Commuting master plan for Växjö municipality

SUMBA

Interreg Baltic Sea Region

EUROPEAN UNION

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Växjö kommun

Växjö's commuting master plan is an output of the Interreg Baltic Sea project SUMBA (2017-2021), Sustainable Urban Mobility and Commuting in Baltic Cities, output 4.2.

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Växjö municipality, 2021

Contents

Introduction

Växjö's Commuting master plan (CMP) is a main output from the Interreg Baltic Sea Region project SUMBA (Sustainable Urban Mobility and Commuting in Baltic Cities). The plan has been written in parallel with updating the municipality's transport plan for 2020-2025. Much of the work involving internal and external meetings, surveys, reference groups and other activities involving stakeholders has been connected to the transport plan. This work however has contributed also to writing the CMP, much of which has been partly financed by the SUMBA project. The two documents differ in that the transport plan follows the municipality's steering process and document guidelines and will be approved by city council. The CMP is an internal reference document with focus on commuting and according to guidelines from the SUMBA project. In accordance with the SUMBA guidelines, the CMP includes a more detailed background and current status of Växjö's transport system compared to the transport plan. Different scenarios for development and modal share are suggested along with strategic goals for 2040. Priority and focus areas in the CMP are connected to the transport plan. Lastly, a list of measures is included in the section Action Plan.

Sustainable transportation in the CMP is defined as walking, cycling and public transit because they contribute the lowest negative impact on society and the environment. In this context, the private car is not considered a form of sustainable transportation because of its greater negative impact on society and the environment. This impact can include, among others, demand for land-use with roads and parking infrastructure (per commuter), relative energy consumption (per commuter), impact on human health and attractiveness of urban areas as well as negative impact on traffic safety and perceived safety of other road users. This despite increasing availability and popularity of emission free vehicles such as electric cars and biogas cars.

Functional area

The functional area defined for the CMP is Växjö municipality (Figure 1), an area with population of 94 859 inhabitants in 2020[1] and current annual growth trend of nearly 1 000 inhabitants. The municipality measures a total of 1,914 km^2 with population density of 49/km^2. By 2050 Växjö municipality is expected to reach 140 000 residents according to its latest development master plan[2]. Located in the southern part of Sweden, the municipality is comprised of the city, small villages and rural countryside surrounded by lakes and forest. Växjö city (Figure 2) contains around 70% of the municipality's population while the remaining are located in villages and surrounding countryside. A large part of the city is in fact shaped by lakes, creating sometimes large separations between neighbourhoods. Much commuting within and to the city runs therefore through the central part of the city.

[1] https://www.scb.se/hitta-statistik/statistik-efter-amne/befolkning/befolkningens-sammansattning/befolkningsstatistik/pong/tabell-och-diagram/topplistor-kommuner/folkmangd-topp-50/
[2] Växjö municipality master plan https://vaxjo.maps.arcgis.com/apps/MapSeries/index.html?appid=f105bb71db174d87acf43bc99bade813

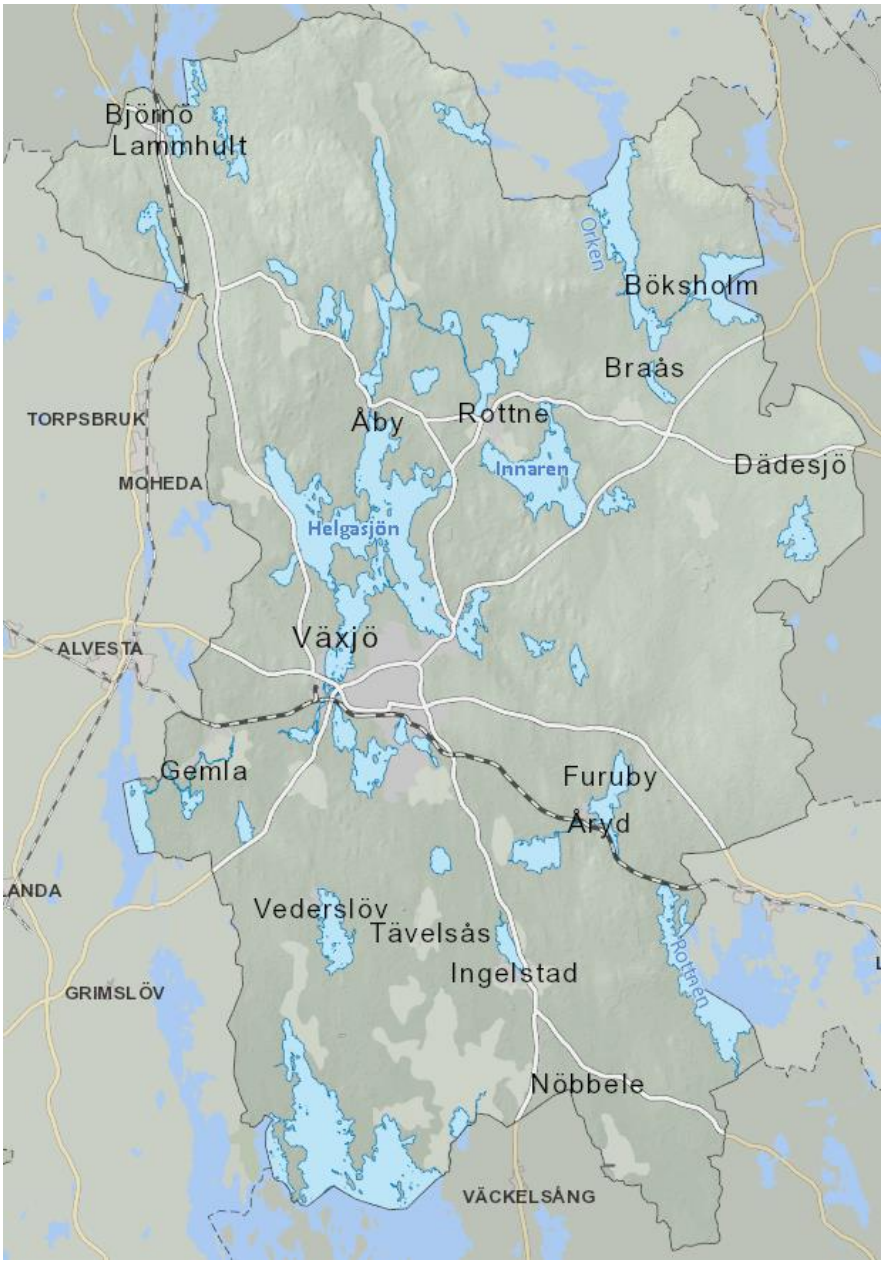


FIGURE 1 - VÄXJÖ MUNICIPALITY

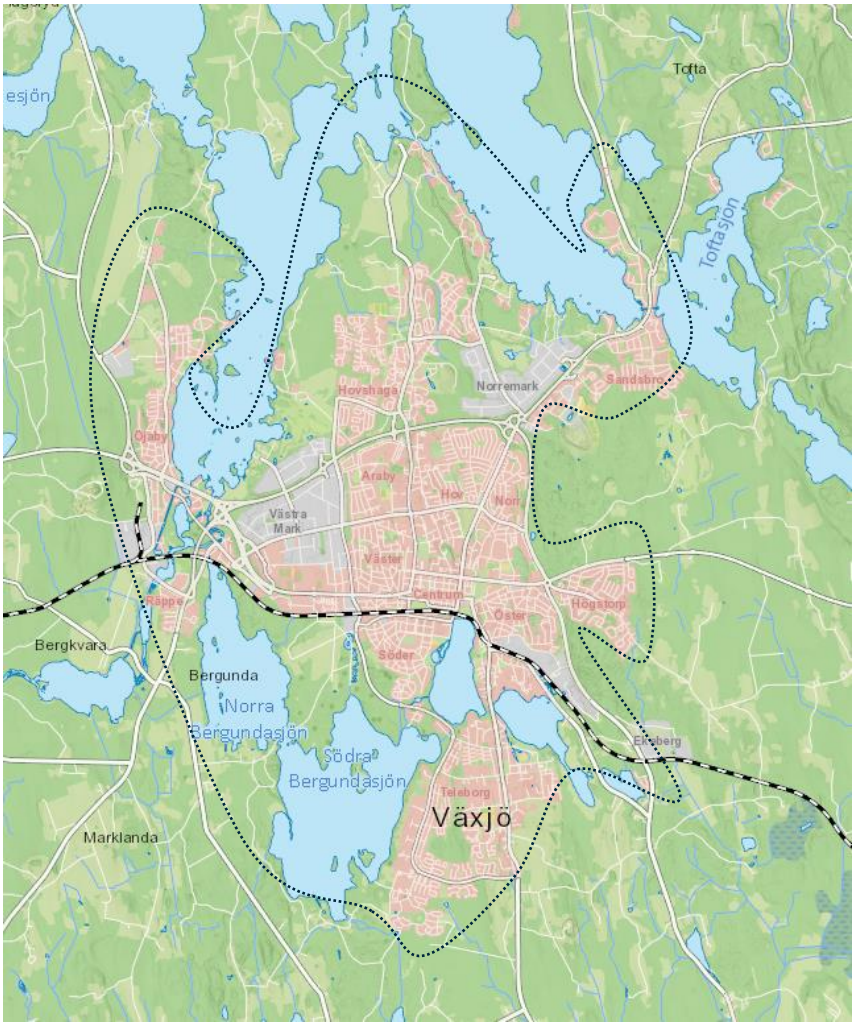


FIGURE 2 - VÄXJÖ CITY

Current status and development plans

This section provides an overview of the municipality's transport networks, it examines development trends in the municipality's detailed planning, strategies for development and transport according to the municipality's development master plan (to be published in 2021). Results from various studies on sustainable transportation and forecasted transport volumes according to Växjö's transport model are also discussed.

Transport networks

Road network

Växjö city's road network consists of municipal and national roads as shown in Figure 3. Regional main roads are municipal roads that connect to the national road network and lead to central Växjö and most important destinations in the city like the hospital, station and university. Posted speed limits on most roads in Växjö are 40 km/h, 30 km/h in dense housing areas and up to 60 km/h on roads with minimal interaction with pedestrians and cycling traffic. Outside the city and other densely populated areas, the posted speed limit is typically 70 km/h if not a national highway.

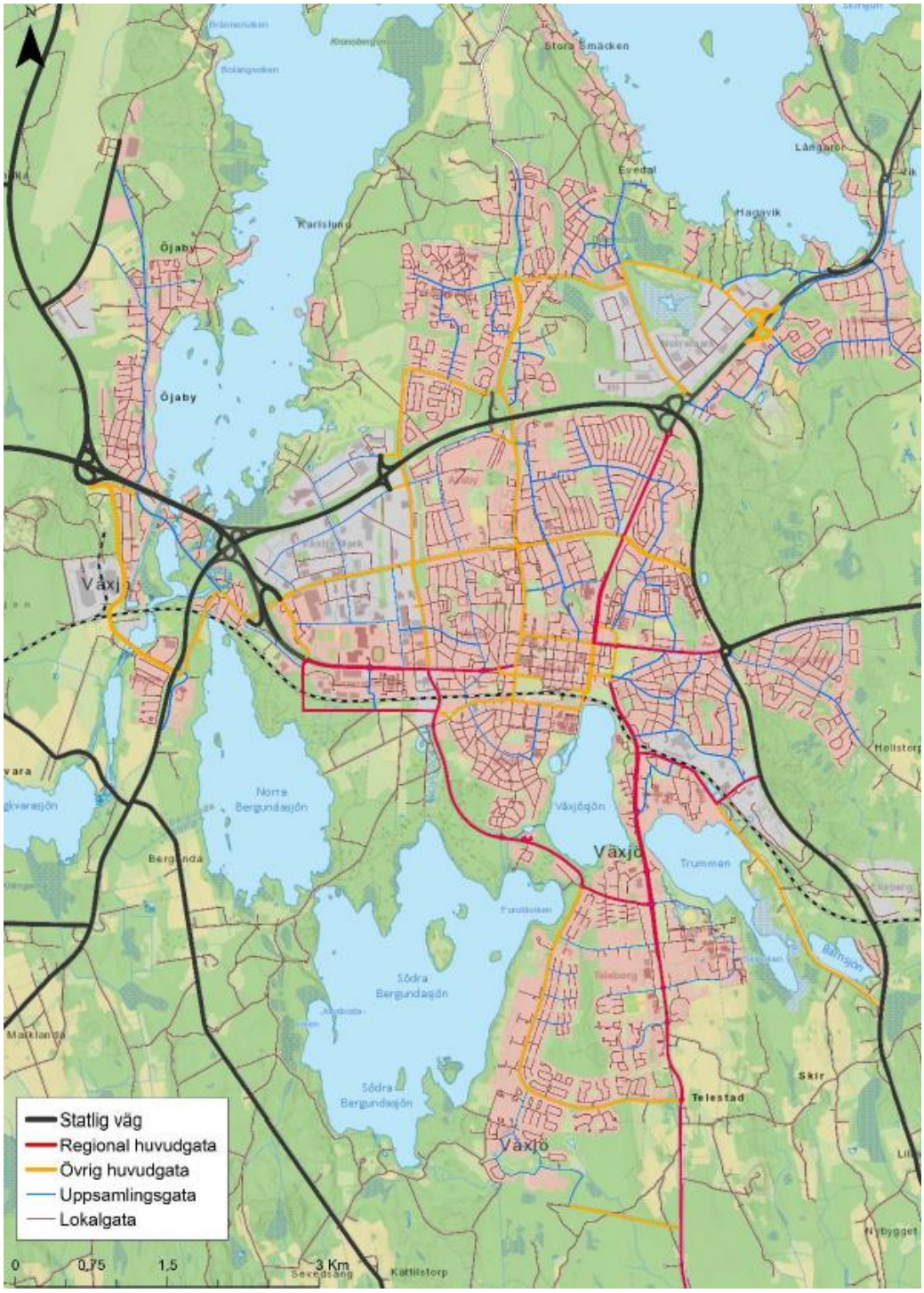


FIGURE 3 – VÄXJÖ'S ROAD NETWORK

Cycling network

The cycling network in Växjö city consist of a total of 12 priority cycling routes that lead from the city's outlying neighbourhoods (including Räppe, Öjaby, Hovshaga, Araby, Sandsbro, Högstorp and Teleborg) to central Växjö. These priority routes are complemented with cycling paths and cycling lanes along larger roads as well as separated cycling paths (for example in parks and forest areas in Hovshaga and Teleborg). In other areas of the city and in the city centre cycling is combined with car traffic. Figure 4 shows existing (blue) and planned (red) cycling routes. These routes consist of different categories including priority, main, and other routes. Each category is decided based on traffic volumes and characterised by different quality standards including path width, painted separation (direction and with pedestrians), signage indicating directions and destinations as well as winter maintenance and snow removal. Outside of the city, cyclists ride on normal roads with the exception of cycling paths like Smalspåret, an abandoned railway line that now forms part of the Sydostleden recreation cycling route.

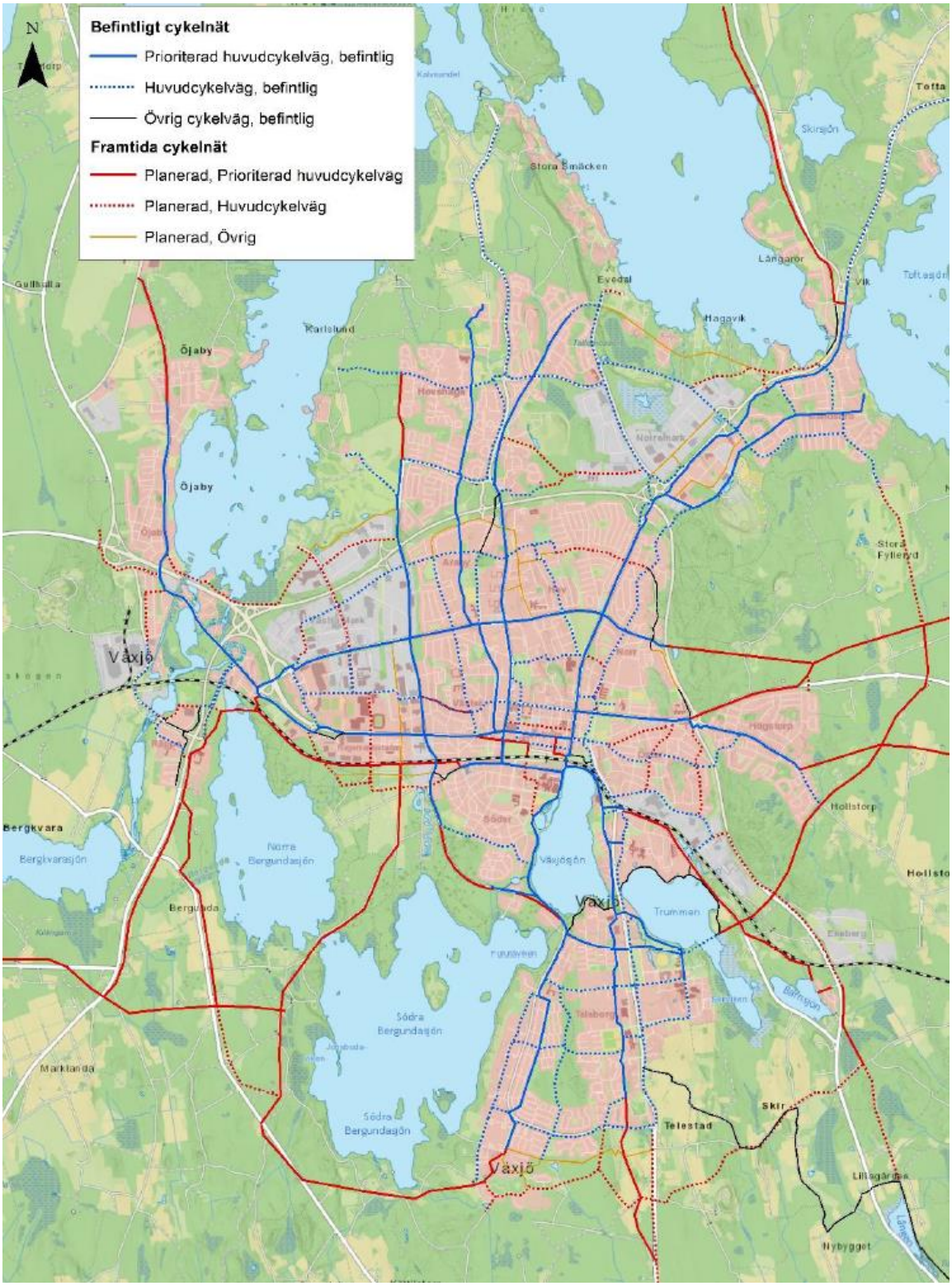


FIGURE 4 – CYCLING ROUTES, BLUE: EXISTING, RED: PLANNED

Public transit network

Länstrafiken Kronoberg is the primary public transit operator in Växjö municipality and operates city bus lines and regional bus lines serving travel within and to/from municipality. Växjö's city bus network, shown in Figure 5 consists of nine lines of which lines 2 and 6 are ring lines that connect Norr and Araby. Line 8 connects shopping center Grand Samarkand west of the city center with Sandsbro, northeast of center. Otherwise, bus lines are of radial nature with the city centre and central station as important exchange points. City bus lines are combined with regional bus lines in Figure 6 in the entire municipality. Bus frequency serving villages outside the city is good with typical 20-30 minute between buses during peak times and one hour frequency during non-peak times. In more rural areas, frequency can be around one hour or even 2-4 times per day for some lines.

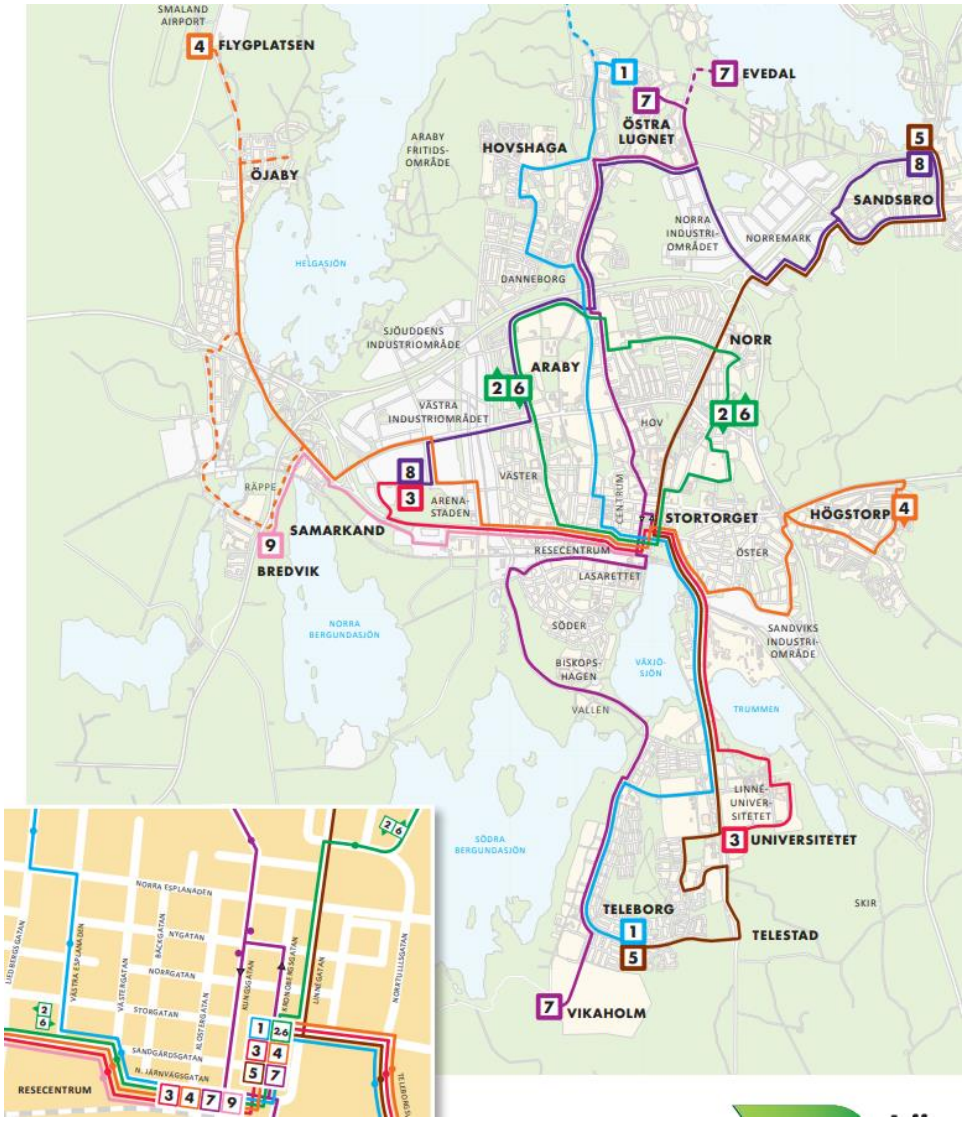


FIGURE 5 – CITY BUS LINES

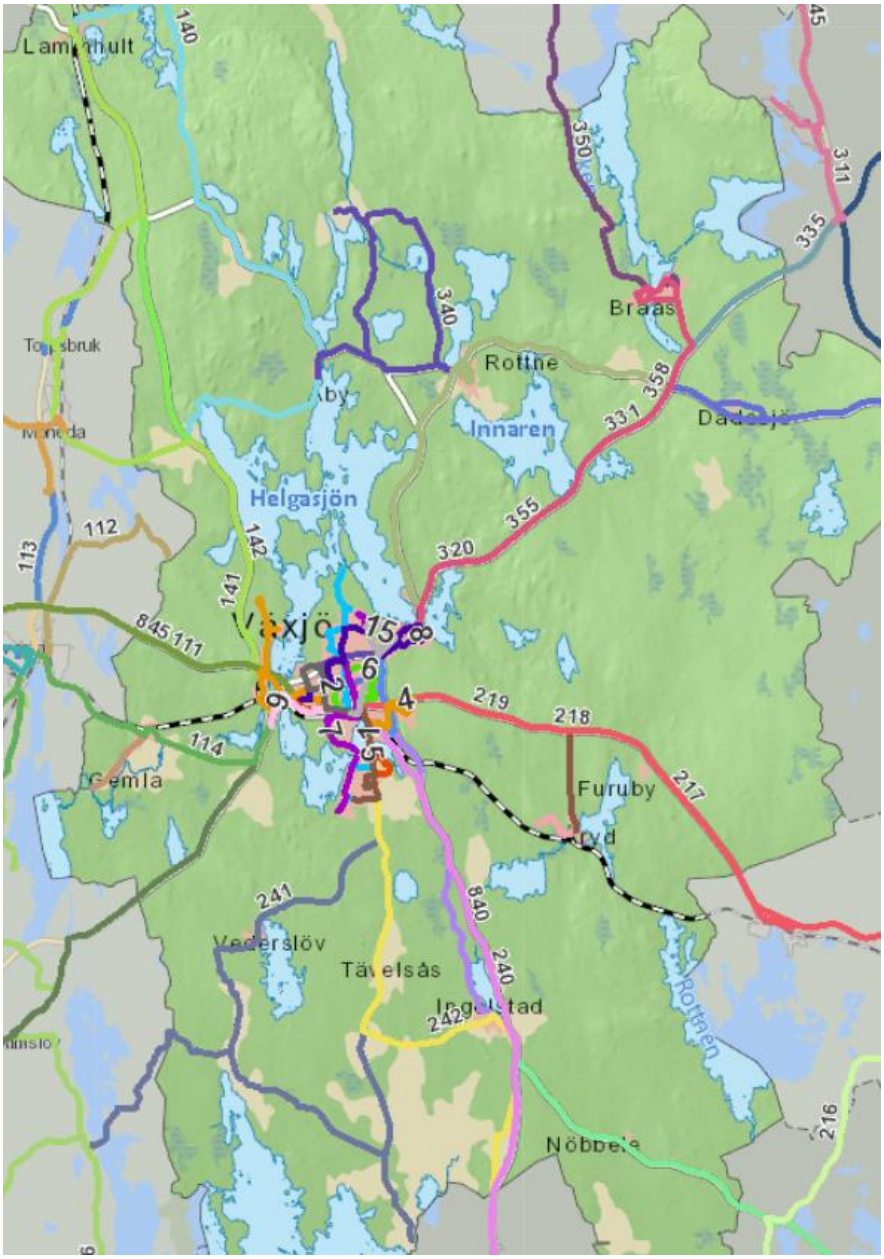


FIGURE 6 - CITY AND REGIONAL BUS LINES

Detail planning

Development including building of housing and industry in Växjö municipality occurs primarily in Växjö city. The map below shows on-going areas of development for housing and industry.

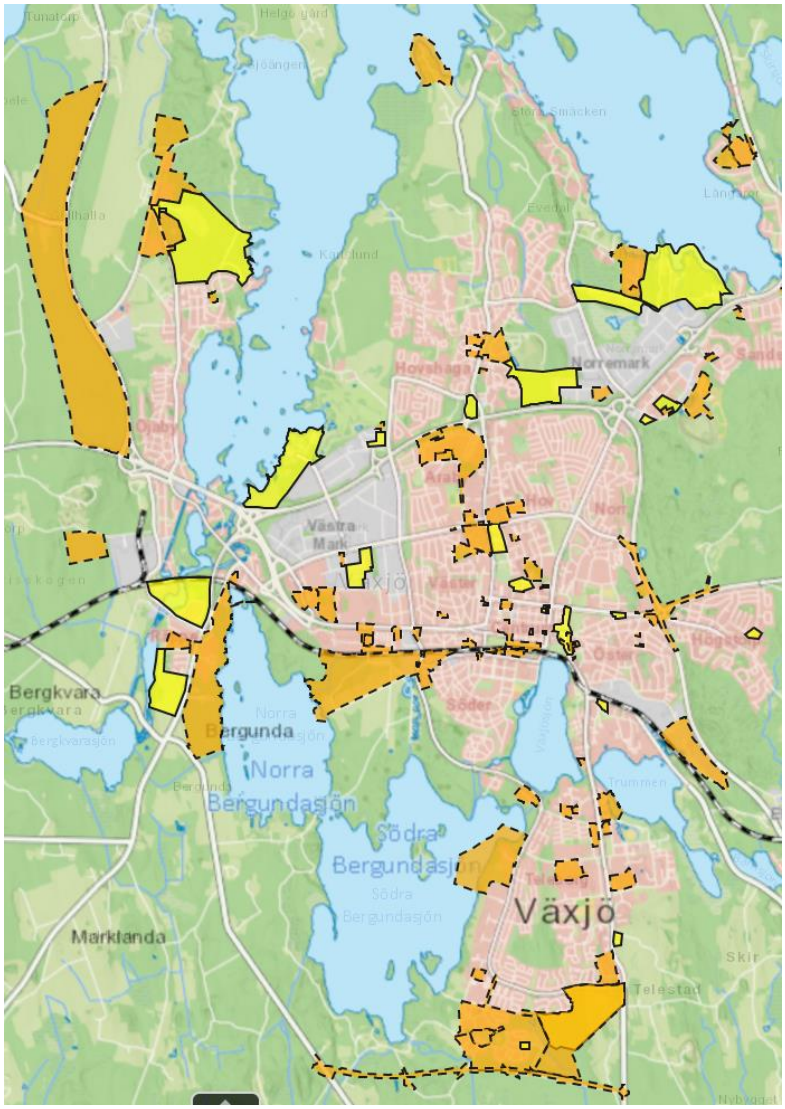


FIGURE 7 -NEW HOUSING AND INDUSTRY PROJECTS

Observations and outcomes related to commuting and traffic of these developments include:

- Increased density of several housing projects in the central portion of the city can provide good access to service and provide the pre-conditions for active transport like walking and cycling.
- Development of housing areas on the outskirts of the city involve longer commuting distances, often beyond what's common cycling distance (> 5 km).

- A large industry area by the airport, Nylanda, is currently being built, this will provide several workplaces that lie just beyond the city limits.
- Building of new city hall / train station will move about 600 workplaces to an even more central location compared to the current city hall and better connect these workplaces to public transit.
- Plans for a new hospital will move workplaces and an important regional destination from its current central location to one on the city border in the western-most neighbourhood of Räppe.
- Proposed new train station by the hospital would help increase access to the hospital and the city by sustainable transportation.

Development master plan

According to Växjö municipality's suggestion of its development master plan, the long-term development of the municipality is of a polycentric structure with sustainability in focus. The polycentric structure provides good accessibility to services, meeting places and other functions while supporting good access to and by sustainable transport, even in areas outside the city. Areas of highest density are planned along five functional routes in Växjö city, along Storgatan, Liedbergsgatan, Sandsbrovägen, Fagrabäcksvägen and Teleborgsvägen, and in four villages Lammhult, Rottne, Braås and Ingelstad. These are shown in the map in Figure 8. Effective and sustainable transport between these villages and the city centre should help to connect residents in rural areas with services available in these centres.

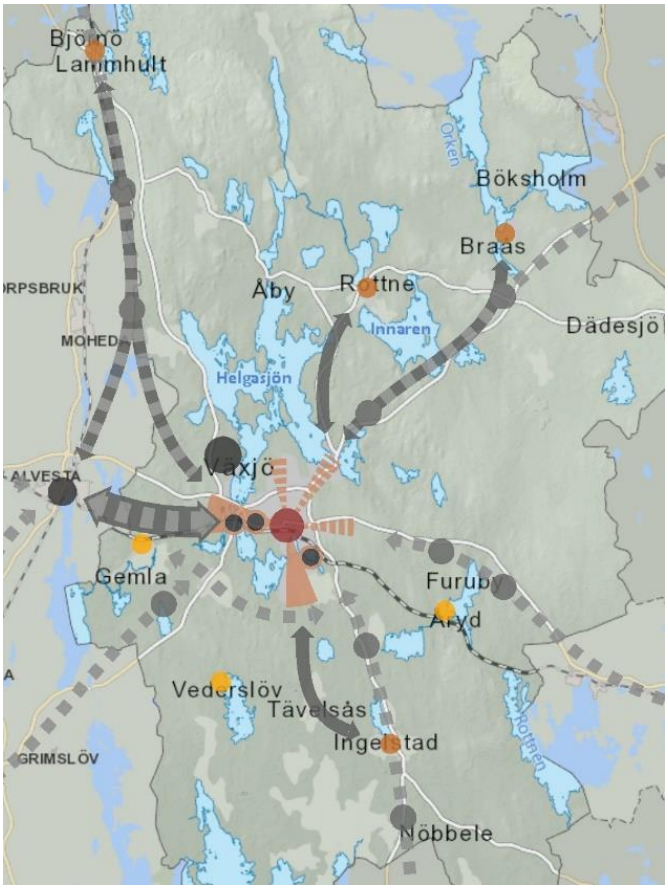


FIGURE 8 – VÄXJÖ'S FIVE FUNCTIONAL ROUTES (RED LINES) AND FOUR VILLAGES (LAMMHULT, ROTTNE, BRAÅS, INGELSTAD) WHERE DEVELOPMENT WILL BE FOCUSED

Transport surveys and studies

The latest travel habit survey for Växjö municipality was conducted in 2012[3]. According to the survey, commuting in Växjö municipality accounts for approximately 25% of total errand trips, with shopping and recreation taking up the bulk of the remaining with 24% and 29%. These figures are the proportion of errand trips (59%) do not include the trip home, which accounts for 41%. This indicates that 9% are combined errands where for

[3] Resvaneundersökning i Växjö kommun (2013)

example a trip to work could include a stop at preschool or shopping. The proportion of trip purpose is shown in Figure 9.

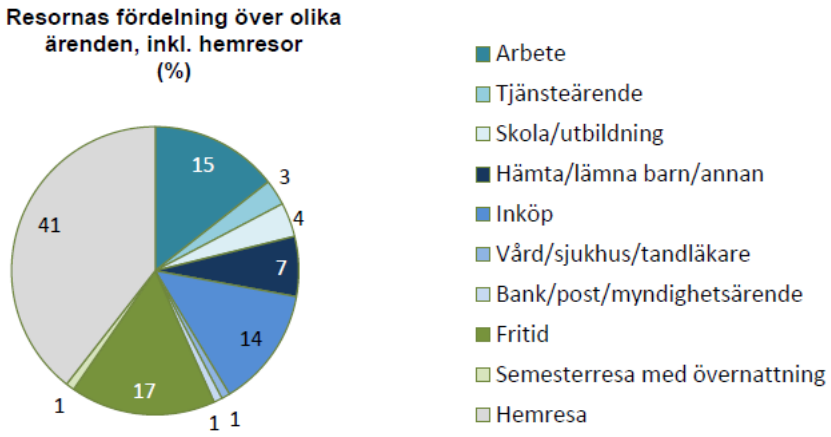


FIGURE 9 – PROPORTION OF COMMUTING COMPARED TO OTHER TRAVEL PURPOSE. WORK: 15%, SHOPPING: 14%, RECREATION: 17%; PICKUP/DROPOFF CHILDREN: 7%, RETURN TRIP: 41%. SOURCE: TRAVEL HABIT SURVEY VÄXJÖ MUNICIPALITY, 2012

Modal share for commuting is divided with 23% by bicycle, 8% on foot, 6% by bus or train and 62% by car, shown in Figure 10. Travel mode choice depends on the length of the journey, with most journeys 1 km and below by bicycle. However, the car dominates when the journeys rise above 1 km and use increases together with the travel length until it exceeds 50 km, when the train becomes a more reasonable mode due to its higher speed. Public transport's share of commuting trips varies between 3–10% depending on the length of the trip, where the share increases for longer trips.

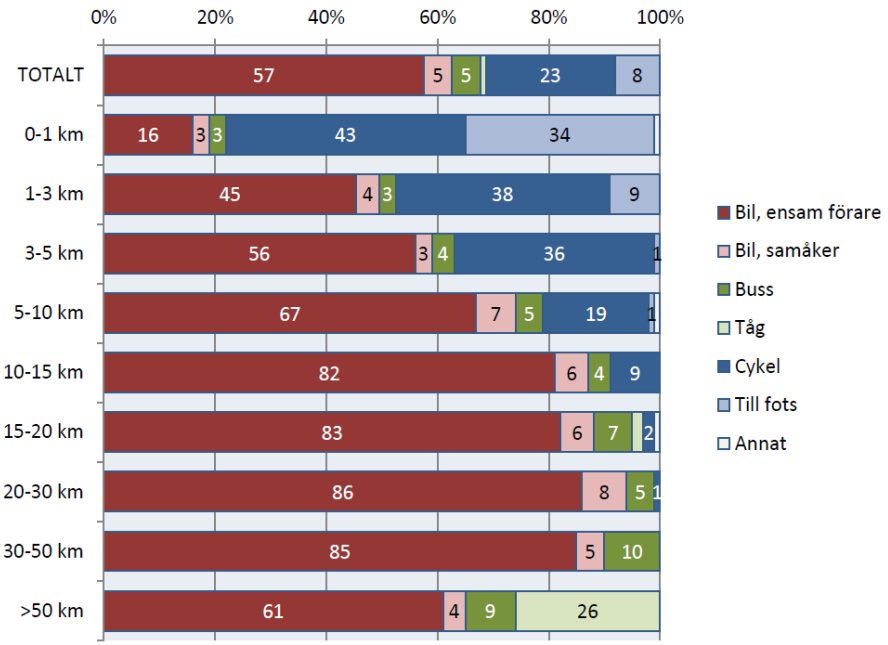


FIGURE 10 – MODAL SHARE BASED ON TRIP LENGTH (CAR, DRIVER; CAR, PASSANGER; BUS, TRAIN, BICYCLE, WALKING, OTHER). TRAVEL HABIT SURVEY, 2012

Approximately 70% of all trips (commuting, shopping, recreation) in Växjö occur within the municipality while approximately 30% are between Växjö municipality and other municipalities, as shown in Figure 11. More than half of trips, 54%, occur within Växjö city while relatively few, 5%, are between the city and neighbouring villages in the municipality and 4% between the city and countryside. A comparison of trip count within the city and between the city and the five larger villages as well as the countryside is included in Figure 12.

While there has not been a travel habit survey conducted since 2012, traffic counts for car and bicycle indicate that modal share has not significantly change since then. This despite improvements to cycling infrastructure that prioritise cyclists and their safety and that fill the gaps in the infrastructure to create continuous, traffic-separated routes.

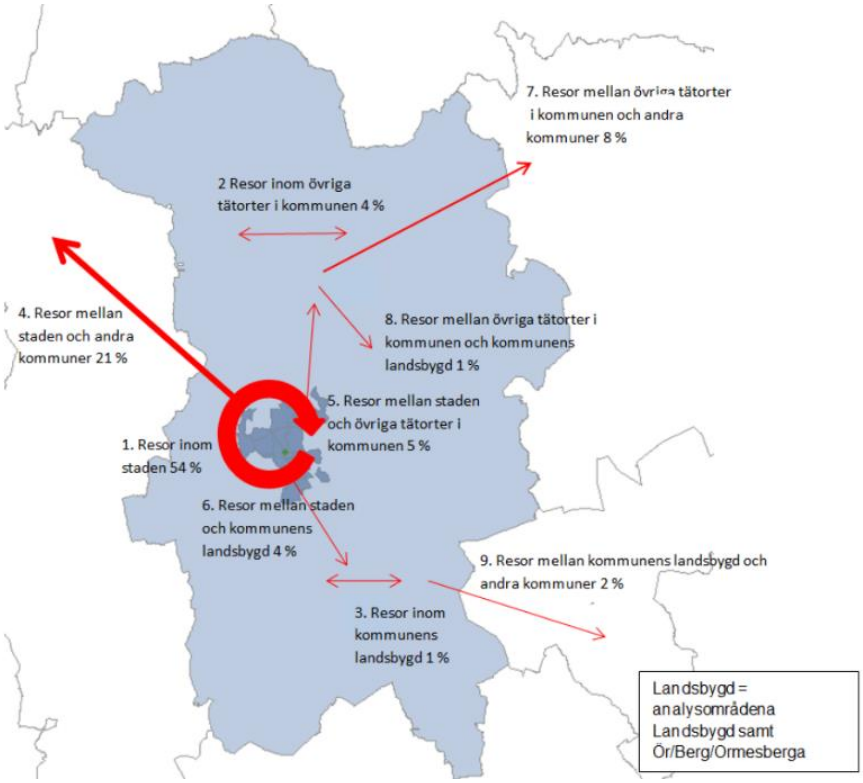


FIGURE 11 – PROPORTION OF TRIPS WITHIN THE MUNICIPALITY AND TO/FROM OTHER MUNICIPALITIES (54% WITHIN VÄXJÖ CITY, 21% BETWEEN VÄXJÖ AND OTHER MUNICIPALITES, 5% BETWEEN THE CITY AND OTHER VILLAGES, 4% BETWEEN THE CITY AND COUNTRYSIDE, 4% BETWEEN VILLAGES). TRAVEL HABIT SURVEY, 2012

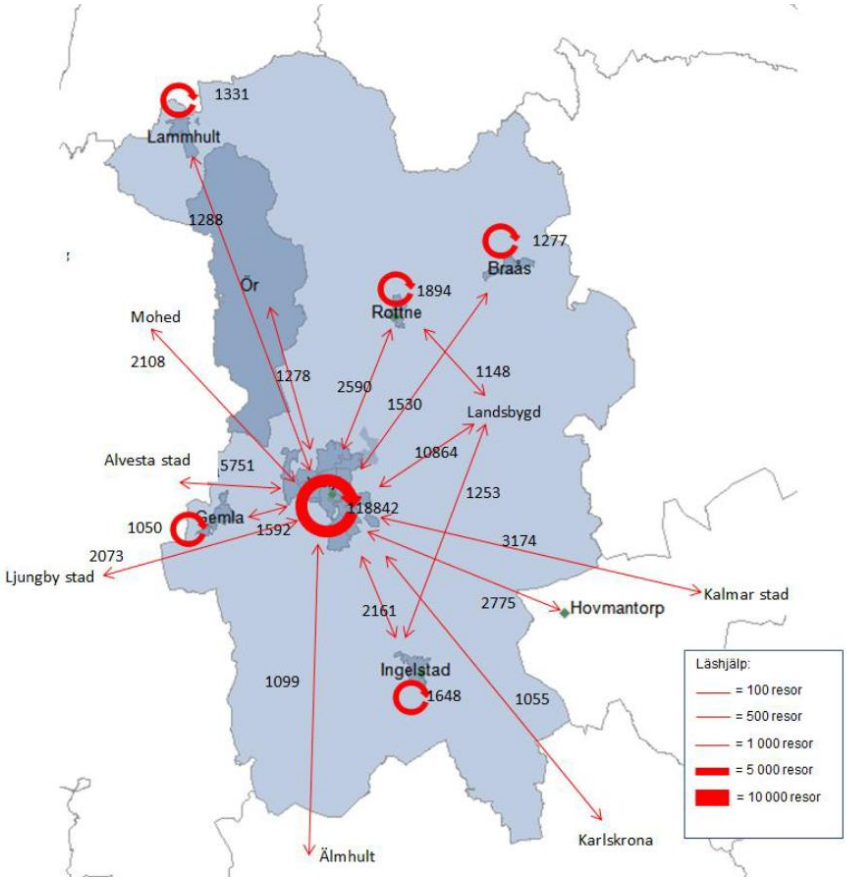


FIGURE 12 – TRIPS WITHIN THE MUNICIPALITY AND BETWEEN NEIGHBOURING CITIES

In 2018, Växjö updated its transport model according to the latest population forecasts and development within the municipality. Forecasts were created for 2040, based on existing detailed plans and expected population growth. A forecast was also created that scaled up the population growth from 2040 to that expected for 2050. Planned upgrades to national highways were included in the forecast models for 2040 and 2050 however only current cycling and public transit infrastructure was included in the analysis.[4] Results from the model show that despite these updates, car traffic will increase such that central roads to reach and exceed capacity. These are shown in yellow and red in Figure 13 below. Modal share according to the model should be largely unchanged, likely

[4] Measures to promote sustainable transportation will be tested in the model as part of a later project.

due to lack of measures that promote cycling and public transit in the model. The model shows that approximately 36 % of trips (all purposes) are under 5 km and 8 % under 2 km, indicating a high potential for cycling in the city.

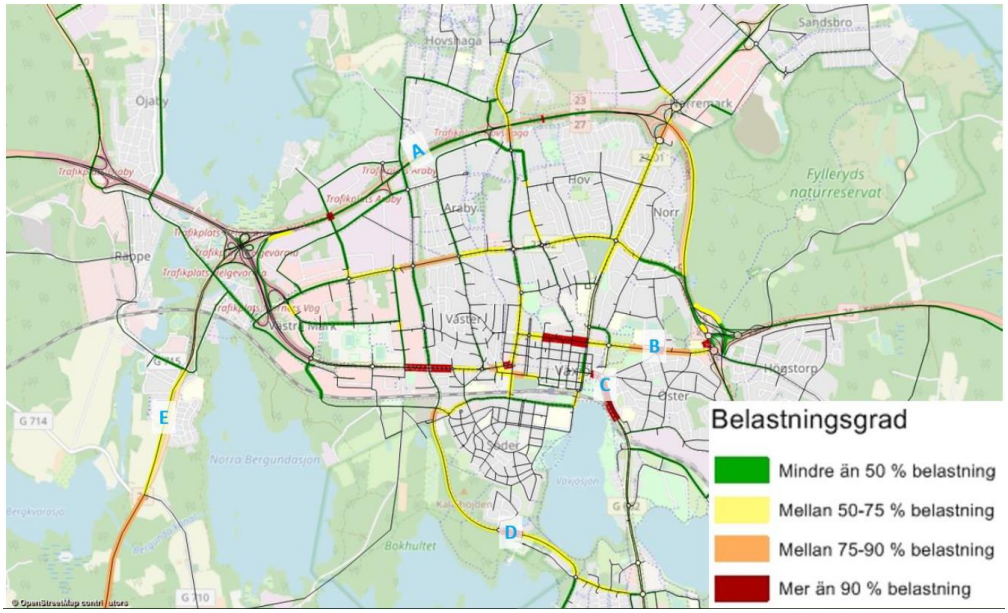


FIGURE 13 - RESULTS FROM 2050 FORECAST MODEL, RED SHOWS MORE THAN 90% TRAFFIC FLOW CAPACITY REACHED

To further investigate the potential for commuting by bicycle and public transit in Växjö municipality a study[5] was conducted that used origin-destination data from the government agency Statistics Sweden (SCB). The data shows the relation between workplace and home address of Växjö's residents that both work and live in the municipality. The study showed that more than 50% of commuters in Växjö municipality could bike to work in 15 minutes, and 65% with an electric bike, as shown in Figure 14. As many as 82% of residents that work and live in the municipality could commute within 30 minutes with an electric bike. The high potential lies within the city where most trips occur and where there is a network of separated cycling infrastructure. In more rural

[5] Potentialstudie hållbart resande https://vaxjo.maps.arcgis.com/apps/MapSeries/index.html?appid=188010451de648af875e7518d198f2d7

areas, there often lacks good cycling infrastructure, important especially on roads with high speeds where cyclists are required to ride together with car traffic.

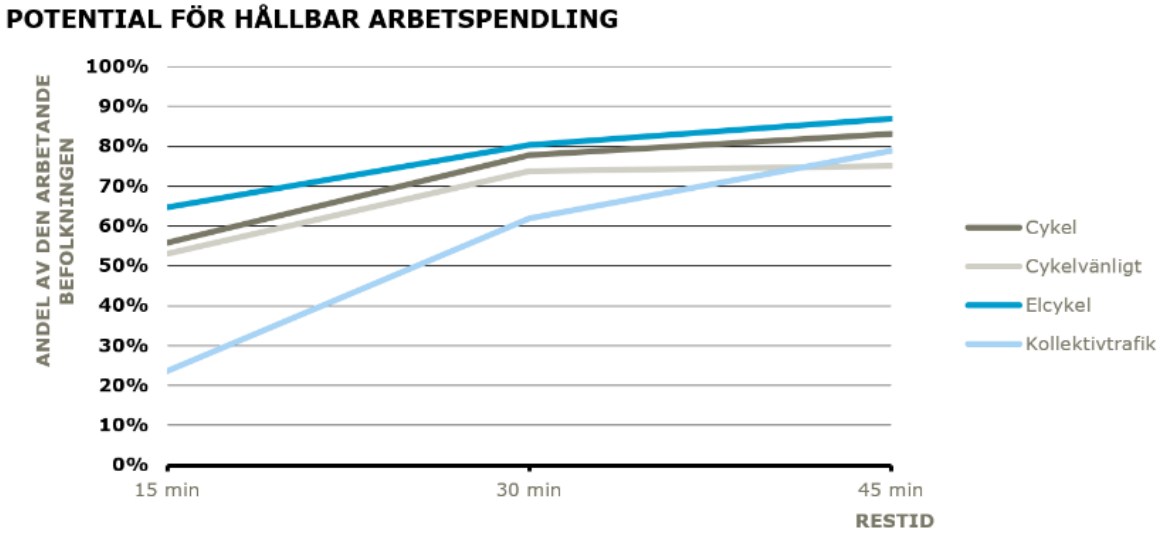


FIGURE 14 - RESULTS OF COMMUTING STUDY, POTENTIAL FOR CYCLING AND PUBLIC TRANSIT

The study shows that commuting with public transport (city and regional bus) struggles to compete with car travel, where travel times can be three times as long or longer. This includes time to walk between the bus stop and start and destination.

Police reported traffic accidents from 2014 to 2019 have increased from 21 to 41 however these dropped to nearly 30 in 2020, likely because of the pandemic. Hospital reported cycling accidents increased from 2019 following an upward trend since 2018. Most cycling accidents involve only the cyclist, often due to slippery road surface including snow, ice, wet leaves or loose gravel. In addition, several police reported accidents have been located at intersections and crossings with other traffic, with Mörnersväg a hotspot road for traffic accidents between cars and cyclists. Here there is high traffic volumes and along and crossing Mörnersväg as well as on many traffic circles cyclists are required to ride together with car traffic.

Stakeholders and participation

Participation of stakeholders was an important part of the strategic planning process in Växjö for both the transport plan and the CMP. This section summarises this work and identifies those involved.

A working group consisting of representatives from several different municipal departments was formed in order to include wider-ranging perspectives and include aspects within city planning, municipal management, culture and recreation, and environment and health. This group met several times during the writing process to develop common planning strategies and agree on a common vision for sustainable transport in Växjö.

An external reference group was also formed with representatives from the Swedish Transport Administration, Länstrafiken Kronoberg, Region Kronoberg and Energikontor Sydost to provide input on transport issues related to national roadways, public transit, regional cycling routes and regional development.

Several dialog activities were organised in 2018 in connection to writing the municipality's new development master plan and its sustainability program for 2030[6]. These activities included town hall meetings and online surveys, together involving 1 400 Växjö's residents. Two main conclusions connected to development of Växjö's transport system: that safety and security are high priority for residents and transport issues are important in the municipality's development. Traffic safety and security were therefore the primary themes in the participatory methods that followed. These methods were primarily digital and survey-based to account for restrictions due to Covid-19 and results are summarised as follows.

[6] Hållbara Växjö 2030 (2019), https://www.vaxjo.se/download/18.58d9f57a16d9ce07d02dd012/1571219603597/H%C3%A5llbarhetsprogrammet%20H%C3%A5llbara%20V%C3%A4xj%C3%B6%202030_antaget%20av%20KF.pdf

Surveys on traffic safety

In 2020, a resident survey[7] on traffic safety was conducted to better understand how residents experience the transport system today with a focus on road design and safety for active road users. Participants were provided three different scenarios for road design at four typical locations in the urban environment: city centre, housing area, school and shopping area, examples of which are shown in Figure 15. The survey was published via social media and open to residents to answer of which 500 people participated. Road designs that favoured walking, cycling and that offered a more human scale approach were preferred by 85% of the participants. A conclusion from the study was that respondents feel that the car dominates the municipality's roads and that changes to the existing road design are needed to promote traffic safety. In addition, when traffic is combined, the difference in speed causes a safety risk. This can even be the case of electric bikes on walking streets.

FIGURE 15 – SCENARIO IMAGES FROM DIFFERENT URBAN AREAS IN VÄXJÖ, TOP: CITY CENTRE, BOTTOM: HOUSING AREA

[7] https://vaxjo.se/sidor/trafik-och-stadsplanering/trafikutveckling/transportplan-2025/medborgarundersokning.html

A survey of school children's experiences with traffic safety was conducted in February 2021. The survey asked students in fourth grade how they travelled to school, which route they take and what their experiences were related to safety. The survey included an interactive map where students could identify the route they take to school and identify locations (crossings, tunnels, roads etc) that they felt contributed to unsafe conditions. A total of 361 answers were received from seven schools. Modal share was mainly dependant on the school, some schools were located in central areas and housing areas in Växjö city where walking and cycling were popular. Other schools located in smaller villages and on city limits have larger student populations from more rural areas and there the use of car and school bus or taxi are more common. Modal share according to students from all schools is shown in Figure 16 and shows that the majority of students either walk or take the car to school.

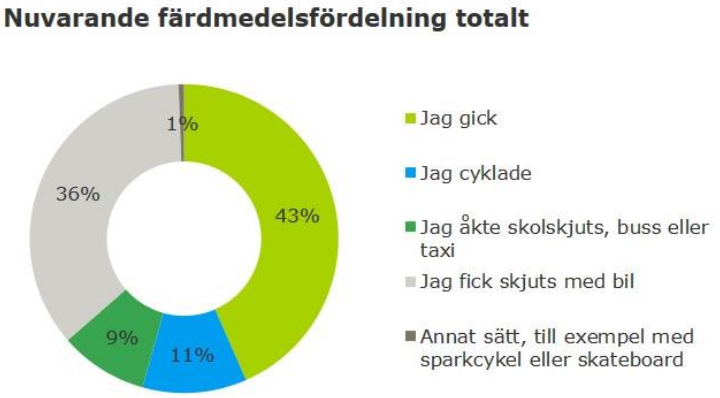


FIGURE 16 – MODAL SHARE OF STUDENT SURVEY (WALK: 43%, CYCLE: 11%, CAR: 36%, SCHOOL BUS OR TAXI: 9%)

When asked how the children's preferred choice of travel mode to school was, 40% chose to bike and 24% chose to walk. Reasons for biking included it being quick and fun. Reasons for walking included being around nature and feeling more energetic when being outside.

More than half the children (55%) answered that they felt safe on their route to school with 34% answering sometimes and 7% no. These proportions are shown in Figure 17. The answers were varied across the different schools making it difficult to compare and find corelations to safety and modal share, with there being too many unknown factors.

FIGURE 17 – SAFE ROUTES TO SCHOOL, ANSWERS FROM STUDENTS WHEN ASKED DO YOU EXPERIENCE YOUR ROUTE TO SCHOOL AS SAFE AND SECURE? 55% YES, 34% SOMETIMES, 4% NO, 7% DON'T KNOW. (SCHOOL SURVEY, 2021)

Locations of unsafe places on the children's school routes were scattered throughout the city, but obvious concentrations were on local roads in housing areas with low traffic volumes, as shown in Figure 18. In addition, several crossings on busier roads were identified as unsafe according to the participating students. In many cases, car traffic and speed were the contributing factors to a low sense of safety. When offering suggestions for improvements to their route to school, the words *marked crossings*, *traffic lights and speed bumps* were words most used according to analysis of written submissions.

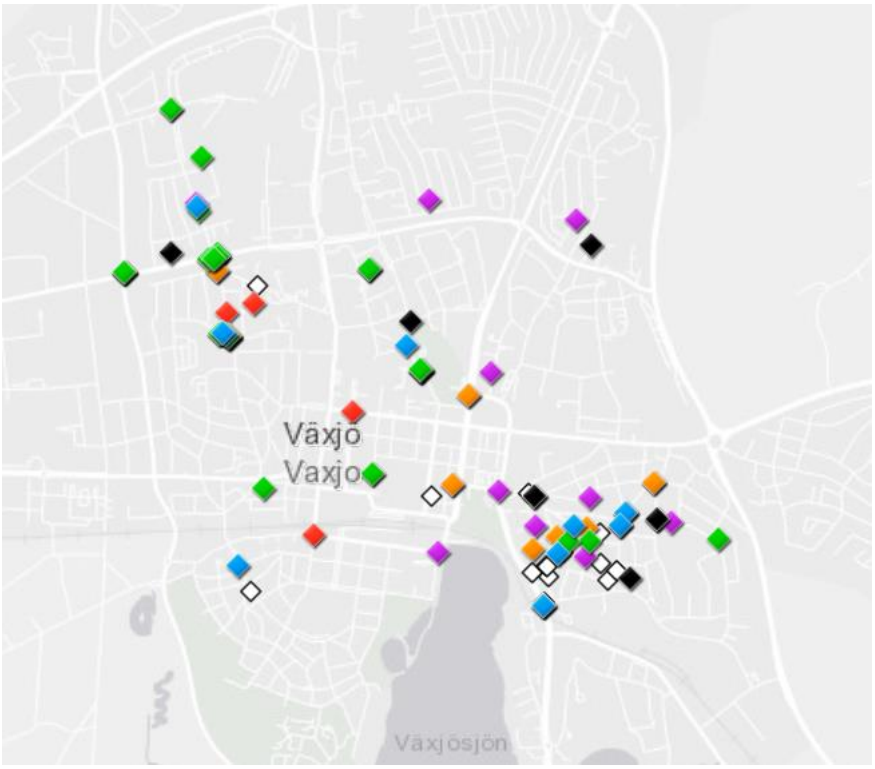


FIGURE 18 – EXAMPLE LOCATIONS THAT CONTRBUTED TO LOW SENSE OF SAFETY IN TRAFFIC ACCORDING TO SCHOOL SURVEY.

Every year the cycling organisation Cykelfrämjandet[8] conducts a survey on how cyclists experience cycling in their municipality in Sweden. In 2020 Växjö placed 18 out of 83 municipalities that answered the survey. Noteworthy results from survey from 400 cyclists in Växjö include:

- 59% consider Växjö a good cycling municipality
- 40% believe cycling is sufficiently prioritised in infrastructure planning
- 25% believe that it is safe for children to cycle in Växjö
- Only 9% believe that cyclists and car drivers are not in conflict with each other

[8] https://cykelframjandet.se/cyklistvelometern/

SWOT analysis and discussion of results

Below is a summary of the results from workshops including an internal traffic expert group and external expert group. Aspects that affect sustainable transport and those that influence intermodality are highlighted in yellow.

Strengths	Weakness	Opportunity	Threat
Many of the city's plans and projects include developing and prioritising sustainable transportation.	Relatively low internal budget for sustainable mobility.	New technologies could make sharing schemes more feasible in smaller cities.	Low and sparse population contribute to minimal traffic delays and low public transit access make the car often a preferred choice.
The city contains a well-developed cycling route network.	Planning of different transport modes is segregated and there is lacking cohesion between different forms of planning and infrastructure development.	Geographically beneficial: short distances and small elevations changes favour cycling in the municipality.	Travel habits are difficult to break and it usually requires a significant change in lifestyle or travel start/destination to disrupt these habits.
Construction of bus lanes along main roads leading into the city.	Insufficient budget and priority for secured bike	New technologies could make it easier to combine transport modes.	Small cities are not attractive to mobility providers (car and bike pool).

	parking (ex. at central station).		
Upgraded bike parking at the station and several bus stops.	Intermodality is not well-represented in planning documents.	Building of new areas creates the possibilities for commuting and commuter parking at the city's boundaries.	Complexity in working with intermodality when several actors are involved.
Bus lines are integrated in new housing developments at an early stage.	Difficulties in steering land use (lack of public land and suitable zoning) needed build mobility hubs and commuter parking in key areas.	Current trends of urbanisation and densification improve accessibility and efficiency of public transit.	Nordic climate makes active transportation less attractive and more complicated.
Test of commuter parking at entry-points to the city.			

A significant challenge for the municipality and Länstrafiken Kronoberg is providing efficient and accessible public transit solutions for commuters that live in rural parts of the municipality, that today consist of over 90% who depend on the car. Technology could play a roll here as well as solutions for vehicle and ride sharing that have not otherwise been developed in small to medium sized cities the way they have in larger cities. In its coming transport plan, the city should include measures for encouraging

mobility sharing services and making the city more attractive for Mobility As A Service (MAAS) providers.

Intermodality is not well-represented in municipal and regional (including public transit) planning documents. Challenges arise when several actors are involved and uncertainty around responsibility and leadership. Responsibility for maintaining bus stops for example lies on the organisation that owns the adjacent road, however a cohesive and cross-border strategy for promoting intermodal travel does not exist and the initiative required will likely rest with the municipality.

As the city is growing, opportunities arise with development of new housing and industrial areas to better plan new mobility solutions and improved accessibility. Early installation of bus lines in new housing areas and commuter parking at entry-points are good examples of how the municipality works proactively to promote sustainable transportation. Additionally, some new development areas could provide multi-functional hubs that combine mobility exchanges with other amenities such as shopping.

Traffic congestion in the municipality, including the city centre, is not sufficient to reduce the car's attractiveness today, but in the near-future, with increased population and movement of goods, the car's attractiveness can be expected to decline due to higher congestion and demand for parking. Växjö city is an ideal cycling city with 90% of the city lying within 5km of the center (Stortorget), and low elevation changes. The bicycle is therefore the logical replacement for many short car trips within the city as well as a convenient last mile solution in connection with bus and train travel to the city. Trivector's report[9] on how Växjö could become a cycling city is a good reference for the new transport plan, including identifying and prioritising measures that would help the city double its cycling modal share.

[9] Växjö som cykelstad (Trivector, 2018)

Strategic goals

The commuting master plan and strategies within it are steered by four goals:

1. Växjö should be a fossil fuel free municipality by 2030

- According to Växjö's sustainability program.

2. Access to sustainable transportation should be increased for all users, with different levels of physical capability.

- This includes safe walking and cycling infrastructure to and from transfer points and transit stops of high quality (efficient and convenient, informative, and easy to use).

3. The portion of travel using sustainable modes (cycling, walking and public transport) should be increased compared to travel by private car.

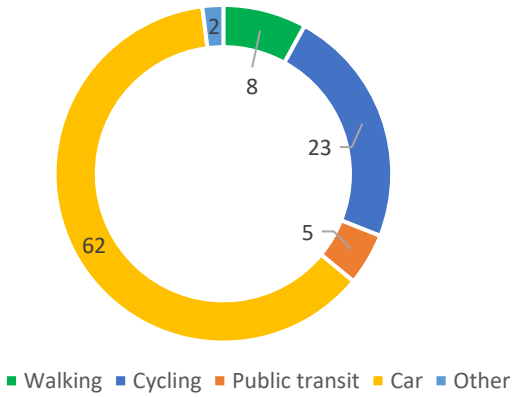
- Scenarios with different modal shares are considered in the following section.

4. Växjö should meet national Vision Zero goal of no serious injuries nor death in traffic and increase the sense of safety for all traffic users, especially pedestrians and cyclists.

Development scenarios for commuting

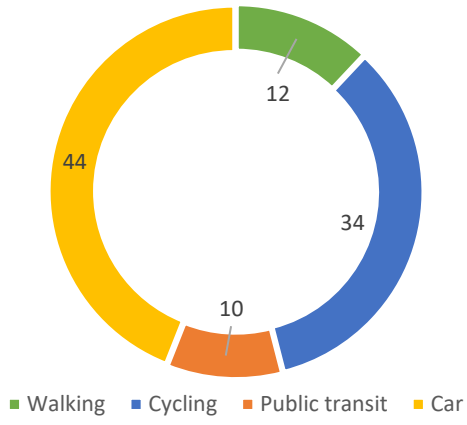
Development scenarios for commuting in 2040 are based on the current status of Växjö's transport system with focus on promoting sustainable transport with varying degrees of modal share for sustainable transportation and the private car.

Scenario 1: Business as usual: this scenario follows the current trends: measures make walking, cycling and public transport more attractive, but accessibility for cars is still a high priority. Measures with negative impact on car travel, including reallocating parking space, are largely avoided. However, bicycle priority crossings and bus lanes along functional routes continue to be built with help of external funding.



Travel by public transit reduced in 2020 and 2021 due to Covid-19 and struggles to recover, however a new fleet of electric buses help to bring modal share back up to 2019 levels. The car continues to be the dominant mode of transportation even in Växjö city where there is otherwise high potential for increased cycling. Residents experience the safety of city and neighbourhood centres, housing areas, schools and shopping areas to be largely influenced by car traffic according to follow-up surveys on traffic safety. Commuting modal share is therefore unchanged since 2012.

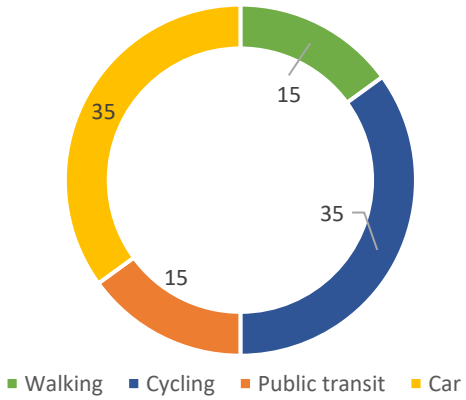
Scenario 2: Växjö as a cycling city: this scenario involves a significant increase of cycling in the city where most journeys take place in the municipality and where there is high potential for transferring commuting trips to bicycle and on foot from the car. For those who work and live in the city of Växjö, the bicycle is the obvious choice, important amenities are reached within 15 minutes thanks to densification around city and neighbourood centres. A circulation plan for the city of Växjö prioritises traffic safety and sustainable travel, making short journeys with the car less attractive. The plan involves redistribution of street space from the car to



active road users, public transport and use as public space for leisure and social activities. Many roads in the city and neighbourhood centres are converted to bicycle priority roads (cykelgator) or walking streets (gångfartsområde).

According to this scenario, bicycle modal share has reached 34% with a large proportion of commuting trips in the city of Växjö. Public transport has recovered following easing of Covid-19 restrictions to similar modal share prior to the pandemic. Sharing services including car and bike pools decrease dependence on owning two or even one car in households. Mobilty hubs containing options for micromobilty help to extend public transit journeys. Development in the city and municipality is along the functional routes and within the five larger villages.

Scenario 3: Active and public transport in Växjö municipality: this scenario is a development of scenario 2 but with increased focus and priority for sustainable transport in both the city and neighbouring villages and countryside.



Parking guidelines and development planning prioritises sustainable transportation including sharing services that replace the need for the private car in new and existing development areas. The 15-minute city concept is applied to inner zones of a more advanced circulation plan that covers a greater area of the city and provides close proximity to daily services and mobility needs.

Bicycle highways link travel between Växjö city and neighbouring villages and countryside. Bus travel is prioritised within the city through the use of bus streets and with help of the circulation plan, making travel time by bus more comparable to that of the car. Public transport is developed outside the city to provide better access for longer commuting trips and coordinating services such as package and grocery pickup near bus stops as a way to combine trip chains. New technologies within IT and vehicle

types help to combine and better integrate public transit in more rural areas outside the city.

Priority areas and focus areas

To achieve Växjö's goals for sustainable transportation, seven priority areas are defined that contain more specific focus areas. These focus areas are broken down into specific measures that are described in the section, Action plan.

The order of the priority areas reflects how the different transport modes should be prioritised in Växjö's transport system. Active transport modes like walking and cycling are prioritised higher in development and in street design compared to other modes like car and bus.

Sustainable urban planning

Current status: As discussed in previous sections, building higher density housing in the city has been a priority for the municipality and has contributed to providing easy access to services like shopping and public transit. In new housing areas such as Vikaholm, an existing city bus line was extended to this area early in its development meaning new residents had access to bus travel as soon as they moved in.

Outside the city centre however the larger shopping areas such as Norremark, Grand Samarkand and I11 are primary areas for shopping, services, and workplaces. Several neighbourhoods lack simple amenities and depend on these large shopping areas; this in turn creates a challenge for a walkable city where residents could access such services within walking distance or even a short bike ride, for example within five minutes.

Going forward: The development of urban and rural communities together with the sustainable transport system should support the necessary preconditions that reduce dependence on the private car. These conditions include increased safety and security, close proximity to services and public transit transfer points and access to shared

mobility such as car and bike pools. According to Växjö's development master plan, in order to promote sustainable transportation, development should primarily take place along Växjö city's functional routes and the municipality's neighbourhood and village centers[10] Along these functional routes there is good accessibility and high level of safety for pedestrians and cyclists and public transportation users. The transport system should also provide good access to important regional destinations such as the hospital and airport.

Växjö should be restrictive to measures that increase car traffic's advantage (travel speed) and access relative to walking, cycling and public transport within the city and village centers. Following results from the survey on traffic safety, it is apparent that changes need to be made to the road network and road design that reduce the dominance of the car and the conflict between different road users, especially when there is a high speed differential among users on shared road space. This is reflected in infrastructure changes, as the third focus area below, as well as communication efforts that are described in the mobility management priority area.

Focus areas:

- Place homes, businesses and services so that they are easy to reach by foot, bicycle and public transport.
- Improve accessibility and safety for sustainable travel, primarily along the city's functional routes and to relevant municipal and regional destination points by reviewing priority at intersections for example.
- Work actively with more car-free areas in the municipality: in the city center, in municipal centers, new residential areas and at schools, thus providing a more attractive urban area for the municipality's inhabitants.

Mobility management

Current status: Activities within mobility management have included promoting travel-free meetings, especially influenced by Covid-19, competition among local workplace to promote bike friendly environments and projects that provide the possibility to test

[10] Such as city neighbourhood centers and village centers

different bicycle models for commuting. The bicycle library pilot was tested during 2019/2020 and revealed a high demand among Växjö residents for testing different bikes, primarily cargo and electric assist. Folding, gravel bikes, electric scooters, and bike trailers for transport of children were also available and helped residents find new ways to travel and commute with the bicycle. Similarly, preschools have tested cargo bikes for transporting children to activities and new destinations that lie beyond walking distance. Some preschools have since purchased their own cargo bike.

In 2018, the project Cykelvänlig arbetsplats (cycling-friendly workplaces) completed its third season and attracted over 40 participating companies that compete to win prizes and recognition by completing a checklist of bicycle promoting measures.

Typically, information campaigns have been connected to new or updated infrastructure, for example priority crossings for cyclists and widened cycling-walking paths with line separation.

Going forward: Mobility management activities are important for informing on the benefits and possibilities for sustainable commuting and help to complement improvements to infrastructure. In addition, increased level of participation beyond the planning and development process is crucial for realising more sustainable communities.

The municipality should also work continuously with issues related to traffic safety and traffic behaviour to reach Vision Zero and to follow the Convention on the Rights of the Child by including children's perspective in traffic and street spaces.

Mobility management measures can help to avoid the need for travel, such as remote meetings with help of new technology, where the municipality and staff can function as good examples of how to reduce carbon footprint related to commuting and travel related to work and continue the habits formed during the Covid-19 pandemic, such as working from home on a more regular basis.

Good alternatives are necessary to facilitate a shift from the private car to sustainable modes. Instead of relying on car ownership, cars and cargo bikes can be available

through sharing schemes and vehicle pools. These sharing schemes are lacking in Växjö however and require some form of stimulus or support to establish them in a medium sized municipality like Växjö.

Work should continue to promote safe travel, especially when different road users share road space. This is important for reducing the effects that the car has on safety and security but also on walking streets where electric bikes and fast commuters create uneasy situation for older pedestrians and families with young children.

Focus areas:

- Work actively with large employers, associations, major destinations as well as new residential, commercial and industrial areas to get more people to use active and sustainable transport.
- Offer various test and try-before-buy activities for sustainable travel, such as the bicycle library.
- Work to establish more companies in Växjö that offer mobility services in sustainable travel, including car and bicycle pools.
- Influence modal choice and create a safer behaviour in traffic through information, campaigns, offers and increased stakeholder dialogue.
- Stimulate municipality staff to arrange travel-free meetings and use sustainable travel for work and when commuting.

Walking and road space

Current status: focus has been placed on improving the quality of infrastructure according to feedback from residents and an inventory of problems along the network of sidewalks and separated walking paths. In 2020, a pedestrian plan[11] was published by the traffic department with strategies and measures for promoting increased walking and accessibility for people of different functional and physical capabilities. Several of these measures are included in the action plan in the following section.

[11] https://vaxjo.se/download/18.2d09db751766fd137de27b2/1608207928301/Fotg%C3%A4ngarplan.pdf

As discussed in previous sections, surveys on traffic safety reveal that road space is largely dominated by the car and changes to road design is necessary to promote increased walking, especially in the more central urban areas including shopping areas where pedestrian infrastructure can be lacking.

Going forward: Walking is a priority means of transport and therefore the modal share of walking trips should increase compared to travel with the private car. Walking often takes place in combination with other means of transport, even in the simplest forms of intermodal travel from home to bus stop or from car and bike parking to shopping centre. These short but important trips should be accounted for in planning to ensure safe and convenient access to public transport and workplaces in general.

Re-allocating road space from cars to people should help to increase Växjö's attractiveness and at the same time increase safety and accessibility for active road users. In an attractive and well-functioning city and village centre, service and destination points should be within walking distance, such as creating the 15-minute city.

Special focus should be placed on increasing accessibility for people with different physical conditions such as children, the elderly and people with disabilities. The operation and maintenance of the sidewalks should continue to be improved to avoid risk of falling an injury.

Focus areas:

- Improve sidewalks to offer smoother, more attractive, safer, and accessible connections with a focus on the city's functional routes, the municipality's centres, and other local and regional destinations within the municipality.
- Improve the maintenance of sidewalks to reduce accidents all year round according to measures in the pedestrian plan and feedback from residents.
- Remove obstacles so that people with different physical conditions can more easily reach their destination.
- Create vibrant urban centres by testing measures where car traffic is limited and road space is used, for example, as a meeting place, activity area, mobility hub, green area, playground and similar during summer months.

Cycling and small vehicles

Current status: in Växjö city there are seven bicycle counters that function year-round since 2013, shown in Figure 19. Counts during 2020 were similar to 2019, causing a plateau of the upward trend from 2017. In total, 1 423 000 cyclists passed over the counters in 2020, this regardless of effects of the pandemic. It can be concluded that where commuting trips by bike may have decreased, trips for recreation and other purposes increased.

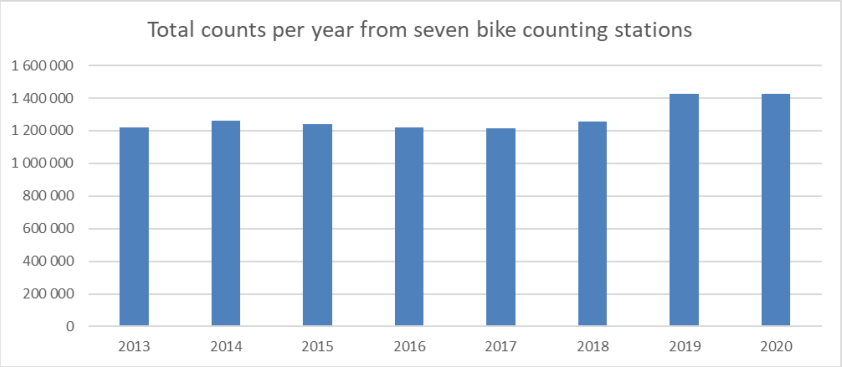


FIGURE 19 - TOTAL COUNTS PER YEAR FROM SEVEN BIKE COUNTING STATIONS

Investments in cycling infrastructure have included cycling passages (cykelöverfart) that prioritise cyclists over cars at specific crossings. These were installed at four locations in 2019-2020[12] including along Mörnersväg to improve safety for cyclists navigating traffic circles with a design that better resembles good practices in the Netherlands.

Electric bikes have continued to be popular with sales increasing since 2012 when data began to be gathered from local bike shops, shown in Figure 20. In 2018 sales increased significantly when a 25% rebate on electric bikes was offered by the federal government. This was ended however in 2019. Covid-19 has hindered bike sales in 2020 and 2021 due to parts shortages, despite high demand during the pandemic.

[12] With a total of 22 priority crossings in the city

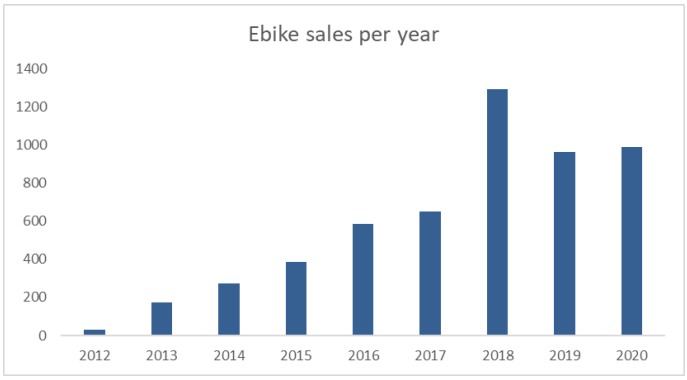


FIGURE 20 – ELECTRIC BIKE SALES PER YEAR, DATA FROM LOCAL BIKE SHOPS

In 2019 Växjö municipality updated its cycling route plan[13] that includes priority lists for cycling infrastructure such as bike paths within the city, in villages and connecting villages with the city. These investments are the basis of several cycling-related measures included the CMP's action plan.

Going forward: Bicycles are a priority means of transport and therefore the proportion of bicycle journeys should increase compared to travel with the private car. A compact urban area, good and traffic-safe cycling infrastructure and an increased cycling culture create conditions for Växjö as a cycling city. For travel within the city of Växjö and the municipality's villages, the bicycle should be the most common means of transport where travel distances favour cycling. For travel between city and village centres and the countryside, conditions for cycling need to be improved. Lacking separated infrastructure and high posted speed limits create unattractive and unsecure conditions for cyclists. This is a challenge, however, as the Swedish Transport Administration administers these roads where efficient travel by car is prioritised.

The electric bicycle and other small electric vehicles should also take shares from car traffic on longer journeys (up to about 30 km). Small vehicles can include electric scooters and mopeds. Mopeds of EU class I are not currently common in Växjö but

13 https://gis1.vaxjo.se/Oversiktsplan/Storymap/Utstallning/MarkochVattenanvandning/Cykelvagplan2019.pdf

could provide faster commuting between villages and the city with electric assist up to 45 km/h.

Focus areas:

- Make it faster and easier to cycle on the main cycle paths while reducing accident risks. The focus is also on reducing the number of stops / obstacles for cyclists according to Växjö's cycle path plan.
- Make it easier to park your bike comfortably and safely with a focus on relevant destination points in the municipality.
- Improve the operation and maintenance of the cycle paths, primarily main cycle paths, so that it is fast, easy, convenient and safe to cycle throughout Växjö municipality all year.
- Implement investments in new and existing cycle paths according to the cycle path plan.
- Work to improve conditions for cycling throughout the municipality, with a focus on safety and security for all types of bicycles and small electric vehicles.

Public transit

Current status: investments in bus lanes along functional routes, improvement of bus shelters and bike parking at high-use bus stops have been made to the attractiveness of public transport and intermodal travel.

The number of passengers on city buses increased during the period from 2009 to 2019 thanks in part to investments in new and additional buses and frequency increases for several city bus lines. Following Covid-19, however, travel by city bus dropped by 55% in 2020 as shown in Figure 21.

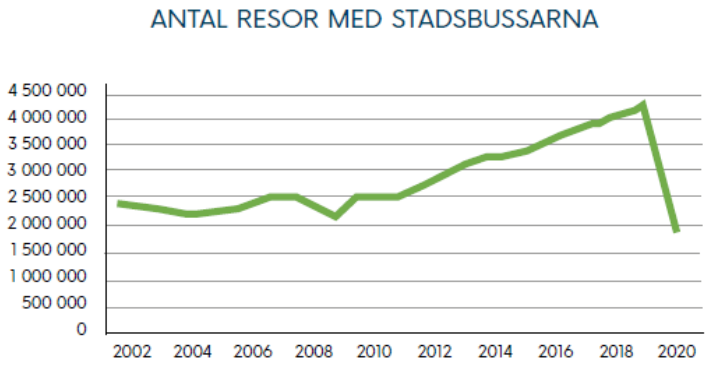


FIGURE 21 - TRIPS WITH CITY BUS

Going forward: Public transport is a priority means of transport and therefore the modal share of public transport travel should increase compared to travel by private car. The focus should be on two areas: prioritizing bus lines that offer fast and frequent mass transport along the city's functional routes, and offer good, high-quality public transport when cycling or walking are not suitable options.

Further work is needed to improve the quality of stops. Some selected stops should also be developed into mobility hubs and/or service points that coordinate the travel chain with shopping and package pickup for example. This provides benefits for public transport passengers, especially in sparsely populated areas of the municipality where this convenience could help balance longer travel times compared to the car. It should also be easy to change lines or modes of transport with mobility hubs to better connect the municipality's urban centres with regional destinations.

Focus areas:

- Improve the quality of relevant stops with bus (weather) shelters, seating, bicycle parking, accessibility adaptation, real-time information about waiting times and changes and more.
- Upgrade suitable stops and interchanges to mobility hubs in and outside the city to improve the possibilities for switching between different modes of transport (train-bus-bike-car and so on) and, if possible, coordinate these hubs with other services.
- Have good operation and maintenance of streets with bus traffic and walking and bicycle paths to the stops so that it is fast, easy, convenient and safe to be travel to the stops all year round.

Sustainable motor vehicles

Current status: According to car mileage statistics gathered from inspections of vehicles registered in Växjö, the total distance travelled per resident in Växjö has remained within 6 % between 2008 and 2018. A drop of 3,7 % in 2019 compared to 2018 was noted however and indicates a potential shift in driving habit, as shown in Figure 22.

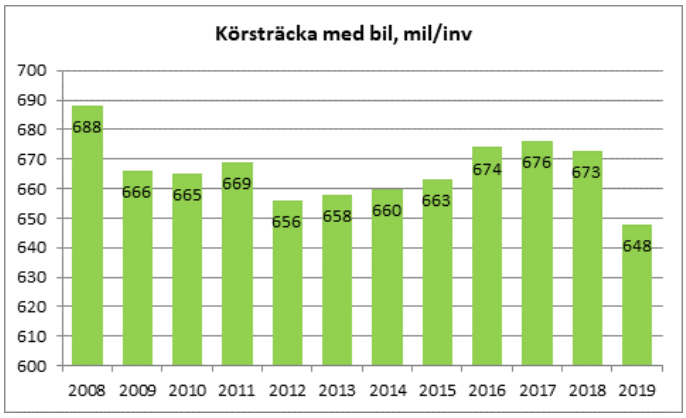


FIGURE 22 - DISTANCE TRAVELD BY CAR PER RESIDENT PER YEAR (1 MIL = 10 KM)

Car traffic is counted at 30 points throughout Växjö city for one week in spring and fall every year since 2000. 12 points are located at the city centre and 18 points at main entry roads to the city. The accumulation of all counts in the city centre in Figure 23 shows a modest linear increase of 86 trips per year from 2000, with a slight increases in 2007 and 2016 as well as a dip in 2018 that was partially recovered by 2020. The trend of counts at main entry roads (Figure 24) shows a more significant linear increase of 2660 trips per year during 2000 to 2020. A small drop in 2020 compared to 2019 is likely due to effects of Covid-19 and time will tell if this trend reverses again in following years or if new trends in working from home will decrease traffic over the long term.

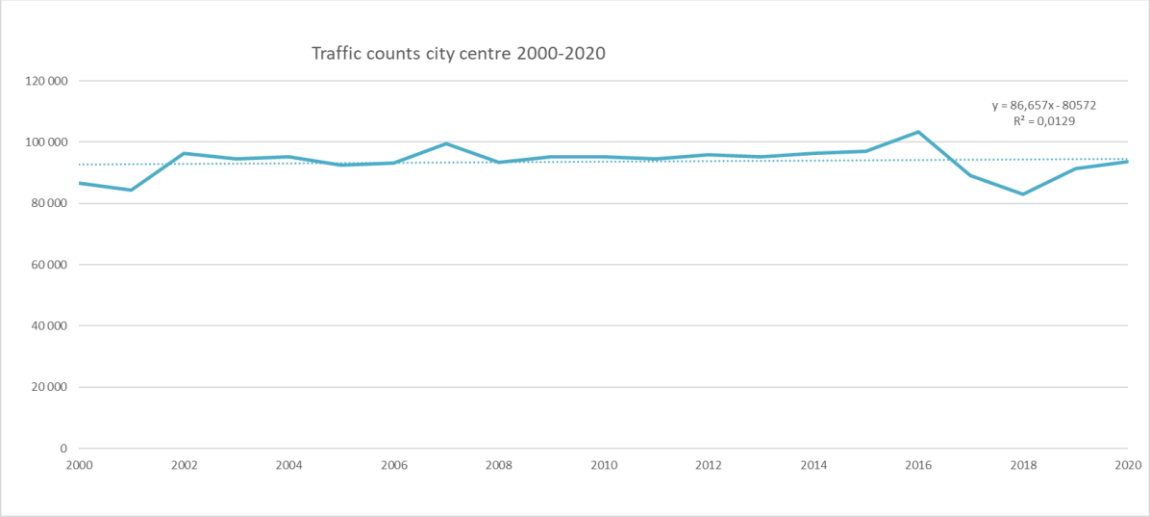


FIGURE 23 – TRAFFIC COUNTS FROM 12 POINTS IN THE CITY CENTRE, 2000 – 2020

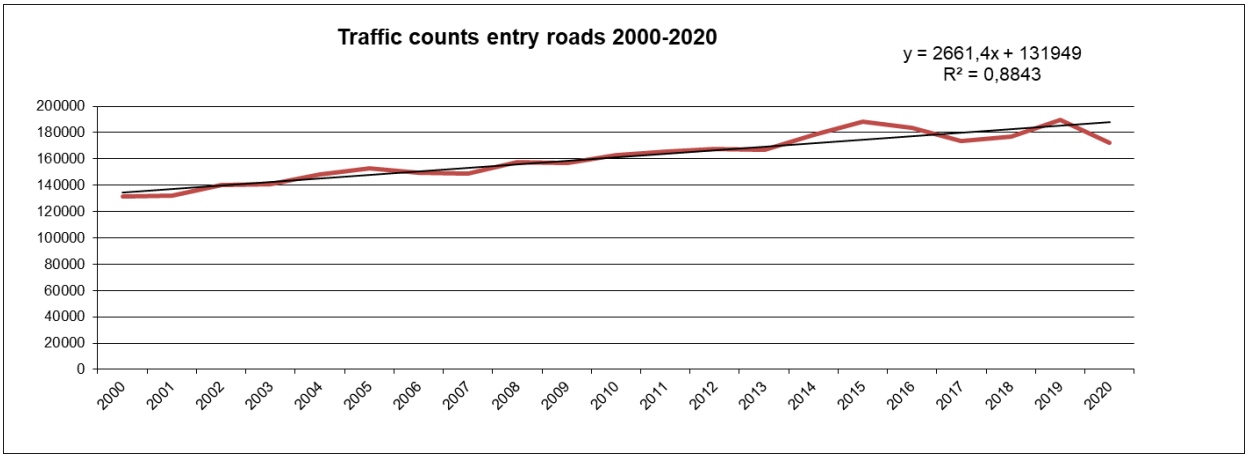


FIGURE 24 – TRAFFIC COUNTS AT 18 POINTS, ENTRY ROADS TO VÄXJÖ CITY

Electric car charging point at 24 locations, partly installed by Växjö municipality, the municipal company, Växjö Energy and by private landowners, for example outside, workplaces, stores and restaurants.

Car parking fees in Växjö city are divided by two zones with rates are between 18 kr (ca 1,8 euro) and 10 kr (ca 1,0 euro) per hour in the city centre.[14] These rates are comparable to other similarly sized cities in Sweden, landing between Halmstad and Lund.

Going forward: The private car is a means of transport that can provide freedom of travel and typically efficient travel times for the individual but also creates several problems for society[15] and therefore the proportion of car journeys should be reduced. This is especially important as negative effects and congestion increase as Växjö's population increases and the flow of road users increases.

Private car trips should be replaced by walking, cycling, public transport and sharing services such as car pools and ride sharing when possible. By transferring car trips to more sustainable alternatives, road space is freed for those that need to take the car as well as commercial traffic and emergency vehicles.

Road safety and security are prioritized to create good conditions for walking, cycling and public transport, as well as to comply with the Convention on the Rights of the Child and to achieve the national Vision Zero. This is done with a new approach to planning such as a circulation plan as implemented in cities like Gent. The circulation plan divides a central portion of a city into different zones; car traffic between the zones is limited and requires travel via a ring road. Pedestrians, cyclists and public transport modes have more free travel between the zones. This is a way to make short trips by care less attractive and to promote sustainable travel without high infrastructure costs.

The motor vehicle traffic that remains should be fossil-free when possible and use electricity, biofuels such as biogas. This is to achieve the municipality's goal of a fossil fuel-free Växjö 2030.

[14] Source: https://www.vaxjo.se/sidor/trafik-och-stadsplanering/kommunal-parkering.html
[15] Congestion, noise, high land-use, creates barriers and unsafe traffic environments, negative influence on public health, emissions (NO_x, CO_2), increased road maintenance costs, for example; *Naturvårdsverket, 2021*

Focus areas:

- Increase traffic safety and accessibility for sustainable travel through a calmer and controlled car traffic on suitable streets, with the help of, for example, speed reduction, prioritization at intersections, and a circulation plan.
- Improve the conditions for creating mobility hubs by making use of existing car parking spaces or commuter parking lots help facilitate the transition to sustainable transport.
- Develop fossil-free zones to gradually drive the process towards a fossil fuel-free Växjö 2030.
- Make it easier and convenient to use electric vehicles and other fossil-free vehicles, for example by increasing access to more electric charging stations and filling stations for biofuels.

Action plan

The following is a list of measures connected to the commuting master plan's priority areas. The measures are evaluated according to effect on modal share and reduction of carbon emissions based on a given implementation cost. The ratio of effect versus cost is included to better compare the measures and to identify those with largest effect per investment. Several assumptions are made under each measure and details of these can be found in the original document[16] produced by transport consultant Trivector.

Every year when the budget for the coming year is defined for Växjö municipality's technical services department, measures can be selected from the action plan for implementation, given available internal and external financing and approval from the technical services steering committee.

The majority of the measures lie within the responsibility of technical services and, in particular, the traffic department. There can be overlap of responsibility, however, in the implementation of the measures, for example sustainable community planning requires coordination with the planning department in Växjö and public transit measures requires cooperation with transit operators, especially Länstrafiken Kronoberg. In these cases, the technical services department plays a role as a cooperation organisation, rather than as financier.

[16] Åtgärdsbibliotek Växjö transportplan

Priority area	Measure	Description	Effect, modal share	Effect, CO2	Cost	Ratio, Effect MS:Cost
Sustainable commuting planning	Compact city	Växjö city is developed as a compact city, providing convenient access to amenities and sustainable mobility.	5	5	1	5
Sustainable commuting planning	Mobility hub / house	Build of mobility house and hubs that provide alternatives to the private car at new housing developments.	5	5	2	2,5
Sustainable commuting planning	Stop of measures that increase car capacity	No new capacity increasing measures such as new roads, new car lanes and through-roads with higher speed than 40 km/h or other infrastructure with the purpose of increasing car capacity.	5	5	1	5
Mobility management	General mobility management measures	Information and habit influencing measures, in part targeting car users.	4	4	2	2
Mobility management	Concept for sustainable commuting	A development of bicycle-friendly workplaces.	4	4	2	2
Walking and road space	Improving maintenance of walking infrastructure	Carry out maintenance of the walking infrastructure according to the pedestrian plan to increase traffic safety.	2	2	2	1
Walking and road space	Improve priority walking routes	Develop an action plan according to an inventory of sidewalks in the city center and priority routes according to the pedestrian plan and implement these measures. Improve lighting.	2	2	2	1
Walking and road space	Remove obstacles	Inventory barriers to walking with focus on accessibility, with	2	2	3	0,7

		the help of citizens and organizations (eg Funkibator, Security & Accessibility Council, SPF) and fix them.				
Walking and road space	Safe school routes	Inventory the traffic around the municipality's primary schools based on a traffic safety and security perspective and develop action plans. Implement developed action plans. (Hard measures.)	2	2	3	0,7
Cycling and small vehicles	Continuous cycling network	Improvements along the functional lanes and other important main cycle paths such as intersections (traffic circles, cycle crossings and improved crosswalks, etc.) to prioritize the cycling and increase safety for cyclists. The assessment is based on about 10 major and about 50 minor intersection measures. Ex improvement on traffic circles, bicycle crossings or improved crosswalks.	4	4	2	2
Cycling and small vehicles	New cycling routes	Build new bicycle infrastructure in the city according to the investment list in the cycle route plan to prioritize / increase bicycle traffic and increase traffic safety.	4	4	5	0,8
Cycling and small vehicles	Remove obstacles for cyclists	Removal of small obstacles, high curbs, holes, gates etc. in the entire main bicycle network and a large part of the local network. The assessment is based on the removal of 500 minor obstacles / new shortcuts	4	4	2	2

Cycling and small vehicles	Widen / separation of priority cycling paths	Improvements along the functional routes and other important main cycle paths with increased width and separation between pedestrian and cycle to increase traffic safety and security for different road users. The assessment based on 25 km must be addressed in terms of width and painted separation.	4	4	4	1
Cycling and small vehicles	Bicycle priority streets	Bicycle priority streets (cykelgator) are implemented in several places in Växjö municipality with a focus on central areas.	3	3	2	1,5
Cycling and small vehicles	Improved maintenance of cycling network	Improve operation and maintenance of the bicycle network and improve winter road maintenance with increased priority a few cycle paths. The assessment is based on a 25% increase in the budget.	2	2	2	1
Public transport	Intermodal journeys and transfer points	Create a traffic that means that buses and in some cases trains meet at fixed times at the junction to offer easy changes in all directions (even less prioritized relationships). Results from Skåne show travel increases in the order of 10%. Can be implemented in both regional traffic and city bus traffic.	5	5	3	1,7
Public transport	Transfer points	Investigate locations where there is a need for an upgrade to a mobility hub or communication node in the entire municipality and the possibilities for service	5	5	4	1,3

		points, according to the general plan and in consultation with Länstrafiken / Region Kronoberg.				
Public transport	Bus lanes / buss roads	Investigate, and start rebuilding, suitable streets that can be converted into bus streets or where bus lanes can be built to increase the accessibility and efficiency of public transport.	4	4	5	0,8
Public transport	Coordinated public transit	Coordinated public transport service in rural areas. Examine conditions together with the Region and Länstrafiken. Implement a pilot based on this concept.	3	2	2	1,5
Public transport	Updated bus stops	Develop a plan to improve the quality of relevant stops along the function routes and other priority bus lines in consultation with Länstrafiken. Can be with bus shelter, seating, bicycle parking, accessibility adaptation, real-time information about the waiting time and changes and more. Carry out a pilot in one of the functional routes.	3	1	3	1
Public transport	Updated cycling and walking infrastructure to bus stops	Develop a plan to improve accessibility and safety (on pedestrian and cycle paths and other roads) adjacent to stops.	2	2	2	1
Sustainable motor vehicles	Circulationplan	Circulation plan / zone structure which means limited traffic for motor vehicles / motorists between areas and which benefits the bicycle as the bicycle becomes a faster and easier	5	5	2	2,5

		means of transport than the car for short journeys between areas.				
Sustainable motor vehicles	Increased access to electric charging and fossil free fuels	Implement the charging infrastructure strategy for electric vehicles. Collaborate with the Swedish Transport Administration, property owners, the freight and logistics industry, haulage companies, and other stakeholders to develop the supply of fossil-free fuel.	1	3	1	1
Sustainable motor vehicles	Create fossil free zones (“Miljözon klass 3”)	Fossil-free zone according to the Swedish Transport Agency, Environmental Zone Class 3, where only electric vehicles, fuel cell vehicles and gas vehicles may drive.	1	3	2	0,5

Uptake

Växjö’s commuting master plan is anchored in the municipality’s new transport plan for 2025. The transport plan is expected to be approved by city council (Kommunfullmäktige) in October 2021.

The plan will be reviewed yearly, and measures budgeted for according prioritisation and evaluation in the action plan and yearly budget allocation.