one of the countries facing severe air pollution for example announced that they plan on selling only electric cars by the year 2030 (Crawford, 2019). However, electric cars may be better than traditional cars in terms of emissions, but many argue they are not a good replacement because of the lithium battery they use. The raw materials to make lithium requires mining and that is a process

that releases major greenhouse gases such as carbon dioxide meaning leading to a huge environmental footprint.

Therefore, the only certain and environmentally friendly mode of transport is active transport (cycling and walking). There is a big chance and potential for reducing emissions as well as exposures explains Johansson et al (2017) if all car drivers living within a 30 min distance of bicycle ride to work would consider changing to bicycle. This would then result in 111,000 new cyclists, corresponding to an increase of 209% compared to the current situation in Stockholm Sweden. Furthermore, reducing vehicle emissions would lead to reduced population exposure, and therefore save 449 years of life annually in Stockholm County (Johansson et al.,2017).

Many other studies have been done to demonstrate how cycling and walking improve the environment by reducing emissions and noise pollution as well as how it increases the physical and mental health of people. Sustainable transport is the center of focus now more than ever across the globe due to climate change and to meet SDG 2030. However, many are still path dependent and despite all the negative effects caused by driving are not willing to give it up.

Many countries have taken steps to implement various solutions that would help reduce emissions and increase sustainable transport, however (Banister, 2007) argues that it does not seem to be enough and believes that the real challenge is not the acceptance of the strong links between mobility and climate change, but the imperative for substantial behavioral change. According to (Banister, 2007) significant reductions of CO2 emissions in transport in the EU can only be achieved through behavioural change. There is little sign that people are aware of the scale of the challenge claims (Banister, 2007) or prepared to make the necessary changes. Banister has a strong argument, and the answer is part of the aim of this degree project. Spreading awareness and educating people is a vital step to reducing the usage of cars and increasing cycling and walking.

5 CURRENT STUDY

5.1 Sundbyberg city (Stockholm)

5.1.1 General information about Sundbyberg city

Sundbyberg municipality shown in Figure 3 is a municipality within Stockholm and one of Sweden's fastest-growing populations with an average growth of 1.52 percent over the past 5 years (Statistikmyndigheten SCB, 2022). Sundbyberg was considered an agricultural settlement in the countryside and consisted of a few estates around 150 years ago (Sundbyberg History, 2019). During the 19th century, factories and workshops began to be built among the residential buildings. Sundbyberg's population then increased by just over a thousand inhabitants over ten years. When the town was formed in 1927, Sundbyberg included only the older town center around the railway. In 1949 the town grew more and more and during the year Lilla Alby, Lilla Ursvik, Ör, Hallonbergen, Rissne, and Brotorp were incorporated with Sundbyberg.

Today, roughly 46,000 people live in an area of just under nine square kilometers which makes Sundbyberg municipality the country's most densely populated municipality. Since Sundbyberg has a central location, it means the municipality is close to the region's and the country's largest concentration of both workplaces and services. This has made the municipality very interesting as a place of establishment in recent years. Forecasts show that between the years 2022–2036, the population in the city of Sundbyberg is estimated to increase by approximately 17,737 people, from just under 53,600 inhabitants at the end of 2021 to 71,301 at the end of 2036. This means an average increase in population with an average of just over 1,200 people per year.

5.1.2 Current transport situation

A study done in 2016 revealed the different transportation means used by the residents of Sundbyberg with only 9% cycling and 16% walking compared to 30% driving (Olofsson et al., 2018). This low percentage of walking and cycling compared to driving could be attributed to fewer cycling and walking paths and in most cases, lack of education regarding the negative impact driving has on the environment as well as on people's health.

The city of Sundbyberg's strategic direction is to increase sustainable journeys on foot and by bicycle (Olofsson et al., 2018). However, several studies try to explain why people choose between different modes of transport. There isn’t much investigation done on how education,

age, and gender impact people's use of the different transportation modes among the residents of Sundbyberg. In order to increase sustainable transportation modes it is vital to know the underlying causes of the current situation in Sundbyerg. The most important way to bring about change is to spread awareness about the consequences that vehicle pollutants have on both the environment and people’s health.

5.1.3 The vision for mobility

To meet the growing population a plan has been drawn up called Vision for Sundbyberg in the year 2030 with the slogan Sundbyberg grows with you (Sundbyberg, 2022) which matches the SDG 2030. This vision lays the blueprint for the future of Sundbyberg City and its residents. The goal describes what Sundbyberg stands for and is a way to unite residents, businesses, associations, and employees in the city to come together in order to shape the municipality's future. The vision describes how Sundbyberg is to be in the future and indicates the long-term direction of the whole city. It is based on three core values that are to be alive, innovative, and together. To bring about it, several meetings took place with citizens, employees, businesses, associations, and politicians. During these meetings, the different points of view expressed were collected and various approaches were used such as workshops and focus groups.

Figure 2-(Forsberg & Carlsund, 2021). Sundbyberg municipality.

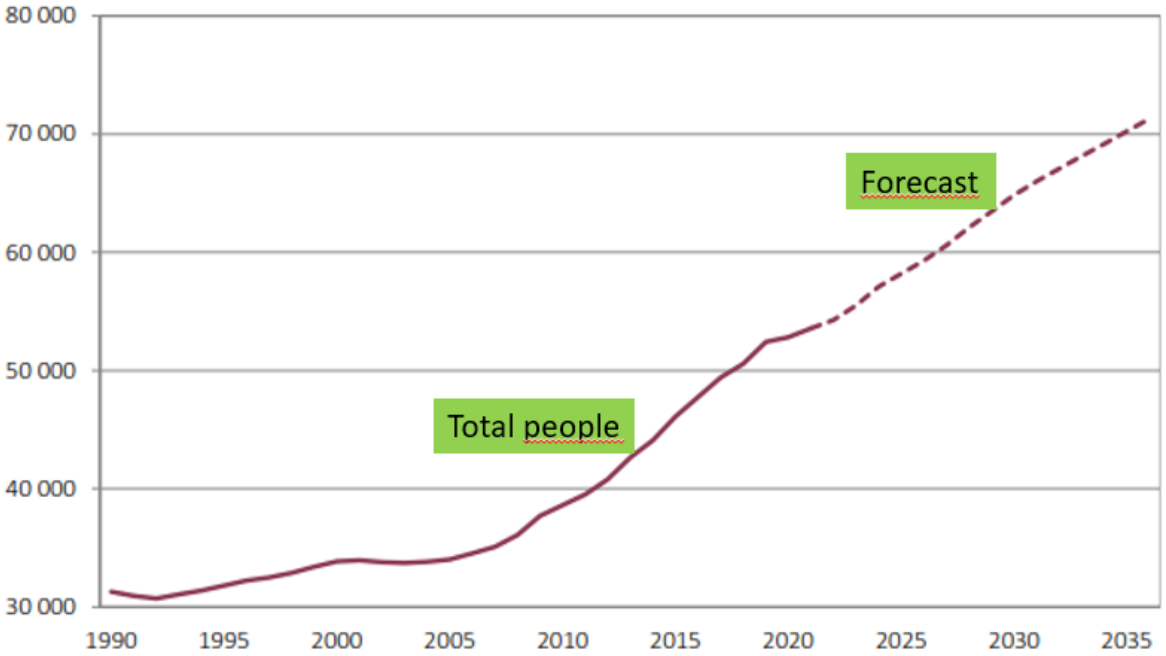

Figure 3- Forsberg & Carlsund, 2021). Population of Sundbyberg municipality between 1990–2022 and the forecasted increase in population to 2035.

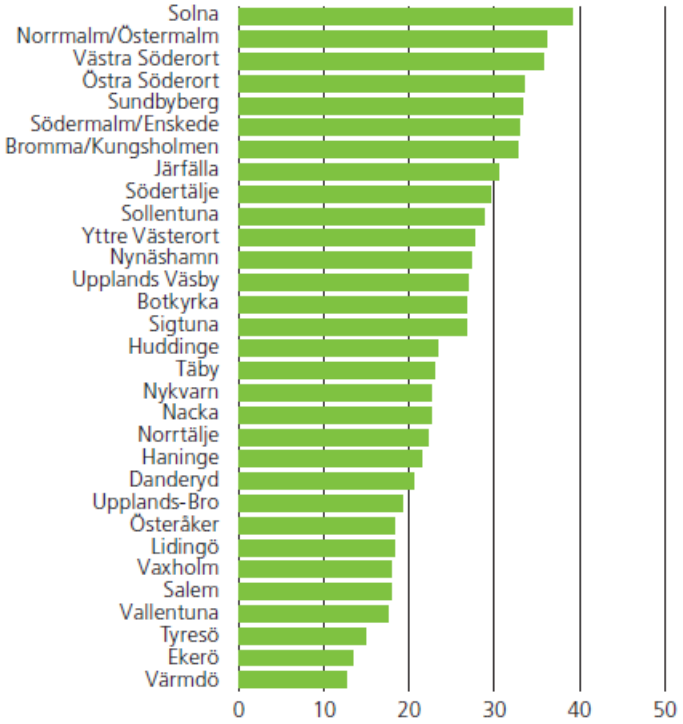

Figure 4-(Georgelis et al., 2017). Places in Stockholm were residents expirence noise due to traffic from with windows towards a road, highway etc.

6 RESULTS

6.1.1 Interviews

This section will present the findings from the interviews that were conducted with the politician and with the sustainable transport expert. The aim will be to answer the research questions “How could the city of Sundbyberg meet its strategic goal of increasing sustainable journeys on foot and by bicycle by the year 2030?” and “What are the factors that make the residents in Sundbyberg city choose between cycling/walking versus driving?”. Furthermore, the secondary data from the survey results that indicate changes in sustainable transport both positive and negative will be answered with direct quotations from the politician Martin Solberg and the sustainable transport expert Jessica Elmgreen. The interview will be presented as themes and the findings presented under each theme.

The literature review will also be linked to the findings that the interviews presented and further discussed in the discussion chapter.

Climate crisis and global warming

The participants felt very strong about the impact climate crises is having on the planet and both linked it to anthropogenic sources. The replies captured the participant's viewpoint towards the main theme which is global warming and is the primary concern for all life before focusing on the the specific aim of the interview which is sustainable transport that intends to provide a solution for the transport sector. Since both participants hold positions of major influence in Sundbyberg city it was crucial to understand their perspective on the global warming issue.

The politician addressed the question by looking at the origin of the issue that is the previous generations and then stated that current generation can act in order for the future generations to have a chance of living on this planet.

The transport expert felt the global warming solution lies on having stronger policies and strict laws.

> We have an ever closing window of opportunity to solve this, and even though all the alarm bells are constantly ringing, we can't seem to muster the courage or the policies to do that and that is deeply concerning (Martin Solberg, april 27, 2023)

Changes implemented and accomplisment

The participants pointed out that they are both are striving towards making sustainable transport the primary objective of the city and that walking and cycling is on top of the priority list. The policymaker has not held the position long enough but stressed that new policies are already implemented to increase active transport. The goal is to reduce the usage of cars and encourage more residents to use sustainable transport.

> We have to enable people to change how they transport to a more sustainable way. The bit complicated answer is that creating new policies takes time and implementing those policies also takes time (Martin Solberg, april 27, 2023)

Future plans to reduce greenhouse gas emissions

Sundbyberg city is working towards meeting SDG 2030 and have their own created their own goals for the future called Vision 2030. According to the policymaker the aim of vision 2030 is not to only reduce emissions and increase sustainable transport but to also help people with low social standings and to reduce poverty and increase education. However, since climate change is critical and the transport sector being a big contributor the city is putting a lot of efforts and resurses explains the policymaker. One method being employed according to the transport expert is to get people to change from driving cars to more sustainable options such as cycling and walking. Awareness and spreading of information is vital tool being used. Both the participants mentioned that tools such as information, potential taxation and restrictions would help reduce usage of cars and improve sustainable transport. The Survey is done every three years explains Jessica and the feedback helps measure the progress.

> We dont count the decrease or increase on greenhouse gas emissions but rather we look at how many people drove a car that we encouraged to rent a bikecycle and we also noticed many of them start to actually using the cycle more moving forward (Jessica Elmgren, may 4, 2023).

The restriction method is done through pedestrian streets only experiments. Sundbyberg has now tested this concept during the summer by closing certain streets for cars during the summer. When the policymaker was asked why this is not done throughout the year, he explained that change takes time, and people need to first see and experience it before grasping the importance. Another similar initiative done is turning parking areas into green areas during the summer that allows people to gather and rest.

> Drottninggatan was car filled street. Strøget in Copenhagen, it took one block at a time and closed it up for cars and slowly but surely got the whole street year by year. Many people are angry when the car disappears, when people see the results almost no one would want the car back. If you ask anyone of the 50,000 people that walk on drottninggatan on any given Saturday almost zero of them would say, I would like to have more cars here. So when we have shown people what we can do with the city, when we get more space to have hotdog stands and people start selling flowers on the streets, there's more space for musicians and artistry you get

> more enjoyment out of that's a place you want to be because you have suddenly a lot of space, you get a new city center, you get a new town square etc. (Martin Solberg, april 27, 2023).

Increase in driving by 4% since 2019

The latest survey data from 2022 showed that there has been a negative trend in Sundbyberg city that goes against the goals of the city and that is increase in usage of cars. The results indicated that sustainable transport was not increasing but rather dropping all be it slowly while the usage of cars was increasing. The policymaker argued that this was not a trend in every part of Sundbyberg but rather on a new city that was recently built called Stora Ursvik.

> A new city called Stora Ursvik was built right after the survey was done in 2019 and this city till this day lacks public transport and not good enough biking infrastructure forcing the residents to use their cars to get around (Martin Solberg, april 27, 2023).

Furthermore, both the participants pointed towards the cronavirus pandemic as a possible cause of the increase in usage of cars since the 2019 survey. The pandemic forced people to isolate and avoid crowded places such as the buss and trains. Although the pandemic is now over, they both believe some people still have the behaviour of using the car.

Central Sundbyberg during peak hours seems kind of scary to cycle in due to the mixing of cars, the tram and people walking.

Part of the methods used for this degree project was a site visit to central Sundbyberg to experience how active transport interacts with the various other modes of transport that exist there, such as cars, busses and the tram. This question was raised to Martin in order to see if he also felt the same way about central Sundbyberg and he agreed that the area could do with changes such as removing a car lane or parking and adding a bike lane. But the points out that it should only be done in key areas that have a high flow of people that bike and not on every passage that leads into and through central Sundbyberg.

> We know pretty well where people are coming from in Central Sundbyberg and where they want to go, so if we take the easiest way to get there and zoom into those streets, because many people take the bike from this area and go through here, since the shortest way from point A to B is where cyclists will be so we take those areas and those streets and make them safe. This way, we don't need to change the whole infrastructure but rather only in a handful of areas that are popular (Martin Solberg, April 27, 2023).

Improving the active transport infrastructure (wider, separated from car traffic, colored.

The leading countries in sustainable transport and active transport all have one thing in common and that is very good infrastructure with wider, separated bike and walking lanes often with bright colours such as red or blue. When the participants were asked what they thought about such infrastructures and if Sundbyberg could see such designs in the future. Both agreed that those types of infrastructures are very good and help encourage more people

to cycle or walk since they provide more safety. This is also supported by many studies cited in this degree project that link better infrastructure to increase in active transport. However, the issue both the policymaker and the transport expert raised was that these types of designs in which separate lanes are built for active transport and colours are used cost a lot. The city has limited budget and they rather build many decent walking and cycling lanes instead of building 1 or 2 super infrastructure with wide, coloured lanes that are separated from car traffic.

> This is a question of cost, creating colored asphalt is two or three times more cost per meter of bike lane so the hard question to face is do we want three bike lanes or one that is red. (Martin Solberg, April 27, 2023).

> I think personally it looks good but I do not see the point of seperating the walking/cycling lane completly from the car lanes. Maybe in crossings a color could be used to highlight this is a crossing which Stockholm municipality has done in several areas (Jessica Elmgren, may 4, 2023).

6.1.2 Site visit/observation

Central Sundbyberg was visited during the peak traffic hours of the morning in order to get a better picture of how cyclist and those walking interacted with the other modes of transport. Central Sundbyberg is where the subway is located as well as majority of the restaurants and offices which makes it a very congested area. During the visit it was observed that there were not that many cyclists which could be due to lack of space for them among the people driving, walking and the trams that drive between all these congestions. Furthermore, the roads were Icey due to the snow that feel the week before and was later followed by rain making it very slippery. It was quite evident that during peak hours in the morning between 8am to 9 am there were a lot of cars on the roads as well as people walking and crossing the road. The feeling that one would get at this part of the city is that cycling would not be the safest mode of transport because of the lack of space and no designated bike lanes. The roads were also. Figures 5 shows a picture taken during the site visit. The lane separation was done after the

photo to highlight were the actual lanes sperate but in real life no one seems to follow them.

Figure 5-Central Sundbyberg showing the road, tram and walking/cycling space (orange lines represents walking path to buss stop, while green lines represent both walkking and cycling path for people.

These observations were raised to the policymaker in order to see what plans are in store for the city centre. The response from the policymaker was that the area could do with changes such as removing a car lane or parking and adding a bike lane. But the points out that it should only be done in key areas that have a high flow of people that bike and not on every passage that leads into and through central Sundbyberg.

> We know pretty well where people are coming from in Central Sundbyberg and where they want to go, so if we take the easiest way to get there and zoom into those streets, because many people take the bike from this area and go through here, since the shortest way from point A to B is where cyclists will be so we take those areas and those streets and make them safe. This way, we don't need to change the whole infrastructure but rather only in a handful of areas that are popular (Martin Solberg, April 27, 2023).

6.1.3 Statistics from the secondary survey data

6.1.3.1. Reporting frequencies

In terms of gender, it was observed that 53.8% of the respondents in the travel mode research in Sundbyberg 2022 were male, while 46.2% were female (N=6619). Tabel 1 presents the results of the frequencies calculated using SPSS software.

Table 3. Frequencies from the survey data obtained using SPSS software.

Gender	Frequence	Percentage
Female	3059	46.2
Male	3560	53.8
Total	6619	100

The age group of the participants varried with the 40–64 years representing the largest percentage (43.4%) closely followed by 25-39 representing 27.9% as shown in tabel 3 and figure 6.

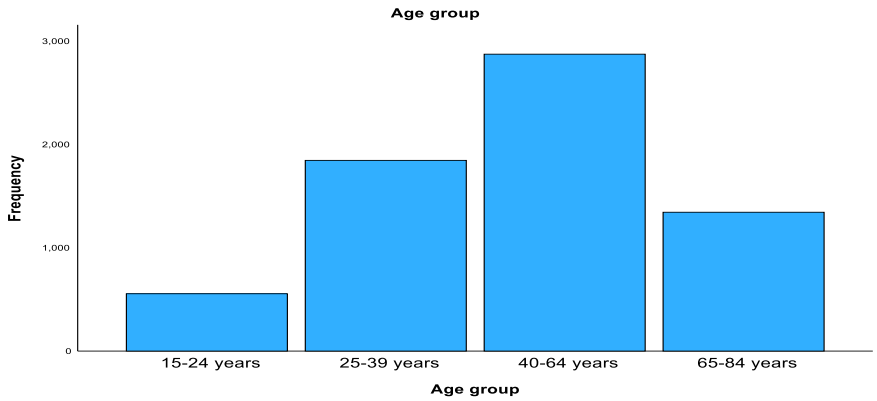

Figure 6-Bar chart created using SPSS showing the age group of participants.

Table 4. Age group of the participants

Age group					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15-24 years	555	8.4	8.4	8.4
	25-39 years	1846	27.9	27.9	36.3
	40-64 years	2874	43.4	43.4	79.7
	65-84 years	1344	20.3	20.3	100.0
	Total	6619	100.0	100.0	

Table 4 and figure 7 show the primary mode of transport of the participants with 937 (16.2%) reporting that they are on foot (walking) while 688 (11.9) % reported that they cycle. On the other hand, 1647 (28.5%) said they drive while 273 (4.7%) said they use car but as passengers. This brings the total number of participants that use car as primary mode of transport up to 1920 (29%).

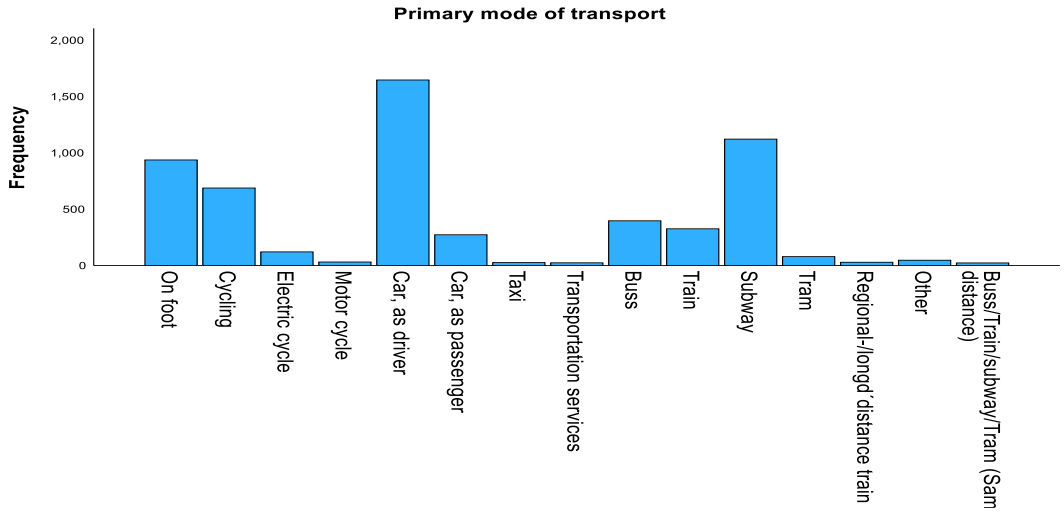

Figure 7-Bar chart created in SPSS showing the primary mode of transport of the participants

Table 5. The survey participants response to their primary mode of transport generated from SPSS.

Primary mode of transport

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	On foot	937	14.2	16.2	16.2
	Cycling	688	10.4	11.9	28.2
	Electric cycle	121	1.8	2.1	30.3
	Motor cycle	31	.5	.5	30.8
	Car, as driver	1647	24.9	28.5	59.3
	Car, as passenger	273	4.1	4.7	64.1
	Taxi	26	.4	.5	64.5
	Transportation services	24	.4	.4	64.9
	Buss	397	6.0	6.9	71.8
	Train	326	4.9	5.6	77.5
	Subway	1122	17.0	19.4	96.9
	Tram	79	1.2	1.4	98.3
	Regional-/longd´distance train	29	.4	.5	98.8
	Other	47	.7	.8	99.6
	Buss/Train/subway/Tram (Same distance)	23	.3	.4	100.0
	Total	5770	87.2	100.0	
Missing	System	849	12.8		
Total		6619	100.0		

6.1.4 Independent T-test

Using SPSS statistical software female and male participants choice of transport was compared, and the aim was to see if there is a link to a certain mode of transport. The three

modes of transport chosen where walking, cycling, and driving. In all the three cases equal variance is not assumed which means the spread of numbers in the two groups (male and female) is not equal.

6.1.4.1. Independent T-test for Walking

In the case of walking the total participants were 5768 (N=5768) out of which 2648 were female and 3120 males. The mean score was 0.35 female and 0.44 male, see figure 8 for the results generated from SPSS software.

Based also on Leven's test for equality of variances there were significant difference(t(5680.721)=7.069,p=<0.001 in the score for female(M=0.35, SD=0.476) was lower than male (M=0.44, SD=0.496). The magnitude of difference in the mean (mean difference = 0.91, 95% Cl:0.116 to 0.065) was significant.

The result indicates that male participants living in Sundbyberg city tend to walk more than females.

Table 6.SPSS statistical software comparison results between female and male participants that walk.

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Which mode of transport do you use? walking	Female	2648	.35	.476	.009
	Male	3120	.44	.496	.009

6.1.4.2. Independent T-test cycling.

The results from the independent T-test performed on the participants that used the bicycle (N=5768) out of which 2648 where female participants and 3120 male participants showed that the mean score was 0.15 female and 0.12 male, see figure 9 below for the results generated from SPSS software.

Based also on Leven's test for equality of variances there were significant difference(t(5439.509)=2.843, p=<0.001 in the score for female (M=0.15, SD=0.353) was higher than male (M=0.12, SD=0.325). The magnitude of difference in the mean (mean difference = 0.26, 95% Cl:0.08 to 0.043) was significant.

This time around the results indicate that female participants living in Sundbyberg city tend to cycle more than male participants.

Table 7.SPSS statistical software comparison results between female and male participants that cycle.

	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Which mode of transport do you use? cycling	Female	2648	.15	.353	.007
	Male	3120	.12	.325	.006

6.1.4.3. Independent T-test driving

In the case of driving cars with the total the independent T-test analyses revealed that the mean score was 0.37 female and 0.22 male, see figure 10 below for the results generated from SPSS software.

Based also on Leven's test for equality of variances there were significant difference(t(5257.927)=12.384, p=<0.001 in the score for female (M=0.37, SD=0.483) was higher than male (M=0.22, SD=0.416). The magnitude of difference in the mean (mean difference = 0.148, 95% Cl:0.125 to 0.172) was significant.

Female participants seems to drive more than male participants in Sundbyberg.

Table 8. SPSS statistical software comparison results between female and male participants that driver.

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Which mode of transport do you use? Car as driver	Female	2648	.37	.483	.009
	Male	3120	.22	.416	.007

6.1.4.4. Independent T-test as non driver/passenger

The test results from the Independt T-test as a user of car but not a driver showed that the mean score was 0.04 for females and 0.07 for male passageners, see figure 11 below for the results generated from SPSS software.

Based also on Leven's test for equality of variances there were significant difference(t(5726.917)=4.659, p=<0.001 in the score for female (M=0.04, SD=0.195) was higher than male (M=0.07, SD=0.250). The magnitude of difference in the mean (mean difference = 0.027, 95% Cl:0.039 to 0.016) was significant.

Based on these results, male participants ride in cars as passangers compared to females participants in Sundbyberg.

Table 9.SPSS statistical software comparison results between female and male participants that are non drivers in a car.

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Which mode of transport do you use? Car as non driver	Female	2648	.04	.195	.004
	Male	3120	.07	.250	.004

7 DISCUSSION

In this chapter the degree project interview findings, secondary survey data analysed through statistical software SPSS and the site visit are discussed. The aim is to answer the research questions through the obtained results from the interview, the results from the SPSS on the survey data and the site visit to central Sundbyberg.

7.1 Interview findings

The interview findings have been very interesting and sheds light on many important factors that shape the present and future of Sundbyberg city in terms of sustainable transport.

7.1.1 Stance on Climate crises and Global warming

The participants Martin Solberg and Jessica hold two different positions at Sundbyberg City but are both influential in the work they do. Martin being vice major for transportation & chairman of the committee for the urban environment plays a big role in how Sundbyberg will look like in the coming few years. When asked about the climate crises and global warming he answered by mentioning how the problem was inherited by the past generations and how it will be looked at by the future generations if nothing is done by the current generation. That was very powerful and showed how he sees the work that needs to be done at the present time. This is in accordance with research by Al-Ghussain (2019) who mentions that if things continue at this rate earth's average surface temperature will continue to rise as humans continue their environmentally harmful activities in particular the burning of fossil fuel. Jessica also revealed her concern with the current situation in terms of climate crises and global warming and interestingly she feels the issue is that policies are not strict enough.

Both Martin and Jessica have a strong desire to move Sundbyberg towards a more sustainable city and increase sustainable infrastructure. They both feel that policies need to be firmer, and Martin stated that three tools are needed to make significant progress in sustainable transport, and they are information, taxation, and restriction. Many European countries already use the taxation method according to (Carattini et al. 2019) carbon taxation is a method used to reduce emissions and has been developed as a method in numerous policy proposals one of them being the EU Green Deal. Significant reductions of CO_2 emissions in transport in the EU can only be achieved through behavioral change explains (Banister, 2007). However, people need to be informed of what is at stake and how this could impact future generations as Martin stated. According to Banister (2007), there is little sign that people are aware of the scale of the challenge or prepared to make the necessary changes. This is also what Jessica maybe was pointing out that more strict laws need to be established to push those not willing to change.

7.1.1.1. Progress in sustainable work at Sundbyberg municipality

In terms of their accomplishment, they both see significant progress, Jessica more than Martin due to her long working time in Sundbyberg municipality. However, they both believe much more is to come in the coming years as they have set in motion many changes and goals for the vision 2030. Martin clearly mentions this when asked about his work so far and states that a lot of his plans will need time to implement while some are already initiated such as introducing summer walking streets and encouraging people to try cycling in the winter which has been a success in the recent time as the numbers have grown significantly. Martin believes that giving people first a taste of things before implementing them is the best practice and that showing them a glimpse of life with fewer cars on the roads and much more active transport will eventually lead to transforming their views. Figure 8 shows a creative tool that counts the amount of cyclist that pass by daily and the total in the year. Therefore, making the policies that will shape Sundbyberg cities more effective in the path to more sustainable transport and fulfil the goals set for Vision 2030 and SDG 230.

While Jessica says her mission started 7 years ago in Sundbyberg and she has been working continuously every year in order to make sure the mobility program is improving and that walking and cycling remain top priorities for the city.

Figure 8- Live daily and yearly cyklist passage count in Sundbyberg City.

7.1.1.2. Future ambitions

It was very interesting to hear from Martin that his specific plans were to reduce cars and mention a well-known fact which is that the transport sector is responsible for a large emission of CO2. He also mentioned how this affects the health of the residents which confirms what was already mentioned in the literature study chapter in which research by Johansson et al (2017) stated that road vehicle emissions are one of the primary causes of human exposure to air pollution. Furthermore, chapter 3.1.2.3 Safety and Health (Ek et al., 2021) calls for policymakers to stress health motives when they promote walking and cycling in the future. When Martin was asked about the importance of information and awareness in the interview, he gave a similar example to (Ek et al., 2021) by using an advertisement outside a school that said your emissions are affecting these children's lungs do you mind not driving your car on this road. Therefore, there is a strong sense of responsibility on Martins's shoulder to implement changes that will make people healthier and fight climate change.

Jessica also stressed that her goals are always to improve active transport and encourage more people to not use the car but rather chose other sustainable modes of transport. This is why her work includes always putting active transport first in the city and taking measures such as removing parking lots and building green areas such as parks etc. According to Kraus and Proff (2021), car traffic alone is responsible for almost 11% of all GHG emissions in Europe. Therefore, trying to reduce the number of cars in the city and increasing sustainable transport will have a very positive impact on both the resident's health and the environment.

7.1.1.3. Viewpoint on the 2022 travel mode research results

The travel mode research survey which is done every three years gives policymakers such as Martin and transport experts such as Jessica a better picture of how the city is improving in comparison to the previous years. It also helps them measure progress and if they are moving according to the goals set or if they are falling behind. Therefore, it was very interesting to hear both their responses when asked why there was an increase in the number of people driving the car since the last survey in 2019 and a decrease in active transport. Jessica was surprised by the decrease in active transport and did not have an answer. Martin, however, was quick to point out that a new city was built within Sundbyberg in 2019 and that the city lacked public transport forcing people to use their cars which explains the 4% increase in cars since 2019. Both also pointed to the coronavirus pandemic being a major cause for the increase in the usage of cars since 2019 since people were told to avoid crowds and public areas so they resorted to driving their cars.

However, other factors could also be behind why certain people chose the car over cycling, and in the literature study chapter factors such as culture and infrastructure were presented by different studies. The cultural parameters that affect the choice of active transport according to Kraus and Proff (2021) involve gender disparity which is when genders are defined to not be equal and in return, these effects individuals' life choices. This will be discussed more in Chapter 6.2.

Another aspect that influences choice of transportation is also income and this is not taken into consideration by Martin and Jessica on their answer to the question. Research done by Stoffers (2011) takes Germany as an example by illustrating how people in the middle class and the working-class groups used the bicycle during the nineteenth century but as soon as the car became popular in the twentieth century and offered more speed, they chose the car instead.

7.1.1.4. Improving the current sustainable infrastructure in Sundbyberg city

On improving sustainable infrastructure by building wider and separated bike and walking lanes with colored asphalt both Jessica and Martin pointed out the cost and that it was a big deciding factor. Martin said he believes wider, separated, and colored bike and walking lanes are safer and more attractive and this was also mentioned in the literature study by Daley & Rissel (2011) that stated some non-riders have reported being afraid of cycling due to sharing the road with cars. Netherlands is a nation that is leading in the number of people that use the bicycle and according to research by Ton et al. (2019), more kilometers are cycled there however, the fatality and accident rates are much lower compared to the cycling-poor countries, which points to a very safe cycling environment.

Although agreeing with how safe separate bike lanes are especially since Martin cycles himself everywhere all the time yet he feels that the cost is so much more. He feels that building these separated, wider, and colored lanes comes at the expense of more regular sustainable transport and explains that building one such lane costs two or three times more than building several normal bike and walking lanes. Jessica on the other hand feels indifferent to separated, coloured lanes and thinks the focus should be on just having more bike and walking lanes. She says colored lanes are important in crossings to highlight such hotspots.

7.2 SPSS statistical analyses on Survey data and answer to research question 1.

The raw secondary survey data provided by Sundbyberg city was taken and statistical analyses were done in order to study closer certain transportation behavior aspects of the residents of Sundbyberg city in order to answer the first research question of the degree project “What are the factors that make the residents in Sundbyberg city choose between cycling/walking versus driving?”. Furthermore, literature studies on gender and choice of transport will be implemented to discuss the results obtained for the residents of Sundbyberg City in order to compare the findings.

7.2.1 Participants.

In terms of the gender of the people that agreed to participate in the travel mode research survey, more male was observed compared to female. The percentage of males was 53,8% while female participants accounted for 46.2%.

The age group represented mostly in the survey are participants between the ages 40-64 followed by participants between the age groups 25-39

7.2.2 Gender and the choice of transportation

According to Ek et al. (2021), men tend to be more prone to choose active transport in comparison with women, and so do respondents with lower income however, no analysis has been done on the income of Sundbyberg cities residents for this degree project therefore, that was discarded. However, the role gender plays in choosing active transport over driving was analyzed using SPSS statistical software.

Based on the results obtained from SPSS statistical software, the mean score was 0.35 for females and 0.44 for males in terms of walking, which indicates that men in Sundbyberg City tend to do more walking than women.

However, when it came to cycling the results disagreed with Ek et al. (2021) with the mean score being 0.15 for females and 0.12 for males meaning women participants cycled more. A possible conclusion that can be drawn from this for the residents of Sundbyberg is that men and women split with men walking more and the women cycling more.

This could be just specific to Sundbyberg city and maybe if the whole of Stockholm or Sweden is taken into consideration men would be more prone to choose active transport as a whole over women and therefore support Ek et al. (2021) research. The answer could be found in another study by Carroll et al. (2020) that states women are more likely to cycle in or close to the city center in comparison to men. Sundbyberg is Stockholm's smallest municipality and this may well be why the results indicate women to cycle more than men.

The same analysis was done for those that drive cars in Sundbyberg and the results revealed that the mean score was 0.37 for females and 0.22 for males, which indicates that women in Sundbyberg are also more prone to driving cars. This was further strengthened by the results from the participants that used the car but as passengers only and the results again showed that men participants were more pron to being passengers in Sundbyberg than women.

7.2.2.1. Analysis of the possible causes behind the results

To encourage Sustainable transport such as walking and cycling a safe and equal opportunity environment needs to be provided for people.

According to research by European Institute for Gender Equality, (2015) there is an unequal division of time and distribution of tasks between men and women in all the European countries, with more time being spent on household work and care by women

Therefore, the results on the choice of mode of transport between the genders obtained by SPSS will be analyzed and the possible cause behind them will be looked at with the help of available studies on the subject.

7.2.2.2. Women walk less than men in Sundbyberg city

Looking at the results from SPSS statistical software on the difference between male and female participants in Sundbyberg in terms of what mode of transport. In Sundbyberg male participants tend to walk more than female participants and the underlying reason behind this can depend on several factors of which are cultural barriers, fear of sexual harassment and assault by men states Iqbal et al. (2020) which are all causes that could be why many women avoid using certain modes of transport as well as restrict them from travel at night. According to Gekoski et al. (2017), it is often during active transport while women are walking or cycling, that they feel most vulnerable.

All the mentioned could be the cause behind why women walk less than men in Sundbyberg city. However, what has to be taken into consideration is that Sundbyberg is a much safer city and environment for women to walk in compared to many other countries across the world, and hence why the gap is close.

7.2.2.3. Women cycle more than men in Sundbyberg city

When looking at the results for cycling, women in Sundbyberg are more prone to using the bicycle. This is a positive result as many studies done on gender and cycling have found that women tend to also cycle less and this was also mentioned by Ek et al. (2021) who argue that women are less prone to active transport (walking and cycling). According to (Böcker et al., 2020) next train stations and between rail crossings men seem to cycle more in comparison to women. Another study by (Reilly et al., 2022) associates congestion and traffic with the frequency of women cyclists by stating that more women cycled in neighborhoods with less traffic.

However, as mentioned the results in Sundbyberg disagrees with all the mentioned studies and the reason could be because Sundbyberg city does not fall into any criteria mentioned by the studies.

Sundbyberg city is divided into 10 towns as shown in figure 2. Only Central Sundbyberg has a tram crossing which forces cyclists to pass over it. The situation of central Sundbyberg will be discussed in Chapter 6.3.

Secondly, Sundbyberg is small and this means women would not need to cycle far from home to reach across the city.

Lastly, the Majortiy of Sundbyberg is not heavily congested exception again could be central Sundbyberg. Therefore, since Sundbyberg seems to lack the obstacles that prevent women from cycling, it explains why the result is in favor of women compared to men in the city.

Furthermore, a study done by (Goel et al., 2022) on gender and active transport looked at 19 cities from 13 different countries across five continents. The study concluded that across the 19 cities, women cycled less than men except in 4 cities all in Europe. Therefore, it seems that women living in europé seem to have a better environment that encourages them to cycle compared to other parts of the world.

7.2.2.4. Women more pron to driving than men; men more pron to being passengers

The other result obtained was that in Sundbyberg women drove more than men while men when using cars were more prone to being the passengers. This can again be linked to safety and security since the car provides both for women in comparison to active transport. According to Goel et al. (2022), car use can provide some protection from dangers. However, in lower-income cities, car ownership is far out of the reach of the majority of the population although that is not the case in Sundbyberg city, hence a possible explanation as to why more women tend to drive. According to research by Emond et al. (2009), Many women prefer to drive overactive transport such as walking or cycling because their activities such as transport of household gods or passengers are far more convenient with the car in particular if they are also using trip chaining to carry out those responsibilities. The preference for driving over bicycling is in most cases an individual-level factor; however, it is also heavily influenced by the household and family relationships, which are a major part of the social environment.

Another study by Polk (2004) mentions that gender division in labor such as housework, childcare, escort trips, or travel with heavy objects tends to make women more prone to driving. Since those activities are not fit to be done by bicycle.

Therefore, having children and doing household work increases the need for driving within the female gender. The mentioned reasons could be the cause for why women are driving more than men in Sundbyberg city, however as mentioned most of the household activities tend to be divided by both genders in Sweden with an exception in some cases where there still is cultural difference. Therefore, the other possibility could be due to fear of proper active transport infrastructure since studies have mentioned women preferring separation from cars.

7.3 Central Sundbyberg site visit

7.3.1 The alternative design

One of the methods used for this degree project was a site visit to central Sundbyberg to experience how active transport interacts with the various other modes of transport that exist there, such as cars, buses, and the tram. According to research by Paradis et al., (2016), the benefit of observations is that it allows for the gathering of information in situ using the senses: vision, hearing, touch, and smell. From the site visit it was clear that central Sundbyberg was a very crowded area during the morning peak hours and many different modes of transport coexisted in a very small space. The space for cyclist and those walking was not clear, and the lane paintings seemed to have disappeared. This along with the tram driving in the middle and cars using the same space as the tram made it feel like it was a very restricted area for active transport during peak hours.

During the interview the policymaker was asked about his view to the situation in central Sundbyberg to see if the observation recorded from the site visit to central Sundbyberg was mutual and not personal or biased. This was confirmed by his answer to the question as he pointed out that central Sundbyberg is the way it is because of how it was originally built many years ago and that the area could do with some changes. However, he explains that not much can be done since the houses cannot be demolished to provide more space for wider walking and bike lanes. Therefore, he believes some changes such as removing a car lane or parking and adding a bike lane are the optimal solution. He also thinks poles could be installed to separate the cars from the remaining traffic such as the tram and busses this way bikes will feel safer. Furthermore, he suggests that the focus will be on key points that are known to have the highest flow of people that use the bike to work or school and not on every passage that leads into and through central Sundbyberg.

The policymaker pointed out an issue that is very much visible in many places in Sundbyberg city and that is that the initial urban planners built the city with the intention of providing more car lanes and besides the area allocated to cars, the remaining area is only available for people to walk into buildings and stores. Therefore, in order to incorporate wider bike lanes now only two possible options are to make the car roads smaller or to demolish the buildings and rebuild new ones that provide more space for wider active transport.

8 CONCLUSIONS

The aim of this degree project was to assess the current standing of active transport in Sundbyberg city and to gather information from policymakers through interviews. Furthermore, through site visit, examination of construction documents, project plans and secondary survey data find out the underlying cause of why certain people choose driving over cycling and walking.

What are the factors that make the residents in Sundbyberg city choose between cycling/walking versus driving?

The factors that seem to make Sundbyberg resident choose between driving, cycling, or walking is primarily due to location, behaviour, and gender. The construction of a new city called Stora Ursvik which is situated at a distance from the city centre that lacks active transport lanes and is supplied with poor public transport has caused an increase in the usage of cars. Furthermore, according to several studies cited in chapter 3 and through SPSS analysis using survey data from the Sundbyberg city gender seems to play a role in the choice of transport as more men tend to use active transport. The results also indicate that women in Sundbyberg are more pron to driving and this could be due to fear of using the bicycle with cars as studies have suggested.

How could the city of Sundbyberg meet its strategic goal of increasing sustainable journeys on foot and by bicycle?

The current simple infrastructure available in many parts of Sundbyberg were cycling lanes are not separated from car traffic could be improved since this is something that frightens many people from using the bicycle. Furthermore, using colored walking and bike lanes could also boost the usage as this has been successful in other countries. Sundbyberg city is aware that the infrastructure needs to be improved however, due to limited budget available building separated cycling and walking lanes as well as coloured options is not possible at the moment.

Can Sundyberg city increase sustainable transport infrastructure to encourage residents to use active transport?

Sundbyberg city is striving to increase sustainable transport and trying to encourage more residents to use it. This is evident through the new policies that are being implemented such as summer pedestrian streets where two streets in Sundbyberg city called Fredsgatan & Vasagatan will be closed for all cars in the summer of 2023 and only active transport will be permitted. Another key initiative is the changing of car parking spaces to make way for green areas such as parks. The city is building more bicycle parking as part of improving active transport infrastructure and the people working at the city also get to borrow bicycles for free during work. Winter bicycle movement has gained a lot of interest during the past two years and more and more residents are trying to use the bicycle even during the winter.

9 SUGGESTIONS FOR FURTHER WORK

This degree project has found that Sundbyberg city has key new policies such as closing streets for the usage of cars that will have a positive impact on active transport and reduce the usage of cars. Future work should look deeper into active transport and how improved infrastructure is linked to encouraging more people to walk and cycle. Improved infrastructure will reduce fear and provide safety for residents according to studies such as Ek et al. (2021) that link the availability of safe routes for walking and cycling as an important factor for the choice to walk or cycle. While (Emond et al., 2009) also state that women seem to be more concerned than men about the negative consequences of sharing roads with vehicular traffic more than men do. Household responsibilities also seem to play a role in the choice of transport however, due to where in the world it is this could be different due to culture and social norms. Another suggestion for future work is to research how gender in Sweden plays a role in the choice of transport and why women in Sundbyberg tend to drive more than men.

REFERENCES

Al-Ghussain, L. (2019). Global warming: review on driving forces and mitigation. *Environmental Progress & Sustainable Energy, 38(1), 13–21.* https://doi.org/10.1002/ep.13041

Andersson, E., Ögren, M., Molnár, P., Segersson, D., Rosengren, A., & Stockfelt, L. (2020). *Road traffic noise, air pollution and cardiovascular events in a Swedish cohort.* Environmental Research, 185, 109446. https://doi.org/10.1016/j.envres.2020.109446

Banister, D. (2007). *Cities, mobility and climate change*. Journal of Transport Geography, 19(6), 1538–1546. https://doi.org/10.1016/j.jtrangeo.2011.03.009

Blomkvist, P., & Johansson, P. (2016). 3: *Systems thinking in Industrial dynamics. In B. e. al, A Dynamic Mind. Perspectives on Industrial Dynamics in Honour of Staffan* (p. Chapter 3). KTH.

Emond, C. R., Tang, W., & Handy, S. L. (2009b). *Explaining Gender Difference in Bicycling Behavior. Transportation Research Record*, 2125(1), 16–25. https://doi.org/10.3141/2125-03

Britannica, T. Editors of Encyclopaedia (2023, February 24). Stockholm. Encyclopedia Britannica. https://www.britannica.com/place/Stockholm

Carattini, S., Kallbekken, S., & Orlov, A. (2019). *How to win public support for a global carbon tax. Nature*, 565(7739), 289–291. https://doi.org/10.1038/d41586-019-00124-x

Böcker, L., Anderson, E. R., Uteng, T. P., & Throndsen, T. S. (2020). Bike sharing use in conjunction to public transport: Exploring spatiotemporal, age and gender dimensions in Oslo, Norway. *Transportation Research Part A-policy and Practice*, *138*, 389–401. https://doi.org/10.1016/j.tra.2020.06.009

Carroll, J. D., Brazil, W., Morando, B., & Denny, E. (2020). *What drives the gender-cycling-gap? Census analysis from Ireland*. Transport Policy, *97*, 95–102. https://doi.org/10.1016/j.tranpol.2020.07.007

Crawford, M. (2019, February 5). *Electric Vehicles: A Solution to Air Pollution? The ADEC Innovations Blog*. https://blog.adecesg.com/blog/electric-vehicles-a-solution-to-air-pollution

Daley, M., & Rissel, C. (2011). *Perspectives and images of cycling as a barrier or facilitator of cycling. Transport Policy*, 18(1), 211–216. https://doi.org/10.1016/j.tranpol.2010.08.004

Eliasson, J., & Proost, S. (2015). *Is sustainable transport policy sustainable? Transport Policy,* 37, 92–100. https://doi.org/10.1016/j.tranpol.2014.09.010

Ek, K., Wårell, L., & Andersson, L. (2021). *Motives for walking and cycling when commuting – differences in local contexts and attitudes.* European Transport Research Review, 13(1). https://doi.org/10.1186/s12544-021-00502-5

Emond, C. R., Tang, W., & Handy, S. L. (2009). *Explaining Gender Difference in Bicycling Behavior. Transportation Research Record*, *2125*(1), 16–25. https://doi.org/10.3141/2125-03

Forsberg, M., & Carlsund, A. (2021). *Sundbybergs stads befolkningsprognos 2022-2036.*

Gekoski, A., Gray, J.M., Horvath, M.A.H., Edwards,S., Emirali, A. & Adler, J. R. (2015). *´What Works` in reducing Sexual Harassment and Sexual*

Offences on Public Transport Nationally and Internationally: *A Rapid Evidence Assessment. London: British Transport Police and Department for Transport.*

Georgelis, A., Eriksson, C., & Andersson, N. (2017). 2017 Miljöhälsorapport Stockholms län.

Georgelis, A., Isaksson, P., & Andersson, N. (2021). Miljöhälsorapport Stockholms län 2021.

Gender Equality Index | 2015 | European Institute for Gender Equality. (2023, May 16). https://eige.europa.eu/gender-equality-index/2015

Goel, R., Oyebode, O., Foley, L., Tatah, L., Millett, C., & Woodcock, J. (2022). Gender differences in active travel in major cities across the world. *Transportation*, *50*(2), 733–749. https://doi.org/10.1007/s11116-021-10259-4

Gupta, A., Gupta, A., Jain, K., & Gupta, S. (2018b). *Noise Pollution and Impact on Children Health.* Indian Journal of Pediatrics, 85(4), 300–306. https://doi.org/10.1007/s12098-017-2579-7

Handy, S. L., Van Wee, B., & Kroesen, M. (2014). *Promoting Cycling for Transport: Research Needs and Challenges*. Transport Reviews, 34(1), 4–24. https://doi.org/10.1080/01441647.2013.860204

Iqbal, S., Woodcock, A., & Osmond, J. (2020). "*The effects of gender transport poverty in Karachi.*" *Journal of Transport Geography*, *84*, 102677. https://doi.org/10.1016/j.jtrangeo.2020.102677

Jevtic, M., Matkovic, V., Van Den Hazel, P., & Bouland, C. (2021). *Environment—lockdown, air pollution and related diseases: could we learn something and make it last?* European Journal of Public Health, 31(Supplement_4), iv36–iv39. https://doi.org/10.1093/eurpub/ckab157

Johansson, C., Lövenheim, B., Schantz, P. M., Wahlgren, L., Almström, P., Markstedt, A., Strömgren, M., Forsberg, B., & Sommar, J. N. (2017). *Impacts on air pollution and health by changing commuting from car to bicycle*. Science of the Total Environment, 584–585, 55–63. https://doi.org/10.1016/j.scitotenv.2017.01.145

Kraus, L., & Proff, H. (2021). *Sustainable Urban Transportation Criteria and Measurement—A Systematic Literature Review*. Sustainability, 13(13), 7113. https://doi.org/10.3390/su13137113

Lanzendorf, M., & Busch-Geertsema, A. (2014). *The cycling boom in large German cities—Empirical evidence for successful cycling campaigns.* Transport Policy, 36, 26–33. https://doi.org/10.1016/j.tranpol.2014.07.003

Odhage, J., Gennäs, S. B. af, & Johansson, E. (2022). *Mål Och Riktlinjer För Hållbar Mobilitet i Sundbybergs Nya Stadskärna.*

Paradis, E., O'Brien, B. C., Nimmon, L., Bandiera, G., & Martimianakis, M. A. (2016). *Design: Selection of Data Collection Methods. Journal of Graduate Medical Education*, 8(2), 263–264. https://doi.org/10.4300/jgme-d-16-00098.1

Perez, P., & Reyes, J. (2002). *Prediction of maximum of 24-h average of PM10 concentrations 30h in advance in Santiago, Chile*. Atmospheric Environment, 36(28), 4555–4561. https://doi.org/10.1016/s1352-2310(02)00419-3

Perrone, K. M., Wright, S. J., & Jackson, Z. V. (2009). *Traditional and Nontraditional Gender Roles and Work—Family Interface for Men and Women. Journal of Career Development, 36*(1), 8–24. https://doi.org/10.1177/0894845308327736

Polk, M. (2004). *The influence of gender on daily car use and on willingness to reduce car use in Sweden*. *Journal of Transport Geography*, *12*(3), 185–195. https://doi.org/10.1016/j.jtrangeo.2004.04.002

Reilly, K. H., Wang, S., & Crossa, A. (2020). *Gender disparities in New York City bike share usage*. *International Journal of Sustainable Transportation*, *16*(3), 237–245. https://doi.org/10.1080/15568318.2020.1861393

Robert Olofsson, Johansson, S. W., & Colbengtsson, A. (2018). *Mobilitetsprogram för Sundbybergs stad*.

Shahidehpour, M., Li, Z., & Ganji, M. (2018). *Smart cities for a sustainable urbanization: Illuminating the need for establishing smart urban infrastructures*. IEEE Electrification Magazine, 6(2),16–33. https://doi.org/10.1109/mele.2018.2816840

Statistikmyndigheten SCB. (2014). *Statistiska Centralbyrån*. https://www.scb.se/

Statistikmyndigheten SCB. (2022). *Statistiska Centralbyrån*. https://www.scb.se/

Stoffers, M. (2011). *Cycling Cultures*. Transfers, 1(1), 147–154. https://doi.org/10.3167/trans.2011.010111

Sundbyberg history. (2019, August 8). *Sundbybergs Stad.* https://www.sundbyberg.se/kommun-politik/kommunfakta/historia.html

Vision 2030. (2022, February 22). *Sundbybergs Stad*. https://www.sundbyberg.se/kommun-politik/kommunfakta/vision-2030.html

Ton, D., Duives, D. C., Cats, O., Hoogendoorn-Lanser, S., & Hoogendoorn, S. P. (2019). *Cycling or walking? Determinants of mode choice in the Netherlands. Transportation Research Part A-Policy and Practice*, 123, 7–23. https://doi.org/10.1016/j.tra.2018.08.023

UN. (2012). UN-Habitat Annual Report 2012 | *UN-Habitat. UN-Habitat Annual Report 2012*. https://unhabitat.org/un-habitat-annual-report-2012

Appendix 1: Interview Questions.

Who is Martin Solberg?

Who is Jessica Elmgren?

1. What's your personal take on the climate crisis and global warming?

2. What have you accomplished so far in your work towards Sustainable tranpsort?

3. What have you noticed changes in Sundbyberg city since your time in terms of sustainability?

4. What are your specific plans, including actions and timetables, for helping to reduce greenhouse gas emissions by a substantial amount, and how will you fund and implement them (vision 2030)?

5. Sommargågata is something that is done in Sundbyberg city often (Fredsgatan & vasagatan) and it has many benefits both for people and businesses, such as restaurants. Why not make it permanent?

6. According to resvaneundersökning 2022 many of the residents want to see improvement in travel modes such as active transport. How much effort is being put into doing that?

7. The pandemic has been very difficult but there are some positives also, such as decrease in air pollution and noise pollution due to less driving. However, RVU from 2022 has shown an increase of 4% in driving. Why is that?

8. The RVS 2022 has also shown that there has been a drop on the percentage of people that cycle and walk compared to 2019. How can Sundbyberg reverse this?

9. What steps are you taking to support sustainable infrastructure projects? (Asked only to Jessica Elmgren)

10. Central Sundbyberg during peak hours seems kind of scary to cycle in due to the mixing of cars, the tramp and people walking. (Asked only to Martin Solberg)

11. Many countries around the world, such as Denmark, Belgium, Spain etc, have very wide, colored, cycling and walking paths that look very attractive. According to a lot of research, many people feel safer to cycle when there are wider and separate lanes for cycling far away from cars. Could Sundbyberg have some of those in the future?

Appendix 2: Interview transcript.

1.What's your personal take on the climate crisis and global warming?

> How I usually see the problem that we face is that we have inherited a problem from four generations, that is our grandparents' generations and before them, that is for us to solve so that future generations can enjoy a planet that is actually livable, and that we don't throw away what we got to my children, my grandchildren, that a percentage or a quarter of the planet is no longer a place that humans can live, and for that matter, animals and plants. And we have an ever closing window of opportunity to solve this, and even though all the alarm bells are constantly ringing, we can't seem to muster the courage or the policies to do that. And that is deeply concerning (Martine Solberg, april 27, 2023)

> I chose my proffesion 20 years ago because of the environment so I have been thinking of it early. Then I ended up on traffic but it is we that can do much by setting requirments and so on. I think we dont take it serious enough. I feel we have many goals that are not worked towards, we could make things more strict, we should maybe make some law changes and that politicans need to dare. (Jessica Elmgren, may 4, 2023)

2.What have you accomplished so far in your work towards Sustainable transport in Sunbyberg city?

> In the environmental policy work and the climate policy work that we do here, my analysis is that the transportation sector is the bulk of the change that we have to do, both in the number of tons of CO_2 that is emitted, but also in the change in the city that has to come forth. We have to enable people to change how they transport to a more sustainable way. The bit complicated answer is that creating new policies takes time and implementing those policies also takes time. Mostly what we have done these first few months is initiating policy changes that is mostly not yet visible for your everyday person out about on the streets. But we have established some goals from thought that I am dedicated on fulfilling, decreasing the number of cars on our streets, increasing the number of bikes, increasing how many people are on our busses, and finding policies to get to those goals. Decreasing the number of cars, not least at the former highway of in enköpingsvägen, but also in our city center where we have almost no free parking spaces because many people still choose to take the car in the part of this city and in the part of this country that is mostly densed populated with public transport, about 30% of people still chose to take the car to work . Some visible changes that I have seen and accomplished are increasing summerwalking streets during the summer to show the people in the city what we can do with the city when we primer sustainable transport, how can we change our streets and our public areas to do something else than what we have done for the last 50 or 70 years. I hope therefore if we have another talk in two or three years I can have a checklist of things we have actually accomplished that are visible to people in Sundbyberg (Martine Solberg, april 27, 2023)

I was part of those that produced Swedens first mobility management plan and got founds for the work. Then I produced a specific mobility program for Sundbyberg during the last 7 years and she feels much has been achieved since then. Many steps had been set and much has improved since then and evalution of the plan is done every year (Jessica Elmgren, may 4, 2023).

3.What have you noticed changed in Sundbyberg city since your time in terms of sustainability?

As an elected official in my position, not many things are visible as of yet, but are to be soon. But as a resident of Sundbyberg city for the last seven something years, I have seen a lot of change, both in the number of people that are using bikes as transport, the amount of people that are using electric cars to transport, and how people get around the city in general, but also even in this city, how we reflect on our choices and the consequences that they have. That I believe is going in the right direction. That's where personal responsibility is something that people take seriously and want the change to come about (Martine Solberg, april 27, 2023)

During my 7 years here I have noticed many changes in Sundbyberg city and significant improvement on sustainable transport such as walking and cycling. Several campaigns have been done to see behaviour changes on people and shown postive results. Furthemore, the evalutions done on mobility management has followed the plan laid out and has been a success (Jessica Elmgren, may 4, 2023).

4.What are your specific plans, including actions and timetables, for helping to reduce greenhouse gas emissions by a substantial amount, and how will you fund and implement them (vision 2030)?

The vision 2030 is adapted from the SDG 2030 goals and is a a local take on those goals where we can make a difference, both in the environmental and climate perspective, but also in how many people feel that they have a low social standing, they can put food on the table. So, both in poverty and in the climate, and in education, and all the other things we work on here. But to focus on the climate and my mental bits, my scope is again primarily the transportation sector, where I believe most work is needed. And the simple solution is to premiere sustainable transportation, meaning walking, biking, take a scooter and use public transportation that don't have the same amount of carbon emissions that regular cars have and moving more transportation to those types of transportation modes, both in a climate sense, but also in a sense that we are extremely densely populated. If everybody here would have a car, we would have nothing but traffic jams all over the city. And for the people that need a car, I mean, a handyman can take his tools and his wood that he needs to build somewhere with him on the bus. For those people, we should ensure that everybody has access to charging stations for electric vehicles. So moving completely away from traditional cars, and moving to electric vehicles that has lower climate emissions in the form of CO_2, also less sound pollution, less air pollution, and it's generally better for everyone around them. Which means we have take a broader perspective of how do we solve the question of charging these cars and to do this, we have a couple of possible routes to take and one of them is to continue and put more money towards making our side walks and bike lanes wider and better. Also, how we take care of them in the winter so that they are walkable and bikeable in the winter. We have brushes that brush away snow and saline /salty solution that is very useful for bike and walk lanes.

Physically expanding the network of sidewalks and bike lanes but also finding ways to minimize the need for a car, not make it unnecessary hard for people that need car but minimizing the need for cars by using shared car systems car pools. These policies will be rolled out in the coming two to three years and towards the goal of the number of people that use cars as their primary mode of transportation today is by 30% and by 2030 it will be 20% and that is more than a percentage per year, which is hard but it is achieveable. (Martine Solberg, april 27, 2023)

Much of the work we do is to get people to change from driving cars to other sustainble modes and we do that based on RVU research we do every 3 years. We put alot of requirments such as creating car pools,cycle pools reducing parking places for cars which means many more can make other choices of transport and that is what I work with all the time, how can we make people change their choice of taking the car. We dont count the decrease or increase on greenhouse gas emissions but rather we look at how many people that drove car we encouraged to rent a bikecycle and we also noticed many of them start actually using the cycle more moving forward (Jessica Elmgren, may 4, 2023).

5.What is your opinion on spreading awarness as a means of promoting sustainble transport?

I mean usually when you talk about these things, you say that you have three tools to use. You have information, you have taxation and you have restriction. Information is telling people are you sure you want to take the car here and drive by this school. With all the children in this school who lungs are sensitive to the pollution that your car emitts? Could you please take a bike insted? That is information, for taxation we don't really have such a tool in Sundbyberg city, it is not on the national level. But to make some mode transportation more expensive while others are cheaper so people are incentivized through their wallet to do some choices. The third one is restriction which is hardest thing and that is to say you are not allowed to take the car on this road because of abc, I think to have a successful climate policy you have to use all three tools. We can also make a parts of the city more enjoyable when we don't have to use as much space for cars and make space for people and that also needed information to accomplish that. We have one project that's called inter biking, where we reach out to people every winter and I say, okay, you bike to work in the summer, congratulations you're doing fine why are you not biking in the winter ? Oh, it's scary. It's slippery. It's cold. Okay. How about you and 30 other people who are thinking about doing this come together? try to do this, challenge each other and we will pay for winter tires on your bike. So we have about 30 to 40 people every winter that, enrolled in this program. It's 30 people that have never had the experience to bike around in Sweden during the winter because it feels scary and I agree it's dark tt's snow everywhere it might be icey and to just give them the experience and show them that this is fine, you can do this is one through information to increase the number of people that use sustainable transport in the winter. Furthermore, for every person that enrolled in this program, they encouraged at least one person around them to do the same thing so 30 in the program made an additional 35 people do it. This resulted in around 70 people more that biked in the winter times and we have dones this the past five years, that's a couple of hundred cyclists and that keeps expanding. Soon I will run out of cyclists to encourage, but that's another problem for another day (Martine Solberg, april 27, 2023)

> Information is not really always successful. The analogy of pictures on cigarette packets shows that people still buy cigarettes and smoke. The pictures don't scare people at all. (Jessica Elmgren, may 4, 2023).

6.Summer walking streets is something that is done in Sundbyberg city often (Fredsgatan & vasagatan) and it has many benefits both for people and businesses, such as restaurants. Why not make the streets permanent?

> We can see with the pedestrian street example Strøget from Copenhagen which is the equivalent Drottningatan in Stockholm. Both of these streets used to be filled with cars and buses even i up to I think the seventies or eighties Drottninggatan was car filled street. Strøget in Copenhagen, it took one block at a time and closed it up for cars and slowly but surely got the whole street year by year. Many people are angry when the car disappears, when people see the results almost no one would want the car back. If you ask anyone of the 50,000 people that walk on drottninggatan on any given Saturday almost zero of them would say, I would like to have more cars here. So when we have shown people what we can do with the city, when we get more space to have hotdog stands and people start selling flowers on the streets, there's more space for musicians and artistry you get more enjoyment out of that's a place you want to be because you have suddenly a lot of space, you get a new city center, you get a new town square etc. So in the long run that's the plan I think it would be good to expand this project to several streets and look into the possibility of making them permanent but what scope of time it could take, I cannot say (Martine Solberg, april 27, 2023)

> We do something simillar, we take parking places and build parks were people can sit and play games just to show people what can be done with area car parking take. This is done from July to september mainly because of the trees and all the green areas that is available during the summer period. (Jessica Elmgren, may 4, 2023).

7.According to travel mode research in Sundbyberg 2022 (RVU) many of the residents want to see improvement in travel modes such as active transport. How much effort is being put into doing that?

> It's such a luxury to read these numbers and to see that the broad majority of people in this city want us to expand biking, walking and public transport. Only a small minority wants to increase the space for cars and trucks and that is not the case everywhere. If you look at my hometown out in the middle of nowhere the, the percentages would probably be the opposite., 70% would want more parking spaces and more places for the car to reach. So we have a luxury of having both understanding residence but also a broad public support for the policy. That is my general take on the survey results, we should work, longer and harder to reach these goals. Both because I think it's the right thing to do, but also because that is what our voters and the people that live in city want us to do. They want to make it easier to take the bike, they want more buses, they don't want more cars and they don't want more parking spaces and I think not acting on that would be foolish (Martine Solberg, april 27, 2023).

> We already have our own priority in which walking is first and cycling is second and that is what we strive to follow in everything we do. We are always trying to improve active transport and this results from the survey confirm that what we are already doing it does not mean that since the residents are saying we need to improve active transport we will start doing it but on the contrarey it shows that we have been improving active transport in several years and the people still feel there is more to be done so we are on the right way. If people would have wanted us to priotize cars then it would have been a different story since that would go against all our goals (Jessica Elmgren, may 4, 2023).

8.RVU from 2022 has shown an increase of 4% in driving while there has been a drop on people that use active transport such as cycling and walking from 2019,why is that?

> I think the numbers show two things. One, that we have had a new part of the city, that has been built since 2019, after the last survey was done that is called Stora Ursvik and unfortunately the public transport hasn't been delivered. We are trying to build a tram system to the part of the city but it's been delayed and delayed. So people that live there has to go to work somehow and we don't have enough biking infrastructure. It's a little bit too far from any to walk to Hallonbergen and rissne where the subways and the tram hasn't gotten there yet. So all too many see cars as their own option. The buses that go there are popular to the degree that they are full so we need more buses because people can't fit on them if you only look at the numbers for that part of the city, the number of people that take the car is higher than almost anywhere else. if you take away those numbers and look more closely by comparing the rest of the city. 2019 to 2022, the increase is almost flat in terms of cars. But still it should have gone down and but why hasn't it? During the pandemic we told the people don't take the subway, don't get on the bus if you don't have to, we have to keep distance on the bus so we don't get each other sick. So many people started working from home and when they had to go into work, they used the car and now the pandemic in that form is over but the comfort of taking the car or just the habit of taking the car has stuck around. So we got an initial big increase also in biking that spiked in 2020. I think it'll be a long time until we'll see those numbers again but also in car usage and getting that to start to decreasing in the end will take time. If we hadn't had the pandemic, I think we should have seen 3% to 4% drop for car usage (Martine Solberg, april 27, 2023).

To reverse this trend martin explain there is a need of improving and increasing active transport.

> Maybe more bike lanes, wider bike lanes, better taking care of snowing the winter. Motivating people to bike, and making it more safe to take the bike. My usual answer for what is a safe traffic solution for cyclist and pedestrians is do you feel safe to let your kids out by themselves on the street? if Yes, the street is safe but if you are nervous about letting your kids bike by themselves to their school, to their football practice we have a problem. So that is my measurement we have too many places in this city still that parents and me, and many of us don't feel safe to let an eight year old go by themselves because cars are everywhere and they go fast and they are hard and kids are not safe (Martine Solberg, april 27, 2023).

> We did the survey right after the cronavirus pandemic and this installed in people new behaviour which was the recomendation of keeping away from people and isolate so people started taking the car and avoiding public transport or cycling/walking. Therefore, to have only 4% increase after the pandemic is actually not so high it could have been much more. Therefore, we will have to wait for the results from the next travel mode research. However, I am surprised that cycling has dropped and not gone upp now that the pandemic is over (Jessica Elmgren, may 4, 2023).

9.What steps are you taking to support sustainable infrastructure projects?

> That depends soly on the budget we have, the bigger budget we get the better we can do for the infrastucture. Regardles we are always trying to improve the infrastructure for the sustainble modes of transport (Jessica Elmgren, may 4, 2023).

10.Central Sundbyberg during peak hours seems kind of scary to cycle in due to the mixing of cars, the tramp and people walking.

> The solution is quit simple and central Sundbyberg would be a good experiment from the things that we know on how to change the outlook of cities. If we create that has two car lanes, and parking and small sidewalk then people will take car there since you can only go by foot so far. If we simply remove one of the lanes or the parking and paint it with red asphalt showing that it is a bike lane, people will start taking there bike there, and to insure that cars dont come there we put some ronds into the ground then we make it safe. If a new lane is made separated with bars then I would personally feel safe because a car cant run into me. We know pretty well were people are coming from in Central Sundbyberg and were they want to go, so if we take the easiest way to get there and zoom into those streets because many people take the bike from this area and go through here since the shortest way from point A to B is were cyclist will be so we take those areas and those streets and make them safe. This way we dont need to change the whole infrastructure but rather only in handfull of areas that are popular. The weird thing about transportation unlike economics is that you have how much demand there is and how much is available then the price is set however, in transportation you can create demand by having supply. If you build to extra car lanes then no more traffic jams and more people will drive there there by the supply was increased and the demand has followed. On the other hand if we increase the supply in bike lanes then people will start finding it easy to take bikes because while others are stuck in their cars during traffic the free bike lanes would make you reach work much faster (Martine Solberg, april 27, 2023).

11. Many countries around the world, such as Denmark, Belgium, Spain etc, have very wide, colored, cycling and walking paths that look very attractive. According to a lot of research, many people feel safer to cycle when there are wider and separate lanes for cycling far away from cars. Could Sundbyberg have some of those in the future?

> This is a question of cost, creating colored asphalt is two or three times more cost per meter of bike lane so the hard question to face is do we want three bike lanes or one that is red. To paint asphalt red the paint needs to be done during the production and this affects the machin

maintaince since the red color needs to cleaned before using the same machin for black asphalt increasing the cost. Furthermore, there is not much demand if they demand was high we would have one facility that only make red asphalt then cost would go down but we are not there yet. If our city and handfull of other cities got togehter and said now we do only red asphalt we could then bring the cost down but nothing as of yet. However, colored asphalt is safer, cars avoid it more and pedestrians avoid it more since the red color means bike its clear. (Martine Solberg, april 27, 2023).

We built Ursvik road and we used red asfalt however, it was a sharing between cyclist, cars and busses. It is costly to use colored asphalt and it gets deterioted, and issues with winter etc. I think personally it looks good but I do not see the point of seperating the walking/cycling lane completly from the car lanes. Maybe in crossings a color could be used to highlight that this is a crossing which Stockholm municipality has done in severa areas but in my personally opinion I dont see why we should seperate bikelanes from car lanes (Jessica Elmgren, may 4, 2023).