Trends in the transport system

*The Swedish Transport Administration’s outlook 2018*
Contents

Content ............................................................................................................................................ 3
Preface ............................................................................................................................................ 4
Summary ....................................................................................................................................... 6
1 Introduction .............................................................................................................................. 9
2 Mega trends that are changing society .............................................................................. 10
   2.1 The effects of digitalisation permeate everything .................................................... 11
   2.2 A wider focus on sustainability and more power to energy conversion .............. 15
   2.3 More people living in growing urban regions and increasing differences in lifestyles................................................................. 19
   2.4 An increasingly service-based economy amidst uncertain global development..22
   2.5 Greater focus on social security and vulnerability ............................................. 24
3 Trends in the transport system ............................................................................................ 28
   3.1 An increasingly digitally based and automated transport system .....................29
   3.2 Greater requirement for fossil freedom and lower emissions ......................... 35
   3.3 Continued pressure for high accessibility and good transport opportunities ...... 41
   3.4 The transport system is becoming ever more integrated into social development................................................................. 45
   3.5 Increasing need for socially secure and robust transport systems ...................49
4 Trends in public administration ........................................................................................... 54
   4.1 Government and public roles and governance are changing.............................. 55
5 Analysis – conclusions and reflections ............................................................................... 58
   5.1 Introduction ........................................................................................................... 59
   5.2 General analysis .................................................................................................. 59
   5.3 City and country .................................................................................................. 61
   5.4 Fossil-free transport ............................................................................................. 62
   5.5 Social security ...................................................................................................... 63
   5.6 Digitalisation ........................................................................................................ 63
   5.7 Automation ........................................................................................................... 64
   5.8 Electrification ....................................................................................................... 65
   5.9 Sharing economy ................................................................................................... 66
6 Source references .................................................................................................................. 68
Preface

Together with others, the Swedish Transport Administration is working to create accessibility in a sustainable society. This means that we ensure that roads and railways are accessible, that roads are designed equipped with mid barriers, that railway stations are adapted for persons with disabilities, that combi terminals are developed, that road users receive reliable traffic information quickly, that driving tests are held and that everything else needed for planning, managing and developing smart infrastructure, taking into account the local conditions of the surrounding urban environments, landscape and climate. We need to be prepared, so that we can act when circumstances change. This means that we must stay constantly informed about changes that occur around us: changes that are happening now and changes that can be envisaged in the future.

The Swedish Transport Administration works systematically to ensure that we constantly follow changes in the field of transport, policy, business, academia, the construction market, procurement and the EU. This report focuses on long-term trends in society, the transport system, as well as in public administration. The purpose of the report is to stimulate discussion about what impact these trends may have in the longer term. This report has been created by the central function Strategic Development at the Swedish Transport Administration, with assistance from other departments and Kairos Future AB, which contributed to the section on mega trends. It does not claim to provide the sole possible description of future developments neither to be exhaustive and nor is it an expression of the Swedish Transport Administration's intent.

It is our hope that this report will contribute to in-depth dialogue, both inside and outside the Swedish Transport Administration.

Borlänge September 2018

Susanne Nielsen Skovgaard
Head of Strategic Development
Summary

The Swedish Transport Administration's third outlook draws attention to long-term trends that we believe could have a great influence on the Swedish Transport Administration and stakeholders in our immediate vicinity. We have made a summary and update of the trends described in the Swedish Transport Administration's second outlook, which was published in 2014.

Mega trends are changes that occur generally in society and that are long-term and global in nature. Trends in the transport system are changes that occur specifically in the transport system and that have the mega trends as their basis. The report also describes changes in the roles and governance of the public sector. The concluding section provides an overview of how the trends might lead to different choices of direction.

Five mega trends

The effects of digitalisation permeate everything. Technical developments have always meant changes to people's living conditions and how society is organised and for many decades now digital technology has been doing so. There are many indications that the fast pace of these developments will continue. For example, artificial intelligence and the next generation of communications solutions will fundamentally change the playing field for many industries and stakeholders.

A wider focus on sustainability and more emphasis on energy transition. The changes in the earth's climate caused by global emissions of greenhouse gases continue with full force. A number of different political measures are being taken to counteract this development, although vested interests and suboptimisation mean that the road forward is far from straight. As a consequence of this, the energy sector is currently undergoing a major transformation, in which digitalisation and the decarbonisation endeavours are fundamentally redrawing the energy map. At the same time, the focus of the practical sustainability work in many industries is being widened to include social aspects.

More people living in growing urban regions and increasing differences in lifestyles. Sweden's population is growing, because of increasing immigration, longer life expectancy and a birth rate that exceeds the mortality rate. There is growing urbanisation with more and more people are living in growing metropolitan regions, commuter suburbs and urban neighbourhoods. Urbanisation changes the demographics. In the cities, the working-age population from 20 to 64 has increased, whereas in rural areas the proportion of older people has increased. Economic segregation has also increased, which has resulted in an increasing gap between areas that are resource-rich and resource-poor – between urban and rural as well as within individual municipalities.

An increasingly service-based economy amidst uncertain global development. For a long time now, cross-border trade has been a cornerstone of Sweden's welfare and our dependence on the outside world is substantial, not least because of the limited size of the domestic market. At present, global development is more uncertain than it has been for many years. Service exports are increasing, while the value of the flow of goods is unchanged. This underlines a development that has been shaping the economy for some time – the growth of a less material economy, with value increases from processing that do not represent the manufacture of physical products.
Greater focus on societal security and vulnerability. We live in an ever more interwoven and open world. Globalisation and digitalisation have created a mutual interdependence within society and led to the increasing exchange of goods, workforce, information and capital. This interdependence also leads to vulnerability. Digitalisation especially leads to new types of risks, with its effects felt by all institutions in society. New risks that can be seen as the effects of globalisation – migration's effect on geopolitics and integration, as well as the inability of individual countries to address the climate threats. New challenges for society and media coverage of attacks on both individuals and societal organisations have contributed to increasing anxiety and a focus on safety and vulnerability by both individuals and social systems.

Five transport trends

An increasingly digitally based and automated transport system. With the aid of new technology, the trend in the transport system is towards ever-greater automation. Volumes of information increase, which potentially lead to new types of decision-making support and services. This may help growth of more efficient solutions, but there may also be a need for governance by society to ensure that use of the new technology contributes to transport policy goals. Security and integrity are especially important aspects to take into account in this development.

Greater requirement for decarbonisation and lower emissions. The need to reduce emissions of greenhouse gases remains a dominant issue in the debate on how the transport system is to be developed. There are ever greater demands from various stakeholders to diminish the climate effects of the transport system and to phase out fossil fuels. Tougher political instruments are seen as a prerequisite, but it is difficult to achieve political agreement on them.

Continued pressure for high accessibility and good transport opportunities. The growing population, economic developments and urbanisation, together with increasing welfare and global trade, are leading to increasing pressure on the transport system – for both passenger travel and freight transportation. There are also increasing demands for sustainable accessibility, such as requirements for decarbonisation and equal opportunity, reducing economic gaps and a transport system for all. This affects and sets new requirements for both social planning and the development of technology and new services.

The transport system is becoming ever more integrated into the development of society. Many of the great social challenges that we face will require input from many different stakeholders in different areas. These challenges relate, for example, to climate effects, housing, the labour market, integration, equal opportunity, security and safety, as well as the provision of transport throughout the country. It is becoming ever clearer that the development of the transport system has a central role in addressing many of these challenges.

Increasing need for societal security and robust transport systems. A functioning transport system is an important prerequisite for other functions in society. There is an increasing demand to be able to maintain the functionality of the system even in extreme weather situations and with reinforced alert. The need for information security also increases in line with increasing digitalisation of the transport system. Many people also feel insecure about moving around in the transport system. The fear of being the victim of crime or terrorist acts can affect people's behaviour.
Trends in public administration

Government and public roles and governance are changing. In a global perspective, Sweden's parliamentary democracy and public administration work well and are characterised by trust in both politics and the institutions. However, Sweden does not stand isolated from what is happening in the outside world. Sweden too is affected by increasing polarisation, mistrust of public institutions, new lines of conflict in politics and changes in the dissemination of information. Future governments will also have to handle an increasing public demand for provision of good public services, not least a requirement for accessible information about public sector activities and for security in an increasingly complex and multi-faceted landscape. This is characterised by requirements for transparency, digitalisation, innovation and services that are based on citizens' needs and situations.
1.1. Introduction

Monitoring is a continuous process in different parts of the Swedish Transport Administration, as well as in the organisation as a whole. Every month monitoring is performed that captures a selection of relevant events. It is disseminated both internally and externally, with the aim to present a picture of the current situation in the field of transport. A summarised analysis is produced every quarter for internal use. This presents important events, tendencies and trends in transport, as well as current issues that affect administrative policy and the Swedish Transport Administration’s mandate. Every four years we produce a comprehensive outlook report that illustrates trends on two levels – mega trends and trends in the transport system.

Mega trends are general changes that occur in society and that are long-term and global in nature. Trends in the transport system are changes that occur specifically in the transport system and that have the mega trends as their basis. Some counter trends and counteracting forces to these have also been identified. The report also describes changes in the role and governance of government and the public sector, a concluding analysis presents choices of direction and critical questions.

The 2018 outlook is the third since the Swedish Transport Administration was formed. The previous issues were in 2010 and 2014. In working on this report, we have worked from previously identified trends and used new observations to analyse their continued direction and relevance. The most tangible difference over the course of these years has been developments in digitalisation. This field was barely mentioned in the 2010 situation report. The 2014 report described the breakthrough of the effects of digitalisation and the current report confirms that the effects of digitalisation permeate everything. The trend of increasing focus on societal security and vulnerability also has a more prominent role in the 2018 report. This illustrates how trends can change over time and that there is great uncertainty about future developments.

The purpose of the outlook is to increase our understanding of the world around us and identify prerequisites for the development of the transport system and the Swedish Transport Administration’s activities, and thus the various parts of the analysis should be looked upon as a basis for discussion. The report is important for the Swedish Transport Administration when preparing proposals for the long-term development of the transport system as a basis for the government’s infrastructure bill. Another purpose is to contribute to discussion on future issues. The outlook is not an expression of the perceptions or intent of the management group or the board.
2. Mega trends that are changing society
2.1 The effects of digitalisation permeate everything

Technical developments have always meant changes to people's living conditions and how society is organised and for many decades digital technology has been doing the same thing. There are many indications that the strong pace of these developments will continue. For example, artificial intelligence and the next generation of communications solutions will fundamentally change the playing field for many industries and stakeholders.

The Internet of Things is growing strongly

More and more organisations are gathering data, and the volume of gathered data continuously increases. The Internet of Things means not only passive data collection but also opportunities for expansion and creativity in both the private and the public sector. The technology of it means that connected things communicate with each other, not just with people, to transfer data, give commands and monitor in real time. This development has already started and is likely to grow strongly in the years to come.

The company BI Intelligence estimates that there will be around 34 billion connected devices by 2020, compared to 10 billion in 2015. In principle, it is connected things, rather than people, that are expected to account for the entire growth. Trebling the number of connected things means that the volume of data will grow even more. Since 2008, the world's total bandwidth has increased from an estimated 30,00 Gbps to 250,000 – eight times as much traffic in eight years, and there is no sign of this trend slowing. On the contrary, in the last three years, it has accelerated and this is expected to continue.

Artificial intelligence (AI) and automation are breaking through broadly

As the connected things process, use and communicate more information, they will also become more autonomous and manage to do more on their own. Sophisticated algorithms and robots are becoming more common, but prominent personalities such as Stephen Hawking and Elon Musk have expressed anxiety about a world of machines that are more intelligent than people.

Artificial intelligence is an area that is predicted to grow strongly, from a global market of around USD 1.3 billion in 2016 to a forecast USD 60 billion by 2025. Automation is no longer just about performing manual work but includes taking over all forms of routine work, whether the tasks involved are physical or cognitive. A clear example of this development can be seen in American labour market statistics, where work with obvious routines only showed a weak increase from 1983 to 2008. Since then it has decreased somewhat, while work that is not based on routine tasks increased strongly over the same period. Another area showing a breakthrough is algorithms and software that is self-learning. AI that not only handles predetermined and standardised tasks, but also can use analysis of input data to learn patterns and give a better answer the next time around, is developing in practice. This development goes hand in hand with the growth of the internet of things and will probably lead to a more holistic digital future, where machines both think and communicate with each other. In this way, these two driving forces will probably be the reason why we have seen only the beginning of an enormous wave of digitalisation in the 21st century.

New business models, platform competition and the chase after innovation

Digitalisation involves not only a linear change in goods and services. It also allows for new models for organising the work. In the same way as industrialisation changed how we looked on manufacturing, it is probable that in the longer term, digitalisation will radically change how we look on work and companies. Today,
new business models are growing that are based on radical innovation, not just incremental improvements. We can find examples of such new ways of thinking and working in what are known as platform companies. These companies work through a centralised platform where the collect customer information, transactions and data – both their own and others’. According to the company IDC, more than half of all major companies will either create or collaborate with a large industry platform during 2018 – and the number of data clouds continues to increase. This means great opportunities, but also threats for some organisations that may find it difficult to maintain direct contact with important customers and suppliers as more and more transactions are channelled through platform services.

For the public sector too, the chase after innovation, new business forms and new platforms is creating a rapid and major change. Platforms for the delivery of public services began to be established a number of years ago, but new ways are now growing that are more social and collaborative in nature. Digital platform services of this type embrace citizen dialogue, private companies as partners and external communication, to help individuals to choose alternatives in, say, health care or education. Even though such transformations in the development of public services are not driven by the same forces as platform building in the business world, they are nevertheless revolutionary in terms of organisation, culture and working methods.

**New legislation for handling concern over the abuse of power and lack of integrity**

Digital developments are challenging existing structures and institutions. Legislators are attempting to simplify the implementation of new technology for creating greater societal benefits, while at the same time countering the negative effects of the use of technology.

Developments in which computer and user generated platforms are the foundation of digital-based services also have their downsides. One of these is the power of the companies that provide the platforms, where for example the “Big Five” (Apple, Alphabet, Microsoft, Amazon and Facebook) build up positions of power that resemble monopolies. There is also anxiety about personal integrity in the use of data about individual users. The GDPR (General Data Protection Regulation) is an EU regulation that came into force in 2018, the purpose of which is to handle these negative aspects of the development. Among other things, the new regulation means that private individuals have more rights over the control of their own personal data and can ask companies,
local authorities and other organisations to disclose what data they hold about the individual, or to delete the data altogether. In turn, this means new standards for the cloud suppliers to conform to.

**The sharing economy is speeding up**
Sharing things to make more effective use of resources is an ancient phenomenon. Today, the sharing economy, based on digital-based service platforms that make the sharing of resources easier, is growing. This enables sharing between people and organisations that did not necessarily have any previous relationship.

Services such as Uber, Airbnb and Hygglo are platforms that reduce transaction costs while giving confidence that the system and the parties involved will not deceive each other. It also involves private individuals' assets being shared in new ways via online marketplaces such as Tradera or Blocket. A similar development is occurring in the commercial area, where Loop Rocks, for example, offers a platform for handling and sharing fill materials, gravel or soil. We are likely to see such sharing services as a natural aspect of many areas in the coming years. These systems also build on size. The more people there are on any platform, the more interesting they are as fora. In spring 2017, one person in three in Sweden had used sharing services at some point during the last year. This development could have great significance for the organisation of people's daily lives and consequently for transport needs and transport solutions.

**The changing communication landscape is moving towards yet another new level**
The communication landscape was one of the first areas to be affected by digitalisation. Sweden is a country with a very large digital footprint (more than 90 percent of Swedish homes have computers, internet and broadband) and when all the facts of the world are just a click away, the old authorities of knowledge, which had the ear of the people because of their control over information, are often losing their position. Instead, it is those who can convey information in a stimulating way that gain the authority and are listened to, often with communication that is based on emotion rather than hard facts.

For young people especially, these new authorities become influencers, that is to say people outside the traditional media who succeed in reaching a wide target group via social media and YouTube channels. For example, Therese Lindgren, who was named in 2017 as one of Sweden's ten most influential people on social media, has over half a million followers. This is on a par with the number of readers of the country's most popular newspapers. At the same time, the SOM institute shows that confidence in the traditional media is relatively stable, although there are great differences between different demographics. Those who have little confidence in other people also have little confidence in the media, while those who generally trust other people also trust the media. In this context, it is often much more of a challenge for an authority to reach citizens than it was before.

These ongoing digital developments will probably lead to a much changed communication landscape in the near future. Developments in artificial intelligence are starting to create a world in which AI-based information production (from robot journalism to so-called troll factories) produces both news and letters to the editor. Information can also be received by personal, voice-controlled digital agents, which apply filters and give people advice. The advice is based on an understanding of the individual's preferences, based on constantly gathered information on how the individual lives their life. This can also be seen where many organisations now develop services based on genuine user needs rather than what would be most rational for the provider of the service.
People and organisations are less location-dependent
One consequence of increased digitalisation is increased accessibility. It is possible for both people and organisations to perform a great many of their daily tasks regardless of where they may be located – which also changes the organisation of transport of people, goods and services. One example of this is the proportion of work that is done remotely, which has increased slowly but surely in recent years. According to Gallup, 43 per cent of employed Americans work remotely, at least to a certain extent, a figure that increased by four percentage points between 2012 and 2016. The workplace is becoming ever more global and independent of location. The same applies to other activities in life. The development of online shopping is an example, with annual growth of about 15 per cent.
2.2 A wider focus on sustainability and more emphasis on energy transition

The changes in the earth’s climate caused by global emissions of greenhouse gases continue with full force. A number of different political measures are being taken to counteract this development, although vested interests and sub-optimisation mean that the road forward is far from straight. Because of this, the energy sector is currently undergoing a major transformation, in which digitalisation and the endeavour to be fossil free are fundamentally redrawing the energy map. At the same time, the focus of the practical sustainability work in many industries is being widened to include social aspects.

Strong focus on phasing out fossil fuel

Overall, global demand for energy will increase strongly over the coming decades because of population growth and economic developments that bring a growing middle class to previously impoverished countries. However, in Europe the IEA (International Energy Agency) estimates that total energy consumption is falling, mainly due to better energy efficiency.

On a global basis, demand for fossil-based energy is increasing, although the rate of increase is slowing. Parallel with this development, there is a strong ambition to reduce fossil dependency in large parts of the world. Notably in polluted cities in Asia, there is great pressure to improve air quality by phasing out burning fossil fuel in households, industry and the transport sector. China has signalled investment in renewable energy production of about SEK 3,000 billion between 2017 and 2020. Other countries are making similar commitments. This means that the rapid and positive development in price and capacity in recent years, especially in solar power production, will probably accelerate. Many assessors are now pointing out that solar and wind power are the cheapest in terms of the cost of newly produced energy and that prices are expected to continue to fall over the next few years. This would indicate that the energy revolution, with a change to non-fossil alternatives, is really taking off.

Change in primary energy demand 2016–2040, million tons oil equivalents.
In Sweden, there is a strong political will to make the country free from emissions of greenhouse gases. This was also a cornerstone of the 2016 energy settlement. The falling consumption of fossil fuel in households and industry has been apparent for many decades. The great challenge on the road to decarbonisation is the energy consumption of the transport sector. This sector currently accounts for a third of Sweden's greenhouse gas emissions. According to the Swedish Energy Agency, the total energy consumption in the transport sector is expected to be largely unchanged until 2019. The proportion of biofuel has increased greatly in recent years, mainly due to increased use of pure HVO (Hydrogenated Vegetable Oil) for heavy vehicles and the addition of HVO and FAME (Fatty Acid Methyl Esters) to fossil diesel. In 2009, the percentage was barely five per cent but by 2017 this had increased to 21 per cent.

In parallel with this development, electric vehicles are expected to become much more common on our roads over the next ten years. The IEA estimates that by 2025 the global electric vehicle fleet will amount to about 50 million vehicles, and about 275 million by 2040. This electrification is being led by the Asian market, and especially China. This is also an important issue for Sweden, considering the significance of the domestic vehicle industry.

Solar and wind power are fundamentally redrawing the energy map

It is not only the phasing out of fossil primary energy that is radically changing the previous energy logic. We are also seeing the beginnings of a change from large-scale, controllable production and distribution of power and heat to systems that are based on small-scale, intermittent prosumption (where the same unit is both producer and consumer). This is enabled by the development of small-scale power production from solar and wind as well as the storage of surplus energy (battery technology). The electrification of the vehicle fleet is also a piece of this puzzle. In the longer term, electric vehicles cannot only be charged but also act as temporary storage of the surplus of intermittent production.

This development is still in its infancy, but practically every large energy companies are producing new business models based on a changing energy landscape. For example, Skellefteå Kraft and A-hus have built an “off-grid house” – a house that, in a cold, northern climate, is completely energy self-sufficient and needs no connection to the power grid or district heating network. An electrified vehicle fleet would accelerate this development over the next decade, in line with a fundamental change in the business models of the energy sector. Many energy companies are now talking in terms of going from “selling kWh” to “guaranteeing effect”.

Continuing focus on energy efficiency

There has been a strong focus on energy efficiency for many years in both transport and the development of the society. For example, the average fuel consumption of new vehicles is lower than it was ten years ago, various systems have been introduced for the environmental classification of buildings and a number of different control instruments have been introduced by central government. It is thought that digitalisation and better systems for automatic energy saving will increasingly influence work on energy efficiency. Many property companies are already installing sensors in heating and energy systems. Using the data collected, smart algorithms can then help to radically reduce energy consumption. Google's AI service "Deep Mind" has succeeded in reducing energy consumption in test properties by 40 per cent at a far lower cost than that of rebuilding.

Removing the obstacles to sustainability proactively, not reactively

Since environmental issues first came into the spotlight in the early sixties, environmental measures have often been reactive and about handling the
negative effects of existing developments. The focus was on removing emissions and handling waste and toxins. There is now an ongoing discussion about how societal solutions can be designed to create sustainability by proactively avoiding obstacles to sustainability at an early stage. In today’s planning, one of the expressions most frequently used is “smart”: smart cities, smart power grids and smart buildings. The smart aspect usually involves energy and transport solutions based on digital AI services that optimise total solutions that take into account a complex structure including many parameters. These systems are being used, for example, in global growth environments where large new cities are to be built from the start.

The scope of sustainability work is also being widened, from a primary focus on ecological sustainability to include the social aspects. In this context, the UN’s Agenda 2030 reflects the major role of driving forces, and the UN’s own framework programme for research, towards increased sustainability.

The structuring of society today makes more use of terms such as liveability, well-being and security. At the same time, it can often be a challenge to work on social sustainability in practical ways, particularly because it is often more difficult to measure the social aspects than ecological sustainability, which has a scientific basis.

The circular economy is making headway

“Circular economy” has been a fashionable term for some time, but it is now starting to make serious headway in both society and the business world. There are increasing demands to make better use of our resources and to meet climate targets, right across the board from countries to individuals. For example, the EU has adopted a strategy for the circular economy that has been implemented in the member countries to a greater or lesser extent.

The EU model for a circular economy

![Circular Economy Diagram]
Resource productivity has increased over the last decade at EU level, which means that material consumption has fallen compared with GDP. This means that resources are used more efficiently and less is wasted. Resource productivity in Sweden has not increased as much, but it is almost 10 per cent above the level of 2000.

At present, the Swedish system is based on waste management, with the focus on recycling and with producer responsibility. The recycling rate here has increased, but a drastic leap to the next level (such as product rather than materials recycling) will require changes in system design. There are many initiatives in this direction at lower levels, but it is difficult to make out any combined effort.

Measuring resource use in relation to GDP is a way of measuring the resource efficiency that the circular economy leads to – it is not only about linear improvement but also in many cases about restructuring business models. Resource efficient business models are being investigated by a number of different organisations, often in collaboration with universities and the authorities. These are expected to be a key to efficient use of resources, reducing waste and creating a more circular economy. It is difficult to say how many companies use circular thinking and to what extent, but incentives to adapt are now greatly increasing.
2.3 More people living in growing urban regions and increasing differences in lifestyles

Sweden's population is growing, because of increasing immigration, longer life expectancy and a birth rate that exceeds the mortality rate. There is strong urbanisation – more and more people are living in growing metropolitan regions, commuter suburbs and urban neighbourhoods. Urbanisation changes the demographics. In the cities, the working-age population of 20 to 64 has increased, while in rural areas the proportion of older people has increased. Economic segregation has also increased, which has resulted in an increasing gap between areas that are resource-rich and resource-poor – between urban and rural as well as within individual municipalities.

Population increase through migration, baby boom and people living longer

Over the last century, the world's population has greatly increased. It was previously thought that the rapid population growth would stabilise and gradually subside, but now the prediction is continued growth for the rest of the century, and at a more rapid pace than before. According to the UN Population Report, by the end of the century the world's population will be 13 billion (7.6 billion in 2018\textsuperscript{38}) and it is mainly the poorest parts of the world that are expected to see the greatest population growth. The most rapid population growth is expected to be in Africa, with a growth of 3.2 billion people by 2100\textsuperscript{39}.

Sweden's population is increasing too. In 2017, the population passed the 10 million mark and is expected to grow to 11 million by 2026, which would be the most rapid population growth in Sweden's history\textsuperscript{40}. By 2070, the Swedish population is expected to reach almost 13 million.

In Sweden, population growth is mainly being driven by increased immigration, increased life expectancy and a birth rate that exceeds the mortality rate. In 2016, about 144,000 people migrated to Sweden, which is the highest figure ever. The number of foreign-born citizens is expected to increase. Today, more than one Swede in six was born abroad\textsuperscript{41}. The corresponding figure for 2010 was one in eight. According to a Statistics Sweden report on Sweden's future population 2017-2060, the number of people born abroad is expected to be 2.4 million in 2027, compared with about 1.9 million at present\textsuperscript{42}.
People in Sweden are also living longer. Average life expectancy has increased and according to a forecast from Statistics Sweden, there are expected to be more than a million people aged 80 or over in Sweden by 2045. Childbirth is also expected to increase markedly in the 2020s. The main reason for the increase is the number of people born in the 1990s who will come into childbearing age in the next ten years, but also that many immigrants are young adults who are in family formation age43.

Growing differences between people, places and regions

Ever since the breakthrough of industrialisation, the development of agricultural methods and improving economic opportunities, people have increasingly turned to the cities. More than half the world’s population live in cities and this is expected to grow to 70 per cent by 205044.

In Sweden too, more and more people are living in growing metropolitan regions, commuter suburbs and urban neighbourhoods. The suburban municipalities have seen rapid population growth in recent decades45. This type of residential pattern has led to an increase in commuting. Urbanisation has also changed the demographics. In the cities, the working-age population of 20 to 64 has increased, while in rural areas the proportion of older people (aged 65 and over) has increased46.

Another aspect is the increase in socio-economic differences. Sweden is the OECD country where economic segregation has increased the most since 199047, albeit from a low starting level. This has resulted in an increasing gap between areas that are resource-rich and resource-poor – between urban and rural but also within individual municipalities48. This has led in a number of areas to increasing differences in living conditions for people living in different parts of the same city and for those living close to a city as opposed to those living further away – in income levels, perceived safety as opposed to crime, unemployment and school results49.

There is also an increasing gap between those who work and those who are outside the labour market, with integration issues being a significant explanatory factor. The housing market is also described as a great barrier to social mobility50. Overall, there is nothing at present to indicate that differences within Sweden will decrease – it is quite the opposite.
More heterogeneous lifestyles and values

In terms of values, Sweden is an extreme country with a combination of a high level of secularisation as well as trust, tolerance and equality. In other words, freedom and individualism are of great importance to Swedes. This strong individualism has led to great acceptance of self-realisation. Lifestyle and interests are key and there is little will to compromise one's own needs and perceptions. In metropolitan regions, one's own needs can be realised in specialist shops, restaurants and leisure interests. In addition, it is easier to find others who share the same lifestyle than in areas with fewer people. Another effect of individualisation is the great increase in one-person households. Sweden has the highest level of one-person households in Europe. In Sweden today, 1.5 million people live alone.

As a reaction to this strong individualisation, many people have felt an increasing desire for community in recent years, but the basis for these communities has changed. Many people are choosing their groups by seeking people with similar values and interests where the community consists of the chosen lifestyle rather than a community based on the people you grew up with (family, relatives or school class). What dominates are each individual's or self-chosen group's welfare, in both value and practical issues.
2.4 An increasingly service-based economy amidst uncertain global development

International trade has been a cornerstone of Sweden's welfare for a long time and our dependence on the outside world is great, not least because of the limited size of the domestic market. At present, global development is more uncertain than it has been for many years. Exports of services are increasing, while the value of the flow of goods is unchanged. This underlines a development that has been shaping the economy for some time – the growth of a less material economy, with value increases from processing that do not represent the manufacture of physical products.

Global trade has levelled off but the volume of goods is increasing

The economic value of world trade has levelled off since the start of the decade, which can be explained by falling oil prices. However, the volume of goods being transported across national borders is increasing. The volume of goods carried by sea increased by about 2 per cent in 2015–2016 and it is expected to increase by 2–3 per cent a year over the next three years54. The value of global service exports has also steadily increased in the last decade, with a combined increased of some 60 per cent since 200655.

![World trade in commercial services, US$ billion](source: World Trade Organization)

Trade opportunities with the outside world are very significant for Sweden. The Swedish economy is heavily export dependent and Sweden is ranked as the world’s seventh most competitive economy56. Sweden’s cross-border trade has steadily increased since the early 1980s, with a temporary fall after the financial crisis of 2008. During the 2010s, the economic value of foreign trade increased by approximately 20 per cent57.

The service industries and immaterial economy are increasingly significant

Global service exports are increasing while the value of goods traded is standing still. This underlines another trend that has shaped the economy for some time – the development of the immaterial economy, i.e. value increases from processing that do not represent the manufacture of physical products. Since the start of this decade, the service industries’ share of all Swedish exports has increased from 22 to 31 per cent58.

At the same time, the knowledge-based proportion of the value of the physical products has increased in real terms, so that the increase in the immaterial economy is even greater. The development towards an increasingly immaterial economy affects the Swedish economy and competitiveness, but it also has a great effect on local labour markets and associated transport needs.
An increasingly asymmetrical world economic order?
Because of urbanisation, the imbalance between former economic situations is also increasing. Many of the growing metropolises have an economy greater than that of some countries. Within countries, it is often the cities' proportion of the national economy that is increasing. In the longer term, we can perceive a development in which it is cities rather than nations that become the basis of the economy, development and taxation.

The major private corporations are growing in size correspondingly. The five largest platform companies currently represent about 40 per cent of the value of the Nasdaq 100 index (the 100 most traded shares in the USA). Their market value is many times greater than many countries' GDP.

World, largest listed companies by market capitalisation, US$ billion

As with the largest cities, it will be important to monitor these large corporations' ambitions to exercise economic power in the future. Is the world moving towards a more asymmetrical order in which the struggle between nations is replaced by an economic struggle between cities, companies and nations in different constellations?

Will increased protectionism and separatism change the global economy?
The development of global free trade has been a cornerstone of global politics for many years. The various regional trade agreements (RTAs) in different parts of the world have been very important for the development of economic welfare. In both the EU and NAFTA, most cross-border trade occurs within the respective trading agreement area and this development has been stable for many years.

However, in recent years there have been indications of this trend decreasing. Above all, it is the various forms of protectionist movements that have become ever more evidently. Brexit, developments in Catalonia, the USA tearing up the NAFTA agreement for renegotiation and the difficulties in arriving at a new TPP agreement are all examples of changes that have great significance for the Swedish economy and by extension transport needs. At present (2018) it is difficult to say whether these beginnings of protectionism are having any real breakthrough or whether they stem from political rhetoric to address domestic opinion.

In spite of everything, the main trends continue – Sweden is more and more incorporated into international collaborations. EU, for example, is intensifying its internal harmonisation and entering into new trade agreements with various countries throughout the world. This can be seen in an ever more interwoven energy market, that more and more EU-based companies are looking towards Sweden for assignments and that Swedish legislation is increasingly dependent on decisions at EU level. It can also be noted that China is showing interest in financing infrastructure in other countries and is buying its way into the European vehicle industry. Thus, the main trend is still global interweaving, but the question of increasing protectionism should be monitored in future.
2.5 Greater focus on societal security and vulnerability

We live in an ever more interwoven and open world. Globalisation and digitalisation have created a mutual interdependence within society and led to the increasing exchange of goods, workforce, information and capital. This interdependence also leads to vulnerability. Digitalisation especially leads to new types of risks, with its comprehensive effects on all the institutions of society. New risks are seen as the effects of globalisation – migration’s effect on geopolitics and integration, as well as the inability of individual countries to address the climate threat. New challenges for society and media coverage of attacks on both individuals and societal organisations have contributed to increasing anxiety and a focus on security and vulnerability by both individuals and social systems61.

Cyber (in)security and digital vulnerability are increasingly relevant issues

In the wake of the growth of the modern, interconnected society, a lack of security in established societal systems has also become evident. Information security and coordination problems in the interconnected society are topics that will become increasingly relevant. This was made clear, for example, in summer 2017, when it was found that security-classified information was being processed by non-security-classified personnel after the Swedish Transport Agency outsourced its IT operation to an external party. Since then, there has been a mustering of political strength to ensure that such situations will not occur again. The government has adopted a new national cyber security strategy. The strategy embraces society as a whole, that is to say central, local and county authorities, companies, organisations and private individuals62.

The Swedish Parliament (Riksdagen) has also passed a new law on protective security. The legislation comes into effect on 1 April 2019 and covers all those who run any kind of security-sensitive operation, whether public or private. It includes, for example, organisations involved in power supply, telecommunications and transport. In these operations there shall be ongoing analyses to determine security needs and each organisation must security classify its activities. The requirements of this legislation may result in increased costs for the organisations affected63.

Increasing geopolitical uncertainty

In recent years, events in Sweden’s immediate vicinity and further afield have given increasing relevance to questions of security policy and the protection of society. Russia is showing a more active role in the region close to Sweden and Turkey has taken a central role in maintaining refugee policy in Europe. Uncertainty about events in Syria and on the Korean peninsula and tension between Iran and Saudi Arabia have also brought security policy into greater focus.

It is not only tension between countries that has increased. In recent years, there have been terrorist attacks and acts of violence in many western cities, including Stockholm, which has led to an increasing feeling of anxiety and uncertainty in these countries64. This feeling has been furthered by the protectionist tendencies in many countries both in the EU and in other parts of the world.

The changes that have occurred in security policy have led to governments around Europe encouraging their citizens to check their preparations for long-term war or crisis. An example of this is when Angela Merkel encouraged the people of Germany to stock up on water and food in autumn 2016. Similarly, in December 2017 the Swedish parliamentary defence committee recommended that every household should be prepared to manage on its own for a week without supplies65.
MSB (the Swedish Civil Contingencies Agency) produced a brochure “If crisis or war occurs” which is intended to increase people’s knowledge about preparations for crisis, raised crisis levels and ultimately war.

The brochure was distributed to 4.8 million households in May 2018. Sweden is also now increasing its defence capabilities in the face of the challenges and threats that have followed from the changing security position in the region. In spring 2017, the government decided that Sweden’s defences should move towards being a more national defence force and decided on basic military training through the reintroduction of conscription.

Fake news, failure of confidence and increasing feelings of anxiety

Arriving at the truth by means of objective information is a key principle of an open society. There is widespread anxiety that this principle has been undermined in recent years. Fake news has been launched as an expression to formulate people’s distrust of the media. There is a lack of criticism of the sources among both consumers and producers of media. There are also reports from both the USA and the Brexit vote of foreign powers using digital trolls to become involved in national political discussion and of how the election campaigns used “dark advertising”, i.e. special messages that were adapted according to who was looking at them. Before the Swedish general election of 2018, the Swedish Civil Contingencies Agency was therefore commissioned setting up a special project group to investigate the need to protect the election and support those who were working on implementing and protecting the election.

Confidence is a kind of capital in society, which is true for all public institutions. The public’s confidence in the legal system is essential for its legitimacy and its ability to perform its work. The national security survey (NTU) of 2016 shows that confidence in the legal system and the police is relatively high among the Swedish population. However, it also shows that insecurity and anxiety about crime have increased compared with previous years. The percentage of people who feel insecure when they go out alone in the evening in their own neighbourhood has increased and almost one person in three is worried that someone close to them will be the victim of crime.

An increasing feeling of anxiety is something that the Swedish Civil Contingencies Agency also found in its Opinions survey. There has been a question about perceived anxiety about the global situation in the survey since it began in the 1980s. Seen over the course of time, the percentage of those who feel great or fairly great anxiety about the world’s political situation is the highest since the 1980s. In recent years, there has been a marked increase in the percentage of respondents who feel great or fairly great anxiety about the world’s political situation. In 2016, the figure was 73 per cent compared with the 50 per cent that had been the stable level from the 1990s until a couple of years ago.

Climate change effects point to vulnerability in society

Researchers the world over agree that climate change is a fact. The question is no longer whether it will occur but how great it will be. A report by the World Meteorological Organisation (WMO) indicates that natural disasters such as storms, floods and heatwaves are occurring five times as often as in the 1970s – an effect that is occurring and is evident all over the world.
Climate change will have consequences for both people and nature all over the world. To be ready for these challenges, society’s buildings need to be increasingly adapted and designed according to climate developments, both today’s weather events and the climate change that is to come. To make work on climate adaptation easier, a collaborative portal for the authorities called klimatanpassning.se has been established. This portal has information about how concrete measures can be taken to protect existing and future buildings and activities from the risks that follow in the wake of climate change.

Since the road and railway networks extend across large rural and urban areas, transport solutions are definitely an area that is affected by, and can be vulnerable to, climate change.
3. Trends in the transport system
3.1 An increasingly digitally based and automated transport system

With the aid of new technology, the trend in the transport system is towards ever-greater automation. Information volumes increase, which could lead to new types of decision-making support and services. This could help more efficient solutions to grow, but there may also be a need for political governance of society to ensure that use of the new technology contributes to transport policy goals. Security and integrity are especially important aspects to take into account in this development.

Automation and AI are developing the transport system

AI, robot technology and augmented intelligence have the potential to bring about great changes in the transport system. To begin with, there is often uncertainty about the effects of technical development. Robot technology with augmented intelligence is being developed exponentially, which is expected to change conditions in many areas. Robot technology with augmented intelligence already exists and its application will become more and more evident in the future.

The technology that permits digitalisation has an exponential pace of change. Individuals start using technology quickly, while adaptation in organisations and the development of rules is slower, which affects the ability to make full use of the opportunities of technology.

Source: Deloitte University Press73.

Automation has long been used in shipping and aviation in the form of autopilots. This development continues and vessels and aircraft are being given more and more automatic functions. Robot technology with augmented intelligence could optimise traffic planning, business transactions and bookings in shipping. Simplified rules and situation management could mean that human input is for handling non-conformances or verifying new traffic data. In aviation, new technology and intelligent systems are expected to make remote monitoring and related services more efficient. The capacity of airspace will need to be optimised to give the increasing number of unmanned aircraft (drones) access in a safe and efficient way.
Automatic trains are found in many places in the form of driverless metro systems, which are however closed systems. It is more complex to introduce automatic trains in open systems with mixed traffic and level crossings. In the relatively near future, semi-automatic support systems will be produced that will help to optimise capacity and minimise energy consumption. In the longer term, these can be developed into fully automatic systems. The use of these new automatic train operation systems will be made easier through the introduction of ERTMS, which is a common EU standard for signal systems in Europe. The system is fully digitalised and allows the operation of railways to become more flexible.

The development of technology for self-driving road vehicles started many years ago, with the focus on traffic safety, technical innovation and cost saving, and is now proceeding rapidly. One explanation of how even this complex environment can move towards automation is that artificial intelligence is being developed rapidly and can now replace drivers by means of self-learning and cognitive algorithms. The rapid development in recent years means that a number of vehicle manufacturers have said that they will be launching self-driving vehicles at level 4–574 (high–full automation) onto the market in the early 2020s75. In a study of how far the development of automated vehicles has come in the Nordic region, 75 experts on connected and automated vehicles said that vehicles with automation will be fully developed and a natural part of the street environment in Sweden in the mid-2030s76. However, others have stated that full automation will not be achieved in the foreseeable future, since technology that could recognise and cope with all possible situations in the complex road traffic environment would take a long time to develop and verify77.

Another expert group has pointed out that cost-effectiveness considerations would mean that the introduction of self-driving vehicles could occur more quickly for goods transport than for passenger transport. This group also believes that it would be easier to convert long-distance road transport into self-driving vehicles than vehicles in city conditions, which involves transport in a complex environment with many loading and unloading points78.
On the way to safer road traffic and increasing congestion?

When self-driving road vehicles are introduced, the traffic in the infrastructure will consist of vehicles with various degrees of automation. The vehicle manufacturers’ approach is to construct self-driving vehicles that would be able to use the existing road infrastructure regardless of the infrastructure managers. However, it is important to monitor this development and how it might affect road design. Regardless of when self-driving vehicles at level 4–5 become reality, a key question remains: How will self-driving vehicles address the transport challenges of today and tomorrow? As well as traffic safety, these challenges involve congestion in urban environments, noise and air quality, sustainable and efficient goods transport and value for money mobility services.

What the effects of automation will be in road transport is uncertain, but since very many road accidents are due to the human factor, we could look forward to safer road traffic as automation is developed. The pace of this development is not only a matter of technical development but also how citizens and society will accept self-driving vehicles. It concerns people’s acceptance of self-driving technology, the cost level of self-driving vehicles and how the rules are developed. Another issue that must be considered is how self-driving vehicles with varying degrees of automation are to be integrated with each other and with other road users.

The long-term benefits of self-driving vehicles are mainly affected not by technological progress but by what role self-driving vehicles will have in our society. It is therefore important that there is a discussion about how rules and political instruments should be used to achieve the greatest possible benefit for society. The introduction of self-driving vehicles could lead to both positive and negative effects on transport policy goals. What effects finally occur could be affected by the services’ design, user acceptance and control by society. More efficient and sustainable transport solutions could be developed by means of combined mobility as a service – that people could buy a journey that combines a number of means of transport. This could increase the proportion of shared journeys as against private car use, but this development is uncertain.

The information flow in the transport system is increasing

Digitalisation generates large volumes of data about traffic and infrastructure through various types of sensors (the internet of things). For example, self-driving vehicles create enormous volumes of data through their own sensors, cameras and radar systems. Estimates indicate that a single self-driving vehicle will produce 4,000 gigabytes of data per day.

The large volumes of data generated from infrastructure and vehicles create new opportunities for analysing the information, for example through what is known as big data analysis, and producing decision-making support of various kinds for vehicle manufacturers, infrastructure owners and contractors. Thus, there will be no shortage of data in the transport system but a resource that can be used in the most effective way. It will be a challenge to handle the rapid growth of traffic-related data that is produced to benefit the transport system. It is thought that developments in artificial intelligence will help in this respect. Another challenge will be to verify the correctness of the information flowing through the transport system. Blockchain technology may have a vital role here, to track goods throughout the transport chain for example. This technology can be used to handle digital transactions in which all transactions are visible to the parties involved.

The volumes of information will improve conditions for using the transport system in a more efficient and sustainable way, for example by making use of available capacity in the transport system. Improved access to data in various
forms provides new opportunities to develop all parts of the planning of the transport system. Having a common picture of the present position, needs, shortages, proposed solutions and targets creates greater opportunities for making well balanced decisions. Digital interconnection of vehicles, infrastructure and portable devices in the system will give new and valuable knowledge about traffic conditions, infrastructure status and traffic behaviour. Issues that must be given special consideration include personal integrity and data security, as well as functional security (see also section 3.5).

Future journeys and transportation may be made more efficient by the development of traffic planning and management, as well as improved information to road users and passengers that is partly based on real time data. Passengers’ and road users’ expectations for relevant traffic information as a basis for choices both before and during their journeys are likely to increase. New solutions will allow for better quality of traffic information, as well as providing traffic information services that cover many forms of transport.

With the aid of new technology, the ability to predict maintenance needs and optimise the maintenance of infrastructure will also improve. This assumes access to the correct information about the infrastructure. Costs can be reduced and quality improved by automating the collection of information about the infrastructure and its condition. Better knowledge of the infrastructure and its condition will create opportunities to predict deterioration caused, for example, by increased traffic, heavier traffic or climate changes. This will also improve opportunities for procuring maintenance contractors based on functional requirements and to follow up these requirements.

Using new ways of collecting and spreading information, traffic safety and winter road measures, for example, could be made more efficient.

In shipping, digital depth data models could give opportunities for optimising load quantities and improve conditions for optimising routes. Being able to load more for each voyage and optimise the route brings both economic benefits and environmental savings. With sea traffic management (STM), digitalisation can optimise processes, improve interaction and information exchange between stakeholders and thereby increase the efficiency and safety of sea transport.
Digital systems for data sharing will enable air traffic to be optimised and disturbances minimised. The opportunity to plan and implement the whole journey can also be simplified. Digitalisation of air traffic service is happening rapidly and is preparing the way for virtual centres where services and the physical working position are connected, which gives opportunities for new business models, redundancy and efficient solutions.

The physical merges with digital descriptions of the physical through what are known as digital twins, which provides an opportunity to augment reality or perceive virtual reality. In the transport system, this could be used to visualise and verify measures before they are implemented. As new ways are created for producing information in the transport system through vehicles, vessels and aircraft, the need for physical installations in the infrastructure to monitor systems or traffic will be reduced. To make use of the potential in the increased volumes of information, new solutions will need to be developed for data exchange between different stakeholders, as well as methods and techniques for both protecting and analysing the information.

**New digital services create the “fifth transport mode” and travel-free accessibility**

Solutions are being developed that reduce the need for many journeys. Technology for participation in work and meetings is being developed rapidly and it is estimated that in the near future augmented and virtual reality technology will give such a feeling of being present at work and meetings that no journey need be made. This means that we could be anywhere in the world and still be present in the contexts where we are needed. Services that are already offered without travelling include education, health care and other care. In health care, a skilled surgeon can be used via digital solutions to perform operations remotely with the aid of operation robots. This example also shows how the accessibility of expertise, resources etc. can be improved with the aid of IT and digitalisation. A person will be able to offer his or her expertise and services and make these available in completely different ways than with conventional travel. This strengthens developments towards an increasingly service based economy.

Using digital solutions to provide accessibility without travel means that capacity problems, including as a result of commuting to the cities, could be better managed. Resolving capacity problems with the aid of travel-free accessibility would also probably be much cheaper than traditional measures. Digital solutions that remove the need to travel could also have positive effects for safety and the environment. For example, the agencies that participated in the REMM project (travel-free meetings for public agencies) reduced their carbon dioxide emissions from business travel by an average of 23 per cent per employee over a five-year period, which can be compared with a reduction of 4 per cent per employee in other agencies.

Reducing travel by methods such as these creates in turn the conditions for savings and for a better balance between work, family and leisure. New technology does not automatically mean that total travel is reduced, however. According to a report by the Transport Analysis (Trafikanalys), it has, until now been difficult to demonstrate that travel has been reduced at an aggregated level as a result for greater use of digital aids. A study by VTI indicates that households that buy food online continue to take the car to the supermarket to supplement what has been bought. In households without cars, buying online helps them to remain car-free. The conclusion is that, because households with cars continue to drive to the shops as well as buying food online, which is transported to the home, the energy saving is limited.
For the transportation of goods, new digital solutions may change transport patterns, with shopping moving from shops to the internet for example, which means that transportation to customers becomes more fragmented. In this context, a subject for discussion is the significance of the last mile in the home delivery of goods. This is a large expense item for the delivery company, which is driving the development of new technical solutions and business systems. Another effect is the increasing establishment of logistics sites (terminals, warehouses and distribution centres). The development of 3D printer technology could mean that traditional intermediaries are reduced, thus reducing the need for the transportation of goods.

Swedish online sales amounted to about SEK 60 billion in 2016, which meant that buying online accounted for about 8 per cent of all retail sales. The development of online shopping continues and industry estimates are that it will represent 20 to 30 per cent of retail sales by 2025. The return of goods that are ordered online involves increased transportation. One Nordic online shopping consumer in ten returns at least one item per month and in the fashion sector, it is not unusual for one item in three to be sent back. 23 per cent of Swedish online shoppers in the 18 to 29 age group have at some point in the last year ordered a product in more than one size or several colours, having already decided to return at least one of them.

COUNTER TRENDS AND COUNTER FORCES

Ever greater requirements are being set for managing data security and personal integrity, alongside the development of rules and standardisation. Accidents involving self-driving vehicles, the fear of someone taking control of the vehicle and difficulties in managing traffic with different degrees of automation could have impact on people’s acceptance of automation of the road transport system. These aspects could limit the use of the growing volume of information in the transport system and influence the pace of introduction of new technical solutions.

Noted at a workshop involving Transport Analysis, the Swedish Transport Administration and the Swedish Transport Agency on 27 April 2018.
3.2 Greater requirement for decarbonisation and lower emissions

The need to reduce emissions of greenhouse gases remains a dominant issue in the debate on how the transport system is to be developed. There are ever greater demands from various stakeholders to diminish the climate effects of the transport system and to phase out fossil fuels. Tougher political instruments are seen as a prerequisite, but it is difficult to achieve political agreement on them.

Driving forces for lower emissions are growing

It is estimated that emissions of greenhouse gases from road traffic in Sweden fell by about 2 per cent in 2017 because of energy-efficient vehicles and more use of biofuels. By comparison, emissions must be reduced by about 8 per cent per year over the next 12 years to achieve the target decided by the Swedish parliament of reducing emissions from domestic transport by 70 per cent in 2030 compared with 201094. We can also see that climate-influencing emissions from air traffic are increasing95 and the same is true for international shipping96. Globally, total emissions from transport are increasing because of increasing demand for both passenger and goods transport of all types97. The increase is greatest in countries that are not members of the OECD (Organisation for Economic Cooperation and Development), while the combined emissions of OECD countries have fallen somewhat over the last decade98. Transportation causes about a fifth of the world’s emissions99.

The EU has stated that, to manage a reduction in total emissions of greenhouse gases of 80 per cent by 2050, emissions from transportation need to be reduced by 54–67 per cent. New regulations for monitoring and reporting carbon dioxide emissions and fuel consumption will therefore be applied for new heavy vehicles with effect from 2019. The regulations will involve mandatory monitoring and reporting systems for heavy vehicles in all EU countries, similar to the system that already applies to cars and light commercial vehicles. This obligation will only apply to new vehicles that are registered in the EU. The main purpose of the system is to ensure that the monitoring and reporting of carbon dioxide emissions is correct and to create a basis for determining and maintaining standards for future carbon dioxide emissions100.

There are also other driving forces for changing energy consumption in the transport system. For example, India hopes to be the first large country where all vehicles are electric, as part of the country’s work on countering atmospheric pollution (in the form of nitrous oxides and particles). It is estimated that this pollution causes 1.8 million deaths a year101.

The International Transport Forum (ITF) predicts in its baseline scenario that passenger transport globally will more than double by 2050 and that the transport of goods will treble102. Economic growth is the major driving force for this. The ITF estimates that emissions will not increase to the same extent, largely due to increased energy efficiency. Even so, global emissions of carbon dioxide from transport are expected to increase by 60 per cent. The ITF also presents a scenario with optimistic, but technically possible, assumptions about lower emissions for all types of traffic compared with the baseline scenario, but where most of the reduction is in road traffic and shipping. Overall, this would mean a marginal reduction in emissions compared with 2015.
Even though there is a strong focus on emissions of greenhouse gases, emissions of other substances have been given a great deal of attention in recent years. One example is emissions of nitrous oxides from existing diesel vehicles, which have proved to be greater than previously believed, which has given rise to discussion on whether such vehicles should be banned from central zones of major cities. The Swedish government has decided to give local authorities the opportunity to introduce three different environmental zones with effect from 1 January 2020\textsuperscript{103}. If such zones are introduced, older diesel vehicles with a poor environmental performance will not be allowed to be used there.

Another example is cruise ships, which can emit so many particles that the air quality on deck can be as poor as in the world’s most polluted cities\textsuperscript{104}. It should be pointed out however that there are technical solutions that can reduce emissions of this kind.

**Major challenges along the way to decarbonisation in the Swedish transport system**

By 2045 at the latest, Sweden should have no net emissions of greenhouse gases to the atmosphere. The interim target for 2030 is that the total emissions from domestic transport, excluding domestic aviation, which is included in the EU system for trading in emission rights, shall be reduced by at least 70 per cent compared with 2010. This is stated in new climate legislation and in the framework policy for the climate. The climate target is also a key part of sustainable development and the UN Agenda 2030\textsuperscript{105}.

In Sweden, emissions from domestic transport, where road traffic is completely dominant, are being reduced. However, the reduction is not at the pace that is needed to achieve the target for emissions reduction from domestic transport by 2030\textsuperscript{106}. At the same time, emissions from international transport (air and sea traffic) are increasing\textsuperscript{107}. If the high altitude effect is included, Sweden’s international aviation emits more than half as much carbon dioxide equivalents as domestic transport. If international shipping is also added to air traffic, including the high altitude effect, emissions from international transport are at the same level as domestic transport.

The transport sector’s energy consumption, in terms of both quantity and type of energy, is a major challenge to decarbonisation. According to the Swedish Energy Agency, the total energy consumption in the transport sector is expected to be largely unchanged until 2020\textsuperscript{108}. The use of biofuels continues to increase and in 2017 the proportion of biofuels in the road transport sector increased from 19 per

---

**Carbon dioxide emissions according to OECD’s baseline scenario, million tons**

![Graph showing carbon dioxide emissions](image)

*Source: International Transport Forum*

Emissions from international aviation and sea air freight are not divided between OECD and non-OECD.
cent to 21 per cent\(^9\). In parallel with this development, electric vehicles are expected to become much more common on our roads over the next ten years.

On an international scale, the proportion of plug-in vehicles is high in Sweden, although it is significantly higher in Norway. In 2017, the number of plug-in vehicles in Sweden was about 50,000, while there were about 175,000 in Norway. In the Nordic countries, plug-in hybrids are growing at a faster rate than pure electric vehicles\(^{10}\). The electrification of the vehicle fleet is also a piece of the puzzle. In the longer term, electric vehicles cannot only be charged but it can also act as temporary storage of the surplus of intermittent production.

Average carbon dioxide emissions according to EU norms for new cars, grams per kilometre

![Graph showing average carbon dioxide emissions for new cars from 2001 to 2017 for various countries.](source: Swedish Transport Administration)

Average fuel consumption for new vehicles is lower than it was ten years ago. This is partly due to improving energy efficiency by setting constantly lower consumption targets. However, this trend now appears to have levelled out. The average carbon dioxide emissions for vehicles sold in 2017 were at the same level as the previous year\(^{11}\).

In Swedish and Nordic shipping there is increasing commitment to different forms of renewable energy sources and technologies for reducing carbon dioxide emissions against a background of rising fuel costs and greater pressure to reduce emissions. This is demonstrated in everything from the possibility of using fuel cells to more efficient use of existing fuels. For example, Wallenius Wilhelmsen recently conceptualised a zero-emission vessel, E/S Orcelle, that will only make use of energy sources that already exist at sea: wind, solar and waves.

In the Swedish Transport Administration’s ferry traffic there is also conversion to decarbonisation\(^{12}\). Between now and 2045, this will involve building 25 new ferries and adapting the existing fleet to use different kinds of fossil-free fuel. Old technology will be phased out and self-propelled ferry crossings will be converted to electric cable operation where possible. Work is also going on to use solar energy for ferry crossings, on energy-saving operation and on the development of sustainable technology.
The Swedish Transport Administration’s ferry Neptunus will have a sister ferry on the Gullmar crossing by summer 2019. The ferry’s name will be Tellus. It is being built as a plug-in hybrid ferry and will become Sweden’s largest environmental friendly car ferry.

Interest is also increasing in non-fossil energy forms for aviation. The government has set up an investigation into instruments to promote the use of biofuels in aviation. Electric powered aircraft are also under development. The ambition in Norway is that all domestic flights will be electric by 2040. Wright Electric has already developed a two seat electric aircraft, but has plans to build a version with room for up to 220 passengers. One challenger to pure battery power is hydrogen. 2017 saw the trial flight of an aircraft developed by the German Aerospace Centre that combined hydrogen powered fuel cells with a powerful lithium ion battery.

**Technical development is rapid – fossil-free fuel technology be cheaper**

A number of technical solutions are being developed in parallel, such as pure battery power, fuel cells, electric roads and various forms of hybrid solutions. Of these solutions, it is primarily battery-powered vehicles that are commercially available today, but it is also possible to buy vehicles powered by fuel cells. There is no clear trend showing which technology will be most successful in the long run.

Fossil-free alternatives mainly exist in the railway system and the car market. Making trucks, aircraft and ships fossil-free is more difficult. However, there are also developments here, primarily in energy efficiency. There is also testing of electrification of road infrastructure, in the form of electric roads. This involves transferring electricity to the vehicle during the transport. Biodiesel also accounts for a high proportion of the diesel sold in Sweden. However, biofuels are not seen to have great potential in the rest of Europe or globally. It is predicted that in a few years the use of cars with fossil-free technology will be cheaper than using present day cars with fossil technology. This has not happened yet, although the sale of electric powered cars is increasing, though admittedly from a low base level.
**Tougher policy instruments are foreseen**

Many people see economic policy instruments as the most realistic way of reducing emissions of greenhouse gases from the transport system. In an inventory of Swedish environmental policy, the National Institute of Economic Research (KI) states that the most cost-effective way of reducing emissions is if all stakeholders have the same margin expenses for the emissions, for example through a uniform carbon dioxide tax\(^{116}\). However in Sweden there are more climate policy instruments than carbon dioxide tax, such as premiums for environmental vehicles, bonus-malus systems, carbon dioxide differentiated vehicle tax and reduction obligations. KI states that the present policy gives great incentives for fuel conversion and efficiency but few incentives to reduce vehicle use.

In Europe, a great deal of the carbon dioxide emissions are regulated through the EU system for trade in emission allowances. This covers emissions from industrial activities and energy production. By successively reducing the number of emission allowances, emissions from the traded sector in the EU will be reduced. Emissions from the fossil fuel that is used in the transport sector are not covered by emission allowances. However, aviation within Europe and the electricity that is used for electric powered vehicles are covered.

Since 1 April 2018, there has been a national air travel tax for flights within and to and from Sweden. Domestically and within the EU, the tax is SEK 60. For travel to countries outside the EU and less than 6,000 kilometres away, the tax is SEK 250 and for longer haul flights, the tax is SEK 400. Opinion is divided as to whether this will affect total air travel or emissions largely, noting that this is not a theoretically optimum design of the tax. However new rules for the annulment of emission rights in the EU ETS (EU Emissions Trading System) mean that it is more advantageous to reduce emissions with other instruments even within the system.

In shipping, the IMO (International Maritime Organisation) has decided that a globally mandatory system for reporting carbon dioxide emissions and fuel consumption will begin to apply in 2019\(^{117}\). The idea is that the information can be used to design instruments to reduce fossil emissions and help to achieve the IMO’s target of halving carbon dioxide emissions from shipping by 2050\(^{118}\).
The sharing economy creates opportunities in the transport system

The concept of a circular economy includes reuse, material recycle and reduced need for goods by means of shared resources\(^{119}\). To help society’s transition to a resource-efficient, circular and biobased economy both nationally and regionally, the government has appointed a delegation for the circular economy\(^{120}\). The delegation is an advisory body for the government, located at the Swedish Agency for Economic and Regional Growth.

Examples of shared resources in the transport sector are air traffic, trains, buses, taxis, car rental and car pools, car sharing and cycle hire. A great deal of freight transport is also done with vehicle resources that are shared between different freight transport customers. Digital development creates the conditions for the even more efficient use of shared resources, which is often manifested in new business models. This means that the accessibility of shared resources can increase while the costs of using them are reduced. Sharing resources in the form of vehicles may mean that the vehicle fleet is replaced more quickly, which could mean the faster introduction of more energy-efficient and safer vehicles that can run on renewable energy. In this way, the increased use of shared vehicles could help to reduce emissions from vehicle traffic.

Opinion is divided on whether more effective opportunities for sharing resources creates increased demand for travel and transport, thereby increasing traffic, or whether they lead to reduced traffic. For example, people who did not previously own a car might increase their car travel if their access to a shared vehicle was sufficiently good and well priced. On the other hand, people who give up their private cars to make use of shared cars have an incentive to drive less. The introduction of the Uber service has attracted not only former taxi users but also people who would otherwise have used public transport. It is felt that future developments will greatly depend on future regulations and taxes.

COUNTER TRENDS AND COUNTER FORCES

International agreements on emission reduction risk losing force as a result of the USA leaving the Paris Agreement and climate sceptics seeing support for their arguments. Travel is increasing and in spite of increased awareness of the climate effects of flying, for example, we are flying even more. Uncertainty about technology, fuel and economic developments risks undermining the stricter requirements for decarbonisation and emission reductions. Politically, it may be difficult to implement the measures needed to achieve the established targets.

Noted at a workshop involving Transport Analysis, the Swedish Transport Administration and the Swedish Transport Agency on 27 April 2018.
3.3 Continued pressure for high accessibility and good transport opportunities

The growing population, economic developments and urbanisation, together with increasing welfare and global trade, are leading to increasing pressure on the transport system – for both passenger travel and the transport of goods. There are also increasing demands for sustainable accessibility, such as requirements for decarbonisation and equal opportunity, reducing economic gaps and a transport system for all. This affects, and sets new requirements for both social planning and the development of technology and new services.

Passenger trends increase with population growth

The world’s population is expected to continue to grow for the rest of the century. The result of population growth and higher expectations for a flexible and accessible transport system will be increased demand on the total transport network. This will mean greater demand for both infrastructure and the services offered. Economic growth also affects demand for travel and transport. There is a strong connection between GDP per capita, fuel costs and vehicle kilometres per person. It is forecast that by 2030 the annual global traffic will amount to as much as 80,000 billion person kilometres, a 50 per cent increase from 2015.

The population of Sweden is also growing, which affects the need for transport. Between 2014 and 2040, total passenger-distance for cars, buses, trains and aircraft is expected to increase by 32 per cent, according to the Swedish Transport Administration’s baseline forecast. Expressed in person kilometres (pkm), this is an increase from 132 to 174 billion. The greatest percentage increase is expected to be for passenger transport by rail: from 14 to 21 billion pkm. This corresponds to an increase of about 1.7 per cent per year.

Greater need for accessibility and mobility

More and more people in Sweden are living in growing metropolitan regions. The growth of the cities is mainly due to people moving within the country, but a birth rate that exceeds mortality, longer life expectancy and increasing immigration are also contributory factors. This demographic change leads to changes in both lifestyle and behaviour. To some extent, this may be due to changing preferences and attitudes, but it could also be a consequence of many people entering the labour market and starting families later in life. The economic gaps are also expected to
increase as an effect of urbanisation\textsuperscript{124}. Creating an inclusive society requires the transport sector to promote sustainable transport solutions that are accessible throughout the country and for all types of societal groups.

Urban metropolises have a tendency to be linked together and form a so-called polycentric network\textsuperscript{125}. One example of this is the Stockholm region, which has an increasing need for a polycentric design. This brings new opportunities for more houses and jobs to be provided closer to different centres, thus increasing accessibility\textsuperscript{126}.

Urbanisation and people’s changing lifestyle preferences, such as a greater focus on health and climate, affect how the transport system must be adapted\textsuperscript{127}. For example, both large and small municipalities around the world are investing in pedestrian and cycle paths. A national survey of travel habits has shown however that cycling is in decline, even though many municipalities in Sweden have seen an increase in cycle traffic. This varied picture could be explained by an increase in cycling along central stretches, where the measurements are often made, but a reduction in cycling outside these stretches\textsuperscript{128}.

Tourism continues to increase in Sweden\textsuperscript{129}. In spite of the EU’s statistics body Eurostat’s earlier forecast of a partially negative trend, the number of bed nights in commercial accommodation in Sweden continues to increase. In total, there were 63 million bed nights in Sweden in 2017, which is a 2 per cent increase over the previous year. The weaker interest in the Nordic market is countered by more foreign bed nights.

Technology and digital services mean new travel habits

Car sharing services are increasing rapidly, reducing the need for private car ownership. Globally, the number of car pool users increased from 346,000 to 4,800,000 between 2006 and 2014 and the number of car pool vehicles from 11,500 to 104,000\textsuperscript{130}. In a global survey in 2017, 8 per cent of travellers with smart mobile phones stated that they share cars, taxi cars or bicycles\textsuperscript{131}. This means that these vehicles could be said to be part of the public transport system. Almost 30 per cent of the privately registered cars that are sold in Sweden are on private leases. These have greatly increased in recent years, from about 3,000 private lease cars registered in 2009 to almost 49,000 in 2016\textsuperscript{132}. However, the trend is no longer increasing; in 2017 around 44,000 cars were privately leased.
In Copenhagen, the use of cars has fallen in recent years and more people are using sustainable means of transport such as walking, cycling and public transport. In spite of this, car ownership increases every year, especially in newly built residential areas where the average household owns 1 to 2 cars. Solutions in the newly built Örestad give an idea of how this trend can be reversed. The norm for the number of parking places per home with new builds has been halved to stimulate the use of a new metro line and make it less attractive to own your own car\textsuperscript{133}.

Stockholm County is facing major challenges from population growth and urbanisation. The effective use of resources is important to be able to maintain and develop the existing position of public transport and contribute to sustainable growth in the Stockholm region. In this context, combined mobility services could be a valuable tool\textsuperscript{134}.

**Freight transports continues to increase**

The development of freight transport is clearly linked to the development of the economy as a whole. The technical development of freight transport will also affect the future, primarily in the balance between different traffic types. In particular, this can be expected to play a role when goods traffic must give up its dependence on fossil fuel in the next 20–25 years. Automation will also affect the balance between different transport modes. While heavy road transports using many vehicles will increase its competitiveness, the trend is probably not as important when it comes to shipping and railways, with fewer ships and trains to automate.

During the period 1995–2015, freight transport in Europe increased from 2,845 to 3,516 billion total ton kilometres, which corresponds to 24 per cent in total and 1.1 per cent per year\textsuperscript{135}. Developments varied greatly between traffic types: road transport increased by 34 per cent, shipping and transport on inland waterways by about 20 per cent and rail by 7 per cent during the period.

The Swedish Transport Administration’s baseline forecast 2018 for freight transport, estimated the annual growth for domestic goods transport at 1.8 per cent per year up to 2040\textsuperscript{136}. By transport mode, shipping is expected to increase by 1.9 per cent, road transport by 1.8 per cent and rail transport by 1.5 per cent per year. Regardless of whether the increase in payload-distance follows economic growth and whether the development is linear or exponential, both history and the baseline forecast suggest that freight transport will increase.
The goal of climate-neutral development attracts great national and international support, with more concrete targets of zero emissions of greenhouse gases by 2045. How can we ensure that freight transport has a place in a future fossil-free society and that the production and distribution of goods and services will continue to contribute to welfare and quality of life? It is assumed, based on forecasts and historical developments, that in the coming decades road transport will continue to dominate freight transport. Transferring freight transport from road to sea and rail will not change this, since the potential is estimated to be limited. However, hopes are high for technological development, such as automation, electrification and digitalisation. This emerges from ERTRAC’s (The European Road Transport Research Advisory Council) strategic research agenda, in which a number of research areas are connected with climate issues and carbon dioxide problems. The ways in which technology may provide breakthroughs and what effects these may have is still largely uncertain.

According to transport-specific analyses and calculations from Transport Analysis, with the aid of a coordinated goods model, between 80 and 90 per cent of the transport volume of goods to and from Sweden is in chains that include shipping. Shipping is most important for ore and mineral mining, the food industry and transport of crude oil, where shipping’s proportion of international transport is between 94 and 96 per cent. One long-term trend in freight transport by sea is that the load capacity of ships is increasing. The average size of newly ordered container ships in 2016 was 8,500 TEU (a measurement of how many 20-foot containers a ship can load). This is more than twice the present average size. This development is clearest in the container segment, but applies also to other segments, such as Ro-Ro vessels.

Digitalisation is another trend that affects shipping and freight transports. Ports and vessels are interconnected and exchange information with each other, which creates conditions for better planning in the supply chains, increases security and decreases energy consumption. Increased automation can lead to more efficient loading and unloading of ships in port.

**COUNTER TRENDS AND COUNTER FORCES**

Increasing protectionism, high customs duties and trade wars can lead to a reduction in international freight transportation. Travel to some destinations could fall because certain locations limit tourism because they think that the load is too great. Fear of terrorism could also affect people’s travel. The development of new technical solutions could reduce the need for physical travel.

Noted at a workshop involving Transport Analysis, the Swedish Transport Administration and the Swedish Transport Agency on 27 April 2018.
3.4 The transport system is becoming ever more integrated into the development of the society

Many of the great societal challenges that we face will require input from many different stakeholders in different areas. These challenges relate, for example, to climate effects, housing, the labour market, integration, equal opportunity, security and safety, as well as the provision of transport throughout the country. It is becoming ever clearer that the development of the transport system has a central role in addressing many of these challenges.

A greater need for collaboration between different stakeholders

More and more people in Sweden live in metropolitan regions, commuter towns and in urban neighbourhoods. Rural areas and smaller towns away from the commuter belt become more rural and have an ageing population. The transport system plays an important role for today’s society by providing the prerequisites for relationships over great distances. Regional planning plays an important role in matching regional and local initiatives for housing and the labour market with a developed and adapted infrastructure, in the first instance together with the business world and local authorities.

In metropolitan regions, regional planning often has a more physical approach and is for example about meeting the need for accessibility across local authority boundaries for a growing population. In rural counties, planning can be used as a basis for long-term development of various kinds of services and commerce. Today the metropolitan regions work as the cities did before; it is possible to live in one place, work in another and have leisure interests in a third. Municipal borders play an ever-decreasing role. To meet these needs, a combined commitment will be needed from central and local authorities, citizens and the business world.

The challenge for urban freight transports is partly access to strategic nodes and partly that they mainly use infrastructure with different road owners. Increasing and denser residential establishments risk removing strategic locations for cargo logistics near the centre, as well as in port areas. It is difficult to draw a clear distinction between urban and long-distance freight transport because the systems overlap.

Changing conditions for rural areas

Rural areas consist of a variety of different environments. They have everything from small depopulated areas to vital locations, key agricultural centres and sparsely populated agricultural and forestry districts. Some rural locations are experiencing a renaissance with digitalisation, new services, increasing tourism and immigration, as well as larger labour market regions providing new opportunities. However, this also means an even greater need for accessibility. Other rural areas are depopulated as access to services is lost, the population becomes older, accessibility is weakened and the tax base is reduced. Over the next decades, municipalities will face a number of challenges to fulfilling their obligations, partly because of demographic developments and the rapid pace of urbanisation.

In spring 2018, a new approach for rural policy was determined, focusing on creating the right conditions for rural areas to develop. In addition to previous rural initiatives, SEK 1.5 billion in 2019–2020 and thereafter SK 400 million per year have been allocated for realising most of the rural area committee’s proposals. This is in addition to the multi billion investments that have already been made and that are important for rural development. Examples include a focus on broadband, public services, an increased central government presence, learning centres and local cultivation.
The Swedish Tourism industry has a vision of increased employment and a doubling of sales. Existing destinations are increasing their export maturity and new destinations are growing, not least in rural areas, through nature tourism for example. One of the main keys achieving this vision is a well functioning transport system – an attractive tourist country is a country with good accessibility and this requires a good physical infrastructure and means of transport that work well. Fast, comfortable and sustainable transport are factors that can strongly contribute to the competitiveness of Sweden’s tourism industry.

**Transport policy is linked to many policy areas**

The links between urban and rural development, transport and other social developments have become ever clearer in policy at both national and regional levels. The term negotiated planning has become commonplace. One example of this is the institution known as Sverigeförhandlingen, which held negotiations with local authorities along the proposed route of a high-speed rail line aimed at co-financing and housing in order to have a railway station built. The focus was on how to create the most benefit for the various infrastructure projects that were included in the negotiations, such as increasing housing and improving the labour market. The negotiations have led to written agreements on station locations, housing and co-financing. In the cities, there have been agreements on new lines and routes for metro systems, trams, express buses, cycles and railways. Sverigeförhandlingen’s work led to undertakings to build almost 300,000 homes, which was about 200,000 more than what was stated in the government’s directive to the negotiators.

The government has also explored opportunities to establish new sustainable urban districts. These investigations have identified a number of municipalities with plans for greater combined residential construction but where plans have not been implemented and where, in many cases, central government decisions on infrastructure have been felt to be vital for the scope of the development. In other cases, developments have been hindered by various forms of difficulty in the planning process. The intention is that central government can help remove the obstacles to development by means of new infrastructure. This may involve new railway tracks, station locations and support for innovations.
In spring 2018, the government launched a national strategy for sustainable urban development. The strategy includes overall targets for sustainable cities and new milestone targets in the environmental quality objectives system, together with prioritising new initiatives aimed at environmentally sustainable urban development. The strategy is intended to help to achieve the national environmental goals, as well as national objectives in other policy areas. It is also intended to help in achieving the UN's sustainable development goals in Agenda 2030, especially with regard to sustainable cities, as well as the UN's New Urban Agenda and the EU's urban agenda. Cities need to be developed so that all the dimensions of sustainable development – ecological, economic and social – are considered. The cities provide opportunities for tackling many of the climate and environmental challenges and work on sustainable urban development is key to achieving the environmental objectives.

There are many examples of agreements between government, local authorities and regions. One example is the West Sweden package, which contains major initiatives for roads, railways and public transport. These measures are intended to contribute to positive development – both in the regional centre of Gothenburg and along the commuter routes. It is also a prerequisite for future initiatives for high-speed trains, housing and urban development, for example. The Stockholm agreement is another example that involves extending the metro to increase capacity and improve access to many parts of the city. An extended metro system creates the conditions for more residential construction. The agreement also means that municipalities agree themselves or through landowners and contractors, to create about 78,000 homes near the metro by 2030.

What is known as the City Environment Agreement was launched in 2015. The purpose of this is to promote sustainable urban environments by creating the conditions for more passenger transportation in cities to take the form of public transport or cycling. These measures are intended to lead to energy efficient solutions with low greenhouse gas emissions and to help to fulfil the environmental quality objectives for good built-up environments. The city environment agreement is based on central government co-financing investments in infrastructure and the local authorities contributing in the form of residential construction, measures for pedestrians, speed adaptations, changed parking policies etc.

**Transport systems will be more cross-border**

There is an initiative at European level for increased integration between transport modes.
The EU transport commissioner Violeta Bulc has declared 2018 the “Year of Multimodality” – a year in which the European Commission places emphasis on supporting multimodality in transport systems in the EU through a number of initiatives for the purpose of promoting the transport sector’s function as a fully integrated system.

Multimodality in the transport sector refers to the use of different forms of transport on the same journey. The concept applies to both goods and passenger transport and can be developed with new digital services. Multimodality exploits the strengths of the different forms of transport, such as comfort, speed, cost, reliability and predictability, which can in combination offer more efficient transport solutions. According to the commission’s proposals, multimodality will be supported through the development of infrastructure, transfer points and digital solutions for the whole EU transport network.

The European Commission has previously established nine freight corridors of which Sweden is a member with the ScanMed Freight Corridor, which runs from Stockholm/Oslo to Palermo in Sicily. The purpose is to make cross-border rail transport easier.

A collaboration between Nordic transport planning authorities was formed in spring 2017. This is a collaborative forum that is intended to contribute to a common view on the development of cross-border routes. The forum also discusses each authority’s data basis and proposals for transport measures and plans, primarily for road, rail and shipping’s land connections. The collaboration is intended to contribute to the development of planning methods for cross-border measures at an early stage, such as strategic choice of measures.

Further initiatives are being taken to integrate transport systems between countries, not least between east and west. One example is the immense new railway initiative “One Belt One Road”. The railway goes from western China, north through India and on to Iran, Turkey and Moscow, before turning towards Belgium and ending in Venice. Volvo, for example, is manufacturing vehicles in Daqing, China and using this east-west route to export them to Europe. In this way, the company cuts its transport times by two thirds compared with moving the vehicles by sea.

In the growing Öresund region, the possibilities for another permanent connection across Öresund are being investigated. The investigation is looking at possibilities for a road connection and also a combined road and rail connection between Helsingborg and Helsingør146.

In Sweden, the Arlanda Council has been formed to work towards the long-term development of Arlanda Airport from a total perspective of all transport modes147. The intention is for Arlanda to be the leading airport in the Nordic region. Aviation plays an important role for meeting the needs of long distance travel, but further measures need to be taken to lessen its negative consequences for the environment and climate. Aviation must be developed in collaboration with other transport modes to create an efficient and sustainable transport system148.

**COUNTER TRENDS AND COUNTER FORCES**

The Swedish model of authorities and public administration at regional and local level can lead to inertia in the system and long drawn out processes. Interest in agreements on residential development and infrastructure investments can melt away if there is an economic downturn.

Noted at a workshop involving Transport Analysis, the Swedish Transport Administration and the Swedish Transport Agency on 27 April 2018.
3.5 Increasing need for societal security and robust transport systems

A well-functioning transport system is an important prerequisite for other functions in society. There is an increasing demand to be able to maintain the functionality of the system even in extreme weather situations and with reinforced alert. The need for information security and security protection also increases in line with increasing digitalisation of the transport system. Many people also feel insecure about moving around in the transport system. The fear of being the victim of crime or terrorist acts can affect people's behaviour.

Increasing requirement for robust functionality

Many companies have the ambition to produce and deliver goods in precisely the quantity and at the exact time that they are needed. The need for local stores is reduced and many receive deliveries every day. The industry organisation Sveriges Åkeriföretag performed a survey in 2014 to illustrate what the consequences would be if road transporters were to stop operations on a Sunday night without warning. The survey showed that shops would run out of milk after only a couple of hours, farmers would have to pour away milk that could not be collected and pharmacies would run out of some medicines during the first day. Within a week, important societal functions such as health care and food supply would be seriously affected.

The government has confirmed that the security situation in our region has worsened and has decided that contingency planning in the form of civil defence should be resumed. The aim for civil defence in time of war or the danger of war would be to defend the civilian population, ensure the most important functions of society and contribute to the capabilities of the defence forces. This is partly about ensuring that the most important functions of society such as infrastructure and the supply of food, water and power would function under the stress.

The transport sector is vitally important for defence and for maintaining life and health and consequently living conditions in society. This is achieved by means of careful preparations to meet the demands on the transport system, whether in time of peace, reinforced alert or finally war. In August 2017, the Swedish Transport Administration received a supplementary instruction regarding the coordination of contingency and defence planning in the field of transport. This means that the Swedish Transport Administration works together with other agencies and takes measures to develop and coordinate contingency planning for a heightened state of readiness in the field of transport. This assignment will present a challenge for a number of years. However, it also brings opportunities – preparing for reinforced alert also brings benefits for the transport system in peacetime.

Information security and protective security are becoming increasingly important

Digitalisation affects practically all parts of our society and offers great opportunities, but also risks. How we handle the risks that come with digitalisation is of great significance for our ability to maintain and strengthen both our welfare and our security.
In the national strategy for society’s information and cyber security, the government concludes that requirements in these areas are increasing at an accelerating pace and are an issue that affects the whole of society. It also points out that the development and changing use of new technology and innovations means that threats become more difficult to detect, that the risks are harder to assess and that dependencies become more difficult to monitor. The vulnerability of the transport system was exposed in autumn 2017 when overload attacks affected many organisations in the transport sector. Rail transport for example suffered extreme delays when an attack knocked out several of the Swedish Transport Administration’s systems.

So-called ransomware is another threat that continues to increase in scope. These are kidnapping programmes that encrypt data on the victim’s computer (or other devices) and demand a ransom to unlock it. In 2017 for example, attacks by WannaCry and Petya made big headlines all over the world when hospitals, companies and other operations were knocked out. In 2018, it is thought that cybercrime is directed more at blocking vital functions to obtain more money for each incident rather than widespread attacks on many individual computers. Budgets for IT security in both the private and public sector are expected to increase over the next few years to meet the increasing threat.

To raise security requirements and reinforce the forms of total information and cyber security work, many changes are now being made to regulations, both nationally and in the EU. The NIS (Network and Information Security) directive, which entered into force on 1 August 2018, affects both authorities and companies who are engaged in activities that are important to society, with requirements for systematic information security work. A new security protection act will enter into force on 1 April 2019. This covers not only confidential information but also security-sensitive activities that are important to protect with regard to aspects of accessibility and correctness. In this way, the area of application will be widened to give protection to information assets and functionality in important societal activities. This means that IT systems that contain open data could be covered by security protection. The government has also introduced restrictions on public authorities’ outsourcing and transfer of security-sensitive activities. Security threats and heightened security risks inhibiting developments and innovations that are based on an open and dynamic stream of data between different systems and where data from new sources are combined. This may also make it more complex for authorities to perform procurements.
Terror threats affect the transport system

The government’s national security strategy states that terrorism and violent extremism are a threat to international peace and security, our national security and our basic values, as well as freedoms and rights. Many terrorist attacks are committed in the world every year. In recent years, violent, extremist Islamic movements have threatened the security and development of many countries, often those characterised by conflicts and weak forms of government. Most terrorist acts are committed outside Europe, but in recent years, both Sweden and other neighbouring countries have been affected. Future attacks against Sweden and our neighbouring countries cannot be excluded and NCT (the national centre for terrorist assessment) judges that in 2018 the overall terrorist threat level is at a heightened level (3 on a scale of 5).

Terrorist attacks in Europe 2016–2017 in which road vehicles have been used

<table>
<thead>
<tr>
<th>Location</th>
<th>How the vehicle was obtained</th>
<th>Timeframe from the moment of obtaining the vehicle to the actual attack</th>
<th>Method used for the attack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nice</td>
<td>Rented</td>
<td>A few days</td>
<td>Promenade des Anglais, during the celebration of the French national day</td>
</tr>
<tr>
<td>Berlin</td>
<td>Hijacked</td>
<td>A few hours</td>
<td>At Breitscheidplatz, Christmas market</td>
</tr>
<tr>
<td>Stockholm</td>
<td>Stolen during a convenient delivery stop</td>
<td>Few seconds</td>
<td>Drottninggatan, pedestrian street</td>
</tr>
<tr>
<td>London</td>
<td>Rented</td>
<td>A few hours</td>
<td>London Bridge</td>
</tr>
<tr>
<td>Barcelona</td>
<td>Rented</td>
<td>A few days</td>
<td>La Rambla, pedestrian street</td>
</tr>
</tbody>
</table>

The most recent terrorist attacks have increasingly focused on public spaces with the transport system both as a target for terrorist acts and as a means of performing attacks, such as truck ramming. The methods used for the attacks in Nice and Berlin in 2016 and in Stockholm, London and Barcelona in 2017 were similar, with stolen or hired trucks used to ram people in streets and squares. Because its infrastructure is open in character, rail transport is also a high-risk target according to the European Commission.

The need for protection against terrorism will increase. The European Commission is in the process of producing guidelines to help member countries handle matters concerning the protection of public spaces. This may include, for example, openness in the railway system being restricted at times of heightened threat and setting up barriers to vehicle traffic in parts of cities. Geofencing is under development, where digitalisation gives an opportunity to restrict access for vehicles to certain geographical areas such as city centres.

It is impossible to build a city that keeps people completely secure from terrorism. The term being used internationally is HVM (hostile vehicle mitigation) which is about preventing vehicles from being used for terrorist purposes. However, securing against terrorism is expensive and the terrorists who have recently been targeting city centres can quickly change their targets and strategy.
Climate change threatens the infrastructure

The UN climate panel IPCC has shown clearly in many reports that the earth’s climate is changing and that these changes will have greater consequences. When the World Economic Forum (WEF) presented its report on global risks at the end of January 2018, extreme weather events were at the top of the list. The risk of natural disasters and of the world failing in climate adaptation were also among the top five risks.

The need for climate adaptation, i.e. adapting society to the present and future climate, is obvious. For those working with long time horizons, such as in developing infrastructure, it is necessary to take into account how the climate is expected to change well into the future. In Sweden, society needs to adapt to a warmer climate, a higher sea level, changing rainfall volumes, shorter periods with frozen ground and more extreme weather events and natural disasters.

Climate adaptation work has already begun in Sweden and many authorities, county administrative boards and local authorities are actively working on this question. Adapting infrastructure is often a key feature of risk and vulnerability analysis on anticipated climate change and there is thus a great need for collaboration between organisations and stakeholders.

Insecurity is limiting use of the transport system

A number of surveys have shown that insecurity among citizens has increased over recent years. The Swedish Crime survey (The Crime Prevention Council, Brå) in 2017 shows that 30 per cent of women said that they feel quite or very insecure when going out in their own neighbourhoods in the evening. This is an increase from 25 per cent in 2015. In the citizens’ surveys performed by the County Administrative Board of Stockholm, insecurity has been increasing since 2011.

In the most recent survey (2017), 10 per cent stated that they often feel scared when they are in central Stockholm, which is a clear increase since 2015.

Insecurity in society and in the transport system can affect people’s habits and implies that they do not dare to be in public environments or to use public transport. This can mean that they do not travel at all or travel in a way that would not have been their first choice.

The government has pointed out the need for safe station environments and has set aside specific funding for the period 2018–2020. The money will be used to increase the number of stations that have camera surveillance, to have more surveillance personnel and more security staff in stations. The government has also stated that this is not just a matter of resources but also a question of coordination and collaboration.

Insecurity in the transport system is also found among truck drivers, especially in rest and break times. In a survey performed by Transport Analysis in 2016, 70 per cent of truck drivers stated that they perceived crime to be a problem in their jobs. About 20 per cent of respondents said that they had been subjected to crime at some point at resting and parking sites in Sweden. The most common crimes were theft of diesel, theft of goods and theft of accessories such as tyres, extra lights etc.

COUNTER TRENDS AND COUNTER FORCES

Improvements in the geopolitical situation may reduce society’s need for reinforced alert. Improved international contacts are a force for good in this respect. An increase in extreme weather could force through new solutions, such as for companies’ warehousing, that are based on the transport system not always being able to function.

Noted at a workshop involving Transport Analysis, the Swedish Transport Administration and the Swedish Transport Agency on 27 April 2018.
4. Trends in public administration
4.1 Government and public roles and governance are changing

In a global perspective, Sweden’s parliamentary democracy and public administration work well and are characterised by trust in both politics and the institutions. However, Sweden does not stand isolated from what is happening in the outside world. Sweden too is affected by increasing polarisation, mistrust of social institutions, new lines of conflict in politics and changes in the dissemination of information. Future governments will also have to handle an increasing public demand for providing good societal services, not least a requirement for accessible information about public sector activities and for security in an increasingly complex and multi-faceted landscape. This is characterised by requirements for transparency, digitalisation, innovation and services that are based on citizens’ needs and situations.

More complex decision making processes

The challenges to society faced by the government, parliament and their administration have become more difficult and interwoven. Many of them can also be described as insoluble or wicked problems: The government will never be able to completely stop crime, for example. Large, important societal issues require more people to solve them – people from the authorities, the business community and the civil society. Globalisation and Europeanisation certainly contribute to this. Central government is already greatly affected by the EU’s agenda, other international organisations, standardisation organisations, non-governmental organisations etc. Additionally, there is the uncertain parliamentary position that is likely to persist for some time. For the authorities, development involves complex, multilevel control. Authorities need to be more proactive in EU work, contribute to government while understanding that they are part of the same thing when acting at EU level while simultaneously acting at regional and local level.

Central government and the authorities are moving towards an ever more network based management and governance. One authority is tasked with coordinating an area that covers a number of authorities and political areas. The use of special coordinators tasked with working across several areas, coordinating a number of others has proved to be effective, and this development is continuing. The use of agreements similar to those in the Sverigeförhandling is a further example of altered and more network-based governance, which continues to be developed.
The uncertain parliamentary position that will probably persist makes it more difficult for a government to get its policies through the Riksdag. It can also be difficult for a government to take the long-term view when it needs to look at more short-term action. Public administration is an important tool for getting policies through and a development can be seen in which the government is more frequently giving specific tasks to different authorities to achieve this.

It is a challenge for administration to be able to act for the long term and to provide policy with an adequate basis. If policy becomes more short-term, it becomes even more important for the administration to act in a more long-term perspective. There is an increasing need for authorities to find ways of resolving increasingly complex and crosscutting challenges. Among other things, increasing demands from citizens and demographic developments are contributing to this. Collaboration across boundaries will need to be further developed in order to tackle the social challenges.

**Market solutions are not universal – the role of the civil servant has increasing significance**

For almost half a century, central government and other publicly owned organisations have had the idea that different market solutions are the way towards greater efficiency. Refining roles and competition have contributed to this. Management of authorities by objectives and results linked to various management models has been brought in to control the administration. During this time, developments within the authorities have moved towards clarifying the autonomy of their own activities, for example by creating their own visions and values as an expression of independence. This development has often been called New Public Management. In recent years, this development has been increasingly questioned, not only in Sweden but also in the United Kingdom, for example.

In Sweden, there has been a discussion for some time about how well market solutions work at different stages and how the control of public activities can be reformed. Excessive scrutiny and investigation have been questioned in favour of greater confidence in the profession’s own assessments. This discussion has mainly concerned education and health care, but transport policy has also been in focus in the debate – particularly when it comes to the difficulties of handling railway maintenance.

Proposals have come from various political parties that were not just about market solutions, while the Löfven government has actively worked at designing new control models and returning responsibility and mandates to activities. This means that the government has a firmer grip on activities, for example in the approach to increasing central government responsibility with regard to railway maintenance. Examples of clearer governance include decisions on the location of authorities and the creation of a national service centre to handle support functions. Examples of increased confidence include a delegation appointed by the government to perform projects that support authorities that wish to achieve a more confidence-based control.

There is much to indicate that the central government role will be accentuated over the next few years while the role of the market will change. What this will look like in detail is difficult to predict, but greater responsibility for resolving society’s challenges could rest with government. This is not a reversion but rather a development in which the government’s responsibilities increase in significance in different sectors. At the same time, requirements for central government and its authorities will increase.
The role of the authorities as impartial, legally secure and efficient will become more important and they will be judged on how they fulfil their tasks and how well they perform. The importance of transparency and of actively understanding people's needs and wishes will increase. The authorities have a significant role in influencing confidence in society and continued initiatives will be taken to strengthen the good administration culture and counteract corruption in society.

**The government group will be more evident in parallel with confidence-based control**

Swedish administration is characterised by having a relatively small group of government offices and authorities at national level, combined with local authority self-government, which is markedly different from most western countries. At the same time, in recent decades we have seen a trend towards more centralisation at several levels.

At national level, there has been a merger of regional authorities, such as the police authority. There has been a proposal to change the county divisions that were created by Axel Oxenstierna in the 17th century from 21 counties to six regions, although this did not find favour in the Riksdag. We have also seen a number of mergers of municipalities and the formation of regions, mainly to be able to improve conditions for giving professional societal services and distribute costs.

With effect from 1 January 2019, the Riksdag has also decided that all county councils in Sweden can take over regional development responsibility from municipal coordination bodies and can call themselves regions with regional authority. This legislation will strengthen the regional level but will not address the imbalance that exists between the large metropolitan regions around the cities and smaller regions such as Gotland. There are proposals that larger authorities should organise themselves according to the six health care areas into which Sweden is divided and to establish further local service offices where several authorities could jointly meet individuals and companies.

“Group-wide initiatives” and decentralisation will run parallel in government administration. Management by objectives and results, combined with various management models, has been questioned as a governance philosophy. This development moves towards reducing the size of administration and provides more possibilities for the profession that is responsible for an activity also developing it. The confidence delegation will contribute to this development.

Digitalisation offers great possibilities for both centralisation and confidence based control, but development cannot be fragmented. Sweden is well advanced in terms of digital maturity and digital competence, but Sweden has lost out to other countries in the public sector. The government has taken a number of initiatives to strengthen Sweden's digital abilities. The introduction of a digitalisation authority is one of these and the Digital First initiative is another. In spring 2018, there was also a report that proposed how the government should proceed with the control of national digital services. Initiatives are mainly concentrated in three areas:

- digital administration and its structures (e-governance)
- developing specific areas with the aid of digitalisation (such as e-health)
- developing local commerce and the civil society with the aid of digitalisation and public support.
5. Analysis – conclusions and reflections
5.1 Introduction
This section begins with an overall analysis of how the identified trends can be expected to affect the development of the transport system as a whole.

We then describe some more specific areas that are anticipated in various ways to be significant for the transport system of the future. These areas are defined as City and Country, Decarbonised Transport, Societal Security, Digitalisation, Automation, Electrification and Sharing Economy. Each area is briefly described based on the sections on megatrends and transport trends. This section also contains all references.

What all the areas have in common is that there is uncertainty over how they might affect both the development of the transport system and demand for both passenger and freight transport. How they affect the transport system also depends on how different stakeholders (especially politicians) with connections to the transport system choose to act. The purpose of the analysis is to point out the different choices of direction where these exist, as well as opportunities and needs for influencing developments through political decisions. The analysis does not claim to be exhaustive and should be looked upon as a basis for a discussion.

The areas are different in nature since they affect the transport system in different ways. Electrification, Digitalisation and Automation represent potential to change and improve the transport system’s technical functionality. Decarbonisation and Societal Security generate specific requirements for how the transport system is to function, primarily in terms of emissions and robustness. Sharing Economy and the development trends in City and Country are societal changes that are mainly expected to affect the users’ need and demand for transport.

5.2 General analysis
The reported trends indicate that demand for transport continues to increase for all transport modes. This is driven by economic growth and demographic development. Road transport continues to dominate domestic transportation, and this is likely to continue for the foreseeable future. Measures taken to date to reduce emissions of greenhouse gases and congestion do not appear to have had any restraining effect on traffic development as a whole. It is however road traffic that causes major problems in the form of accidents and environmental impact. Technological developments could also bring about better utilisation of capacity on the roads, which could help to reduce congestion. In total, this indicates that the competitiveness of road traffic can be further strengthened in relation to other traffic types.

Naturally, other transport modes also have potential for development and will play an important role in the transport system of the future, especially in the market segments where they already are strong. In sub-markets such as long distance aviation and international shipping, there are in many cases no alternative forms of transport. Railways are an excellent alternative for some types of freight transport as well as for passenger transport in large commuter areas. It can be assumed however that in the areas of competition between transport by road and other modes of transport, the future distribution between traffic types will mostly depend on how the competitiveness of road transport develops.

For this reason, road transport has a central role in the analysis. The dominant position of road transport is due to road transport being a very competitive alternative to other transport modes. There are advantages in terms of cost, flexibility and time. The technological development trends that we have identified have the potential to further reinforce these relative advantages, even if the alternatives also will be developed. There are also possibilities in the longer term of making road transport more or less emission-free, which would decrease the major disadvantage. There are also opportunities for considerable improvements in traffic safety. We must thus assume that the basic competitive advantage of road transport could be further reinforced.
There are ambitions, especially in the major cities, to reduce car use by means of denser settlement, improved opportunities for pedestrians and cyclists, better public transport, fewer or more expensive parking spaces etc. This could of course have a restraining effect on demand for car transport, although it might for example lead to fewer visits to city centres, in favour of more peripheral places to shop that are more accessible by car. There are also ambitions to enlarge labour market areas by improving opportunities for commuting, which would give people the opportunity to live further away from the built-up areas where most of the jobs are. There are indications that, in addition to longer commuting, this also increases the need for other daily journeys that are often done by car, even though the journey to work itself is by public transport.

There is also a tendency for the growth in travel to relate to journeys other than the journey to work, which involves flows that are more heterogeneous in both time and space. It can be difficult to service these with traditional public transport, which is often aimed at journeys to and from work and school. When it comes to transport in rural areas, cars and trucks are even more dominant and we can see that traditional public transport tends to be reduced as a consequence of low use or in some cases may be replaced with on-demand traffic. For reasons of cost, passenger transport on railways with low traffic levels tends to be replaced by buses.

Increasing traffic poses increasing demands of road safety. This is especially true for reducing accidents among cyclists and other unprotected road users. The earlier positive road safety development has stagnated, but various initiatives are being taken to strengthen the work, for example the government’s new start for the vision zero and the Swedish Transport Administration’s mission to lead overall road safety cooperation. New technology helps to improve road safety. Other efforts are also needed to achieve the goals set, for example to promote compliance with traffic rules. It is also about allocating financial resources and adapting regulations so that new and existing technologies are used.

One important aspect is that, as most means of transport increase their competitiveness, so does the total demand for transport increase. This trend is further strengthened by the presumed continued economic growth and thus greater possibilities for consuming transport services. Major changes in behaviour could affect demand for transport, but these are very difficult to predict. However, the driving forces for a continuing increase in transport are strong. The present dominant position for road transport will continue, unless powerful instruments are introduced that increase the cost of car and truck transport or make accessibility more difficult or both. Then the effect could be reduced mobility rather than significant transfer to other means of transport. Public transport and railway initiatives are not anticipated to greatly influence this effect.

The development of the part of the transport system that has the longest life, the infrastructure, has a relatively limited effect on how the transport itself will develop in the longer term, which may appear to be paradoxical. The reason for this is that today’s physical social structure, including transport infrastructure, is so enormous that new infrastructure that could come in the next 20–30 years would be relatively marginal. Obviously the new infrastructure in itself is a benefit for transport, but seen in the context of the system as a whole it is small over a foreseeable time scale. At the same time, it is the changes in societal structure and infrastructure that are made today that can be expected to be the most unchanged over time. Taxes and other instruments can be changed much more quickly.

How to relate to long-term planning of the infrastructure itself is therefore an important question. Should it primarily be considered as a way of controlling the development of the whole transport system or should it instead be seen as a way of adapting the infrastructure to a future demand situation that will mainly be
determined by other factors? The answer is probably that it is not entirely one or
the other. Infrastructure measures can have a great effect locally where they are
performed but they need to be designed with consideration for the anticipated
traffic developments as a whole.

Anticipated future demand for transport by all transport modes is significant for
most of the choices of direction facing the various stakeholders. It is therefore
important to have knowledge about the factors with the greatest significance for
how demand will develop and how great the changes might be.

5.3 City and Country

Urbanisation is increasing both passenger and freight transport in the cities.
Congestion leads to lost time and an unhealthy environment. Automation and new
digital, individually adapted services increase accessibility, but in the longer term
can increase the number of journeys and transports. Many cities have an ambition
to reduce the use of cars to create an attractive urban environment. To maintain
good accessibility without heavy car traffic, combined city and traffic planning is
even more important. More powerful policy instruments will be needed, as well
as physical measures in urban areas. Better opportunities for pedestrians, cyclists
and public transport can be achieved, for example, by reallocating street space and
developing green areas.

The population in rural areas grows more slowly, or is even reduced in the most
rural areas. Societal services in rural areas disappear but expectations for access
to services, culture and consumption increase and are considerable no matter
where people live. Important social services such as emergency transport, medical
travel, home visits and school support depend on reliable accessibility. Centralised
welfare services also make demands for both physical and digital accessibility.
The development of broadband is important for satisfying the demand for access
to certain types of goods and services. However, in rural areas and small towns
where the tourism industry is dominant, it is a challenge for the transport system
to maintain sustainable mobility, especially during tourist high seasons.

The tourism industry is growing and leisure travel is increasing, which places
demands on the transport system. The tourism industry is biggest in the cities,
but there the transport system has good capacity and usually manages to provide
robust accessibility for tourism, because these journeys mainly occur outside the
rush hours.

Increasing socio-economic gaps within cities, but also great differences between
the cities and rural areas, increase the importance of the transport system
being socially sustainable. Social vulnerability and insecurity can limit the use
of the transport system. Efforts to increase safety in the transport system, such
as in walkways, stops and travel centres, can improve the situation in such
environment. One solution to many of the challenges is to restrict mobility by
means of various instruments. This means a loss of accessibility for the individual
and weakened competitiveness for the business community, but the negative
effects of transport on society are reduced, for example in the form of reduced
congestion, lower emissions and fewer accidents. There may also be undesirable
effects for distribution policy. The effects depend on how different instruments
are used and designed for different transport modes and different parts of the
country. New technology and market driven development can help to create
sustainable mobility, but there is also a risk that developments can have negative
consequences. Policy and the public sector can influence and control future
developments.
Choice of direction and critical questions

• How should resources be divided between densely populated areas with great potential for economic growth, energy conversion etc. and rural areas, to meet the need there for basic and traffic safe accessibility?

• Instruments will be needed to achieve sustainable mobility in both urban and rural areas. Should instruments be designed to be equal for everyone or should differentiated taxes be used to benefit rural transport?

• Should there be a continuing focus on enlarging regions with increased opportunities for longer journeys to work and services, and thus good opportunities to live in rural communities, or should the focus be more on increasing density in the big cities and their immediate surroundings?

5.4 Decarbonised transport

Emissions of greenhouse gases are falling, but not fast enough to achieve the emission objectives for 2030. Achieving a decarbonised transport system is therefore one of the great challenges. The ambition is high and there is no shortage of suggestions for how to achieve it. There is broad political agreement on the objectives, but not as much agreement on the means. Some measures are perceived to be more politically sensitive to perform. The measures also have different potential and cost-effectiveness for reducing emissions. Powerful instruments will be needed to minimise greenhouse gas emissions from road traffic. Measures could be aimed at increasing energy efficiency and electrification of vehicles, fossil-free fuels and a transport-efficient society with a different pattern of demand, especially for road traffic.

The number of electric vehicles is increasing at a relatively fast pace, partly as a result of beneficial tax rules, but they still represent a small proportion of all vehicles. Instruments are also helping to increase the proportion of renewable fuels, especially biodiesel. However, road traffic is increasing and thus diluting the emission reductions, since most road traffic still runs on fossil energy.

Choice of direction and critical questions

• The choice of instruments aimed at energy efficiency, reducing fossil energy and reducing road traffic is of great significance for both tax revenues and transport costs. More knowledge is needed about the effectiveness of different instruments and their socio-economic impact.

• The reduction in emissions from the transport sector has largely been thanks to an increasing proportion of biodiesel and a significant proportion of this is imported. Global access to biofuels is limited at present, which means that other countries could find it difficult to follow Sweden's example and that there could be a shortage in Sweden if other countries increase their use. There are therefore compelling reasons for increasing domestic production of biofuels.

• If instruments aimed for road transport were to significantly increase driving costs, this could have a negative effect on the total mobility of people and goods. Even if people chose to walk, cycle or use public transport, it could also mean that they made fewer journeys. With a powerful effect on road traffic, it would probably be very expensive to offer alternative travel and transport opportunities to an extent that would fully compensate. There are also distribution policy risks if driving cars became restricted to those on high incomes.

• What consequences arise if the design of infrastructure is adapted to a transport system that has been changed to meet climate objectives and what would be needed for the design of infrastructure to contribute to the conversion?
5.5 Societal security
Security in our region has become poorer and many civil authorities have begun contingency planning to be able to ensure that the most important societal functions will work during a period of reinforced alert. Terrorism and violent extremism threaten security and development in more and more countries. Being prepared for reinforced alert, being protected against terrorist attacks, managing information security, and protected security all mean increased costs. Those parts of the transport system that are most dependent on systems, such as railways, are extra sensitive to disturbance.

Digitalisation involves risks and requirements for society’s information and cyber security are increasing at an accelerating rate. Risks that can be difficult to protect against could also inhibit developments that make use of the opportunities of digitalisation. This could also affect willingness to use new technology, such as self-driving vehicles.

The earth’s climate is changing and the changes are assumed to have great consequences. Climate change that brings extreme weather phenomena increases the vulnerability of the transport system. There is therefore a need for climate adaptation of the infrastructure, both existing infrastructure and new infrastructure being developed, which will mean increased costs.

Choice of direction and critical questions
- New technology has properties that both increase and decrease the robustness of the transport system. A balance must be struck between the risks and opportunities that the introduction and use of new technology involves.
- What parts of the transport system should not be digitalised for security reasons?
- There is no such thing as a society that is safe from terrorism. Measures to increase security could reduce accessibility. How much can we, and how much should we, protect ourselves against possible terrorist attacks? How do we safeguard an open society?
- How do we prioritise measures that do not have any direct benefit now, for example to secure robustness in a changed future climate?

5.6 Digitalisation
Digitalisation provides opportunities to develop the transport system in many ways and also affects the demand for transport. Developments in the areas of automation and the sharing economy are especially dependent on digitalisation.

A characteristic of digitalisation is that it becomes cheaper and easier to collect and store information and to analyse and disseminate information. Among other things, this leads to great potential for efficiency improvements to increase accessibility for given resources or to offer the same accessibility with fewer resources. There is great potential for improving efficiency in the transport sector, for goods transport and passenger travel but also for infrastructure owners. New technology can also reduce the need for transport, with digital meetings for example. Thus, digitalisation has possibilities for increasingly contributing to satisfying the need for basic accessibility.

It can be assumed that those who provide transport services use digitalisation to increase the competitiveness of the service being offered. What can be made more efficient (reduced costs, reducing travelling time etc.) will be made more efficient.
If this development is allowed to occur without control, there is a risk that it would lead to less sustainable changes, such as by increasing demand for transport that has negative environmental effects or by some services not being available to certain groups. Another challenge is to ensure the quality of the information collected and to protect data from cyber attacks. There will therefore be a need for control, so that digitalisation can lead to increased efficiency that also helps to increase sustainability, as well as active participation from the public sector to influence developments.

**Choice of direction and critical questions**

- How can we implement the advantages that digitalisation can give and at the same time minimise the disadvantages? Increasing the use of digital meetings is one example of how the need for travel can be reduced. Individualised online shopping with free returns involves a risk of increased demand for transport and thereby an increased environmental impact.

- Should there be controls to ensure that improved efficiency from digitalisation is primarily used to offer the same accessibility with fewer resources or to increase accessibility with the same resources?

- The exchange of data between vehicles and between vehicles and infrastructure must occur in a reliable, robust and secure manner. Should a digital platform that safeguards quality-assured and robust data exchange between stakeholders be developed in the public sphere or should this be left to the market?

**5.7 Automation**

With the aid of new technology, the trend in the transport system is towards ever greater automation. Automation is already being used in shipping, aviation and in closed train systems. The development of artificial intelligence also allows the automation of road transport. Some expert assessments claim that self-driving vehicles will be fully developed and a natural part of road transport by the 2030s, while others believe this will not happen in the foreseeable future. Driving forces in the form of increasing demand and cost-effectiveness might mean a breakthrough for freight transport more quickly than for passenger transport.

With road transport there is uncertainty about what consequences automation could have, compared with other transport modes. The introduction of self-driving vehicles could lead to both positive and negative effects on transport policy goals. They could lead to safer traffic and increased accessibility for groups that do not today have the opportunity to drive a car. However, they could also lead to more demand and to congestion, especially in the cities. In freight transport and public transport, improved efficiency could come in the form of automatic systems replacing drivers.

For a long time to come, the road transport system will be used by vehicles with different degrees of automation together with vehicles that are driven manually.

**Choice of direction and critical questions**

- Increased automation could improve traffic safety and demand for car transport, which risks increasing congestion problems and environmental impacts in urban environments. How should the positive aspects be balanced with the negative?
• The acceptance of the general public is vital for a breakthrough for automation. This is about the design of the legal framework, at what pace and in what way the technology is implemented and how secure it is perceived to be in terms of both road safety and reliability. How would the vehicle manufacturers ensure that self-driving vehicles could not be hacked and an external party take over control? Should the vehicles be introduced throughout the road system or only in certain zones? To what extent should automated vehicles be mixed with conventional road vehicles?

• Should part of the functionality for automated driving be provided by the infrastructure owner? Should the infrastructure be adapted? If so, what investments and what level of operation and maintenance of the infrastructure would be needed, and at what cost?

5.8 Electrification

The cost of electric vehicles is expected to fall, partly due to cheaper batteries and longer manufacturing runs. One uncertainty is the availability of raw materials, such as cobalt, which is an important component in today’s batteries. A shortage situation leads to high raw material prices and could counteract the potential for lower battery prices. A further challenge is managing the environmental effects that arise from battery production. Instruments that increase incentives for electric power should be introduced successively, for example through support for buying electric cycles. Politicians have shown interest in promoting the development of charging infrastructure. Tests and demonstrations of electric roads are being performed by different organisations, and this is initially expected to be a solution for heavy vehicles. The number of electric cars (pure electric cars and hybrids) is increasing rapidly, but still represents a low proportion. Sales of electric cycles are also increasing rapidly.

Encouraging the use of electric cars would probably mean ensuring that they have a tax advantage over the fossil alternatives for the foreseeable future. This might lead to lower tax revenues for central government. Only raising taxes for fossil power risks not being sufficient to maintain the total level of tax revenues. There would then be increasing encouragement to convert to fossil-free alternatives, with reduced tax revenues as a result.

The relatively low margin costs of using electric cars could imply more use, for those with access to such a car. The threshold for use would be low, even though walking, cycling and public transport were available as alternatives.

Choice of direction and critical questions

• Maintaining the economic incentive to choose electric cars could mean reduced tax revenues and increased traffic work. To maintain the tax revenues from road traffic it may be necessary, in line with the increase in the use of electric cars, to raise the taxes for using electric cars. At the same time, this would reduce the incentive to choose electric cars.

• With electric roads, the energy supply is mainly in the infrastructure, as with railways. Are electric roads a successful concept or will the development of other technologies such as batteries and hydrogen make the electric road solution less interesting?
5.9 Sharing economy

There is a growth in digital service platforms that facilitates sharing resources because it is easier, cheaper and faster to get to the resource. This could refer to both sharing vehicles and sharing journeys. New business forms for sharing services in the transport sector are being developed, such as Uber and car pools. Attractive and cost-effective shared services could increase accessibility for groups that have limited opportunities for travel at present. Sharing could lead to fewer vehicles, but it is uncertain whether travel would be reduced. If travel becomes cheaper, there could actually be more journeys than at present with increased congestion and environmental problems as a result.

When a vehicle is shared, the fixed costs are shared by many, which increases opportunities for buying more expensive vehicles, such as electric cars or self-driving cars. The vehicles also wear out more quickly because of the increased use, which would mean new technology that for example can improve traffic safety and decrease the environmental impact, breaking through into the vehicle fleet more quickly.

People have become more insecure in recent years. This could affect people’s willingness to share travel with others, as in various forms of car sharing. The perceived value of owning your own car could also restrict the breakthrough of shared transport services.

Choice of direction and critical questions

- Demand for shared services depends largely on how competitive they are compared to the alternatives. Instruments can be introduced to increase the incentive to share, for example by making sharing services easier or by making it difficult to own or park your own car. There is a risk that effective sharing services could increase travel and add to congestion and environmental problems rather than reducing them.

- How could instruments be balanced to avoid transfers from public transport and cycling?
6. Source References


3. Stephen Hawking says A.I. could be ‘worst event in the history of our civilization’. 2017. CNBC.  


https://doi.org/10.1016/j.giq.2016.01.010

www.computersweden.idg.se/2.2683/1.677000/moln-gdpr-amazon-ibm

www.dagensanalys.se/2017/05/den-svenska-delningsekonomin-ar-pa-frammarsch/

10. Svenskarna och Internet. 2017. IIS.  
www.iis.se/docs/Svenskarna_och_internet_2017.pdf

www.medieakademien.se/aktuellt/#de-ar-maktigast-pa-sociala-medier-i-sverige-maktbarometern-2017


www.theguardian.com/world/2017/nov/14/how-400-russia-run-fake-accounts-posted-bogus-brexit-tweets


15. E-barometern, Q3 2017. HUI och PostNord  

www.ipcc.ch/meetings/session44/12_adopted_outline_sr15.pdf

17. World Energy Outlook. 2017. IEA  
www.iea.org/weo2017/


www.regeringen.se/4add1a/contentas-sets/790b8bd7c164279a39c9718854e025/faktabladi_fossilfritt_sverige_webb.pdf


www.energimyndigheten.se/statistik/prognoser-och-scenarier/
23. Minskade utsläpp men snabbare takt krävs för att nå klimatmål. PM. 2018. Trafikverket. www.trafikverket.se/contentassets/07f80f01d92144eebf1a01fcb60ac923/pm_vagtrafikens_utslapp_180225.pdf


65. Beskedet: "Du ska kunna klara dig själv i en vecka". [2017-12-20] SvD. 
www.svd.se/svensk-motstandskraft-vid-krig-ska-starkas

66. Fakta om broschyren Om krisen eller kriget kommer. 2018. MSB. 
www.msb.se/sv/Forebyggande/Krisberedskap/MSBs-krisberedskapsvecka/Fakta-om-broschyren- Om-krisen-eller-kriget-kommer-

www.regeringen.se/regeringens-politik/forsvar/genomforandet-av-forsvarsbeslutet---regeringens-atgarder-pa-forsvaromradet-

https://www.regeringen.se/artiklar/2018/01/starkt-psykologiskt-forsvar-och-atgarder-mot-paverkansoperationer-

69. Nationella trygghetsundersökningen. 2016. BRÅ. 
https://www.bra.se/download/18.3719ae158196cb172d6047/1483969937948/2017_1_Nationella_trygghetsundersokningen_2016.pdf

70. Opinionier. 2016. MSB. 

71. World Meteorological Organization. [2018-07-02] 
https://public.wmo.int/en

72. MSBs arbete med naturolyckor. 2014. MSB. 
www.msb.se/RibData/Filer/pdf/27413.pdf

73. Digital Disruption is a People Problem. [2017-09-18] MIT Sloan Management Review. 

www.sae.org/autodrive


76. How long is the road to driverless vehicles? Assessing how close the Nordics are to autonomous vehicles. 2017. PA Consulting. 

77. Practical Challenges to Deploying Highly Automated Vehicles. Drive Sweden Göteborg. [2018-05-14] 
https://www.drivesweden.net/sites/default/files/content/bilder/practicalchallenges4drivesweden.pdf


https://blogs.thomsonreuters.com/answerson/connected-car-data-open-data-

82. Vad är Blockchain? – En introduktion till nästa teknikrevolution. IBM. [2017-03-18] 

https://it-ord.idg.se/ord/digital-tvilling/

84. The surgeon who operates from 400km away. [2014-05-16] BBC. 
www.bbc.com/future/story/20140516-i-operate-on-people-400km-away
86. REMM ökar andelen digitala möten i svenska myndigheter. 2018. Trafikverket. www.remm.se/
94. Minskade utsläpp men snabbare takt krävs för att nå klimatmål. PM. 2018. Trafikverket. www.trafikverket.se/contentassets/0780f01d92144eebf1a01fcb60ac923/pm_vagtrafikens_utsvalp_180225.pdf
105. Åtgärder för minskade utsläpp av växthusgaser. PM till Nationell plan för transportsystemet 2018-2029. 2018. Trafikverket. https://trafikverket.ineko.se/se/%C3%A5tg%C3%A4rder-%C3%B6m-skat-%C3%A4m-%C3%A4utr%C3%B6r-%C3%B6m-%C3%A4t-och-%C3%A4tv%C3%A4s-utslapp-fran-utrikes-sj%C3%B6fart-och-flyg/
106. Minskade utsläpp men snabbare takt krävs för att nå klimatmål. PM. 2018. Trafikverket. www.trafikverket.se/contentassets/0780f01d92144eebf1a01fcb60ac923/pm_vagtrafikens_utsvalp_180225.pdf


Minskade utsläpp men snabbare takt krävs för att nå klimatmål. PM. 2018. Trafikverket. www.trafikverket.se/contentassets/07f80f01d92144eebf1a01fcb60ac923/pm_vagtrafikens_utslapp_180225.pdf


Minskade utsläpp men snabbare takt krävs för att nå klimatmål. PM. 2018. Trafikverket. www.trafikverket.se/contentassets/07f80f01d92144eebf1a01fcb60ac923/pm_vagtrafikens_utslapp_180225.pdf


134. Årsrapport. 2016. Stockholms läns landsting.


152 Nationell strategi för samhällets informations- och cybersäkerhet. 2017. Regeringskansliet. www.regeringen.se/49f22c/contentassets/3f89e3c77ad74163909c092b1beae15e/nationell-strategi-for-samhallets-informations-och-cybersakerhet-skr-201617213


