Capgemini invent

THE SUSTAINABILITY IMPACT OF CAR SHARING

Value created for cities, property developers, companies and consumers

in association with

Volvo Car Mobility

KEY TAKEAWAYS

Mobility planning is an essential activity if today's cities want to be more sustainable

- In this report, we have studied the sustainability effects of Volvo Car Mobility's car sharing service M on four key stakeholder groups: the city, property developers, companies, and individual customers
- Although the core of the report and its findings are focused on Stockholm, where the company's service was first established, the perspectives and takeaways are most likely valid for similar metropolitan areas.

Each Volvo Car Mobility car removes up to 8 privately owned ones from the streets of Stockholm, which implies that there are up to 4,515 fewer cars in total

We surveyed active customers and asked them about changes in their car ownership as a result of Volvo Car Mobility membership.

of cars owned by active customers were sold as a direct effect of their membership

of the customers avoid buying another car as a direct effect of their membership

The reduced number of cars on the streets of Stockholm bring tangible and meaningful impact on the environment

During the last year, the service has contributed to up to:

a reduction of **8,200** tons of CO_2 from tailpipe emissions

3.2 M liter of reduction in fuel consumption

3.8 M liters in water savings due to fewer car washes

As many customers avoid to buy a car over the coming year:

up to **41,300** tons of CO_2 emissions can potentially be avoided from fewer cars being produced, i.e. reduced consumption

Additionally,

- Active customers of a car sharing service tend to drive less in comparison with private car owners.
- Volvo Car Mobility increases the share of new cars on the streets. New cars are more fuel-efficient and yield lower emissions than older cars.

More than 56,000 m² of the urban area can be freed up by removing up to 4,515 cars from the streets of Stockholm

56,400 m^2

area of land can be freed up due to a reduction in number of parking spots needed

the freed up area could be replaced with green infrastructure or housing to increase potential value

Green infrastructure

1,000 trees planted would save **1,350** tons of CO_2 from the atmosphere

or

Living spaces

Allowing an additional **10,300** citizens in Stockholm would contribute to the region's economic growth and international competitiveness

The Volvo Car Mobility service has positive impacts on costs for property developers, society, as well as companies, and consumers

430 M SEK

In reduced construction costs as fewer parking spots need to be built

Volvo Car Mobility will be a cheaper option than owning a car up to a travelled distance of **7,000 - 9,000** km/year for consumers and companies

Improved human safety due to increased number of safe cars in traffic

Additional value Volvo Car Mobility brings:

- More consumers and companies can access cars without having to invest a large amount of money.
- A customer of the service does not need to spend time on car maintenance, which frees up time for consumers and companies.
- Customers drive less, continue to use public transportation, and walk or cycle more, thus contributing to less traffic congestion.
- The service allows consumers and business partners to be part of a sustainability movement that enhances living conditions in the city.
- Lastly, Volvo Car Mobility increases the electrification of the vehicle fleet in a city, which is considered key to achieving climate neutrality in thtransportation sector.

INTRODUCTION TO STUDY

The UNFCCC (United Nations Framework Convention on Climate Change) recognizes the importance of building sustainable transportation to tackle the climate crisis.[1] In particular, the transportation sector plays a crucial role in achieving the goals of the Paris Agreement, given the fact that 25% of energy-related global greenhouse gas emissions come from transportation.[2] Shared mobility is essential in the shift to a low-carbon economy according to the EEA policy, "A European Strategy for Low-Emission Mobility". The EEA policy encourages cities to undertake a multi modal shift in the mobility sector that includes shared mobility and car sharing in the quest to reduce congestion and pollution in cities.[3]

As several research papers already have acknowledged, the potential sustainability impact from shared mobility is high. However, we felt that there is a case to further examine the car sharing facet of shared mobility in greater detail. Therefore, this study aims to shed light on the sustainability effects and value derived from car sharing services. Our report looks into two areas:

1. What are the sustainability effects of Volvo Car Mobility's car sharing service M?
2. What value does the car sharing service create towards cities, property developers, companies, and individual customers?

Capgemini Invent was commissioned by Volvo Car Mobility, a wholly-owned, standalone venture of Volvo Car Group, to conduct a study on its sustainability impact. With their extensive database, the company was able to provide the data needed for the intended analysis. Their car sharing service M has been live for one year in Stockholm and is so far only present in Sweden, thus, we decided to conduct a case study on the company's service within the geographical scope of Stockholm. As their service offers station-based car sharing, our report focuses on station-based car sharing, in comparison with private car ownership.

M's proprietary tech platform is central to Volvo Car Mobility's business model; Capturing customer behaviors and allocating cars based on AI data-driven decisions, they have set a new standard for the development of shared mobility.

To attain an in-depth understanding of the impacts and value generated by Volvo Car Mobility compared to private car ownership in Stockholm, we researched the topic using internal, external and secondary sources. We rely on quantifiable data and qualitative analysis to support our argumentation. In addition, we conducted one-on-one interviews with several industry experts and surveyed more than 1,500 of the company's active customer base (only B2C customers) by assessing:

- Their car ownership before and after joining Volvo Car Mobility's service M.
- Whether membership in the service influenced their decision to sell or avoid buying a car.

Whether their driving behavior, use of public transportation, and walking or cycling behavior, has changed since becoming a member of the service.

It is also important to note the limitations of this report. This report does not focus on the entire lifecycle of the cars, but rather the effects generated from Volvo Car Mobility's service from the point the car enters the fleet until it is rotated out and remarketed. Additionally, we do not measure the company's footprint related to internal operations, but only the effect directly connected to the operational running of the service.

Finally, in this research, when referring to sustainability, we use one of the most common models to define sustainability, which consists of three pillars: economic, ecological/environmental, and social.

CITY MOBILITY - A SUSTAINABILITY CHALLENGE

The transportation sector is the primary cause of air pollution in cities, and air pollution is, in turn, the principal environmental factor driving disease in the EU.[4,5] At the same time, the planet's population is growing, and urbanization is continuing. Projections indicate that by 2050, 84% of Europe's population will be living in cities, increasing traffic congestion and straining the infrastructure.[6,7]

This development is evident in Stockholm. The number of cars per person increased by almost 30% between 1974 and 2000, and has remained at a relatively constant level ever since.[8] As Stockholm is one of Europe's fastest-growing cities[9], the total number of cars in the city will likely increase, bringing additional emissions, pollution, and congestion.

Furthermore, cars require space in terms of both road infrastructure and parking spots. The recent report "Framtiden för parkering och nya bostäder" ("The future of parking and new housing") indicates that there may be more space in Sweden allocated for parking than for living (50 m² of parking space compared to 42 m² of living space).[10]

Ambitious global and local level goals aim to address sustainability challenges, including those connected to transportation.

Global goals

2015 was a landmark year for multilateralism and international policy. Several major agreements, such as the 2030 Agenda for Sustainable Development, had at their core 17 Sustainable Development Goals (SDGs) that provided a blueprint for peace and prosperity for both people and the planet.[11]

In addition to the SDGs, the European Commission has set goals to reach climate-neutrality. The "100 neutral cities by 2030" goals aim to support and promote 100 European cities in their transformation towards climate-neutrality by that date.

The objectives for the mission are to help the cities in the systematic transformation, offer cities financial means, and to collaborate with European businesses to contribute to innovation and improve their global competitiveness.[12]

The 17 Sustainable Development Goals are:

No poverty | Zero hunger | Good health and well-being | Quality education | Gender equality | Clean water and sanitation | Affordable and clean energy | Decent work and economic growth

Industry, innovation, and infrastructure | Reduced inequalities | Sustainable cities and communities | Responsible consumption and production | Climate action | Life below water | Life on land | Peace, justice, and strong institutions | Partnership for the goals

When investigating the effects that Volvo Car Mobility has, we identified a positive contribution to the following goals:

Goal 3: Good health and well-being

Better public health from fewer and safer cars in traffic

Goal 8: Decent work and economic growth

More time efficiency and less traffic congestion

Goal 11: Sustainable cities and communities

Better utilization of city area with greener infrastructure and more housing

Goal 12: Responsible consumption and production

More efficient use of resources

Goal 13: Climate action

Lower CO_2 emissions

Stockholm-specific goals

The city of Stockholm's vision for growth is made up of three target areas: 1) a versatile city for all, 2) sustainable growth, and 3) a smart and innovative city. The city's environmental program for 2020-2023 defined several goals related to climate impact, climate adaption, circular economy, biodiversity, and emissions. If met they will contribute to their overall vision.[13] The prioritized targets are:[14]

- A fossil-free and climate positive Stockholm by 2040: This involves limiting the environmental impact from consumption, and restricting the total greenhouse gas emissions to no more than 1.5 tons CO_2e (carbon dioxide equivalent) per inhabitant.
- A fossil-free organization by 2030: This includes two milestones - efficient energy consumption and restricting total greenhouse gas emissions to no more than 105,000 tons CO_2e from the city's operations.
- A climate-adapted Stockholm: Stockholm will need to strengthen its ability to limit the effects of heavy rain and heatwaves.
- A resource-efficient Stockholm: This includes smart consumption and resource use, increased recirculation of resources within the city, and increased resource efficiency in the building process.
- A Stockholm with biodiversity in well-functioning ecosystems: To achieve this, Stockholm will need to implement more ecological compensation, maintain functions and make connections for biodiversity across the blue and green infrastructure while improving water quality and increasing the proportion of food and goods that foster biodiversity.
- A Stockholm with fresh air and regulated noise levels: The city will need to reduce noise pollution as well as citizens' exposure to nitric oxide and particles.
- A Stockholm free from poisons: The city can achieve this by decreasing the levels of harmful substances in goods and chemical products.

In addition to the above targets, the Swedish government has decided on various transportation-related goals. The overall objective is to provide an efficient and sustainable provision of transportation for citizens and businesses across the country for all socio-economic groups. First, the functional goal implies that the design, use, and operational function of the transportation system should provide good availability and quality, as well as contribute to the overall development of the country. The second classification of goals is related to the security of the transportation system. It should ensure that no one is killed or seriously injured in traffic.[15]

Cars in a smart and sustainable city

Cars are unlikely to disappear from our cities anytime soon. However, they need to be used in a more purposeful way enabling citizens to move towards a multi-modal lifestyle, using the car as a complement to – rather than a substitute for – public transportation, biking and walking. Cities can enable such multi-modal transportation behavior through smart city initiatives.

These initiatives include shared mobility solutions, such as car sharing. A more efficient transportation allows for the reduction of privately-owned vehicles.[17] Fewer cars would enable cities to not only address challenges related to emissions, pollution, and congestion but would also allow them to reclaim space that would otherwise be reserved for parking and roads. This space could be transformed into green infrastructure or be used for other purposes.

> *A smart sustainable city is an innovative city that uses information and communication technologies and other means to improve quality of life, efficiency of urban operation and services, and competitiveness while ensuring that it meets the needs of present and future generations with respect to economic, social, cultural, and environmental aspects."* [16]
>
> ***The UNECE–ITU Smart Sustainable Cities Indicators***

ACCESS ECONOMY

Access-based consumption - a way to deliver on the sustainability goals

By now, the sharing economy is a widely recognized concept. A related concept is "access-based consumption," similar to asset sharing, which is defined as "transactions that can be market mediated but where no transfer of ownership takes place." Thanks to digitalization and improvements in the exchange of goods and services, access-based consumption has become an increasingly important phenomenon as companies find ways to monetize it.[18]

Interestingly, this concept can potentially improve the sustainability impact of a company's business model. Companies that can respond to demand can increase the use of their assets or products. This implies that there will be less need for producing additional products, as the company already succeeds in increasing the use of existing assets. This has a positive impact on the environment by reducing waste and saving energy.

Access-based consumption will potentially become even more efficient through artificial intelligence and other future technological advances. This implies that the potential of a sustainability impact should not be overlooked. This is likely to be the reason for why asset sharing is part of the UN's Global Compact list of breakthrough business models. Companies can use access-based consumption to meet the SDGs.[19]

Car sharing - reducing the need for private car ownership

Car sharing gives customers access to a fleet of cars on an as-needed basis. It is a type of access-based consumption with several sustainability benefits. A privately-owned car is estimated to be used around 5% of its lifetime, meaning that it remains parked for the rest of the time.[20] By allowing others to access the car, its use should increase, and the number of privately-owned cars might be reduced.

In general, commercial car sharing is classified into two types*: station-based (roundtrip) car sharing (in which the vehicles are returned to their station locations) and free-floating car sharing (in which the vehicles can be left anywhere within a designated service area).[21]

It is important to understand the differences between these two models when studying the sustainability effects of car sharing. International research suggests that households that use station-based car sharing services behave differently than households using free-floating services. Differences in behavior usually relate to the vehicle miles traveled, and the use of public transportation.

Accessibility
Consumption through accessibility
"My car sometimes"

Ownership
Consumption through ownership
"My car always"

Table 1: Comparisons between free-floating and station-based car sharing models

Free-floating	Station-based
The car can be parked anywhere within a designated service area[22]	Dedicated stations for parking
Often seen as an alternative to public transportation[23, 24]	Often resulting in more use of public transportation, as it is seen as a complement [26, 27]
Usually tend to increase the number of car trips[25]	Larger positive effects on car replacements and kilometers driven[28]
	Usually used for trips outside the city center[29]

Car sharing in Stockholm

Car sharing has grown to be a natural part of city mobility around the world and Stockholm is no exception. In 2010, there were 74 registered car sharing cars, a number that has grown to 2,049 in 2019.

Out of these, 582 were station-based and 300 were free-floating. A further 1,167 of the shared cars were privately owned.[30]

*Note that definitions vary and that we in this report are focusing on commercial car sharing. We are therefore excluding e.g. cooperative carpools and peer-to-peer car sharing models from our study.

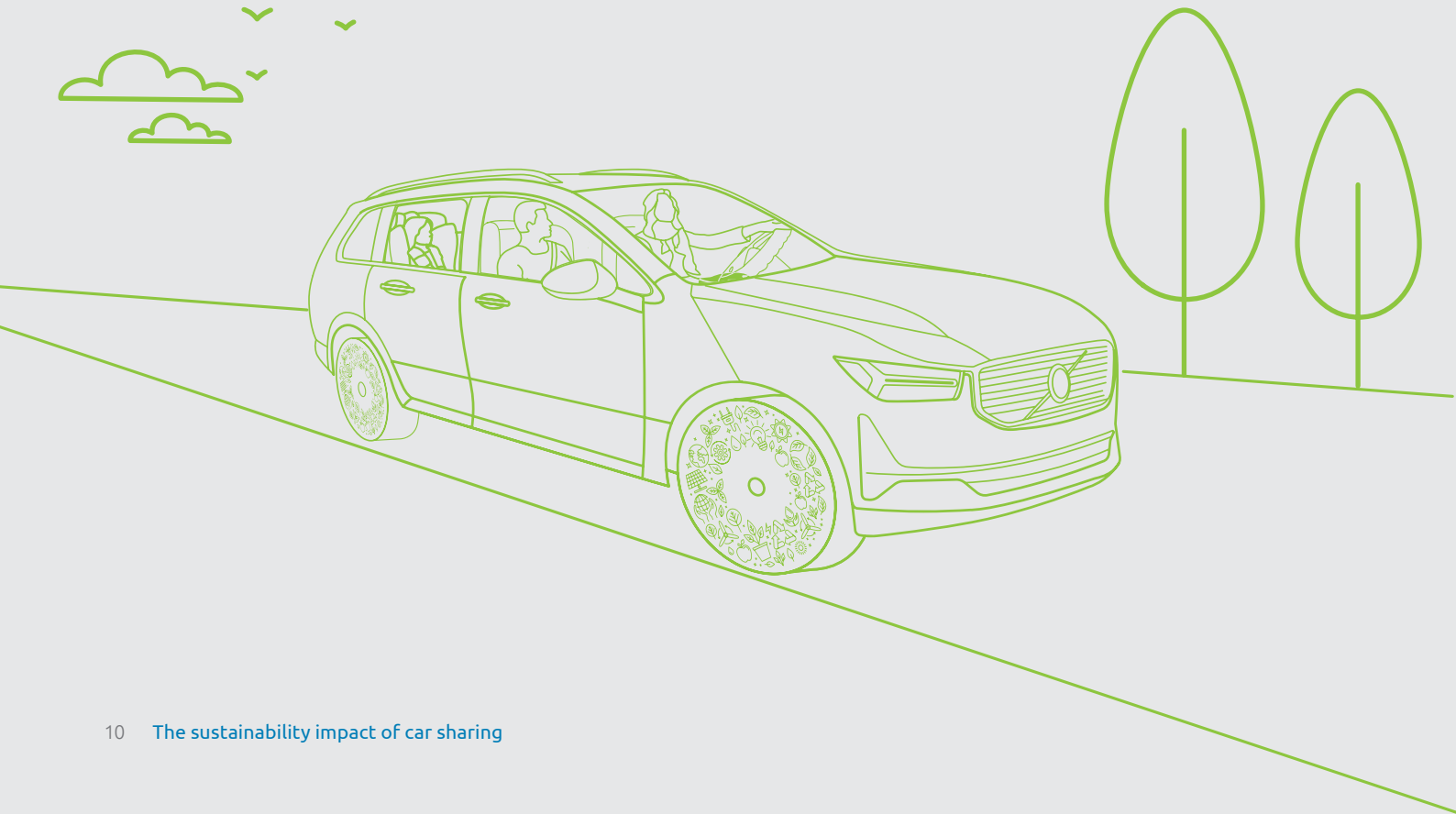
ABOUT VOLVO CAR MOBILITY

This case study is an analysis of Volvo Car Mobility, a wholly owned, independent subsidiary of the Volvo Car Group. The organization was established in 2017 as a strategic investment to meet new consumer preferences. They launched their first service M in Stockholm during September 2019. The company is located in Stockholm with local offices in Gothenburg and Malmö and employs 150 people.

Volvo Car Mobility's service M is a station-based car sharing service offering urban individuals and businesses on-demand access to a car, without having to own one, by using the power of the access economy. The company does not operate closed stations with restricted access to the cars, rather all customers can use all available cars at all stations. Customers pay for the time they use the cars, and the kilometres they drive. The service was initially launched in the Swedish cities of Stockholm, Uppsala, Gothenburg, Malmö, and is also live in Linköping, Borås, Lund, and Helsingborg. Operating with 614 stations/depos each with multiple cars (December, 2020).

Volvo Car Mobility is focused on bringing disruptive change to traditional car sharing. Through their vertically integrated technology they leverage user and operational data to predict demand. Additionally, they continuously improve the availability of the fleet of cars through its dynamic scheduling system which is driven by machine learning. With this proprietary technology stack, they are able to effectively match a car with a customer's reservation as close to the desired time as possible. This provides both an improved customer experience, through a faster and smoother booking experience, by automatically providing alternatives which enables Volvo Car Mobility to operate with both high utilisation and high availability. Reducing the cars in the city. This analysis was conducted after M had been live in Stockholm for one year.[31]

Volvo Car Mobility



EACH VOLVO CAR MOBILITY CAR REMOVES UP TO 8 PRIVATE CARS

Using car sharing services instead of owning your own car is an effective way to reduce your environmental impact and contribute to a more sustainable future. When discussing the sustainability effects of car sharing, one often refers to the number of private cars that can be removed from the streets by sharing instead of owning.

According to previous local studies, each shared car removes 4-6 privately owned cars from the streets.[32] This study analyzed how many private cars one Volvo Car Mobility car has replaced in Stockholm to determine the sustainability impact of its service.

Our results show that up to **8** privately owned cars are removed from the streets for each Volvo Car Mobility car. This means a total of up to **4,515** fewer cars on the streets in Stockholm based on the company's current vehicle fleet size.

How we arrived at this number

We conducted a customer survey in which we asked active customers to think of specific changes in their lives stemming from access to Volvo Car Mobility's service M. Key survey questions that formed the basis of the result were related to reduction and suppression effects. The reduction effect shows the share of cars owned by active customers that were sold due to their car sharing membership, while the suppression effect shows the share of respondents who avoid buying a car as a direct effect of the membership. A customer is defined as active if he or she has used the service at least 6 times in total over the last year.

The results show that access to a Volvo Car Mobility's car sharing service allows multiple households to both get rid of a car and/or avoid acquiring one. The fact that one Volvo Car Mobility car removes up to 8 private cars from the streets is a key driver behind the sustainability impacts shown in this study.

26%
of cars owned by active customers were sold as a direct effect of their membership.

51%
of the customers avoid purchasing another car as a direct effect of their membership.

THE SUSTAINABILITY EFFECTS OF VOLVO CAR MOBILITY'S SERVICE

Summary of sustainability value created

The value that Volvo Car Mobility's car sharing service creates for its key stakeholder groups relates to all three pillars of sustainability: economic, ecological/ environmental, and social.

The positive sustainability effects are grouped into seven areas, which are summarized in the below table. The table also illustrates which stakeholder groups that are affected by each value.

Table 2: Overview of value derived

Areas	Value	Stakeholder
Lower emissions, reduced fuel consumption and water savings	From driving: A reduction of CO_2 emissions and fuel consumption due to fewer cars on the streets	Consumer, Company, City
	From production: A reduction of CO_2 emissions from reduced consumption as fewer cars need to be produced	City
	Water savings due to fewer and more environmentally friendly car washes	Consumer, Company, City
Freed up space	Enabling transformation of reclaimed parking area into green infrastructure, resulting in CO_2 savings	Consumer, Company, City, Property Developer
	Enabling transformation of reclaimed parking area into housing, resulting in a possibility to accommodate more people in Stockholm	Consumer, Company, City, Property Developer
Reduced costs	Reduction of costs for car ownership or leasing	Consumer, Company
	Reduction of construction costs for property developers as fewerparking spots need to be built	Property Developer
	Improvements of human safety and potential reduction of costs for medical treatment due to increased share of safe cars	Consumer, Company, City
Increased car access and time efficiency	Enabling increased car accessibility for more people	Consumer, Company, Property Developer
	Enabling people to spend their time more efficiently as customers do not need to spend time on car maintenance	Consumer, Company
Positive impact on traffic congestion	Contribution to less traffic congestion as car sharing customers drive less, continue to use public transportation, and walk or cycle more since joining	Consumer, Company, City
Sustainable movement	Allowing consumers and business partners to be part of a sustainable movement	Consumer, Company, Property Developer
	Enhancing the living conditions in the city	City
Increased electrification and access to smart technology	An increase in the electrification of the vehicle fleet in the city	Consumer, Company, City, Property Developer
	An increase in the share of smart cars in the city, implying a faster uptake of newer technologies	Consumer, Company, City, Property Developer

Lower emissions

Car sharing services contribute to making Stockholm a more sustainable city. Removing up to 4,515 cars from the streets of Stockholm brings several positive environmental effects, such as reduced CO_2 emissions, fuel consumption, and water waste.

Volvo Car Mobility has reduced up to 8,200 tons of CO_2 tailpipe emissions

We have calculated the reduction of CO_2 tailpipe emissions based on the removal of up to 4,515 cars from the streets of Stockholm. To get the results, we multiplied CO_2 tailpipe emission data with the average distance driven by an average car, which is 12,240 kilometers per year in Stockholm.[33] We have also taken into account the added emissions from the Volvo Car Mobility cars in the calculations.

51% of the respondents in our survey claimed that they will not buy another car within the coming year due to their customership in Volvo Car Mobility. This implies that up to 2,671 fewer cars will be bought within the coming year. If we assume that all of these cars would have been new, the demand for new car production would decrease by up to 2,671 cars during the coming year. If the emissions from production of one average car amounts to around 15.5 tons CO_2, this decrease yields a potential saving of 41,300 tons CO_2.[34]

Environmental impacts of Volvo Car Mobility's service in Stockholm:

- Total reduction in CO_2 tailpipe emissions: up to **8,200** tons.[35]
- Potential CO_2 car production emissions saved: up to **41,300** tons.[36]
- Total reduction in fuel consumption: up to **3.2** million liters of gasoline and diesel.[37, 38, 39]
- Total water saved: up to **3.8** million liters of water.[40, 41]

When calculating the emissions in this report, reference is made only to CO_2 emissions, and the rest of the greenhouse gas emissions (methane, nitrous oxide, and fluorinated gases) are not included.[42] In this report, the CO_2 emission data from driving is based on the "Worldwide Harmonized Light Vehicle Test Procedure" (WLTP) methodology using real-driving data, gathered from around the world.[43]

Up to 3.8 million liters of water saved due to fewer car washes

Fewer cars also means less water is wasted in total. The car sharing fleet is washed more frequently (19 times per year) than privately owned cars (12 times per year). Despite this, the net amount of water waste has decreased. Our calculation for private cars is based on an assumption that 50% are washed in automatic car washes while 50% are washed manually.[44] Volvo Car Mobility only uses high-pressure washing which consumes 40 liters, compared to approximately 65 liters in average automatic car washes, or 75 liters in manual car washes. (On average 250-400 liters of water are used in automatic car washes; however, 80% of the water is reused, netting an average consumption of 65 liters). Although a higher frequency of washes, fewer cars means fewer washes in total.[45]

Increased share of new cars reduces emissions and fuel consumption

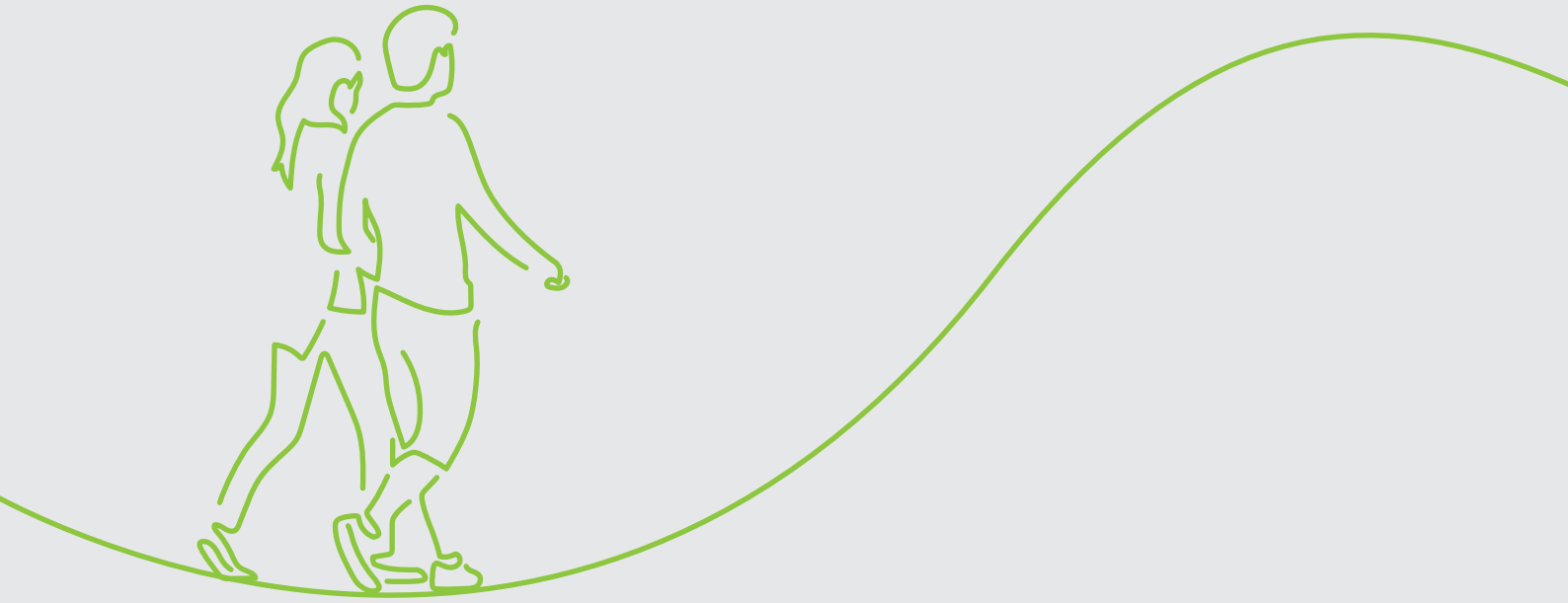
The age of privately owned cars in Stockholm also affects emissions and fuel consumption. The latest technology ensures that new cars gain more fuel-efficiency than older cars e.g. by turning off completely rather than idling.[46, 47] In this report, we define a new car as less than 5 years old. All of the cars in Volvo Car Mobility's fleet are new, while only 30% of all privately-owned cars in Stockholm are new.[48]

Based on this, one can assume that 70% of the private cars that the service removes from the streets are old, while all the cars added to the fleet by the service are new. This is an additional indication that the car sharing service reduces CO_2 emissions and fuel consumption in Stockholm.

By using car sharing services, people tend to drive less

Additionally, researchers argue that when people use car sharing compared to privately owned cars, they tend to drive less.[49, 50] Our customer survey results support this. When analyzing the results from all respondents, approximately one third answered that they have been driving less since joining the service. Of customers who had access to a car before using Volvo Car Mobility, 68% drive less.

Furthermore, respondents who reduced their car ownership once joining the car sharing service reduced their distance travelled by 43%. This shows that a large share of customers change their driving behavior, which results in a positive impact on emissions and fuel consumption.



Freed up space

More than 56,000 m² of parking spaces can be freed up by removing private cars from the streets

Today's parking norms in Stockholm force property developers to build a certain amount of parking spots with new housing developments. This norm only vaguely correlates to the actual supply and demand dynamic for parking spots, thus the risk of over production of car parking spots is clear. These norms were formed at a time when the number of cars and car owners were expected to constantly grow.

However, this is presumed to change. For example, Berlin has eliminated its parking norms while Helsinki and Oslo use a combination of maximum and minimum norms to successfully reduce the number of parking spots. Similarly, how parking is regulated in Sweden is in many ways now up to each municipality.[51]

As parking spots take up a lot of space, changed Mandatory Parking Minimums are needed to release land for other purposes that will create value for cities, property developers, and consumers.[52]

As up to 4,515 cars are removed from the streets of Stockholm and each car would have occupied parking space of some sort, we can assume that Volvo Car Mobility has enabled this space to be freed up. The average size of a parking spot is 12.5 m², which corresponds to a total area of 56,440 m² of freed space.[53] If the reclaimed area were replaced with green infrastructure, housing, or office/commercial buildings, the area could be used to increase value.

About the Mandatory Parking Minimum:

The Mandatory Parking Minimum is a commonly used measure when new buildings are constructed to indicate how many parking spots are needed in a specific area. It is usually the relationship between the number of parking spots and the number of cars or living spaces.[54]

Potential value created if the reclaimed area was transformed into:

- Green infrastructure and trees: circa **1,350** tons of CO_2 saved from the atmosphere.[55, 56]
- Housing: 56,440 m² could potentially accomodate up to **10,300** people in Stockholm municipality. This could provide a potential positive contribution to economic growth by **4.2** B SEK.[57, 58]

Transforming area into green infrastructure

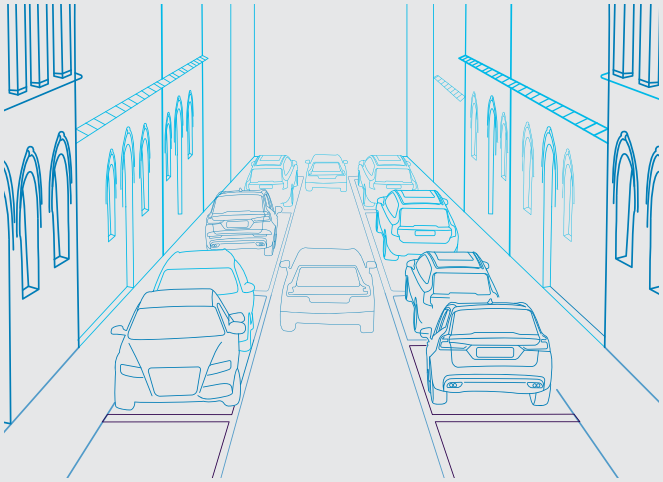
Trees bind CO_2 as they grow. With one cubic meter of logs, trees will on average bind 1.3 tons of CO_2 from the atmosphere.[59] Stockholm has a density of circa 0.02 trees per square meter. [60, 61] An average oak[62] has a volume of circa 1.38 m^3 and an average scots pine[63] has a volume of circa 0.65 m^3.[64, 65] This means that an oak will bind 1,790 kg of CO_2 when fully grown and a scots pine will bind 850 kg of CO_2. This would imply that a total of circa 1,350 tons of CO_2 would be saved from the atmosphere if the reclaimed space were transformed into green infrastructure, assuming that it consists of 50% oak and 50% scots pine.* Moreover, this would increase the tree density in Stockholm.

Transforming area into housing

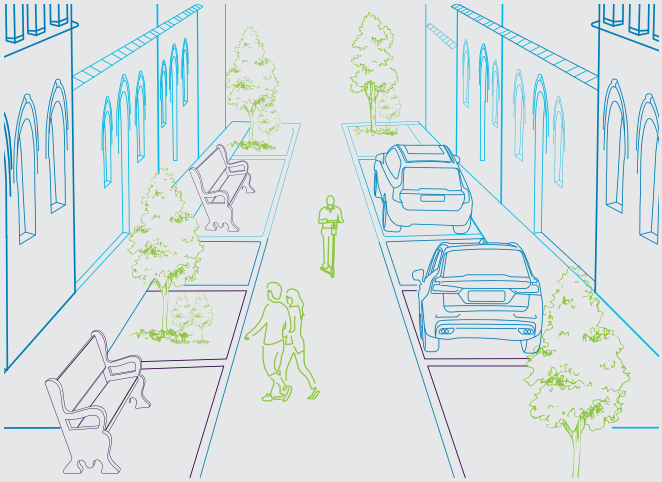
Another option is to transform the reclaimed area into housing. With an average living space of 33 m^2 per inhabitant[66] and 6 stories high buildings[67] in Stockholm municipality, the reclaimed area has a potential to accommodate up to 10,300 people. Based on an average yearly salary in Stockholm and the assumption that all are working age adults, this would provide a potential positive contribution to economic growth by circa 4.2 B SEK.[68]

If the reclaimed area is used for housing, offices, or stores, there is a further monetary contribution in terms of additional rentals and sales. This would have a meaningful impact on property developers and the city.

Street view of today



Street view of tomorrow



* Note that we have used oak trees and scots pine trees when calculating CO_2 emissions saved from the atmosphere as these are two of the most common trees in Stockholm municipality.[69]

Note that the calculations show indicative values to illustrate the potential of alternative area use. In practice, the freed-up space would be used for a combination of purposes and it would not be possible to use all area exclusively for housing.

Reduced costs

Volvo Car Mobility and its service M, not only contributes to environmental sustainability, there are economic benefits to it as well. These advantages come from the removal of the cost of ownership for consumers and companies, decreasing construction costs for property developers, and reducing the costs of accidents within the City of Stockholm. In the following section, we will elaborate on these cost savings.

Reduced costs from car ownership or leasing

Customers of Volvo Car Mobility get access to cars without making large up-front investments, required with ownership. Instead of being subject to the main costs of car ownership* they pay a subscription fee and a usage cost[70]. The latter depends on the time and distance that the service is used. With reference to these differences, we have compared the monthly cost of owning a car with the cost of a "lagom" membership in Volvo Car Mobility for consumers and a "medium" membership for companies. This allows us to identify a break-even distance one can drive before the cost of membership exceeds the cost of ownership or leasing.

The results indicate that for consumers, the Volvo Car Mobility service is cheaper than owning a car if you drive equal to or less than approximately **7,000** km per year. For consumers who privately lease a car, the equivalent is **9,000** km per year. Similarly, for companies, it is cheaper to use Volvo Car Mobility than to own a car up to a distance of **9,000** km per year per car.*

Our calculation is based on the current price plan for Volvo Car Mobility, so the break-even points would change if the price plan was updated. However, this indicates that using Volvo Car Mobility is currently a less expensive option for consumers or companies who need access to cars for traveling short to medium-long annual distances.

Cost transparency decreases the distance traveled

Results from our customer survey suggest that households that did reduce their car ownership after joining Volvo Car Mobility, decreased their distance traveled by approximately 43%.[71] There might be several reasons behind such a behavioral change. One reason could be that, since you pay per use when using car sharing, a trip feels more expensive than it does when taking your own car.[72]

This is supported by recent research published in "Nature," where a group of researchers surveyed 6,000 citizens across Germany to investigate whether consumers grasp the total cost of car ownership. They found that car owners underestimate total vehicle costs by about 50%. If consumers were given information on the cost of car ownership, it would encourage them to switch to cleaner transportation with lower emissions.[73] At the same time, the perceived high costs impact how people drive, resulting in fewer unnecessary trips.[74]

*Note that these calculations are based on a total of the main cost items associated with private consumer car ownership (fuel[75, 76, 77], depreciation[78], repairs[79, 80], tax[81], insurance[82], service and maintenance[83, 84, 85, 86, 87], and inspection[88]) and company car ownership[89], as well as average distance traveled by Stockholm residents per car per year[90].

Reduced construction costs for property developers

In the analysis, we have assumed that each removed car frees up the space of one parking spot, which equates around 56,000 m². It is therefore reasonable to assume that fewer parking spots need to be built. Since the process of building parking areas is associated with high costs, there is potential gain for property developers and cities.

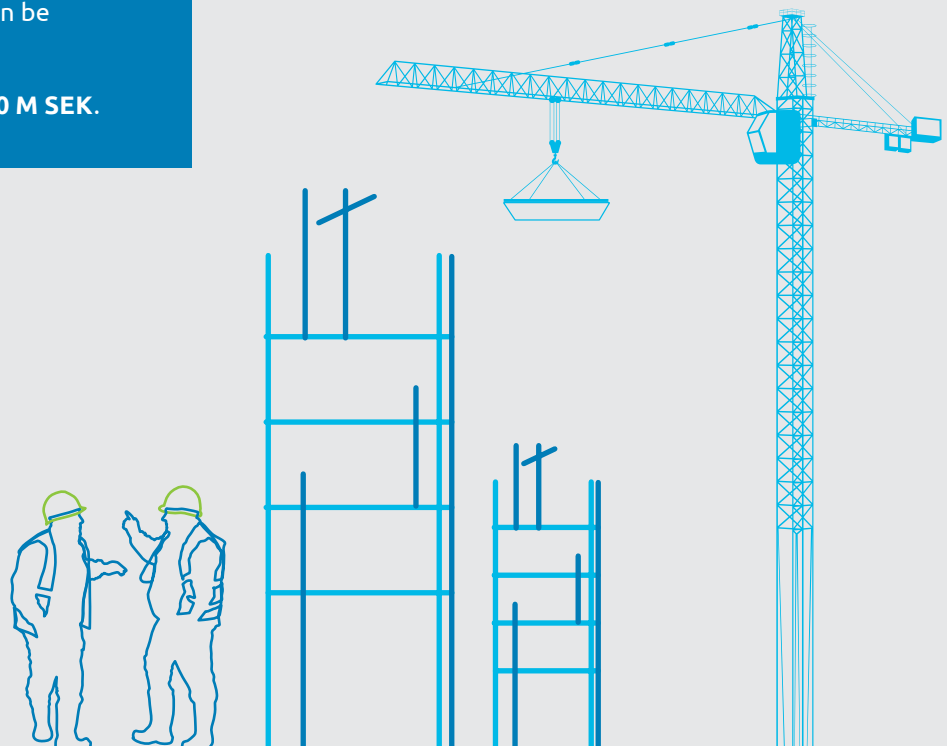
Today's parking norms are based on an outdated form of ensuring that people have the right level of access to mobility. Mandatory Parking Minimums[91] obligate property developers to build a minimum amount of parking spots with new housing developments, which do not necessarily match the actual demand for parking spaces. Local building standards that lower the Mandatory Parking Minimums will consequently lower construction costs for both buildings and parking spots.

In practice, the people living in the connected houses pay for these parking space costs, regardless of whether they use a parking spot or not.[92] Consequently, the construction of parking spots will have a direct impact on the possibility to build more living spaces at a lower cost. The Swedish Environmental Institute writes that low Mandatory Parking Minimums have helped make more small and affordable housing options available to its customers.[93]

In the fall of 2020, the City of Malmö is expected to decide on a new policy for parking in which the city suggests that housing apartments that are built in public transportation dense areas, shall be allowed to build close to zero parking spots. They further claim that this initiative will keep housing prices down.[94]

How to calculate the cost of building parking spots in a city:

- Assumed distribution of parking spots: **65%** spots located on the street and **35%** garage spots.[95]
- Construction cost per parking spot in Stockholm: **15,000 SEK** on the street, and **250,000 SEK** in garage.[96]
- Number of parking spots that can be avoided: **4,515**.
- Total costs potentially saved: **430 M SEK**.



Improved human safety - Why new cars are safer than old cars

In 2019, one of Sweden's largest insurance companies, Folksam, released their yearly car safety report, in which they assessed the safety level of 324 car models, based on 202,000 accidents in Sweden.

The result from Folksam's research shows that new cars are considered safer than old cars. In their list of tested vehicles, none of the 278 cars with the model year 1990-2011 were classified as "good choices." However, among the 46 cars with a model year 2012-2019, 37 were classified as "good choices."

The research shows that the risk of permanent medical impairment is reduced by 75% if car accidents where car models from the early '80s have been involved are compared with models released during the past 5 years. Over the same period, the risk of death has been reduced by 85-90%. Overall, the research confirms that new cars are safer than old.[97]

About Volvo Cars and safety

Volvo cars stand out on Folksam's list since all their new car models included in the report are more than 40% safer than the average car.

According to Volvo Cars Safety Vision, no people should be seriously injured or killed in a new Volvo car. To meet this vision, Volvo has developed several safety features throughout the years, such as Whiplash Protection System (WHIPS), Side Impact Protection System (SIPS), side airbag, run-off road protections, and auto-braking city safety systems. These features are installed in all new cars to reduce the risk of injuries.[98]

To be classified as a "good choice", the car must have:

- A safety score of 5 based on performance i n road accidents.
- 5 stars from Euro NCAP.
- Approved whiplash protection (60% of injuries from car crashes lead to whiplash).
- Autonomous emergency braking for cars and pedestrians (shown to have avoided 25% of all accidents).
- Electronic stability control (halves the risk of death and serious injury on slippery road surfaces).

Safer cars in traffic

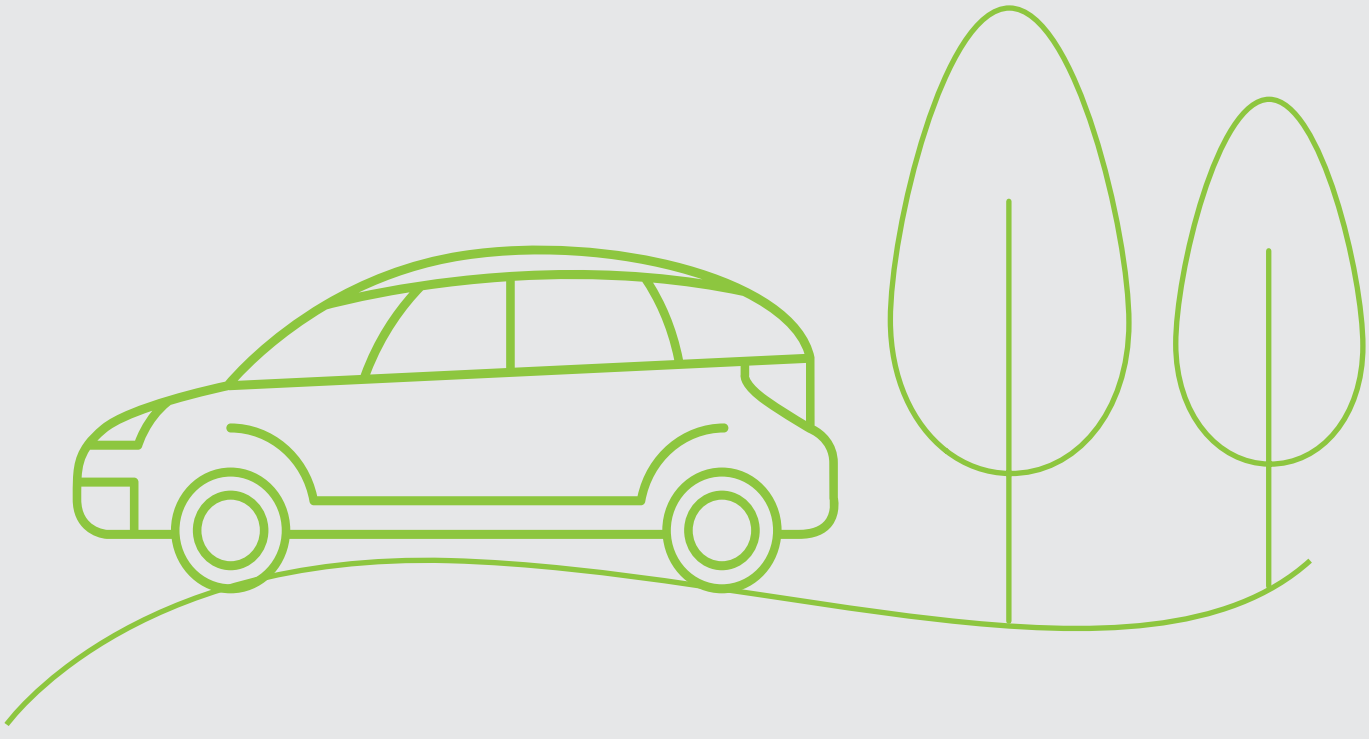
Each year, 7% of vehicles in Sweden are renewed.[99] Volvo Car Mobility contributes to this renewal of the vehicles in Stockholm by introducing new cars to both their fleet and the privately-owned fleet. This is because the cars are rotated out and remarketed after 2 years of use in the service.

Since around 70% of the vehicles in Sweden consist of old cars (model year 2014 or earlier)[100], one can assume that 70% of the private cars that the service replaces are old. This means that the share of newer and safer cars within the secondhand market is increased.

A reduction of accidents would have a positive effect on costs associated with medical health care. Overall, this indicates that the value to the city increases as costs lower, whereas having access to safer cars provides direct value to consumers and companies, as well as to the City of Stockholm.

About accidents in Stockholm County:

- In 2019, 20 people were killed and 348 were injured in car accidents in the Stockholm area.[101]
- The average economic cost associated with a killed person is 129,694 SEK, and the cost of treating a patient injured in an accident is 57,391 SEK.[102]
- This implies a total cost of medical treatment of 23 M SEK 2019.



Increased car access and time efficiency

Enabling more people to access cars

One of the many benefits of car sharing is that consumers and companies can access a car without having to invest a large amount of money. Since launching in Stockholm, Volvo Car Mobility offers the opportunity for people who previously were unable, to experience the brand and cars of Volvo Cars.

Another important factor making car sharing services attractive and accessible for the customers is that the geographic distance between residence and parking is short.[103] The distance to the nearest Volvo Car Mobility station in Stockholm is on average 380 meters for its customers, which is arguably quite close. This distance equals, or is in some cases shorter, than the average distance to where people have the ability to park their private cars in central Stockholm.

In addition, the company does not operate closed stations with restricted access to the cars, but all customers can use all available cars at all stations. Thus, Volvo Car Mobility enables car accessibility to more people.

Time is money

People are becoming increasingly stressed.[104] They value their time more and therefore want to spend as little time as possible on unnecessary and non-value-creating activities.

As a customer of a car sharing service you do not have to spend time on maintenance or administrative tasks related to car ownership, as these are catered for by the service. This creates value for the customer and is one of the main reasons for using a car sharing service. This is substantiated in a customer survey conducted by Volvo Car Mobility asking 4,000 customers about the primary benefits of using their service. The results indicate that more than half of the respondents consider "Everything is taken care of e.g. maintenance, 24/7 customer support, etc." as the primary benefit.[105]

An additional benefit of using station-based car sharing is that there is always a parking spot available when returning the car. This saves time. The lack of balance between parking supply and demand creates varying levels of "search traffic," i.e., drivers searching for a parking spot. A review of 22 studies showed that 8-74% of all traffic in cities in Europe and North America consists of search traffic. The average search time is between 3.5 and 14 minutes.

There are large differences between the cities, but the studies show searching to be a large part of the traffic.[106] Stockholm is no exception.[107]

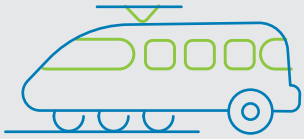
Positive impact on traffic congestion

Stockholm, like many other cities, faces problems such as congestion, pollution, and accidents caused by transportation and traffic.[108] Stockholm is constantly growing and by 2030, the population in Stockholm County is expected to reach 2.5 million inhabitants. More people living and working in Stockholm means increased transportation and an increase in congestion.

A wide range of factors affect congestion levels in Stockholm, and in addition to a growing population, the business cycle and congestion taxes are two of them.[109] Strategies normally used to reduce traffic congestion include increasing the amount of public transportation, cycling and walking.[110]

How transportation habits have changed due to membership in Volvo Car Mobility's service M

68% of customers who had car access before joining Volvo Car Mobility drive less.



82% of respondents use public transportation the same amount or more since joining Volvo Car Mobility.

25% walk or cycle more since joining Volvo Car Mobility.

Our customer survey and other studies indicate that people tend to drive less after joining a car sharing service.[111, 112, 113] 68% of customers who had car access before joining Volvo Car Mobility drive less since starting their membership and 25% drive the same amount as before. This implies less traffic and less congestion.

Secondly, our survey also shows that there is no decrease in using public transportation since joining the service, i.e. 82% use public transportation the same amount or more as before. Therefore, one can argue that a station-based service is a complement to public transportation and not a substitute.

Thirdly, customer survey results showed that the company's service has had a positive impact on their customers becoming physically more active. 25% of the customers walk or cycle more compared to before, whereas 73% walk or cycle the same compared to before. This also indicates a positive impact on congestion.[114]

The above underlines the intention of Volvo Car Mobility's product and business model. It is not constructed to be a substitute for public transportation.

As a Volvo Car Mobility customer:

- You need to return the car to the same parking spot from where you picked it up.
- The minimum booking time is 1 hour. This reduces the likelihood of customers using Volvo Car Mobility for short, spontaneous or one-way trips.[115]

Sustainable movement

The importance of making conscious choices for consumers

"Green is the new black" – consumers are increasingly calling for a more sustainable, environmentally friendly, socially responsible, and economically inclusive tomorrow. Recent research by Capgemini Research Institute shows that consumer preferences are strongly impacted by sustainability. In fact, eight out of ten consumers are already making conscious purchase choices based on social, economic, or environmental impact.

The overall conclusion is that consumers feel an emotional connection to sustainable companies.[116] By making conscious choices, consumers also develop their personal brand identities, which is becoming increasingly important in today's society. Increased information sharing, ease of access to technology, and online tools are considered key drivers for personal branding.[117], [118] Since the personal brand has emerged as a strategy for individuals to emphasize their distinctiveness, people tend to grow more aware of their existence and the footprints they leave behind by making conscious choices.[119]

In a brand-tracking survey performed by Norstat in May 2020, 43% of respondents claimed that environmental concerns were one of the top reasons they pursued a car sharing service.[120] It is thus reasonable to assume that using Volvo Car Mobility's service helps the customers to reflect their identity around sustainability.

Companies aim to strengthen their sustainable profile

Being a progressive company with high ESG (environmental and social governance) ambitions and performance, is advantageous as it may lead to higher profits and market value. Researchers that confirm this relationship argue that ESG practices will improve relationships with stakeholders, leading to a larger customer base and an enhanced corporate reputation.[121] Even the appeal of ESG performance has shown to drive up stock prices and consumer demand.[122]

We can see that sustainability is also one of the main motivators for companies choosing Volvo Car Mobility. For example, a consultancy company specializing in digital products said that their collaboration with Volvo Car Mobility is "in line with our values to take an active part in the transition towards more sustainable urban mobility".[123] Moreover, a fast-growing apparel care company reported that they chose Volvo Car Mobility Business for its "enhanced availability and sustainable profile" and claims that more sustainable car utilization, combined with the flexibility it provides, have influenced their decision to partner with them.[124]

Car sharing enhances the living conditions in the city

A working group of international NGOs (non-governmental organizations) has designed ten principles to guide urban decision-makers toward shared mobility for livable cities. Among others, they express their support for shared and efficient use of vehicles and land, and suggest that autonomous vehicles in dense urban areas should be operated only in shared fleets. They argue for shared fleets to provide more affordable access to all, maximize emissions benefit, and realize the promise of fewer vehicles, parking, and congestion.[125] This emphasizes Volvo Car Mobility's role in realizing these principles and their ability to contribute to the sustainable movement of society.

Mobility services companies have a role to play in the development of the modern city by bringing new services and solutions to help overcome traditional challenges. For example, Volvo Car Mobility, together with property developers, actively engaged in developing and optimizing the range of mobility services in the Stockholm district of Haga Norra.

Additionally, the company is involved in a project called "Street Moves" in Stockholm together with ArkDes Think Tank, Stockholm Stad, Vinnova, LundbergDesign, Swedish Transportation Agency, and Voi. The ambition of this project is to ensure that every street in Sweden is healthy, sustainable, and vibrant by 2030. This addresses priorities from the two collaboration programs "Nästa generations resor och transporter" ("Next Generation travel and transportation") and "Smarta städer" ("Smart cities"). The project has designed and developed a prototype consisting of modular building blocks that are placed on different streets in Stockholm. The purpose was to create a shared mobility "hot spot", where cars, e-scooters, delivery vehicles, and share bikes coexist. If successful, this will create a blueprint for all Swedish cities.[126]

Increased electrification and access to smart technology

Increased electrification

In an address to the Global e-Mobility Forum in Warsaw, November 2019, the Deputy Executive Secretary of UN Climate Change, Ovais Sarmad, said:

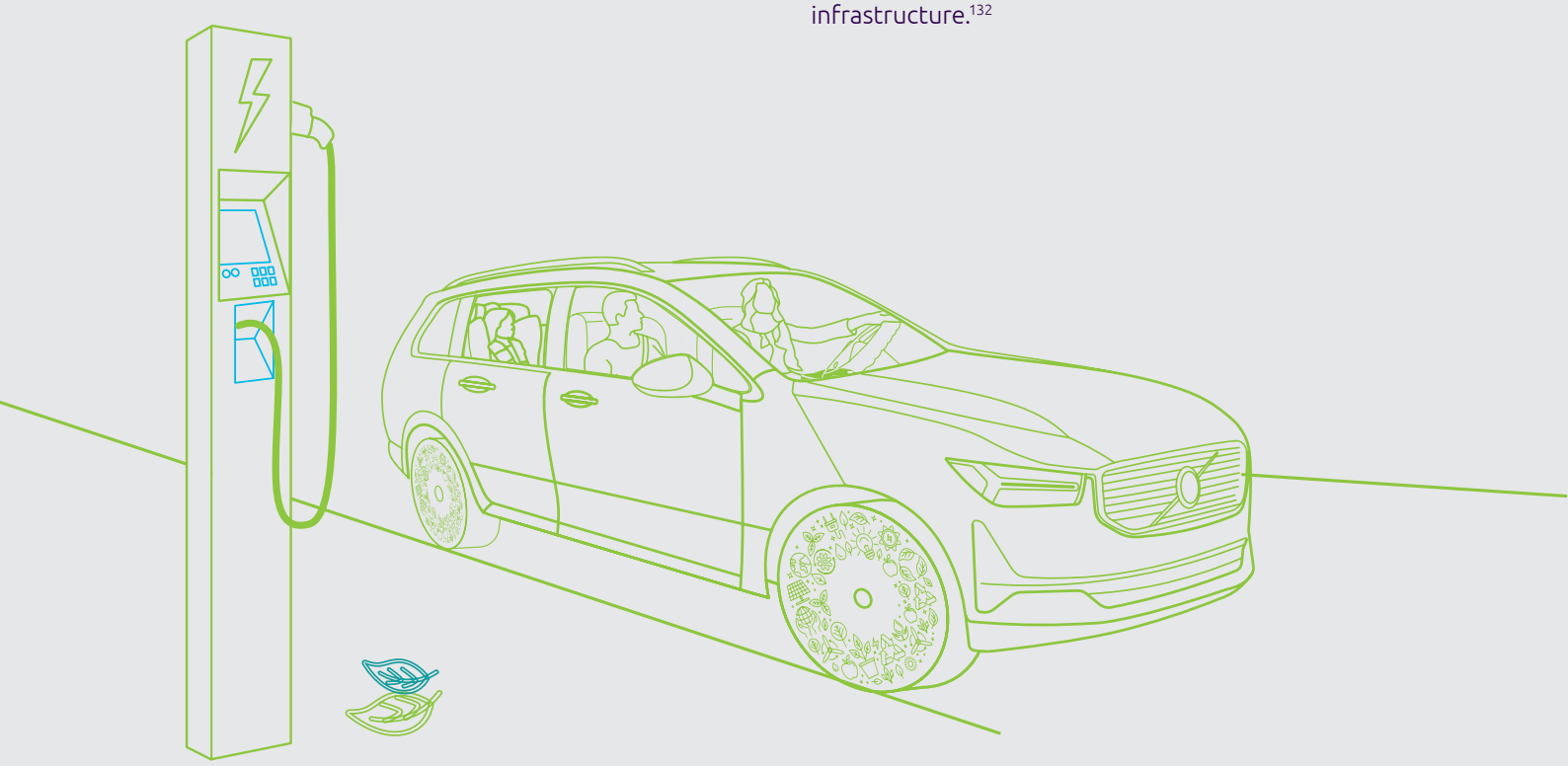
> *We urgently need sustainable and clean transport systems. The good news is that the prospect for this is promising as innovation and technological progress in recent decades have led to significant advances in e-mobility.*[127]

Over 500 participants in the forum, representing administration, business, science, NGOs, experts, and market practitioners from all over the world, agree that the development of e-Mobility is a priority to come closer to the zero-emission targets for the transportation sector.[128]

As electrification is necessary for the transportation industry to reduce its CO_2 footprint, cities around the world need to build the required infrastructure to support the shift to electrification and thereby stimulate the public demand for electric cars.

Apart from political decisions, additional factors affecting the adoption of electric vehicles are technological developments such as the prices of batteries, and customer preferences.[129] A recent survey conducted by Castrol targeting 10,000 customers, fleet managers, and industry specialists across eight of the world's most important electric vehicle markets, showed that not only infrastructure but also the charging time, the driving range, and choice of vehicle affected adoption of electric vehicles. 38% of the consumers cited the price of the car as the single most important factor.[130]

Additionally, the Swedish government aims to create the conditions for the development of the market, submitting a proposal in January 2020 that both new and certain existing car parks should be prepared for the installation of charging stations.[131] In June, the Swedish Transportation Administration also received an additional 50 M SEK to increase the coverage of charging infrastructure.[132]



How car sharing services contribute to the positive impact of electrification

A car sharing service can contribute to the electrification of the general vehicle fleet in several ways. One way is by providing electric vehicles as part of its fleet. Volvo Car Mobility's fleet currently (October 2020) consists of 13% PHEVs (petrol hybrid electric vehicles), and the company has the ambition to constantly increase the share of electric cars following the development of the charging infrastructure in the cities where they are active. After two years in service, the car is rotated out and is remarketed, thereby increasing the share of electric vehicles in the second hand market. Additionally, by lowering the barriers for people to gain access to and use electric vehicles. It thus becomes easier for people to move from a petrol or diesel car to an electric one.

Volvo Car Mobility has and continues to offset all kilometers driven by all their customers in all cars since the beta period (pre-launch period) by 110%.

As Volvo Car Mobility's strategy is to further improve the sustainability of its service, the company has also set several targets for increasing the share of electric and hybrid cars. Therefore, this analysis also explores the effects of a future scenario. By increasing the share of fully electric cars and hybrid cars in the fleet, the CO_2 emissions and fuel consumption are reduced.

Table 3: Scenario analysis of a changed vehicle mix and its impact on CO_2 emissions

Fleet mix	Current scenario	Future scenario: 50% plugin hybrid vehicles, 50% electric vehicles
Petrol vehicles[133]	4%	0%
Diesel vehicles (run on miles diesel and miles diesel bio)[134]	83%	0%
Plugin hybrid vehicles (run on electric and petrol)[135]	13%	50%
Fully electric vehicles (run on Swedish energy mix)[136]	0%	50%
Reduction in CO_2 emissions from the fleet		**-79%**

The emissions in the tables are only connected to driving, and not production or recycling of the cars. The emission data is based on the WLTP methodology.

While the introduction of more electric cars will reduce CO_2 emissions, the electricity consumption will increase. Due to differences in emissions depending on the energy source, electricity needs to be produced through renewable sources to lower the environmental impact.[137] Sweden has good conditions to use environmentally friendly electricity as the electricity production in Sweden is almost fossil-free.[138]

It is widely known that electric cars usually generate less noise due to the absence of combustion engines.

In fact, up to a speed of 30 km/h, electric cars and hybrids maintain an average of 3-10 DB lower noise levels than conventional vehicles.[139] Consequently, a higher share of electric cars in traffic would contribute to lowering the noise levels in Stockholm.

Volvo Car Mobility enables access to smart technology

Volvo Car Mobility is more accurately described as a tech company. Through their proprietary AI platform, they have positioned themselves at the forefront in the transition towards a more technology-driven society. This platform has helped project consumer behavior and efficiently plan the allocation and distribution of cars based on extensive data-driven decision making. This makes the proprietary AI platform a central feature of Volvo Car Mobility's business model.

By introducing smart solutions and new cars to the market, the company has enabled a faster uptake of newer technologies and set the standard for future development.[140] Like the argument for increased vehicle fleet electrification, Volvo Car Mobility's business, therefore, has contributed to a higher share of smart cars in traffic.

BARRIERS AND MEASURES FOR INCREASED CAR SHARING

To facilitate a transition towards increased car sharing and mobility, traffic planning should be done based on expected behavior and the desired society, which is referred to as goal-steering rather than forecast control. The idea is that low Mandatory Parking Minimums, if combined with greater access to shared mobility services, will reduce people's need for private cars. As such, norms for high Mandatory Parking Minimums work as a barrier to more car sharing. To achieve the course of goal-steering, the entire chain of politicians, property developers, architects, and suppliers needs to be aligned.[141]

The need for policy measures to enable full sharing was also brought up in a recent European study conducted by Europe's leading NGO Transport & Environment. They identify policies that are required at the national and city levels to achieve "mobility heaven."

For example, they suggest that countries should support the installment of fast chargers, either dedicated to shared vehicles or allowing shared vehicles to charge for a lower cost. Moreover, a taxation policy that promotes mobility budgets for employees rather than incentivizing car ownership should be developed.

At a local level, cities are recommended to introduce road pricing and congestion taxes to limit transportation flows and stimulate demand for shared mobility. Finally, parking policies that regulate the street design to take into account new forms of mobility and space allocated to private cars are also considered effective.[142]

FUTHER COMMENTS ON THIS ANALYSIS

We have so far mainly focused on the value and positive effects that the car sharing service has created towards cities, property developers, companies, and consumers. However, some potential critiques against car sharing, electric vehicles, and Volvo Car Mobility could also be raised. We wanted to address some of them in this section.

One may argue that since car sharing cars are used more frequently than private cars, this will speed up the turnover of resources, generated waste, and increased emissions derived from car manufacturing.[143] As such, one may question the positive impact of reduced car ownership on lower production levels outlined in the report.[144] However, in a study conducted by the International Transport Forum and OECD, they argue that despite much longer distances traveled and shorter lifecycles, car sharing services enable faster uptake of newer, cleaner technologies that will in turn contribute to a more rapid reduction of CO_2 emissions from urban mobility.[145]

Car sharing might increase the amount of driving among some groups. For example, our customer survey indicates that those that did not have a private car before using Volvo Car Mobility increased their amount of car driving on average by 17%.

This finding is supported by other research that suggests that households that did not own a car before joining a car sharing service increase their driving due to higher car access.[147] However, as substantiated by both our analysis and other research that people tend to drive less when joining a car sharing service.

In addition, Volvo Car Mobility customers cannot book a car for less than one hour. This secures that customers do not use M over other mobility modes such as walking, cycling and public transport when traveling short distances.

Additionally, critiques have been made on the sustainability effects regarding the use of electric vehicles in general. Increased production of electric vehicles implies increased use of lithium-ion batteries, which have been shown to be major contributors to greenhouse gas emissions. When producing electric vehicles, emissions are generated both from the sourcing of materials for the batteries (e.g. cobalt and nickel)[148] and from the manufacturing process of the battery. This needs to be taken into consideration when comparing the emissions generated between producing electric vehicles and combustion engine vehicles.[149] As electric cars generate high amounts of emissions in the manufacturing process, it is even more important that these cars are shared. Thus, potentially fewer cars need to be produced.

APPENDIX

Methodology

About the survey

We surveyed 9,955 active private customers in Stockholm, Gothenburg, and Malmö that have used Volvo Car Mobility at least 6 times during the last year. The total number of responses was 1,573, which corresponds to a response rate of 15.8%. Respondents were asked questions on car ownership and driving behavior before and after using M, as well as whether they walk, cycle, or use public transportation more often. For questions related to their driving behavior, use of public transportation, and walking/cycling habits, answers were restricted to only respondents in Stockholm (926).

Figure 1: Behavioral changes due to membership

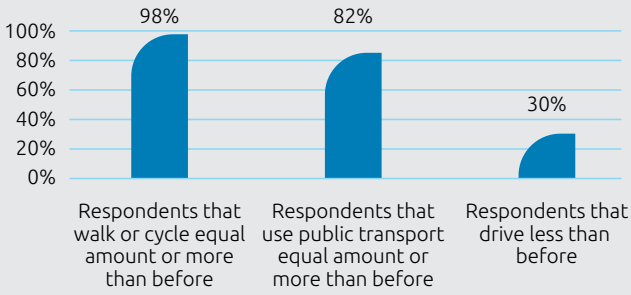
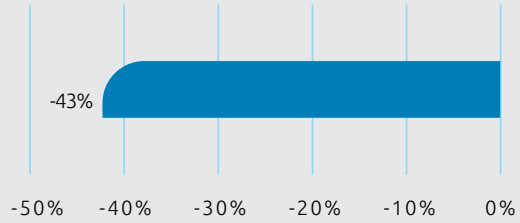


Figure 2: Total change in kilometers driven for customers that got rid of a private car



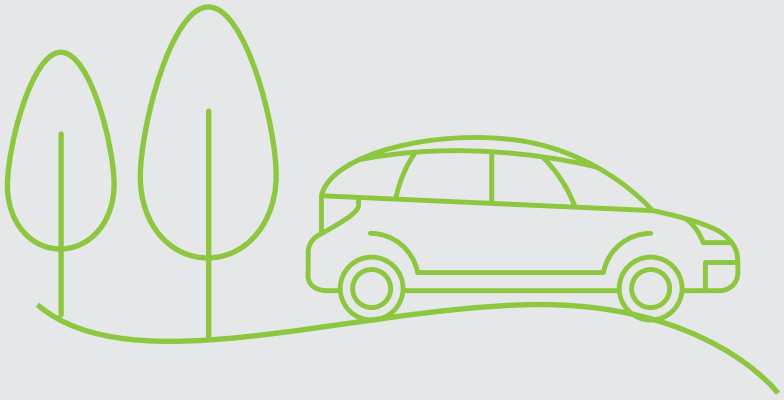
Methodology to calculate the number of private cars replaced per Volvo Car Mobility car

Respondents were asked questions whether they got rid of a vehicle due to their membership in M - Volvo Car Mobility, as well as whether they were planning to buy a car within the next year but avoid to do so. The respondents were also asked whether their membership contributed towards the decision to sell the car or not to buy another car. Respondents could also indicate if they had sold a car or changed their intentions to buy a car for reasons other than their membership. There were 411 cars reduced in total. 802 were suppressed. The sum of these numbers (1,213) was then divided by 1,573, the total number of responses. This gave the average number of cars removed from the street per respondent (0.77).

We applied this factor to the survey base of 9,955 customers, that were defined as active. This scaled factor was then divided by the size of the fleet to obtain the number of cars replaced by each car sharing car. Since the survey only includes private use of the service, the vehicle fleet was adjusted based on the share of booking time made by Volvo Car Mobility's private customers (0.711). The suppression effect was included in our calculations since car sharing services also reduce the number of cars bought in the future.

Table 4 : Calculation of replacement number

Variable	Number
Total survey base	9,955
Total number of responses	1,537
Number of cars owned by active members sold due to their membership	411
Respondents that avoid buying a car due to their membership	802
Cars reduced per respondent	0.77
Average number of cars in the fleet over the analysis time horizon	1,389
Share of booking time by private customers	0.711
Number of private cars replaced per Volvo Car Mobility car	**up to 8**



Some limitations exist in these findings. First, when calculating the number of cars reduced per respondent, we included both the number of cars reduced and the number of cars suppressed. However, potential double counting among respondents has not been taken into consideration. Double counting could potentially occur when respondents indicate that they both sell and suppress a vehicle purchase. Since we do not know whether the respondents would have both kept their current car and bought another one in the absence of Volvo Car Mobility, we decided not to consider this, but rather to see it as a limitation in the calculation methodology.

However, it is important to mention that we, unlike other similar studies, did not apply the replacement factor to the entire customer base. To get an as reliable number as possible, we only applied the replacement factor to the active customer base.

Second, the impacts of Volvo Car Mobility on respondents are self-reported. However, since the respondent is the most knowledgeable as to whether their membership decreased their car ownership or not, this limitation is unavoidable.

Third, vehicle suppression was restricted to one vehicle per household to reduce complexity in the analysis.

Fourth, results reflect the estimated impact on individuals who have used the service at least 6 times. This is due to the fact that active customers are more likely to change their car ownership relative to the general population. Finally, the survey was sent out in a period of COVID-19 which may have influenced the above results. Respondents were, however, asked to disregard this effect.

Research methodology

The sourcing of the report has been done by conducting extensive research between July and October of 2020. We have combined external data, such as industry reports and national statistics, with internal data provided by Volvo Car Mobility, to obtain credible and nuanced results. Some data points have also been validated by relevant experts within the field of city planning, property development, and car accident research.

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