

A Changing World

Trends and implications  
for public transport in  
the Stockholm region

# 2019

# Foreword





Globalisation and technological progress have helped to create a world that is more inextricably linked than ever before. Accelerating digitalisation is generating new opportunities for public transport as well as new risks. People's lifestyles are changing and demands for individualisation are increasing. The underlying megatrend of population growth and demographic shifts is causing a sustainability challenge that we need to meet together.

Overall, this trend analysis shows that the trends are challenging public transport to meet an increased demand for a developed and sustainable transport system in which public transport is an increasingly important prerequisite. At the same time, they show it is possible to meet these challenges if the key actors make informed decisions and actively move forward.

The following report aims to highlight the trends and describe what implications they have for public transport in the Stockholm region. It is intended as a support in the strategic work of Stockholm County Public Transport Administration and as a basis for deeper discussions.

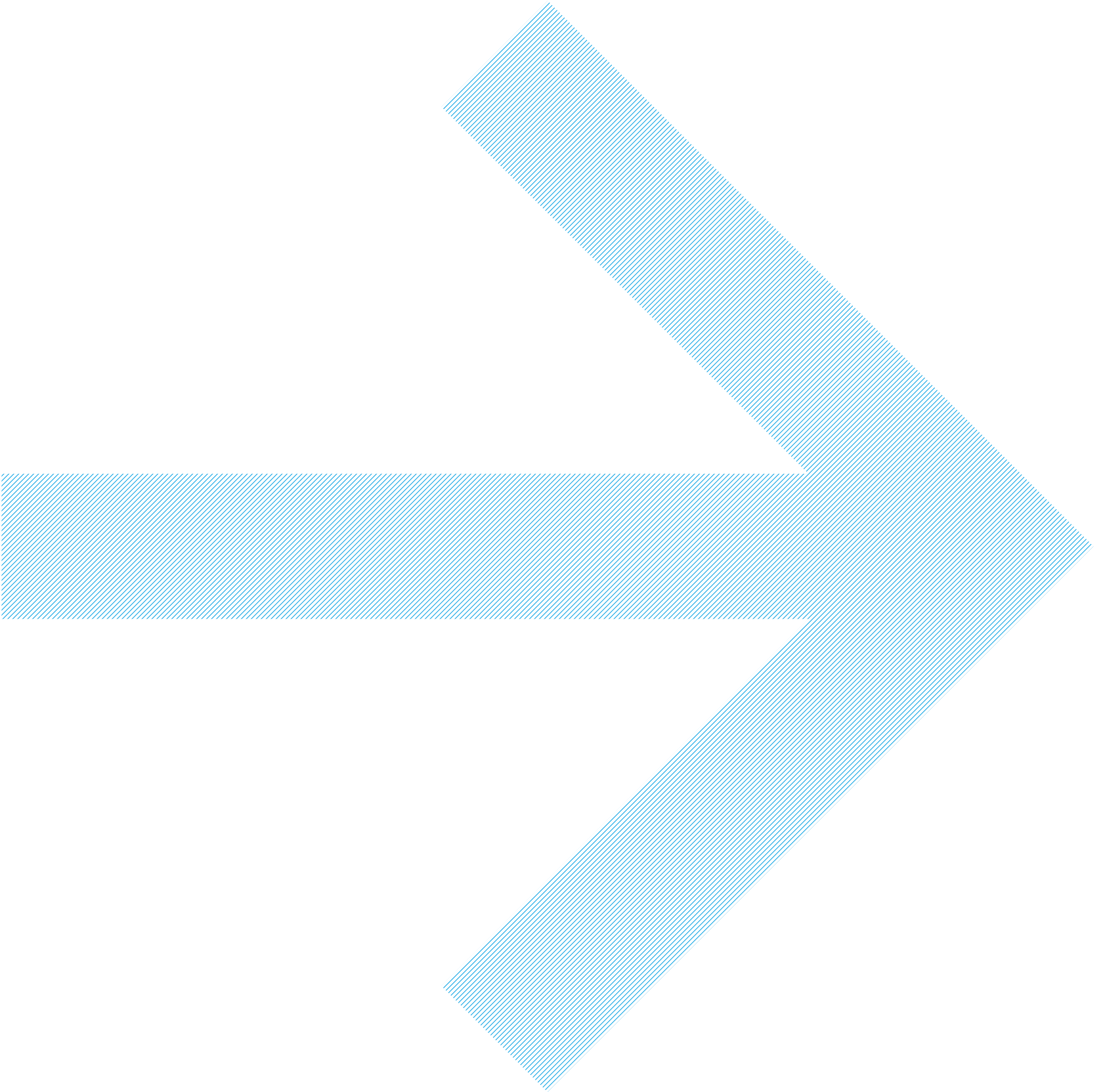
The report is based on workshops conducted with employees and external participants, interviews with strategists and experts, and the systematic trend monitoring that is conducted continuously at the Public Transport Administration.

A large number of individuals have contributed their commitment and expertise to the project. Their help has been invaluable in creating this report. I would like to express my gratitude to the employees at the Public Transport Administration, with a special thank you to those of you who work with continuous trend monitoring, or who have committed time to reading and writing.

I would also like to thank the Railway Group at the Royal Institute of Technology in Stockholm and John Hultén at K2, the Swedish Knowledge Centre for Public Transport, for their considerable help with workshops, interviews and analysis.

Our hope is that this report will provide valuable knowledge and insight into the external trends and changes that are taking place around us, and that it will contribute to inspiration and reflection.

Jens Plambeck  
Head of Strategic Development





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# Summary – external trends

The Public Transport Administration's competitive intelligence and trend analysis monitors trends that are expected to have a major impact on the development of public transport in the Stockholm region. A review and update has been conducted of the trends that were observed in the second edition of "A Changing World", which was published in 2016.

The external changes for public transport are described in four megatrends:

## **Demographic shifts, pressure on global resources and demands for sustainability**

An underlying megatrend is the continued rise in the global population and increased exploitation of the world's resources. An expansion of the middle class with a high standard of living and a larger proportion of elderly people is leading to increased pressure on our finite resources. Climate scientists have long warned of the risks and the need to steer people's behaviour towards a more sustainable lifestyle while ensuring that decision makers act on the basis of the reported climate challenges.

The trend indicates that the population may be open to a more sustainable lifestyle and are calling for decisions. Decision-makers are beginning to realise the importance of sustainability and the issue is now on the agenda, which is the first step to meeting the challenge. Technological progress can enable more efficient resource management and the creation of a structure of urban societies underpinned by a sustainability perspective. Together, the various elements can contribute to achieving greater sustainability.

## **Globalisation with urbanisation**

Another megatrend is continued globalisation and urbanisation. Global flows of data and information are still growing dramatically, while trade, capital and populations are increasing more slowly. In a global economy, resources and people tend to gravitate to centres, which are growing in power and importance. Globally speak-

ing, the urbanisation trend is shifting to even more megacities in China and India, as well in Africa and Southeast Asia.

As regards the Stockholm region, growth is primarily generated by immigration from other countries and an increase in new-borns, as well as the fact that an increasing number of inhabitants are living longer. The Stockholm region is the most appealing in the Nordic region and forecasts suggest that the population of Stockholm is likely to rise to 3.4 million inhabitants by 2050, a demographic growth of 50 percent.

The growing population in the Stockholm region, with more young people, seniors and immigrants, will increase the pressure on public transport. It will be essential to continuously analyse exactly when and where an increase in demand for public transport will occur. The transport needs of inhabitants primarily concern work and school commuting, as well as leisure travel. It is essential that public transport can meet these transport needs with attractive journeys in a robust and high capacity public transport system with a high degree of accessibility.

## **Digital acceleration into the future**

In 2020 and the following years, the "acceleration of digitalisation" megatrend will entail both opportunities and challenges for public transport. The new 5G technology will enable an expansion of the Internet of Things, where everyday objects contain sensors and processors. Communication between the connected devices will be simplified, data exchange across the network will increase, and new opportunities for data processing will emerge through AI. Digital development will generate enormous volumes of data, which will represent a strategic resource in the development and management of businesses and organisation.

Digital technology is creating a basis for development in other areas such as new business models and service and product development. Going forward, this will result in a breakthrough for Mobility-as-a-Service and for self-driving cars. Developing trans-

port services that can compete with the cars of the future will be a challenge for public transport. To meet this challenge, public transport will need to be receptive to and act as a facilitator for development and testing in these areas.

The challenges of digital expansion are that it requires openness to change as well as staff recruitment and skills development for a digital transformation. The introduction of new technology, in parallel with the maintenance and management of existing facilities, will be essential in order to enable development of the facilities and organisation of the public transport system. Another challenge of digitalisation is the capacity to deal with the rise in cyber threats that emerge in an increasingly digital world.

### **Lifestyle changes in a fragmented future**

Our lifestyles are constantly evolving as a result of external influences. One trend is that people are calling for a society with a higher level of individualisation, where information and services should be selectable, fast, simple and dynamic. At the same time, this is causing the fragmentation in society to increase in terms of how people live and what values they have. All of us are unique and individual.

The changes will impact public transport by increasing the demands made on services, with journeys expected to be easy to plan, quick and comfortable to make, and with the possibility of other activities during journeys. Inhabitants will require more from their travel experience than today, and more from related services such as journey planning, service information and so on. There will be a greater need for public transport actors to understand the travel expectations of the population in order to provide the right services and ensure the right product development.

The younger generations are focused on social and environmental sustainability and they are interested in sharing services. They are aware that their lives will be affected by the policy decisions that are made today and by the risks inherent in the climate change issue. Demands from these groups for decisions that lead

to sustainable solutions are increasing and there is also a rising demand for sustainable travel transport options.

### **Summary of implications for public transport**

Overall, the trend analysis shows that current trends will challenge public transport to meet a rising demand for a developed and sustainable transport system in which public transport is an increasingly important prerequisite.

At the same time, the trends show that it will be possible to meet these challenges if the concerned actors make informed decisions and actively move forward by:

- *investing resources in a growing region in order to expand the capacity of the transport system in a resource-efficient manner for attractive journeys*
- *creating sustainable alternatives while preserving robustness for people who require more individualisation*
- *leveraging the new technology and developing a strategy for how digitalisation is adopted and used in operations*



# Assignment, method and reading guidelines





### **Assignment to conduct a systematic trend analysis**

For the past ten years, public transport has been highlighted as a means for social progress in a way that was not previously the case. This has happened because public transport is seen as a solution to several contemporary social challenges such as climate, health and demographic challenges that are putting growing metropolitan regions under increasing pressure. In addition, digitalisation is transforming public transport and the way people travel, which has created both opportunities and challenges for the Stockholm region.

The purpose of this report is to shed light on these trends and describe their implications for public transport in the Stockholm region. The goal is to support the strategic work of Stockholm County Public Transport Administration and form a basis for deeper discussions. It is aimed at Swedish public transport stakeholders.

### **Method of trend analysis**

The competitive intelligence and trend analysis have been carried out by means of a structured, step-by-step method.

Work began with a review of the historical data and previous reports from the Public Transport Administration and a status report based on the Public Transport Administration's continuous trend monitoring. After that, an external environment model was developed to help sort and structure all the information on external trends that had been gathered.<sup>[1]</sup>

The next step was to conduct extensive data collection, including comprehensive secondary research of the competitive intelligence and trend analysis of other organisations, as well as a number of workshops with internal and external experts in the field of trend monitoring and personal interviews with experts in the Public Transport Administration.<sup>[2], [3], [4], [5] and [6]</sup>

Once the collected data had been sorted and structured, competitive intelligence and trend analysis was conducted in several stages, both individually and in groups of varying sizes. Key driver analysis and uncertainty analysis of megatrends was performed as well as an impact analysis of the implications of the trends for public transport in the Stockholm region.

During the course of the work, information about and establishment of results from the various stages was reported to the management team at the Department of Strategic Development as well as to a reference group.

Having reported to the Traffic Committee, production of digital and printed reports began, after which reporting and discussion of the report's conclusions continued with the relevant stakeholders.

### **Reading guidelines**

This trend report begins with a description of the four megatrends that have been identified as the primary trend drivers. The next chapter examines what characterises these trends, their pace, how they influence each other, and what subrends and counter-trends they encompass.

This is followed by an impact assessment of the different megatrends on public transport in the Stockholm region and what implications they might have. Each subchapter ends with a summary.

The concluding chapters describe the framework of the work and the external environment model that steered interpretation of the data, and present a list of sources used in the analytical work.

A high-angle, black and white photograph of a large crowd of people, likely at a sports event or concert, filling a stadium. The image is overlaid with a semi-transparent green circular graphic. Inside the circle, the text "the first megatrend" is written in a white, sans-serif font. The crowd is dense, with many individuals looking towards the camera or slightly away. The overall tone is serious and contemplative.

**the first  
megatrend**





Demographic  
shifts,  
pressure  
on global  
resources and  
demands for  
sustainability



### **The latest un census shows that the world's population is growing**

The latest forecast for future population growth indicates that the world population is likely to reach 9.7 billion people by 2050 and about 11 billion by the 2100. The rate of growth, measured as a percentage of the population, has declined since the 1960s when it was at its peak. The number of individuals is increasing annually by just over 80 million, which is about the same as the population of Germany. The population plateau that the un is forecasting will not occur until 2100, which means that an increasing number of world citizens will be sharing the same space in the foreseeable future.<sup>[7]</sup>

Forecasts predict that by 2050 India will surpass China to become the country with the largest population. They also indicate that African countries such as Nigeria, Congo, Ethiopia and Tanzania will join the top-ten list of largest populations. Other countries with high population growth are Pakistan, Indonesia, Egypt and the USA. The growth is mainly in areas that have not yet reached the same development level that exists in Europe.

From a global perspective, research shows that the three factors that impact population growth have declined: mortality, the birth-rate per woman and the proportion of the population of childbearing age. The decline is slow at a global level.

Economic development, an increase in women's rights and opportunities for girls to receive education are factors that reduce the average birthrate per woman. In some countries with low fertility rates, the population is approaching a plateau, for example Japan and several European countries.

In Africa, a large proportion of the population is young and of fertile age, which means that the population in Africa is expected to continue growing at a high rate. Africa is also the continent with the greatest development potential in terms of its economy and built environment.

### **Economic development is leading to a demographic shift with a larger middle class**

Data from the World Bank is showing a strong trend towards a reduction in global poverty. Currently about 10 percent of the world's population live in extreme poverty, which is a major decline since 2000. More than half of these poor people live on the African continent. Poverty has declined most rapidly in countries with high economic growth. In China, extreme poverty has been virtually eradicated since the very high levels of the early 1990s.<sup>[8]</sup>

The declining poverty is resulting in a dramatic increase in the middle class. In five years from now, the number of people in the middle class will overtake the number of poor people, which can be considered as one of the most significant global changes of our age. The middle class will be concentrated in existing metropolitan areas and in emerging cities in countries with high growth.

Rising incomes are driving an increasing demand for products and services that require energy. In India, the middle class is expected to rise to 700 million people by 2035. The energy needs for this population group are expected to require 300 new power plants, which is the equivalent to twice India's current energy supply.

When people are enabled to change their lifestyle and transition from poverty to the middle class, it can mean that every individual increases their consumption of global resources by up to 5 to 10 times. Thus total demand for resources is significantly higher than the percentage growth in the population, in other words pressure on the earth's resources is increasing at an ever faster rate than the population.<sup>[9]</sup>

At the same time, there is a countertrend in Europe and the USA, where the middle class is shrinking. Resource distribution in developed countries is trending towards a decreasing number of people at the top of the economic pyramid taking a larger slice of the pie. The rising inequality can lead to a backlash and the emergence of populist movements around the world. This is partly due

to the fact that people from a middle class that is losing ground feel disregarded and demand that politicians focus on domestic policy challenges and take their demands seriously.<sup>[10]</sup>

### **The global health level is leading to a demographic shift and rising life expectancy**

There is a trend of rising life expectancy in every part of the world. It has increased by 20 years since the 1960s, and currently stands at 72 years. According to the UN's latest report, it is expected to exceed 77 by 2050, a significant increase compared to the current situation. Life expectancy and child mortality are key indicators of the general health situation, but they also reflect economic development and resource distribution.

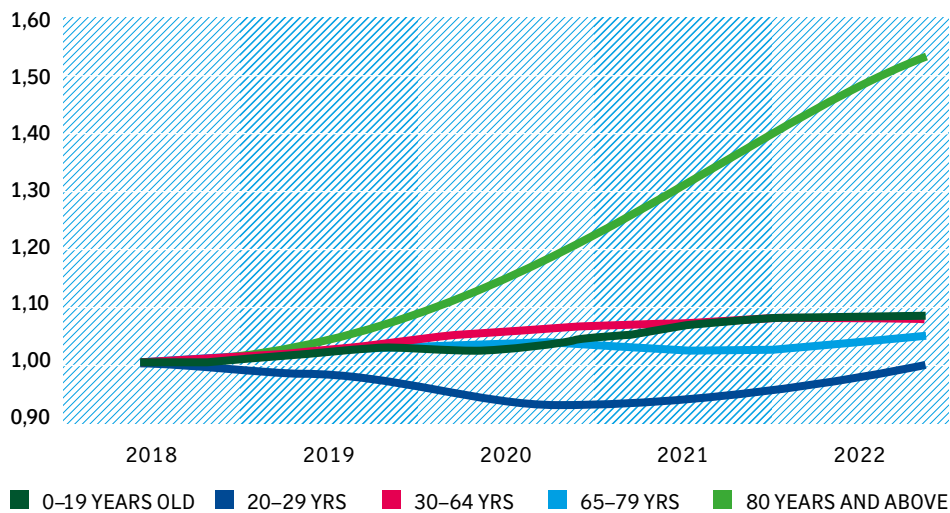


FIGURE 1, SCB, 2019/ EXPECTED POPULATION TRENDS IN DIFFERENT AGE GROUPS

Child mortality is declining across all continents, which is due to both improved social and economic conditions as well as to improved general living conditions. The UN estimates that investments in measles vaccine, mosquito nets and medication for malaria have saved over 20 million lives, mostly children. A decreasing number of people are dying of HIV/AIDS thanks to investments in the development of anti retroviral medication.<sup>[11]</sup>

When the general health level rises and the economic level develops, this leads to an increasing number of older people living longer and attaining a high age. The proportion of elderly people in the most economically developed countries such as the European countries and Japan is currently greater than it has ever been in history. This is an ongoing demographic shift all over the world.

An ageing population also leads to different buying patterns. The large proportion of elderly people will spend more on, for example, medicine, anti-ageing products, transport services and financial services such as insurance.

### **Sweden is showing the same demographic trend**

In Sweden and the Stockholm region, population growth is being driven primarily by increased immigration, a longer life expectancy and a surplus of births. Statistics Sweden forecasts that the number of residents in the Stockholm region born overseas will increase by 200,000 by 2027.<sup>[12]</sup>

According to the National Board of Housing, Building and Planning, the generation of baby boomers from the 1940s are now pensioners and about 20 percent of Sweden's population is aged 65 or over. The proportion of elderly people varies greatly between different municipalities, and in some smaller municipalities where outmigration is high, the proportion of elderly people is more than 30 percent. As of 2020, the proportion of the Swedish population aged 80 or over will also increase. This trend will be especially strong amongst people over the age of 85. By 2050, it is expected that the number of people aged over 85 will have doubled compared to today.<sup>[13]</sup>

Sweden has long had a well-developed health system and an economy that performed well in terms of GDP per capita. The country has a large middle class, a high average age and the average lifestyle is characterised by a large consumption of natural resources.





**FIGURE 2/ DESCRIPTION  
OF CLIMATE IMPACT**

### **The earth's climate is under pressure from rising demand**

Rising demand for the earth's resources is leading to increased pressure on the ecosystem. Impacts include ever-increasing levels of environmental pollution, more greenhouse gas emissions, unlimited exploitation of natural resources, and worsening climate effects that impact the population's ability to lead a normal life, which may in turn lead to climate migration. <sup>[14]</sup>

The World Wide Fund for Nature has calculated that Sweden makes a major ecological footprint. It would need more than four planets for all the people on earth were to live their lives according to the Swedish lifestyle and Swedish consumption habits. <sup>[15]</sup>

According to the UN, the overall impacts are impossible to determine and so extensive that humanity has never seen anything like it before. The trend is for humanity's impact on ecosystems to continue increasing. This is the megatrend that is most fundamental and the most challenging for all of us to relate to.

Scientific reports from 2018 and 2019 show a planet upon which the human footprint looms very large. Three quarters of the world's land has changed significantly as a result of human activity and about 1 million animal and plant species are in danger of extinction within a decade. Satellite data shows that the deforestation of tropical rainforests is more rapid than ever and in the summer of 2019, forest fires ravaged Amazonia at record high levels. <sup>[16][17]</sup>

Enormous quantities of plastic are accumulating in the world's oceans. Microplastics have been discovered in the sediments on the deepest seabed and in the ice floating in the Arctic. How this is impacting nature and humanity itself remains to be seen. <sup>[18]</sup>

Local effects on weather caused by climate change are occurring in more and more places, and the strength of these effects is tending to increase. Statistics show that extreme weather is increasingly impacting everyday life for people across large parts of the world. <sup>[19]</sup>

### **Water and food – scarce commodities and strategic resources**

Limited access to water is one of the greatest global challenges. Climate impacts such as increased temperature risk are having a negative effect on both the water and food supply worldwide. This means that water is very likely to become a conflict resource – the amount of water on earth remains constant while the demand for food and water is rising as the population grows.

If difficulties in obtaining food and water in the longer term become a reality in some regions, it may lead to an increase in climate refugees fleeing to areas of the world with better access to food and water. <sup>[20]</sup>

### **A sustainable future, a common commitment to adaptation**

In the UN General Assembly, the leaders of the world have committed to achieving seventeen global goals by 2030. These goals are described in Agenda 2030 – the global goals for sustainable development. <sup>[11]</sup>

In autumn 2018, the UN Panel on Climate Change, IPCC, reported that the climate goal of the Paris Conference 2015 to restrict global warming to within 1.5°C to 2.0°C is achievable. The report emphasised that it is absolutely essential that activities to reduce risks must be initiated forcefully today, especially if the aim is to remain within the lower level of warming.

There is a clear trend of many parts of the world community that previously did not consider sustainability to be a top priority now understanding the importance of this issue. In 2019, the World Economic Forum meeting in Davos focused on sustainability issues. Extreme weather, natural disasters and our inability to adapt to a changing climate were the three most important risk factors discussed in its annual risk analysis. <sup>[21]</sup>

This awakening has contributed to the start of a shift away from fossil fuels. The capacity of renewable energy sources such as solar, wind and hydro power is growing rapidly and prices are falling.



FIGURE 3/AGENDA 2030, THE GLOBAL SUSTAINABILITY GOALS

Sustainable energy modes are already economically competitive today. Until now, the global rate of growth in fossil fuel consumption has risen faster than the rate of conversion, which has led to a total increase in the climate impact and the emissions.

Rising pressure on our natural resources and the increasingly severe effects of extreme weather, both in the short and long term, are providing an incentive to develop routes to sustainability in all parts of society, not least in the transport sector and public transport.

**Trend in energy consumption – increased electrification, smart solutions and the pursuit of increased sustainability**

In Sweden, household and industrial consumption of fossil fuels has decreased significantly for several decades. A major challenge in achieving “freedom from fossil fuels” is energy consumption in the transport sector, which accounts for about one third of greenhouse gas emissions in Sweden. <sup>[22]</sup>

Electrification of vehicles in both the automotive industry and in public transportation is a strong trend. Electric motors are both highly efficient and energy efficient. Electric buses are a step towards using energy more efficiently, reducing emissions and increasing the degree of sustainability.

Electrification of the vehicle fleet also generates side benefits in the form of reduced noise pollution and improved urban air quality. At the same time, there is a risk of higher traffic volumes with more congestion and queues on the roads due to the low marginal costs that electric vehicle usage entails. <sup>[23]</sup>

There are strong indications that electrification will increase in Sweden in the coming years in terms of private cars, buses and trucks. However, according to Transport Analysis, turnover in the Swedish vehicle fleet is slow, and cars in Sweden have an average lifespan of 18 years. This has resulted in very slow progress, and

the proportion of electric vehicles in Sweden will remain relatively low until 2030. The same is true in the bus industry, where the transition from fossil fuel-powered to electric-powered buses has been slow and diesel buses will remain predominant on the roads from a 10-year perspective. <sup>[24]</sup>

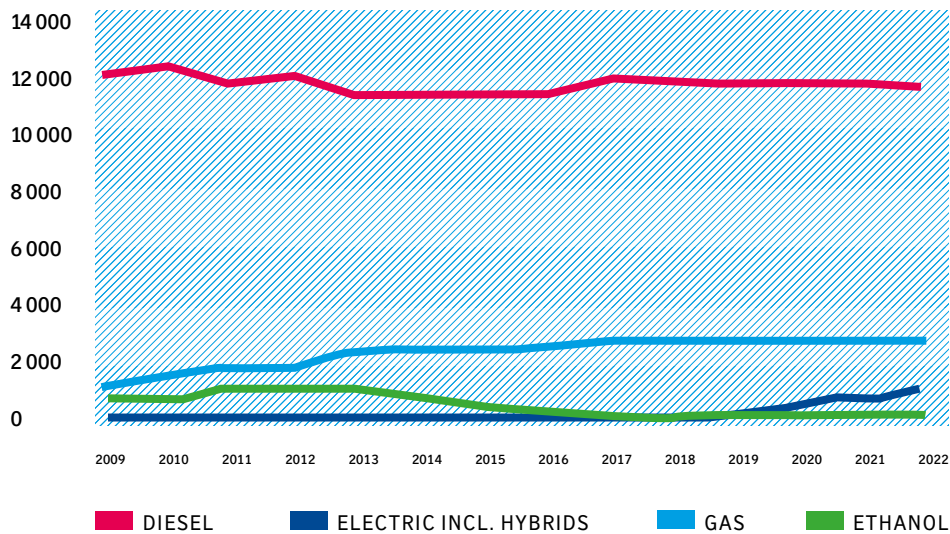


FIGURE 4, TRAFIKANALYS/TRENDS AND FORECAST REGARDING FUEL FOR BUSES IN SWEDEN, 2019

Electrification of vehicles is part of an external trend in which the demand for electricity is rising in many parts of society. The increased digitalization and the expansion of IoT is one sector that causes increased electricity consumption. Server halls use electricity and a very sharp increase in the number of sensors and processors means higher electricity consumption, although newer technology may be more energy efficient per unit than current technology.

According to studies by Ellevio, the total increase in demand for electricity is creating challenges for the Swedish electricity grid including the risk of power shortages. The Swedish infrastructure is weighed down by a number of investment liabilities. This applies to rail, water and drainage networks as well as the electricity grid. When demand for electricity increases sharply, problems can arise when the capacity of the electricity grids is simply no longer

sufficient. The lead times for building electricity grids are long and, according to the study, the infrastructure investments made in the upcoming years can be expected to have a major impact. <sup>[25]</sup>

Another challenge with electric vehicles is that they use batteries. Manufacturing the batteries generates carbon dioxide emissions that reduce the climate benefits of the vehicles compared to fossil fuel-powered vehicles and, in addition, critical metals such as cobalt, nickel and lithium are needed to produce the batteries. The bulk of several earth metals is mined in China, while cobalt is almost exclusively mined in Congo under questionable conditions in terms of social and climate sustainability. Earth metals are also known as “conflict metals” and any increase in demand for them may lead to problems where they are produced. <sup>[26]</sup>

One advantage of electrification is the reduced emissions that the vehicles produce compared to fossil fuel-powered vehicles. Many metropolitan areas all over the world face challenges in terms of emissions and poor air quality. This is a major issue in which car use, fossil-fuel power stations and private combustion of coal and wood for cooking contribute to the problems and create unhealthy cities.

### Challenges in order to progress

Despite the power of the political process to improve the sustainability of our societies, there are a number of backlashes that are hampering progress. Some special interests are contributing to sub-optimisation, and political leaders that are sceptical about climate threats have come to power in several large countries. They are turning a blind eye to the unanimous picture of science of the impact of the climate footprint on our global environment. At climate conferences such as in Paris and Katowice, the differing outlooks of the developing countries compared to the major economies have been evident.

Political activities in the two superpowers USA and China indicate major challenges for joint efforts to reduce the climate footprint.



The USA withdrew from the Paris Agreement, which prompted sharp reactions from the EU and the rest of the world.

There is a downside to China's climate policy as Chinese carbon dioxide emissions are increasing despite investment in the expansion of renewable energy sources such as solar and wind energy. Coal energy is increasing faster than renewable fuels in terms of capacity because coal has such a dominant position in China. <sup>[27]</sup>

### **Sustainability is becoming increasingly important**

In the EU, there is an action plan regarding the "circular economy" whose aim is to steer the member countries towards a more sustainable approach and to establish frameworks for resource-efficient business models. Insight into these issues has increased in many parts of the world. <sup>[28]</sup>

Most major companies have initiated a sustainability policy or expanded an existing policy according to data from a McKinsey survey. Important elements of this trend are efforts to save energy and the commitment to develop green products as well as to work to retain and motivate employees who call for sustainability and ethics. Companies have seen that it is financially profitable to act sustainably and are gradually becoming more aware of the increasing demands and expectations of consumers. <sup>[29]</sup>

Issues related to climate, ecology and ethics are of particular interest to younger generations, who react when they see threats to their future. Sustainability issues are increasingly important to inhabitants, for example recycling among the population is rising. <sup>[30]</sup>

It can be said with certainty that the future will resemble nothing that has gone before it. A world of ten billion people living well over the age of 70 is a major change. The simultaneous increase in income, and hence lifestyle, consumption and production, will magnify this change. The conditions for human life and our interaction with the planet will be new.

This requires that we manage to cope with these development challenges at the same time. Research data shows the risks of continuing on the current path. We need to become more sustainable and we need to do it quickly.





the second  
megatrend

Data has a b





# Globalisation With urbanisation

better idea

### Continued expansion of global connections.

Through globalisation, more people are able to participate in technological progress, economic cooperation and cultural exchange, regardless of geographical affiliation. The 2016 trend report reported that signs of globalisation as a trend were slowing. In recent years, an increasing number of backlashes have appeared on the horizon and at a political level the scenario is one of reduced international cooperation and trade.

Meanwhile, the global economy has not stopped expanding. Rapid technological progress is driving globalisation, with more people connecting to the Internet and benefitting from global information and communication. As regards cross-border data flows, volumes have increased dramatically in recent decades and above all in the last ten years.

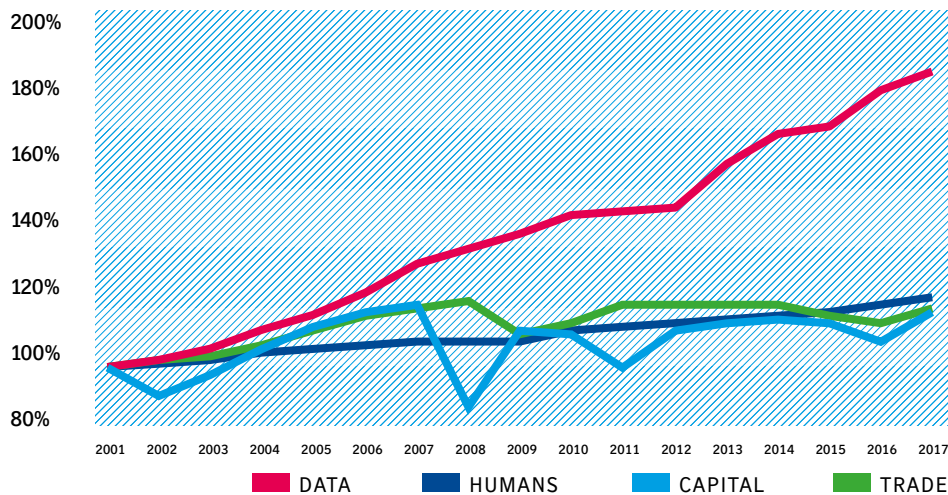


FIGURE 5, DHL, 2018/GLOBAL CONNECTEDNESS INDEX

Since the start of the millennium, the logistics company DHL has been compiling a global connectedness index, with the most recent edition showing that the index is still trending upwards in all four globalisation factors that it measures: people, capital, trade and data/information. While the trends for capital and trade have fluctuated somewhat, the trend for information flow slopes steeply upwards compared to the other factors.<sup>[31]</sup>

Global digital technology giants have created digital platforms and use scalable cloud solutions. Key players such as Google, Amazon, Apple, Microsoft and Facebook have generated enormous value in recent years and they currently hold five of the top ten places in the list of the largest US companies based on company valuation. China has equivalents such as Alibaba, Baidu and Tencent.<sup>[32]</sup>

Their platforms also enable small and medium-sized enterprises to operate globally and become “micro-multinational companies”. However, critical voices are being raised that the tech giants are controlling the flow of information, monopolising advertising revenue and eliminating potential competitors. Some people consider them to be a threat to democracy.<sup>[33]</sup>

One element of the global economy that is continuing to grow is the intangible economy of services and innovations. This is an important area for Sweden that can, through high levels of expertise, compete in creative and innovative industries. The private service sector currently employs the largest proportion of the Swedish workforce, with close to 30 percent working in this sector.<sup>[34]</sup>

With new digital technology and new business models, banking and commerce have become more tightly knit on a global level. This affects how business is conducted and how the roles of banks and insurance companies develop. The pace of change is high.<sup>[35]</sup>

Globalisation has been a contributing driver in the improvement of economic development and the reduction of poverty. Economic development leads to global infrastructure expansion in the form of roads, high-speed trains and expanded airports and air routes. In conjunction with better financial conditions for individuals and an increasing interest in visiting other countries, this has led to more people travelling internationally.



### **Countertrends and geopolitical conflicts – power is shifted to Asia**

There is a strong backlash to the current global world order and a tendency in segments of the population in many countries to desire less globalisation. Some political forces are responding to this.

In 2016, the UK voted to leave the EU. Political discord has delayed the exit process, which has led to continuing uncertainty for economy and trade. At the time of writing, the Brexit situation remains unclear.

In autumn 2016, one of the most unexpected election victories in US history occurred when Donald Trump emerged victorious in the presidential election. His political agenda includes, *inter alia*, increased isolationism and a reduction in free trade. Since his election, he has overseen the USA leaving the Trans Pacific Partnership (TPP), the renegotiation of the North American Free Trade Agreement (NAFTA), and the USA's withdrawal from the Paris Agreement on climate action. The shape of US foreign policy going forward will depend on the upcoming presidential election in 2020.

The growing significance of Asia in the global political economy is one of the fastest and most fundamental movements at global level. Asia's share of global GDP was about 30 percent in 2000 in purchasing power-adjusted terms. According to OECD forecasts, in 2025 Asia will account for more than half of the world's total GDP, with the region accounting for almost 60 percent of the world's population. <sup>[36]</sup>

China's rapid economic growth is the most important change factor. In terms of its share of global GDP, China has in recent years already overtaken the USA as the country with the greatest purchasing power. In the short term, China's position as the most powerful player in the world market will be strengthened. According to many analysts, its growth rate will slow after 2025 due to demographics, cost trends and economic profile. <sup>[37]</sup>

China is currently investing heavily in consolidating its international role and broadening its sphere of influence. Its infrastructure investments in many parts of the world are frequently made in exchange for necessary natural resources. According to the Chinese media, China has recently developed a financing package of over USD 550 billion aimed at expanding the infrastructure in African countries. Much of the support consists of cheap repayable loans. <sup>[38]</sup>

A huge infrastructure project, the Belt and Road Initiative, has been adopted by the Chinese government. Its goal is to connect more than half of the world's population by means of waterways, ports, highways and tunnels. The improved communications will impact about a quarter of all the goods moving around the globe. One illustration of China's rapid rise from developing country to superpower is its astonishing statistic for cement consumption in recent times; China uses as much cement in every two-year period as the USA did during the entire 20th century. <sup>[39]</sup>

China is also at the forefront as regards developing new technologies such as artificial intelligence (AI) and quantum computers. China's political structure and its ability to leverage access to vast amounts of data through AI-friendly legislation are enabling the prerequisites for China to become a leader in digital development. In 2017, more money was invested in Chinese AI companies than in American AI companies. <sup>[40]</sup>

In addition to China's growth, the change in the relative economic size of Japan and India is another important change. In purchasing power-adjusted terms, India has now overtaken Japan and the gap between the countries is expected to increase by 2025. India is also expected to have the largest population growth. The country has a high education level and favourable economic development, which will soon result in India threatening the USA's position as number two in the world. Examples of more countries whose economies are forecast to grow strongly by 2050 are Indonesia, Mexico and Turkey. <sup>[41]</sup>

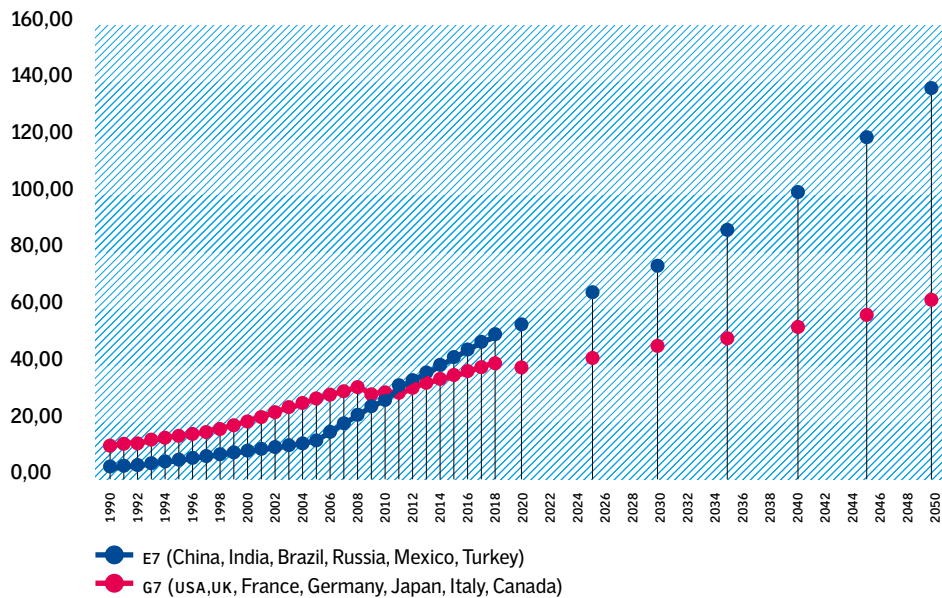


FIGURE 6, WORLD BANK AND PWC/DATA ON GDP FOR THE E7 AND G7 RESPECTIVELY WITH FORECASTS FROM PWC, 2018

The USA has responded to the ongoing power shift by introducing trade barriers in the form of tariffs against China. China responded with its own tariffs against the USA. There is a risk that the conflict will escalate into a full-scale trade war.

In the 2016 trend analysis, a scenario was discussed in which a multipolar worldview and economic structure were about to emerge. Data indicates that this trend has been reinforced and that world events support such a scenario. One of the consequences of globalisation is that national domestic conditions are shaped by international events to a greater degree and citizens are calling for increasing levels of security and prosperity.

A weakened USA with a reduced presence on the world stage creates gaps that can be exploited by authoritarian powers such as China and Russia. According to the World Economic Forum, an international order consisting of competing spheres of influence may increase the risk of regional conflicts between, for example, India and Pakistan or between Iran and various Middle Eastern countries such as Israel and Saudi Arabia.<sup>[42]</sup>

### Migration is a growing challenge

Geopolitical unrest has created record numbers of migrants in the world according to UNHCR. Many refugees sought asylum in the EU in 2015 and 2016 due to the Syrian war and the rise of IS. The influx of migrants has created tensions within the EU regarding how to deal with them and how to monitor EU borders.<sup>[43]</sup>

A tough immigration policy has been a high-profile issue for Donald Trump. During the election campaign, he promised to build a wall on the Mexican border to stop criminals and drugs from entering the country. He has toughened the USA's migration policy considerably and there is zero tolerance for illegal immigration.

What the future policy of the EU and the USA will be as regards migration issues remains to be seen. The trend has been that demands for a more restrictive approach to migration are increasing among the population.

### Tension and inequality in a changing world

Economic development and technological progress can lead to the relocation of manufacturing to low-wage countries or workers being replaced by robots. In a society where sections of the population lack education and thereby the prerequisites to find employment, there is a considerable risk of creating a permanent underclass, which may also become a breeding ground for nationalism and extremism.<sup>[44]</sup>

In Sweden – as in many other Western countries – discontent is growing. Tension builds when the pace of change is fast and if societies fail to create new jobs at the same pace as the old jobs disappear. Unemployment and a feeling of exclusion can have a negative effect on individuals. By extension, this can undermine social cohesion.

The world has been developing economically, but the distribution of resources from this development is distributed very unevenly. A report from Credit Suisse shows that 1 percent of the world's

population now owns more than half of all global financial resources. The lack of wealth distribution runs the risk of increasing tensions. Many of the backlashes that can be seen in different parts of the world have occurred when people feel that the system is unjust and that they are being neglected. [45]

**Urbanisation will not stop – the rise of megacities**

As part of an inextricably linked world, the engine of urbanisation continues at the same high rate as before. Urbanisation is a force that derives from the fact that resources, capital and population tend to gravitate to large cities.

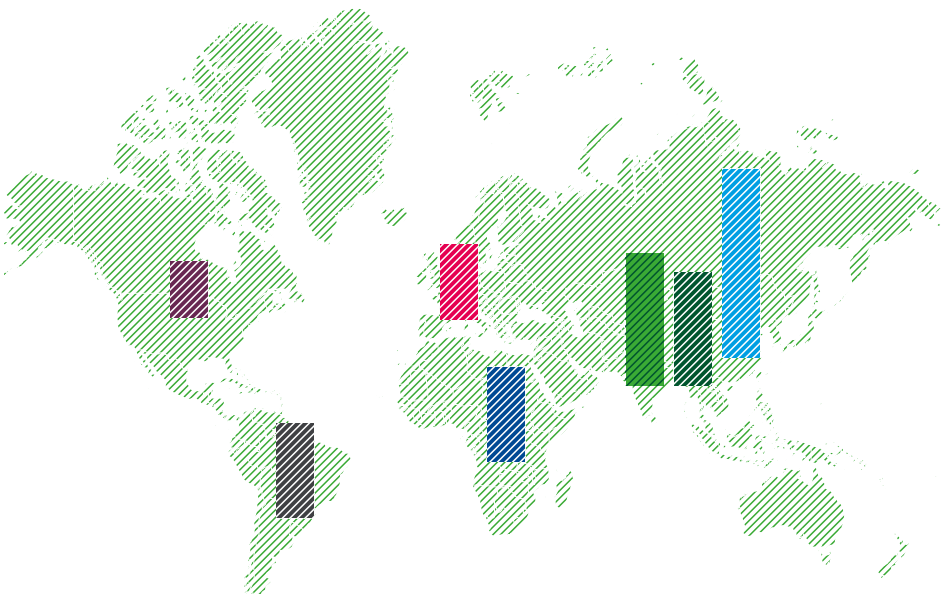
The reason that people gather in cities is that there are major benefits to be gained from living together in the same place. Opportunities to obtain education and employment increase. The possibility of starting a business and find labour is simplified. Urbanisation facilitates social encounters and forms a basis for cultural and leisure activities.

According to UN statistics, the proportion of the world's population living in cities has grown from just over 40 percent in 1990 to 55 percent today, and this proportion is expected to rise to as much as 65 percent by 2050. At present, urbanisation is increasing considerably faster in developing countries than in the West, which experienced major urban growth during the 20th century. Emerging metropolitan regions are still largely driven by industrial growth, which applies, for example, in Africa. In China and India, both industrialisation and the service economy are the growth engines for megacities. [46]

According to UN forecasts, there will be 40 megacities of more than 10 million inhabitants by 2030. Virtually all new megacities will be found in the developing countries, and it is in Asia that the most growth is expected. According to statistics from McKinsey, the world's 100 largest cities account for 40 percent of global GDP, a figure that is projected to rise rapidly. In other words, development in the largest cities is crucial to global economic development. [47]

Urbanisation has both commercial and political significance. Global corporations search for the urban areas that generate the most growth, which causes a competitive situation between different cities to attract companies. In terms of politics, this means a shift in the centre of gravity within and between countries.

Corporations can have an impact on policy by choosing where they locate their businesses and where they pay taxes. They can have a greater political role in a society that has deregulated its markets and where private companies play a prominent role.



CHINA (10)	INDIA (7)	REST OF ASIA (6)	AFRICA (5)
EUROPE (4)	SOUTH AMERIKA (5)	NORTH AMERIKA (3)	

FIGURE 7, UN DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS, 2018/ DATA ON URBAN POPULATIONS AND PROJECTED FORECASTS FOR 2030.





**The Stockholm region – probably the Nordic region’s most attractive metropolitan area**

Urbanisation has also persisted in Sweden. The metropolitan regions of Sweden and the Nordic region are expected to show a strong population growth in the coming years and the Stockholm region is one of the most appealing.

Population growth forecasts for the Stockholm region have been produced by Statistics Sweden, and based on expected growth the population will increase to 2.9 million in 2030 and to approximately 3.45 million in 2050. This is an increase of about 50 percent from the current level. The population growth in the Stockholm region is assumed to be due to increased immigration, increased longevity and a surplus of births.<sup>[48]</sup>

As regards domestic migration flows, about as many people are migrating away from the region as are moving into it. In 2018, there was a negative domestic net migration for the region. Analysts believe that one partial explanation for this is the situation



in the housing market, with a shortage of low-cost housing and a stricter mortgage market. It is both difficult and expensive to find housing in the Stockholm region. <sup>[49]</sup>

Only a small proportion of the current urbanisation in the Swedish metropolitan areas is due to depopulation in the countryside. An increasing number of people are choosing to live in growing commuter communities and in accessible rural areas. The expanding cities have been transformed into metropolitan regions.

As urbanisation increases, demographics change accordingly. In the large cities, the population of all age groups is rising, whereas in the rural areas there has been an increase in the proportion of older people but a decrease in the working population aged 20–64, as well as job opportunities and services. <sup>[50]</sup>

In order to maintain a high level of competitiveness and attract people, the housing, infrastructure and transport in large cities needs to be developed in to create accessible regions. Following trends regarding increasing demands for sustainability and rapid digital development are other factors that can cause the population to stay put or attract new people to a region. The Stockholm region is often ranked high by external analysts in these areas.

A growing population in the Stockholm region, with more young people, seniors and immigrants, is expected to lead to rising demand in areas such as health, education, culture and transport. This will put pressure on all the key stakeholders in society to meet the increased needs..





The background of the slide features a high-contrast, black and white image. On the right side, there is a profile of a person's face, looking downwards. The image is rendered in a way that makes it appear as if it's a negative or a high-contrast filter. In the upper left portion of the image, there is a mechanical structure, possibly a crane or a piece of heavy machinery, with various beams and supports. The overall aesthetic is industrial and futuristic.

**the third  
megatrend**





Digital  
acceleration  
into  
the  
future



### **Digitalisation is one of the key change factors of our age**

Historically speaking, technological progress has been one of the strongest driving forces behind how human lives are shaped on an individual and social level, which is grounded, inter alia, in the capacity for innovation and creativity that exists in humans, as well as our curiosity and willingness to take that next step.

The trend that started in the 1970s with an enormous development in computing power per unit and a rapid increase in the data transfer rate has endured to this day and represents a continuing megatrend. It has enabled numerous advances that have dramatically impacted our social lives, for example through computers, the Internet and mobile phones, and so on.

The fact that everyone is constantly connected to the Internet opens up new opportunities for communication between people and the possibility of interaction between organisations, individuals and entities.

### **The pace of digitalisation is accelerating**

The power of digitalisation and how it impacts on other fields has resulted in an explosion of technology and a situation in which more and more fields are combining and feeding one other at an increasing rate. The most radical technological advances have come not from linear improvements in a specific field but from a combination of inventions in different disciplines. Fields that achieved such unexpected combinations are, for example, cancer diagnostics, biomedicine and food production.<sup>[2]</sup>

It is difficult to predict what impacts might result from as yet untested technological combinations. It is quite possible that technological advancements will change the very definition of what companies in different industries can do. One example is the automotive industry, which nowadays is not merely a matter of manufacturing cars, but involves companies transitioning to considering how to offer mobility solutions, value-added services and, in the future, autonomous vehicles. The increasing use of the

Internet of Things, artificial intelligence and machine learning is leading to revolutionary changes in the industry.

Competitive conditions in different markets are changing, which also applies in the transport market. It tends to develop interconnected networks of partners, platforms, customers and suppliers that influence roles in the market. It could be considered a new ecosystem with new connections on unbeaten roads.

The intelligence from the 2016 trend analysis has in fact materialised, with a proportional increase in the number of connected individuals, an increase in the number of smartphone users and an explosion in real-time society.

Physical meetings between people will obviously not disappear. They are still the most fundamental and desired form of contact for humans as social creatures, but the channels for how we can communicate are continuing to evolve.

In 2019, it is not uncommon for an entire room of people to socialise while watching a screen. Parallel to personal meetings with friends and acquaintances, people socialise with other people in other places via social media. They follow threads on social media, they post group selfies on Instagram, they post selfies, they chat with friends, and they tweet.

The rate at which humans are adopting new technological advances is accelerating as well as the pace of digitalisation, where new products and services become public goods in a shorter time than before.

Statistics from Reportal show that, at a global level, the prevalence of Internet users and the proportion of people using social media is continuing to grow at a strong pace in, for example, Africa and Asia, which is a consequence of the spread of digital technology.<sup>[51]</sup>



It took about ten years for 75 percent of the Swedish population to have access to the Internet. The rate at which new technologies are breaking through on a broad front is tending to increase and it took only five years for three quarters of the population to have access to smartphones and tablets.

In the Swedish Internet Foundation's annual survey, results for 2019 show that in the first year of researching the prevalence of units included in the Internet of Things, 50 percent of the population responded that they already had units like that in their home. In other words, the pace seems to be accelerating even more. [52]

speed; it also has a shorter delay in terms of data transfer and can manage more connected devices at the same time, according to the Swedish Post and Telecom Authority. The unique aspect of 5G is that more services can be combined technically in the same mobile network without compromising connection quality. [53]

The enhanced technology of 5G will enable new applications, both in business and in vital societal functions. Going forward, this could mean, for example, remote-controlled and self-propelled vehicles, new advanced functions in industry and health sector, and brand new gaming experiences in mobile devices.

The Internet of Things is a catch-all for the development by which all units such as machines, vehicles, household appliances as well as animals and people are equipped with small built-in sensors and processors. This allows the units to perceive their surroundings, communicate with them and thereby create behaviours that are adapted to different situations and contribute to creating smart environments and services.

The number of devices that are connected via built-in sensors has increased dramatically in recent years and forecasts indicate a huge increase in connected sensors and processors by 2025, which could mean 75 billion units according to Statista.com. [54]

Sensors in vehicles and facilities will be able to communicate with one other and with traffic management. Opportunities to create tools and interfaces that benefit the population will increase. Data and digital tools will ensure that the needs of the public for service information and other services are met.

Data, both internal and from external sources, will become the most important strategic asset for organisations. Data management will impact areas such as planning, product development, operation and maintenance. One trend is that different condition monitoring systems are being used to detect the condition of tracks and rolling stock and perform predictive maintenance.

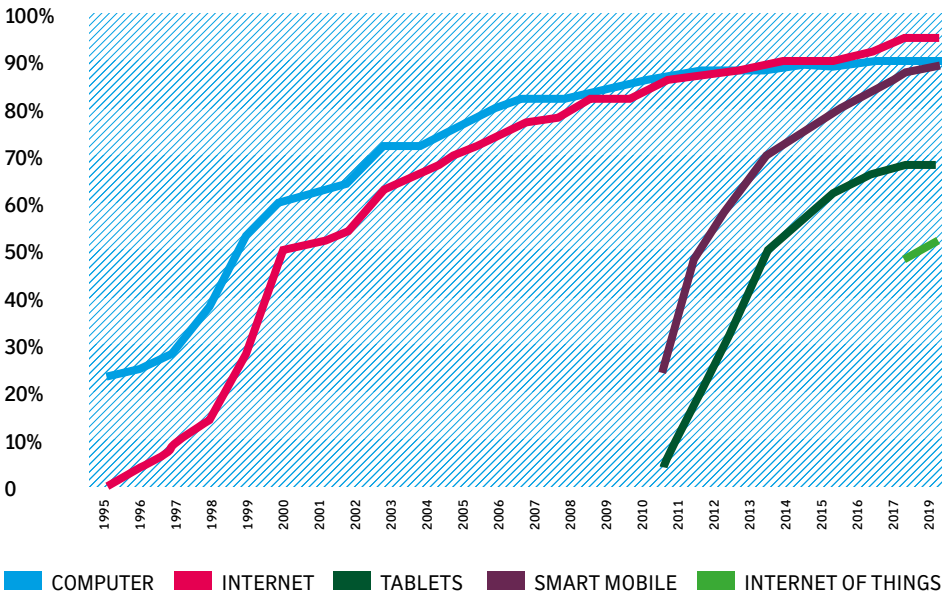


FIGURE 8, SWEDISH INTERNET FOUNDATION, 2019/ PERCENTAGE OF THE SWEDISH POPULATION WITH ACCESS TO VARIOUS DIGITAL TOOLS IN THE HOME, TREND FROM 1995 TO 2018

5G and the Internet of Things

The next development leap will be the introduction of 5G, the next generation of mobile broadband for data transfer. The 5G network will be launched in the near future, although it will probably take several years before it is fully developed and has replaced the current 4G network. The advantages of 5G are not only its faster

### **Artificial Intelligence – an expanding reality**

Data volumes up to and including 2025–2030 are expected to grow dramatically according to sources such as Gartner and International Data Corporation (IDC).<sup>[55]</sup>

The gigantic volumes of data produced will need to be processed by artificial intelligence (AI). AI is programmes and algorithms that mimic human thinking and enable automatic data processing. This results in faster and more efficient ways of acquiring data-based knowledge than has been possible using conventional methods. Data can be analysed in real time, interpreted and applied when designing new services.

The concepts of AI and Big Data have long been discussed as hot trends without having made any tangible imprints on society on a broad front. Improved tools and software with advanced user interfaces now mean that AI is spreading to more areas and among more key players. By means of AI and machine learning in which algorithms read, interpret data and refine their processing of data patterns, data-based organisations can enhance their business processes and create a sound basis for service development.

Gartner is forecasting that AR, augmented reality, using automated AI will spread rapidly in society and comprise half of all data analytics worldwide within a five-year period. They predict that the results of the advanced tools will continue to be interpreted by humans. AI cannot replace the complexity of human relationships and it is hard to predict how humans will behave in a given situation. Human gut feelings cannot be programmed. Qualitative analysis remains crucial as well as the question “why?” when interpreting results.<sup>[56]</sup>

The AI trend is placing increasing demands on organisations to transform and increase their focus on evaluation and reflection. This involves giving employees the opportunity and responsibility to work analytically in order for their organisations to become data-driven in reality. As regards public transport, it means that

data analysis will lead to a better long-term understanding of the population’s public transport needs.

### **Need for new approaches – essential for dynamism and creativity**

The approach of technology and IT companies, which work in an agile way and with short lead times, generates a rapid rate of development. The competition is fierce and innovating new ideas and solutions that can be tested quickly is essential. In addition, it is extremely difficult to predict which services will be winners or how they will be designed. Successful players combine a wide range of collaborative skills and they need entrepreneurship, good timing and extensive testing of different discipline combinations that have not been previously tested.

An agile approach also aims to merge development and operation into a team that works constantly on new iterations of a product or service. In a so-called DevOps culture, the product is never fully developed and there is no distinction between development and management – small adjustments are made, they are tested and iterated in a never-ending loop.<sup>[57]</sup>

One trend in the IT sector is for everything to be stored and delivered in the Cloud, which is a delivery model for data processing whereby different servers, programmes, data and other resources are interconnected into networks. These function as a single ecosystem and are provided as an online service. Often they are virtual services, the bulk of which consist of self-service features, i.e. the customer receives access in order to self-manage important activities and does not have to wait for the supplier’s staff to do it. It is an approach that saves time.<sup>[58]</sup>

### **New business models are challenging**

When new businesses emerge, they are often referred to as disruptive. It is obvious that these new activities will lead to a shift in approach for an entire field and that everyone in the industry will change perspectives and approaches at the same time. The steps

that a player needs to take in order to become relevant in the new field are often inconvenient but they sow the seeds for new opportunities in the process.

Companies that embrace the new approach are quicker to adopt the business models that are generated with the help of technological advances and are more able to challenge today's giants. McKinsey describes this trend by dividing companies into three categories:

- **Linear value chains:** dominated during the 20th century, with the goal of producing and selling products.
- **Horizontal platforms:** emerged during the IT era of personal computing and the Internet. Companies own hard assets and sophisticated architecture, typically built around advanced software and technology stacks.
- **Ecosystems:** for example Uber and Airbnb, companies that operate at the centre of digital platforms, but are distinctly asset-light. Instead they offer an arena for global services.

New companies often operate by connecting people with each other online in a global ecosystem, for example in the role of seller and buyer. The largest and most successful companies such as Amazon control this operation on numerous levels. They own the cloud, they own the platform and they own the subsystems of warehousing and logistics. Traditional companies see Amazon as a future threat in retail and logistics. <sup>[59]</sup>



FIGURE 9/ IMAGE WITH DESCRIPTION OF THE TECH-GIANT MARKET

The global giants frequently offer their employees benefits that are provided by the public sector such as health care, elderly care and education. Google, Amazon, Microsoft and Apple are considering launching their own educational initiatives in order to meet their skills needs. This approach has existed at major companies before, but the trend is growing.

The social safety net that they offer will be a competitive advantage and a way of holding onto loyal employees in the long term in a world where freelance work and global mobility make it more difficult to attract and retain skills in the workplace. <sup>[60]</sup>

A new area of technology that has been created on the basis of a combination of increased connectivity, cryptography and advanced analytics is what is known as blockchains.

A blockchain is a digitally distributed, global transaction database that replaces third party involvement and aims to increase transparency in agreements. It is potentially a revolutionary technology in a longer time horizon, as transaction costs represent a significant portion of the world's commercial costs. Blockchains were created out of a desire to avoid the transaction costs incurred during negotiations.

Blockchains have yet to break through on a broad front and experts believe this is due to trust issues caused by a lack of regulation, technological ignorance in the market, and concerns about authorisation and security. It remains to be seen whether the technology will gain a foothold with the general public. <sup>[61]</sup>

**Smart cities, mobility services and autonomous vehicles**

The concept of “smart cities” is a vision of urban development based on data about people, entities and ecosystems. The goal is to build a city and its infrastructure while ensuring that it is attractive to residents, cost-effective, climate-friendly and socially sustainable. For example, this involves prioritising new digital technology and developing transport and travel that is more sustainable.



The vision of smart cities has been in existence for a while, but no major steps have been taken in this area compared to 2016. The emergence of IoT, the introduction of 5G and the prevalence of digital platforms are expected to provide greater opportunities to create solutions in the near future that facilitate the creation of smart cities.

UITP, the International Association of Public Transport, reports in Urban Mobility Index 3.0 that many cities have made strides in their mobility development by introducing multimodal travelcards and car pooling systems. The top-ranked cities are cities with a high technological maturity level in terms of digital tools and a high population percentage with Internet connectivity. In these cities, a relatively high proportion of journeys take place using sustainable transport modes: public transport, cycling and walking. In order to achieve the vision, innovative thinking and openness to the electrification and automation of the vehicle fleet is needed. [4]

The emergence of digital platforms has enabled more opportunities to offer new transport and sharing services. Advancements in the field of mobility-as-a-service (MaaS), a cohesive travel service that, based on a digital platform, enables information about, payment of and travel with different transport modes, have advanced rapidly in recent years. [62]

Mobility services meet the transport needs of the population with a menu of complementary transport options such as public transport, car or bike sharing, car hire, taxis, electric scooters, or a combination of these. The added value for users lies primarily in increased travel possibilities, simplicity and choice. The purpose of mobility services is, inter alia, to provide an alternative to private cars, reduce the climate footprint and reduce congestion on urban roads.

MaaS is based on a business model that is more flexible than the traditional set-up in the transport sector. Many people habitually rely on a single transport mode, such as their private car or travelling by public transport with a travelcard, and rarely travel by any other mode. A segment of the population relies on a mixture of transport modes and transfers between them. MaaS allows passengers the option of choosing the transport mode, or combination of modes, that is rational for a specific journey in a unique situation.

MaaS involves more roles in comparison to traditional public transport, where data and system integration and the provision of combined transport services are new roles. In combination, they create a value chain: infrastructure, transport supply, data and system integration, provision of services and users.

All over the world, key industry players are working to test pilot projects and analyse data in an attempt to find a successful format and attractive packaging. At present, a large number of mobility services with different contents and formats have been tested with varying degrees of success. Achieving service profitability

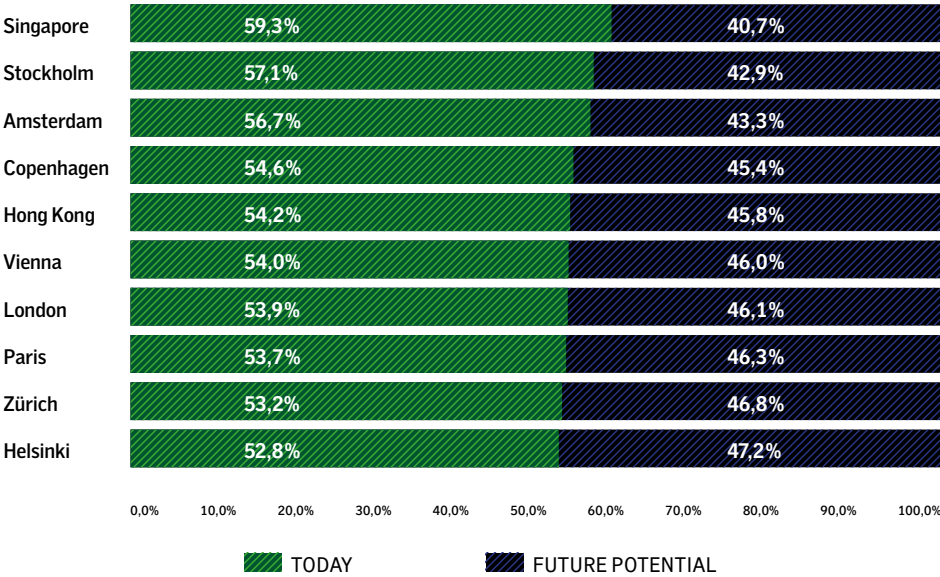
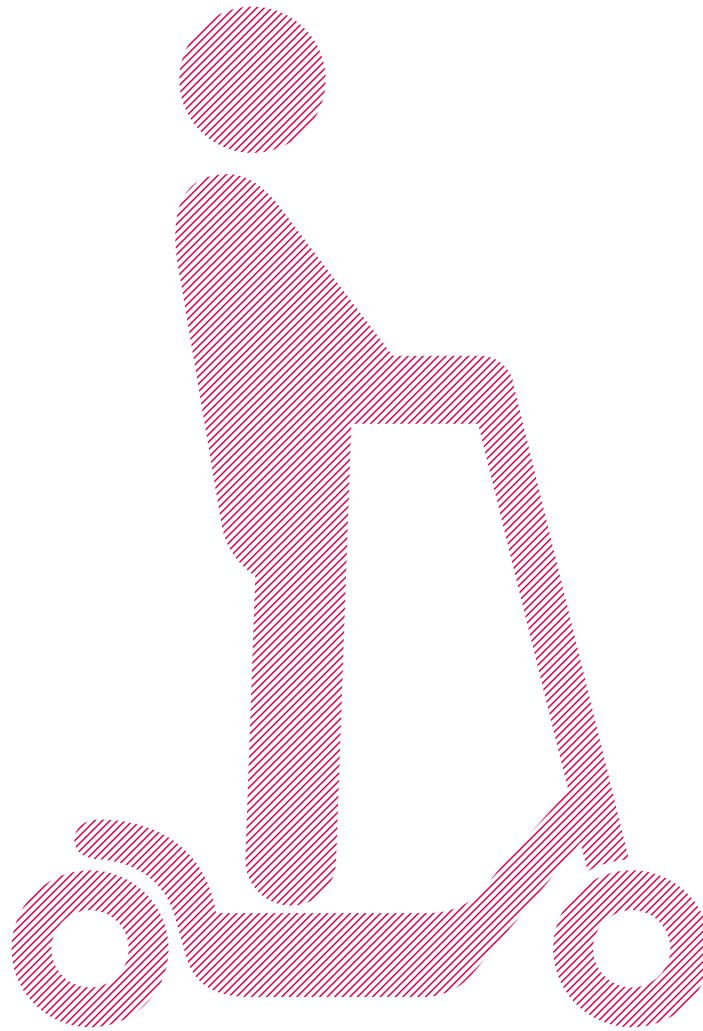


FIGURE 10, UITP, 2018/ TOP TEN CITIES IN THE MOBILITY INDEX 3.0



has so far proved difficult, partly due to the thresholds needed to attract passengers to use and pay for new services and partly due to difficulties in creating cost-effective services.

With further advancements in digital tools, AI and increased autonomy, mobility services are eventually expected to reach a level whereby they represent an attractive transport alternative for people in daily lives.

In scenario analysis that UITP has conducted, it is assumed that the trend towards autonomous vehicles will persist at a rapid pace. Smart cities are expected to have a “high proportion of autonomous vehicles” and “a positive attitude to public transport”. The trend for self-driving vehicles has been a hot topic for many years, and development of the new technology is performed in parallel by both conventional automotive companies and challengers from other areas such as Tesla, Google (Waymo), Apple

and Uber. There has been a great deal of investment in developing this field as many players are realising that the market for cars and car journeys is about to change. The benefits that autonomous electric cars can bring are appealing.

A traffic system with autonomous vehicles has the potential to significantly reduce traffic accidents, traffic jams and exhaust emissions, and enable the optimisation of route choices, driving times and energy consumption. It could lead to an increase in shared travel and a higher proportion of energy-efficient journeys.

Self-driving vehicles will also enable individual mobility for people without a driving licence such as children, elderly people and the functionally impaired, which provides enhanced accessibility and increased equality. It is also more convenient and frees up time spent driving the vehicle, which increases efficiency.



According to the Swedish Transport Administration's trend analysis from 2018, automation of the vehicle fleet also has the potential to increase efficiency for freight deliveries and contribute to better safety, enhanced efficiency and reduced environmental impact. The implications for society and public transport could be far-reaching once automated vehicles are ready for use on a large scale. <sup>[5]</sup>

In recent years, automation of the transport system has been an issue that has enjoyed a high position in the so-called "hype cycle for new technologies", which the research company Gartner publishes every year. In 2018, self-driving vehicles dropped down in the cycle and the decline in expectations is presumed to be due to a number of fatal accidents during the year. Researchers say that there is great uncertainty about whether computers can cope with the complex decision-making structures needed to achieve fully-automated vehicles. Both moral dilemmas and human elements need to be incorporated into the decision-making systems of the computers. <sup>[63]</sup>

There has been a basic level of autonomy in modern cars for a while, with automatic cruise control, steering and braking in the event of a collision risk. These features are ranked at level two in the six-level scale in terms of autonomy. At present, a few isolated tests have been conducted at level 4 in autonomous vehicles.

The management at Waymo, one of the players that has progressed the furthest with pilot projects in the USA, has said that autonomy will always have its limitations, that sensors work differently depending on the weather and that it may take decades for self-driving cars to become commonplace on the roads. The industry's general view is that major challenges exist and that development will take a considerable time. <sup>[64]</sup>

In order for self-driving vehicles to have a major impact, it is also essential that the population has confidence in the technology. On an individual level, it is very likely to take a long time before

people's willingness to travel in autonomous vehicles, their trust in the safety of self-driving vehicles, and their interest in sharing vehicles with other people reaches the right threshold. <sup>[65]</sup>

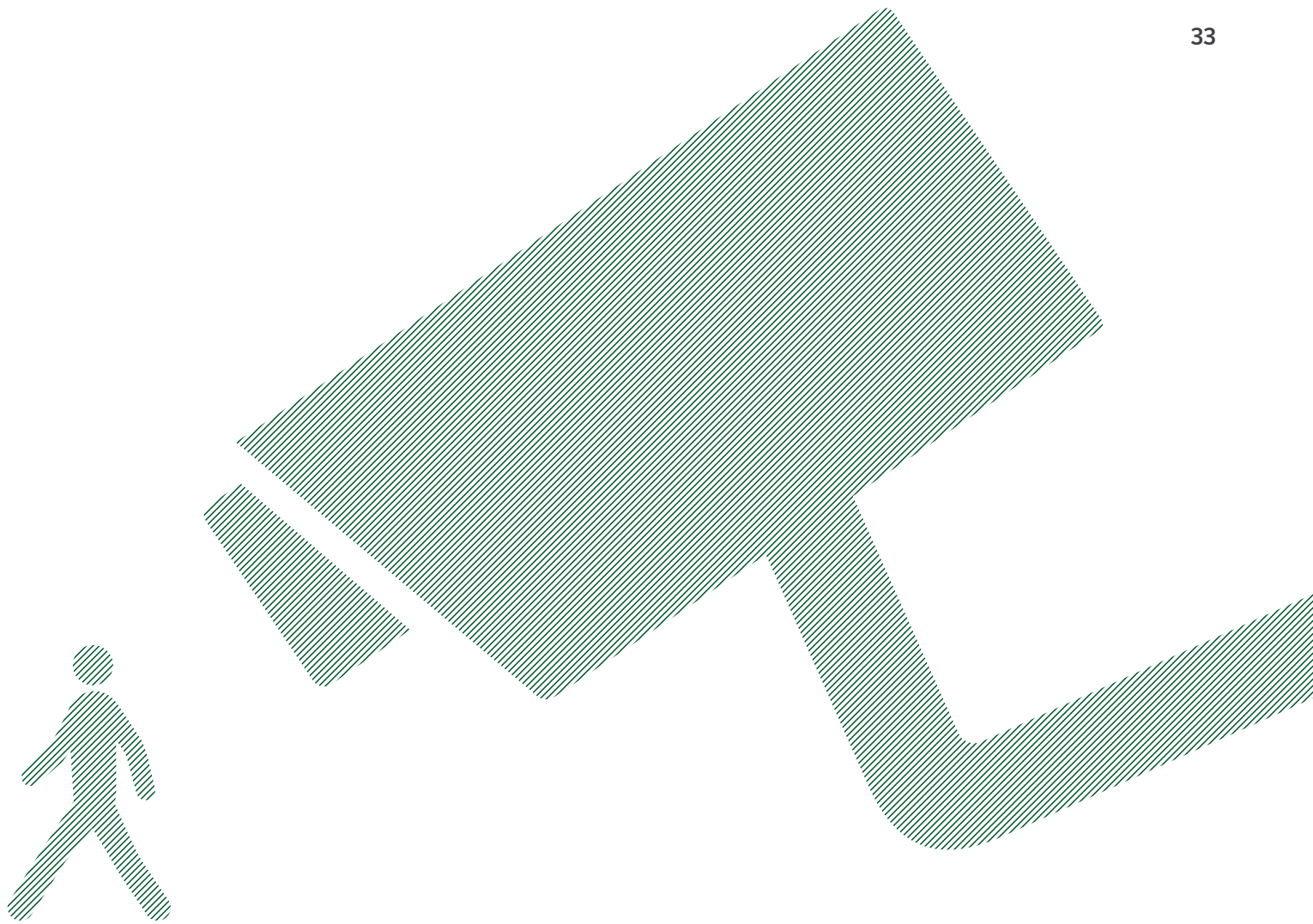
On a societal level, it is a matter of factors concerning the design of the legal frameworks, how the technology is implemented and how safe self-driving vehicles are perceived to be in terms of road and operational safety. For example, how will vehicle manufacturers ensure that automated vehicles are not hacked and prevent an external operator from taking control? Should autonomous vehicles be introduced throughout the road network or only in certain zones? To what extent should automated vehicles be mixed with conventional road vehicles?

There are also questions concerning how future business models should be designed. Companies such as Uber and Lyft offer taxi services but they are reporting huge losses. Their aim is to include autonomous vehicles in their future fleets. A report from the Massachusetts Institute of Technology questions whether it is possible to operate a going concern with a fleet of self-driving taxis. According to the researchers, there is a risk that capacity utilisation will be low and the costs of servicing and monitoring the vehicles will be high compared to conventional cars. <sup>[66]</sup>

One potential countertrend to autonomous vehicles is that in many countries owning and driving your own car is an indication of high status. It will be a challenge trying to persuade people not to buy and use their status symbols, especially in developing countries with a growing middle class. The higher cost of self-driving electric cars compared to conventional cars is another threshold that will offset the pace of any shift.

### **Increased risk of cyber threats**

Increased digitalisation with the Internet of Things allows more opportunities for threats and attacks. When every device has a processor and a sensor that can be attacked with cyber threats, the number of parts that need to be protected increases very quickly.



There is a trend of increased cyber threats on a global level, which applies to all industries and not least to public transport systems. Public transport operates complex and technology-heavy systems that will become increasingly digitalised. The new technology brings with it increased risks to the robustness of the transport system.

Research shows that many companies have unprotected data and poor cyber security methods in place, which makes them vulnerable to intrusion and data loss. The trend of storing all data in the cloud may lead to an increased risk of data breaches. Cyber security issues are becoming a daily struggle for companies and organisations.<sup>[67]</sup>

The General Data Protection Regulation (GDPR) applies in the EU and aims to create a uniform and equal level of protection for personal data so that the free flow of data within Europe is not hampered. The goal is to improve privacy and strengthen citi-

zens' rights. GDPR legislation places high demands on databases and data management. This can cause limitations and challenges when developing digital tools.

Nobody can predict with any great accuracy which future solutions will emerge from work in AI, automation/robots or the development of quantum computers. There is a real possibility that disruptive technologies will emerge along the way.

The acceleration of digitalisation is causing changes that will be felt by everyone. The trend is having a major impact on how people interact and how we live our lives. Information is disseminated around the world faster than ever before and the pace is accelerating. It is not difficult to understand that the world will work very differently in 10–15 years from now.



**the fourth  
megatrend**

*EVERYWHERE*



*...THEY KNOW*



*I GO...*



*IT'S ME.*

Lifestyle  
changes  
in  
a  
fragmented  
future



### **People embrace the digital world**

People's everyday lives are strongly influenced by the global megatrends of increasing sustainability needs, increased urbanisation and accelerated digitalisation. There is nothing to indicate that the pace of technological progress will slow, quite the contrary, the pace seems to be increasing.

People's demands and expectations regarding information and services are changing with the new digital technologies. The availability of new technology, and the information that can be acquired, is a balancing factor between groups at both local and global level.

The youngest generations are often referred to as Millennials and Generation Z. The latter generation were born between 1995 and 2010 and have grown up with the Internet. They are accustomed to being constantly connected by mobile phone. They are the first generation of digital natives. The Millennial generation, born between 1980 and 1995, grew up in an economic boom. They search for experiences and are happy to pay for status brands. Generation Z is characterised by their ability to find information easily and their frequent communication. They place high demands on products, brands and work tasks. They are flexible and fickle with low brand loyalty, but they have strong ethics and are prepared to pay for increased sustainability in society. Generation Z is difficult to reach with conventional marketing. They prefer to get their information and recommendations from people they know or from influencers in the digital channels. <sup>[68]</sup>

The primary sources of information for younger people are YouTube and social media. Digital channels with a younger audience are more often interaction-based than traditional media channels. Engaging with the channel and influencing activities to a higher degree of individualisation is an effect of the user interfaces.

### **The digital world is fuelling individualisation**

Advancements in the digital world with all its various tools are shifting the power of how products are designed and services are

used away from producers and closer to consumers. It is the individuals who are influencing how products are designed and how they are consumed.

People are able to communicate directly with companies in an easy way and many of them choose to do so. They want more choices, more individualised designs and more self-expression. Google is known for quickly incorporating direct feedback from its customers into product design, and Adidas has tested building automated factories that create footwear designed by individual consumers. Consumer perceptions of the meaning of added value are in the process of changing, and customers appreciate free goods and services that are sometimes offered online as well as product individualisation. <sup>[69]</sup>

As regards freight and public transport, the demands of inhabitants will evolve as regards what defines an "attractive journey" in terms of speed, simplicity, comfort and sustainability. Robustness and capacity in the transport system are basic hygiene factors that need to be provided in order to create attractive journeys. In addition, inhabitants will expect more from their travel experience as well as services related to service information etc. than they do today.

### **Urban environments are reinforcing individualisation**

Access to work, resources and social arenas is better in large cities. When a majority of people live in larger cities with well-developed digital infrastructures, lifestyles and values are influenced faster than before.

Urban environments provide more leeway for people to shape their own lives. Increased access to new tools and information sources enables dramatic new opportunities for individuals to influence their own life circumstances. The result is that individual freedom of action increases, and individualism is strengthened and spreads. In urban habitats, acceptance of diversity is more common and it is easier to blend into the crowd in large cities with a heterogeneous population. <sup>[70]</sup>

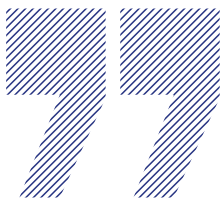
In Sweden, which has a high degree of secular individualism, self-fulfilment is widely accepted, especially in the metropolitan areas. In larger cities, it is possible to realise one's own needs in a different way through food, culture, entertainment and leisure interests. An additional effect of individualisation is the large increase in single-person households. Sweden is the European country with the highest proportion of single-person households, 1.5 million people, of which almost 400,000 live in the Stockholm region. About one in five Stockholm residents are single.<sup>[71]</sup>

A higher degree of individualism in the population implies an expectation of tailored offers to the individual, which changes the rules of the game for both companies and authorities in their relationship with citizens and customers. There is an expectation or requirement for two-way communication channels through which the population can feed back experiences or provide feedback to authorities and suppliers.<sup>[72]</sup>

Interest in environmental issues and several independent attitude surveys indicate that the young generation is very concerned about water quality, global warming and the extinction of animals and plants. An overwhelming majority believes that these are urgent issues that need to be addressed by the powers that be.<sup>[73]</sup>

The school strike for the climate was started by Swedish school student Greta Thunberg and it struck a chord among young people across much of the world during spring and autumn 2019. Many young people think that sustainability issues are important and they expect world leaders to act.

To what degree and how fast the intensified struggle for increased sustainability will produce measurable effects in terms of behaviour change remains to be seen. Human behaviour usually changes very slowly. The rate of change in several of the megatrends is



## A higher degree of individualism in the population implies an expectation of tailored offers to the individual which changes the rules of the game for both companies and authorities

In order to create channels of communication, companies and organisations need to leverage the palette of possibilities that has been developed, be it through existing applications, via social networks, through customer panels or other channels.

### **Insight into sustainability is being driven by the younger generations**

People's insight into sustainability issues increases when they themselves experience extreme weather such as heat waves, storms and floods. The younger generations react strongly when they see and experience threats to their future. There is a trend of sustainability issues growing in importance to inhabitants.

This trend is very evident in the younger generations, the so-called Millennials and Generation Z. Both of these groups have a strong in-

tending to increase. Whether by extension it will accelerate behaviour change in the population is an adjacent issue.

Making conscious choices as regards one's own consumption and environmental footprint is becoming increasingly natural. The younger generations are pushing for an ethical and sustainable approach that is being adopted by other groups. Public opinion is moving towards increased sustainability, which means that the relevance of travelling by public transport and other climate-neutral transport modes is increasing. In a context like this, travelling by public transport can become an active stance, a conscious signal of responsibility acceptance, which will create new opportunities for public transport. Demand for digital tools that support sustainable choices in everyday life may increase.<sup>[74]</sup>

**Trend for car traffic**

As regards the trend for conventional cars in Sweden, statistics and forecasts from Trafikanalys show that the number of cars looks set to continue increasing in the short term.<sup>[75]</sup>

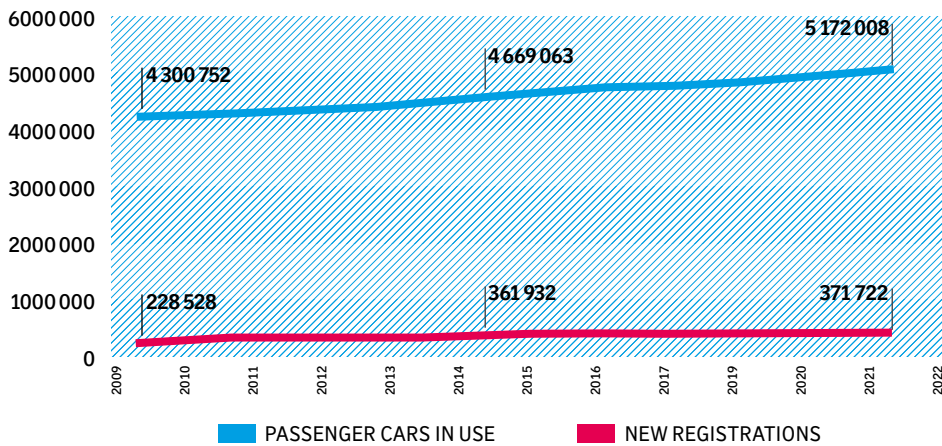


FIGURE 11/ TRAFIKANALYS, DATA AND TREND FOR NUMBER OF CARS IN SWEDEN, 2019

In statistics published by Statista.com, the annual number of cars sold in developed countries has levelled off is expected to decline by 2030. Instead, car manufacturers are investing in sales to the growing middle class in Asian countries such as China and India. The total number of cars on the roads is expected to increase over the next few years in areas where the economy is improving for inhabitants.<sup>[76]</sup>

How the cars of the future are designed will be influenced by ongoing megatrends related to resource scarcity/sustainability, urbanisation and digitalisation. There is a large chance that the cars of the future will be electric or powered by other renewable fuels, that they will have a high level of autonomy and will in many cases be used as a shared resource.

An engine for the development of a sharing economy is the opportunity to reduce costs. Owning a car is expensive, and mobility services have the potential to reduce costs for individuals as well as providing increased flexibility. There has been a strong trend in recent years of people buying flexibility through leasing contracts instead of owning a car.

**Challenges of a fragmented society**

The trend of increased individualisation is causing increasing fragmentation. Individuals are pursuing their own style and there will be fewer large groups with similar opinions. A countertrend to individualisation is that people are seeking out groups with niche interests. They want social cohesion based on the values and particular lifestyle they have chosen.

Traditional media channels are tending to lose space and influence. One consequence of this is that there is no common starting point for citizens to have a conversation from outside. The large number of channels and formats amounts to a noise, and channels find a niche in order to break through that noise. An increasingly fragmented picture of reality is flourishing in our society.

One risk of the increased fragmentation is that malicious actors may have an interest in disseminating misleading information. The principle that objective information is truthful in an open society is being increasingly challenged, and there are concerns that the truth is being undermined and that public distrust of the media is growing. Neither consumers nor media producers use fact-checking and conflicts arise about what is “fake news” and what is not.

More and more democracies are reporting that foreign powers have tried to influence the outcome of elections through targeted information campaigns and “troll factories”.<sup>[77]</sup>

An example of a fragmented world with parallel countertrends concerns the field of health, exercise and nutrition. There is a trend of increased interest in health with a focus on food and personal training in certain social groups. At the same time, the proportion of overweight and obese people is increasing in the world population. In other words, trends in health, exercise and diet are moving in opposite directions in different social groups.<sup>[78]</sup>



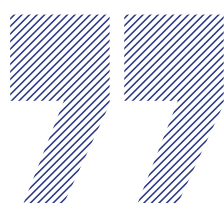
In the developed countries, the higher level of influence for women has been seen as confirmation that equality is increasing. At the same time, women are discriminated against in most areas of society. Women earn less than men in every country in the world. In some parts of the world, fewer than one in five employees in paid work are female and women make up three-quarters of all unpaid workers.

According to statistics from Statistics Sweden, women in Sweden have a higher level of education than men, but still earn less salary, have a lower annual income and, by extension, lower pensions. There is still a long way to go before we achieve an equal society.<sup>[79]</sup>

The trend of increased focus on climate sustainability is highlighting an area of conflict between urban and rural areas based on issues of economy and accessibility. In countries where governments are imposing higher taxes on fossil fuels, which leads to more expensive petrol and diesel, groups that feel disadvantaged by this policy have launched strikes and protests.

economic segregation has increased most since 1990, albeit from a low level. Sweden has experienced declining school results, increased immigration, rising housing segregation and an increasing income differential. In the Stockholm region, a scarcity of housing has become an obstacle to social mobility and has caused a low level of diversity in residential areas. The result has been increasing gaps between high resource and low resource areas – both as regards urban and rural areas, and between areas in metropolitan regions. Differences in living conditions exist regarding, for example, income levels, perceived security, criminality, unemployment and school results for people living in different parts of the same city or town.<sup>[80]</sup>

There is a trend of increasing mental ill health in society, especially among children and young adults. Stress, sleep disorders and suicidal thoughts are conditions that are increasing among young people in society. Analysts say that individual concerns about the future and a tougher labour market are the causes of this increase in, above all, anxiety and depression in the population.<sup>[81]</sup>



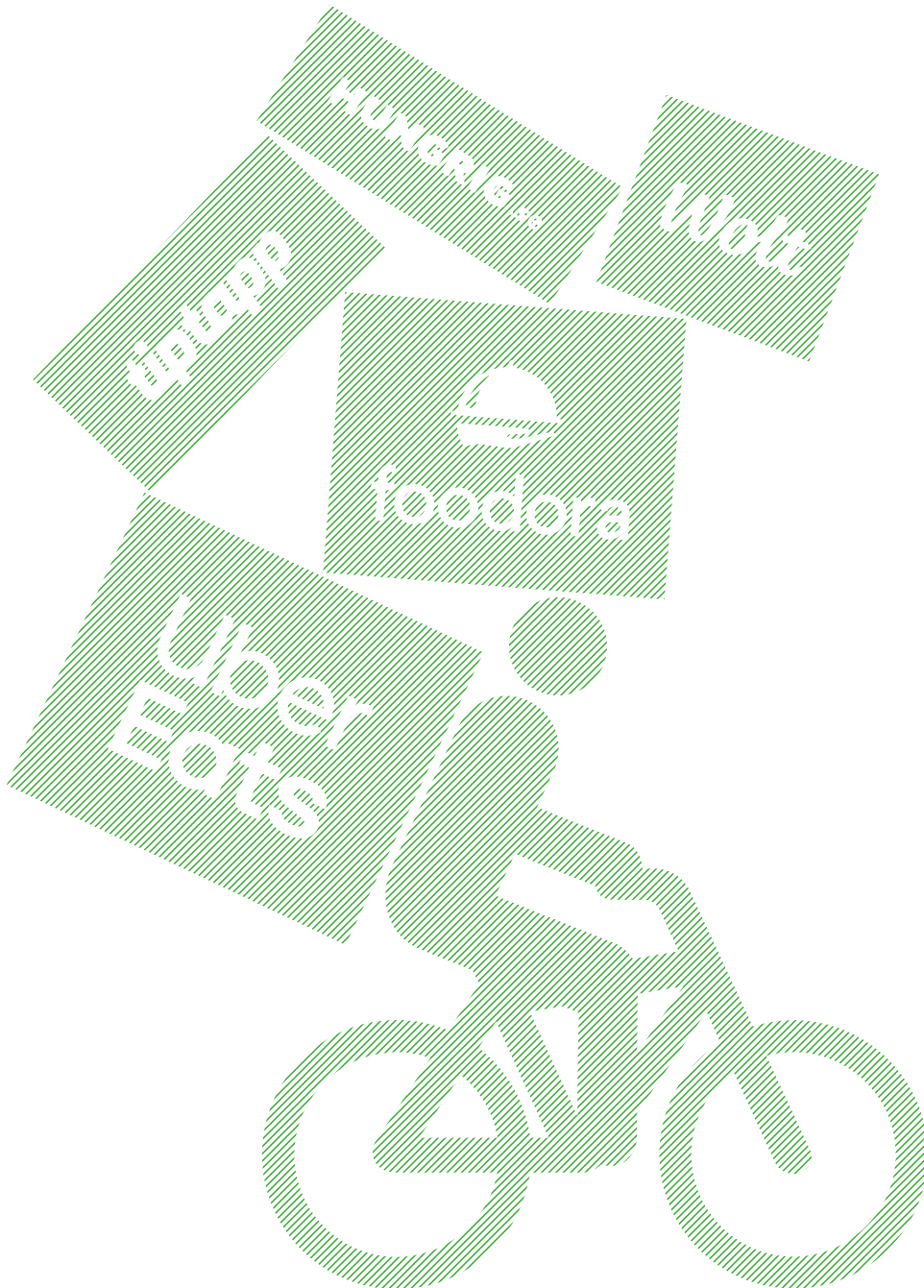
**Women in Sweden have a higher level of education than men, but still earn less salary, have a lower annual income and, by extension, lower pensions. There is still a long way to go before we achieve an equal society**

For example, the Yellow Vests movement in France is the most high-profile case, with riots in Paris in spring 2019. The protesting groups have interpreted the tax as a collective punishment and feel that the central government is not ruling equitably. A Swedish group on Facebook that is protesting about petrol prices has received record support. These conflicts between national leaders and the population show that there is fragmentation in society regarding transport and social issues.

In growth areas, there are often challenges in terms of major socio-economic differences. Sweden is the OECD country in which

A gap that is tending to widen is the one between people in work and people who are outside the labour market. One partial explanation is the challenge of migrant integration, partly as regards learning the language and partly in finding a way to integrate migrants into working life in a new country. This is leading to social problems as people are unable to support themselves.

Increased digitalisation can affect people who have difficulty adapting to new tools and interfaces and risk being sidelined. In the short term, this development can result in a digital divide and greater inequality.<sup>[82]</sup> A strong trend is the so-called gig economy,




which is spreading to more and more industries with a platform business model. This trend is more prevalent in the USA than in Europe.

Gigging means that the people who do the work are no longer permanent employees, but instead work in short assignments as self-employed freelancers. Another tendency is for an increasing number of people to have multiple occupations. They might be employed by several different employers or combine employment with self-employment or odd jobs on digital platforms such as Uber. For some people, multiple occupations may be necessary in order to earn a living.<sup>[83]</sup>

Technological progress and economic development will determine which occupations survive and which new occupations emerge as a result of new needs. Automation and robotics are replacing manual labour in more and more fields, but people will still be required for inspection and monitoring. In the long term, the trend towards automation may lead to human work becoming less demanding, with more time for other activities. Technological progress and changing approaches also tend to create new occupational categories for people, and new roles are created that can replace the jobs that are lost.

Lifestyles will evolve in line with other megatrends. Markets will adapt to and exploit the technology that emerges to streamline and create new attractive services. Which formats and solutions are successful in 10, 30 and 50 years from now will depend on a wide range of factors and are impossible to predict.

# What impacts will the megatrends have on public transport in the Stockholm region?



The following chapter describes how the megatrends will impact public transport in the Stockholm region based on the so-called Doughnut model, with an outer climate dimension and an inner social dimension. The model is described in more detail in Chapter 6.



# Implications of the demographic shifts, pressure on resources and demands for sustainability





### **Demands for public transport to provide a solution for more people and more journeys**

The realisation that the climate is changing has increased in society. A few leaders, though ones with great influence, still maintain that climate threats, goals and measures are false. At the same time, there is global support for goals that limit climate impacts.

Sweden's overall climate goal is to achieve zero net greenhouse gas emissions by 2045 and then to achieve negative net emissions, including the Stockholm region. Copenhagen and Oslo are other regions that have set goals to reduce emissions dramatically by 2030.

The most important considerations are developments in the transport sector, which accounts for one third of Sweden's greenhouse gas emissions, and in the trading system, which includes large-scale industrial plants, power and district heating plants as well as air transport and which accounts for almost 40 per cent of emissions. At present, developments in these sectors are not in line with the requirements for achieving Sweden's goal of zero net emissions.

As public transport has a low climate impact with the possibility of transport-efficient solutions, particularly in metropolitan areas, calls for the Stockholm region to offer an efficient and sustainable transport system are increasing. Demands that may be imposed on public transport in the region are an increase in capacity and that it is used both for commuting and to solve other transport needs.

As a result, public transport will need to be capable of transporting people to leisure activities, on shopping trips, to greet friends and on holiday trips, which means that public transport may also need to accommodate luggage and leisure equipment such as bicycles. Nor is it unreasonable to expect calls for lower or differentiated fares with the aim of reducing congestion during rush hour traffic and spreading journeys throughout the day. A rising demand for sustainable transport will also result in a need for capacity, efficiency and robustness in the public transport system.

The challenge and the greatest uncertainty is how quickly actions will be taken and behaviours will change. Based on the Swedish Climate Policy Council's latest report, there is insufficient governance to achieve the climate policy goals. The current low rate of emissions reductions means that national targets will not be reached. Progress is too slow. The Climate Policy Council also believes that there is insufficient governance at EU level to reduce trading system emissions to zero in all Member States. <sup>[23]</sup>

The recommendations of the CPC are that there is a need for radical social change and a high rate of development throughout society. This partly involves stronger leadership and governance from the government, and partly the introduction of both general and specific instruments such as accelerating the electrification of road transport and discontinuing subsidies to car transport. For public transport, this may lead to demands that the shift to electric power be implemented more quickly than planned so that renewable fuels for internal combustion engines can be prioritised for other transport systems such as freight and air transport. For the Stockholm region, increased electrification will pose the challenge of meeting electricity supply needs in the event of a large increase in demand for electricity. The Council's report shows how wide the gap is between a probable scenario and the set goals.



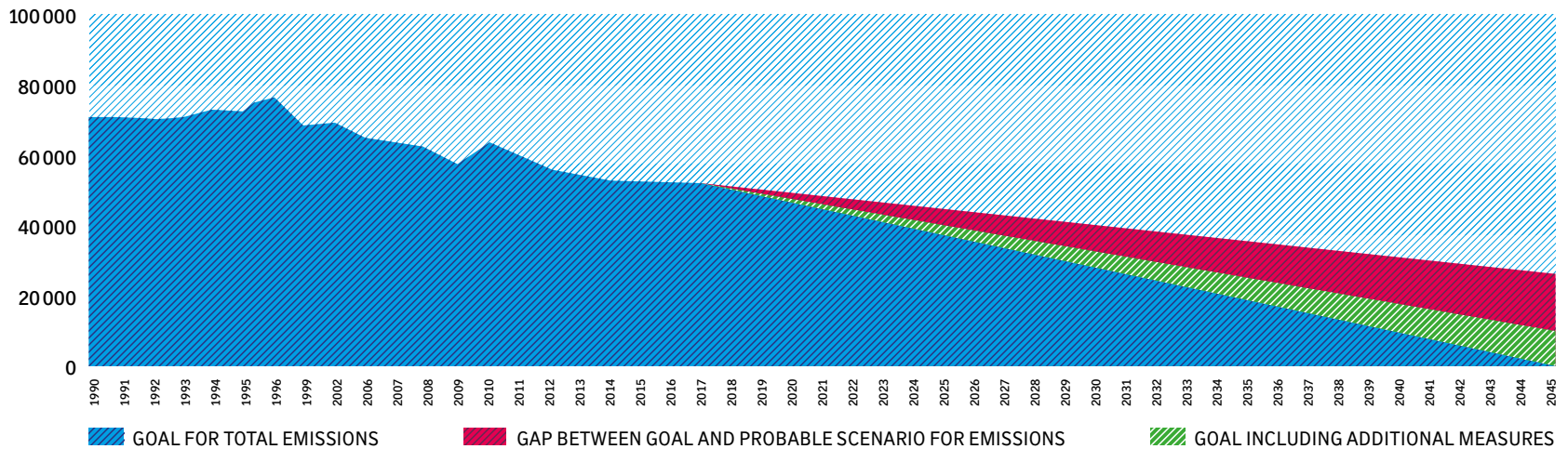


FIGURE 12/ CLIMATE POLICY COUNCIL, DATA ON HISTORY OF EMISSIONS AND SET GOALS, 2019

### Climate-conscious transport consumers raise the status of sustainable transport

The trend is that the noticeable effects of humanity's over-consumption of natural resources are increasing worldwide. This is leading to a realisation of how important it is to transform lifestyles and adapt to more sustainable alternatives. The issues of climate, ecology and ethics are engaging many people, not least the younger generations.

Sustainability is already one of the driving forces behind the popular demand for travel by public transport in addition to cycling in particular and to some extent walking. At the same time, this driving force is not being fully exploited because car usage does not appear to be decreasing to an equivalent degree. There is probably an untapped potential in convincing more people to choose public transport for climate reasons.

Cycling, walking and public transport have the opportunity to strengthen their market shares as attitudes to increased sustainability become more positive both in the population and among commercial players. Several regional players will use the state of opinion to strengthen their brands. At the same time, capital-intensive players in the automotive industry are competing for the attention of inhabitants as they highlight their products and ser-

vices and demonstrate increased sustainability in electric vehicles with reduced emissions.

### Demographic shifts will result in increased demand for transport

As a result of a general population growth, demand for sustainable transport will increase in the Stockholm region. Changes in the region's population structure are posing a financial challenge for the public sector as welfare service costs increase due to a larger proportion of young people, elderly people and people with foreign backgrounds. According to forecasts from the Stockholm County Administrative Board, the demographic dependency ratio in the Stockholm region will increase from the current 0.66 to 0.75 by 2030, which is due to a smaller proportion of working-age residents.<sup>[84]</sup>

The implications for public transport are that an expansion to meet the need for enhanced capacity will increase costs. At the same time, pressure on public budgets is rising, which in increasing calls for austerity in every sector, including the public transport sector.

Numerous factors have played a role in the cost increases, including an increase in supply, more requirements on vehicles, increased demands for accessibility and an increase in journeys during peak periods.<sup>[85]</sup>



Even if public transport succeeds in slowing the relative rise in costs in comparison to total supply or journeys, costs will rise in absolute terms as a result of increased public transport. These costs will need to be covered by the passengers themselves, by collective taxes, or by others who benefit from public transport.

From an international perspective, there are large variations in the proportion of costs that are covered by passengers. In cities where public transport has a very strong position such as Singapore, passengers cover 100 percent of the costs, whereas in cities where the role of public transport is minor, this figure can be less than 10 percent.

**Increased risks and threats are affecting the transport system**

The increasing pressure on the earth's resources is leading to increased risks of climate impacts such as extreme weather that may affect the robustness of public transport, for example infrastructure such as tunnels and bridges in vulnerable locations. Any maintenance debt for vulnerable parts of the infrastructure will lead to an increased risk of accidents. A dramatic example of in-

adequate maintenance was when a highway bridge in Italy, the Morandi Bridge in Genoa, collapsed. The incident led to fatalities, material destruction and transport problems for private individuals and the business community.

The implications for public transport is that demands will increase with regard to climate adaptation of infrastructure for events that were previously considered unlikely and in terms of maintaining infrastructure and vehicles, which in turn will lead to increased costs for public transport.

From a long-term perspective, climate change may lead to changing weather patterns in Sweden, for example longer periods of warmer weather, shorter winters and changing amounts of precipitation. The risk of flooding in tunnel systems, on highways and on rail infrastructure is increasing and measures are needed to prevent the consequences of changing sea and lake water levels. Another implication for public transport could be the emergence of new transport services and transport modes that compete for passengers.



**SUMMARY –What are the implications for public transport of the demographic shifts, pressure on resources and demands for sustainability?**

**Awareness of climate footprints is increasing both among the population and among commercial players, which is leading to more calls for transport with less environmental impact** – public transport is an attractive, sustainable and competitive transport means and has an oppor-

tunity to further consolidate its role in the transport system and thereby strengthen its market share.

**Climate awareness is causing an expectation that public transport will solve more travel needs** – thereby increasing demands for greater capacity in the public transport system with increased costs for investment and operation.

Population growth is leading to an increase in travel on all transport

modes – in order to maintain and develop public transport, costs will increase. Changes in the region's population structure represent a financial challenge for the public sector as welfare service costs increase.

**Increased risks of extreme weather** – a consequence of climate change is that the infrastructure needs to be adapted to events that were previously considered unlikely. The risk of extreme weather is an increasing threat and public transport must

maintain its robustness and security as regards infrastructure and vehicles. The safety and perceived security of inhabitants needs to be highlighted. The consequence is increased costs for mapping and corrective actions.

**Increased demands for sustainability** – public transport needs to continue reducing its overall climate footprint, for example emissions, energy consumption and noise related to both vehicles and facilities.

# Implications of globalisation with urbanisation





The continuing trend of urbanisation is creating an increased need for efficient transport solutions that enable mobility and accessibility in metropolitan regions with strong population growth. This chapter analyses the implications this will have for public transport from an urban development perspective.

### **Globalisation and urbanisation – is leading to increased demand for journeys**

Public transport is a sharing service by nature, and through smart solutions, good packaging and efficient communication, the future supply of public transport needs to be competitive for large groups of the population. In thoroughfares with major transport needs in the Stockholm region, public transport currently plays a major role as a capacity-intensive means of transport. Public transport can be expected to maintain this position in the medium term.

The expected population growth in the Stockholm region will cause a general increase in demand for public transport journeys in the region, which requires that the public transport system copes with an increased capacity while maintaining efficiency and robustness. An increase in the number of young people and people with a foreign background is contributing to increasing demands for a greater capacity in the public transport system, as these groups tend to travel by public transport to a greater extent in comparison to the average.

A proportion of future job opportunities will be centralised in the regional hubs as well as in Stockholm city. Densification will enable the development conditions for more cost-efficient public transport and a better potential to cover the cost of transporting passengers.

The closer we get to 2050, the fewer the opportunities will be to build close to public transport services and in regional hubs as competition for attractive land increases. There is a risk that citizens in a growing population will be forced to live far from their workplaces. It is necessary for public transport to be involved at an early stage in the planning process and produce well-thought-

out decision-making documents in order to enable sufficient room for expansion.

### **Challenges of creating attractive, sustainable services**

It is a challenging task to balance costs in order to introduce climatically and socially sustainable transport alternatives in the region.

One challenge arising from population growth and urbanisation is that a larger proportion of the population will not have Swedish as their native language. The implications for public transport will be an increased need for multilingualism in the transport network in terms of signage, information sources and real-time systems as well as human interactions.

At the same time, a large proportion of the people working in the transport sector, including various transport operators, originate in a country outside the EU. From this perspective, immigration can increase the diversity of recruitment within public transport.

Urbanisation often leads to some geographical areas in large cities having weaker economies and a population with a high proportion of people who have difficulty entering the labour market. Areas like this tend to experience more crime and insecurity, frequently in the vicinity of public transport stations. Public transport needs to ensure that safety and security issues are taken into consideration at an early stage in planning processes when developing the transport system and infrastructure.

How the increasing proportion of elderly residents in the region will impact the demand for public transport journeys is difficult to determine at present. Statistics have shown that more elderly people own a car nowadays and that a larger proportion of elderly residents are fit and healthy well into advanced age and travel without the help of social services. Pensioners have time for self-chosen activities, which increases the potential for more journeys in this group overall. Karlstad University is currently focusing on gathering new knowledge about the travel habits of elderly

people. The aim is to identify factors that might be important for changed and more sustainable travel habits among the elderly. An increase in the need for special public transport services may occur as the proportion of elderly residents in the region increases. How the balance between increasing and decreasing demand for public transport, mobility services and patient transport services from a medium-term perspective is difficult to say. <sup>[86]</sup>

Increased demands and expectations of public transport as regards climate and social sustainability as well as accessibility and security run the risk of raising operational costs. Achieving high levels of accessibility, attractiveness and sustainability requires significant investments of time and money.

In addition, in order to meet the increased demand for journeys, it is important to ensure that transport services and the public transport system are attractive and competitive. In order for public transport to compete against cars and achieve the goal of a larger market share of motorised journeys, the product needs to be developed.

Individual choices of mode are based on several factors, where, for example, the mode's relevance to transport needs, speed, simplicity, information and comfort are important ingredients when choosing between public transport, cars, cycling, walking and other types of transport. In order to create attractive public transport on important routes, it is necessary to develop fast high-frequency services with a high degree of accessibility and reliability as well as efficient transfer points. <sup>[87]</sup>

In a competitive market, active mapping of market potential and competitive intelligence is needed in order to develop products and services efficiently. As is the case with other service companies, public transport needs to actively research and monitor the needs of the population and, in collaboration with other stakeholders, make informed decisions in the transport market. This also applies to contracted services.

Regulatory frameworks for increased sustainability are important instruments that can include limitations and restrictions on, for example, car traffic. The majority of laws and directives that affect the daily work of public transport are framed in the EU. Current issues

include the EU's transport policy, sustainability, public transport procurement regulations, the standardisation of rail transport and intelligent transport systems, passenger rights and European co-operation on ticketing and payment systems. The implications for public transport are that it must closely monitor the work of the EU, the UITP and government initiatives. <sup>[88]</sup>

### **Opportunities and risks in a globalised market**

The trend of globalisation has persisted, even if the pace has slowed in recent years. Many global companies are active in public transport in the Stockholm region, as operators, vehicle manufacturers and software companies or in other fields.

Globalisation and stiffer competition often leads to technological progress and reduced costs. In a sufficiently large and relevant market, competition can lead to benefits for both suppliers and customers. This relationship can benefit public transport in the Stockholm region.

How an economic power shift to Asia and away from Europe and the USA might impact the situation for public transport operators is difficult to predict. Investments in public transport vehicles and infrastructure include long-term perspectives, and global players in an open market may choose to focus their resources where there are attractive business opportunities and the potential to develop operations. The implications for public transport are that it must ensure that the conditions for this type of business are created in order to enable relevance and to attract players to submit tenders. In order to be able to carry out complex assignments in public transport, contracted parties, both Swedish and international, need to possess the right roles, skills and resources. The competition for the right skills is an overarching challenge for the public transport sector.

### **Densified and smart cities**

The trend is that large cities are endeavouring through new technology and new approaches to become smart cities and to provide residents with the prerequisites to live a good life. In smart cities, there are expectations of attractive, efficient and digitally smart public transport with a focus on climate and social sustainability.



In order for public transport to participate actively in the development of a smart city, there is a need for advancements in systems thinking, customer orientation and increased collaboration between public and private service providers. Collaboration is required in the actual selection of transport as well as for other immediate services that can create social benefits. One challenge in densified cities is the issue of mobility for different transport modes and how to balance the various modes that have to share the city.

Reducing the climate impact of vehicles, for example reducing emissions, is a challenge for society. This applies to car journeys, air transport and ferry journeys and at all levels from global to local. In order for public transport to achieve sustainability goals, the initiated work to increase the efficiency of vehicles and facilities needs to remain a priority. Densification of cities causes challenges with low-frequency noise and structure-borne noise. Central locations are attractive for residential builders but they can also be noisy as they are close to roads and rail services. The implications for public transport are that noise issues must be incorporated into the planning.

Increased urbanisation with cities expanding in locations close to public transport can help to increase the appeal of public transport in relation to cars. This in turn may increase the potential for increased cost coverage. Sensitivity to changing fares varies, partly between different types of journey, where work journeys are less sensitive, and partly between different passenger groups. Generally speaking, young people and people with access to a car are more sensitive to fare increases.

An increase in demand for public transport offers more potential for commercial solutions in which private players can contribute with financing. This phenomenon is referred to as land value capture and is becoming an increasingly common feature when investing in public transport facilities in connection with the development of new urban districts. At the same time, an agreement and collaboration between parties is required for the potential to be realised.

A smart city usually includes the concept of “Mobility-as-a-Service”, which involves the expansion of the public transport system to include transport modes that would not currently be associated with public transport. Public transport needs to monitor developments actively and, if necessary, be proactive in testing new solutions.



### **SUMMARY – How will public transport in the region be impacted by globalisation with urbanisation?**

**Population growth in the Stockholm region will provide a general increase in demand for public transport** – this will require that the public transport system is able to cope with an increase in capacity while maintaining efficiency and robustness.

**Metropolitan regions need smart and efficient transport to grow** – the role of public transport in providing

subsidised transport opportunities and establishing high-capacity trunk services on thoroughfares with major transport needs will most likely persist until 2030 and 2050. Public transport needs to be included at an early stage in the planning process to achieve accessibility, attractiveness and sustainability goals.

**Public transport needs further development to meet competition from car journeys** – in order to compete and remain attractive in comparison to cars, public transport

needs to map market potential and competitive intelligence and provide a basis for sound decision-making for continuous service and product development.

**Attractive business opportunities attract global players** – public transport needs to be able to offer the market attractive business opportunities with the possibility of innovation and development to stay relevant to those players with the right skills and resources for the Stockholm region's complex transport situation.

**There will be more residents in the Stockholm region with a foreign background** – public transport needs to plan for an increasing need for multilingualism in the transport system with regard to signage, information sources and real-time systems, and for enhanced safety and security measures in urban areas that have issues with integration and economic standards.

# Implications of digital acceleration into the future





### **Digitalisation is leading to increased data focus**

The “Digital acceleration into the future” megatrend is creating pressure for change in public transport. Public transport actors – both public authorities and transport companies – need to adapt their organisations to a reality in which it is individual passenger requirements as well as the possibilities and limitations of digital systems that are increasingly setting the agenda. The role of owning, managing and analysing data is becoming more essential.

Data from an organisation’s own operations as well as from external sources is becoming a strategic asset. AI and AR for data analysis will enable opportunities to develop and optimise operations and influence planning, operation and maintenance. These features are in their infancy and they are not yet capable of replacing the current system. The implications for public transport can be better on-time performance, better robustness, lower maintenance costs and a reduced climate impact. <sup>[89]</sup>

Access to digital technology makes it possible to create a more attractive and individualised customer experience with fewer disruptions and smoother journeys. The implications for public transport can be that data analysis provides a better understanding of passenger needs and the opportunity to optimise existing services.

### **Digital platforms enable new transport services**

Digitalisation entails an increase in the conditions and demands for information and interaction related to local and regional travel.

The emergence of digital platforms that utilise open data has facilitated the development of new mobility services that use apps and other digital tools. Mobility-as-a-Service is on the way to becoming established and may compete with or complement traditional public transport. New services in this area may emerge very rapidly.

For public transport, active participation in expanded transport services linked to other transport modes can be one of the ways forward in terms of increasing the number of sustainable journeys and attracting new passenger groups to public transport. The implications for public transport are that it must have a strategy for collaboration with different actors, be flexible and be able to act quickly as regards testing and evaluation of new services that are generated by contractors that leverage the digital landscape.

It is currently unclear how an ecosystem for mobility services will be developed and which actors will take on the different roles. The area is under construction. One scenario is for Mobility-as-a-Service to be driven primarily by commercial technology companies or service development companies, which might generate more innovative and commercially oriented solutions, but ones that run the risk of being suboptimised and unsustainable. Another scenario is that regional public transport authorities assume a leading role in ensuring co-ordinated services, but ones that run the risk of not fulfilling needs quickly enough and limiting innovation and entrepreneurship.

According to the European Metropolitan Transport Authorities, a collaboration of public transport authorities in 27 large cities, Mobility-as-a-Service could enable a more dynamic pricing of infrastructure and services as well as the spreading of journeys away from peak periods. A greater availability of integrated transport data provides opportunities for industry actors to develop services and infrastructure on a holistic level. On the basis of a model like this, public investment can be more effective and provide improved accessibility for everyone. <sup>[90]</sup>

The digital trend is not about to stall and future opportunities to offer transport services will continue to increase. The implication for public transport is that it must actively follow this trend and participate as a facilitator in further development. This is a way of achieving the long-term goal of attractiveness and efficiency in the transport system.

### Autonomous vehicles

Autonomous metro trains are already an existing standard and account for the majority of the metro systems under development in China. For the Stockholm region, automation would require completely new or major changes, not only as regards vehicles but also signalling systems, traffic management and platforms based on an existing system.

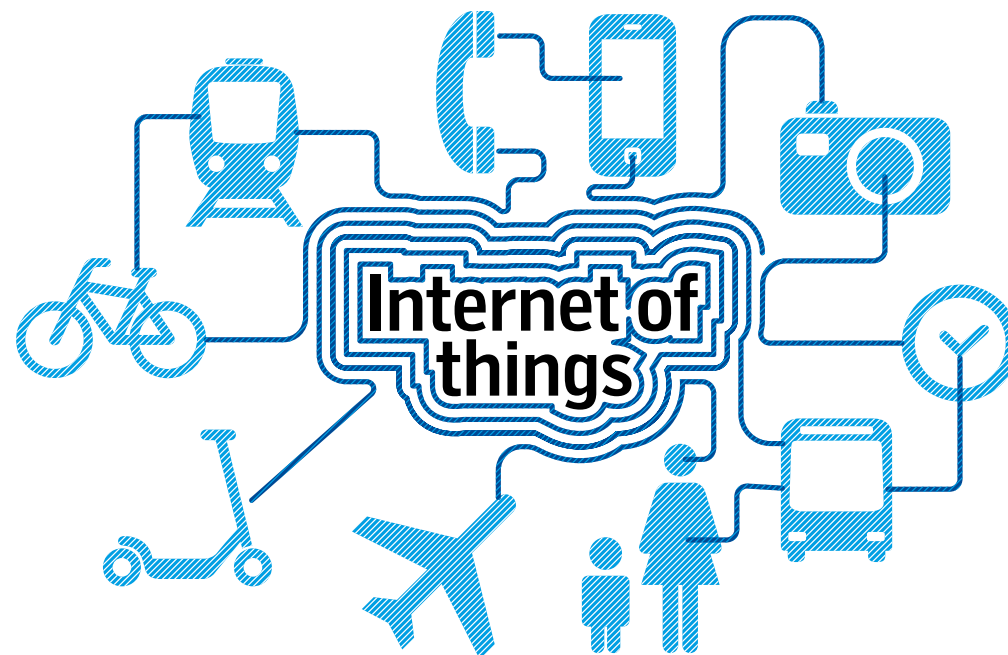
Unlike rail vehicles, autonomous road vehicle technology is far from fully developed. Experts are flagging that it will take longer than expected for self-driving cars to have an impact. In the longer term, there is a high probability that the technology will have matured and that self-driving vehicles will account for part of the transport system.

How public transport will be impacted by development of self-driving cars as regards the formulation and design of regulations, business models and vehicles when the concept catches on remains an unanswered question.

The trend is that technological development is further ahead than other parts as regards self-driving cars. The implications for public transport are difficult to predict, as in one scenario self-driving cars may become a competitor while in another they can become part of the public transport system.

It is important that development does not lead to more congestion on the roads or that existing transport modes are outcompeted if the system is not properly regulated. This would be a counterforce to the expected benefits.

Openness to the changes that arise from technological advances can contribute to enabling state actors to create good conditions for autonomous vehicles not to become a threat. Instead it can act as a support for development in the field. From a longer-term perspective, the technology can become part of the work to achieve the region's long-term goals of improved cost-efficiency and increased accessibility, safety and security.





### Areas where digitalisation will have an impact

Various areas of public transport have already been impacted by the introduction of digital tools, for example planning, control and traffic management, operational and maintenance issues, safety and security issues as well as interfaces with inhabitants such as journey planners, ticketing systems and customer services.

The continued development of the digitalisation trend can provide the following opportunities for public transport:

- The Internet of Things can provide better opportunities to leverage existing capacity and give rise to measures that contribute to a sustainable transport system. In road transport, this would mean the chances of reducing emissions and accidents involving injuries or fatalities.
- In rail transport, new technologies can enable opportunities to optimise capacity utilisation and increase attractiveness by allowing increased frequency and reducing delays without compromising safety.
- ID-based systems can enable the development of ticketing systems and service information and update systems that meet the population's increasing calls for simplicity. Open data can provide opportunities for increased collaboration in the transport industry in this area. Contactless cards for travel and payment simplify ticket purchases, above all for occasional passengers and tourists, and make journeys more attractive.<sup>[91]</sup>
- One longer-term development facilitated by ID-based journeys is the elimination of ticket gates and introduction of so-called Be-In/Be-Out, BIBO, which allows passengers to carry their passenger ID without needing to touch in. Journeys are automatically detected by deployed sensors.<sup>[92]</sup>

- The GDPR-legislation of 2018 imposes high data management requirements with the aim of protecting citizens. This may cause limitations and challenges when developing digital tools, for example ID-based travelling.
- New technology can provide increased flexibility for transport systems and reduce problems of passenger congestion on board vehicles during peak periods.

### Cyber threats an increased risk to public transport

Because public transport systems are undergoing a modernisation process, public transport actors need to understand the necessity of integrating cyber security into the transport system. As public transport is an important part of the society, service information and traffic management needs to be designed with a high level of cyber security. This also requires skills within the organisation.<sup>[93]</sup>

### Other threats

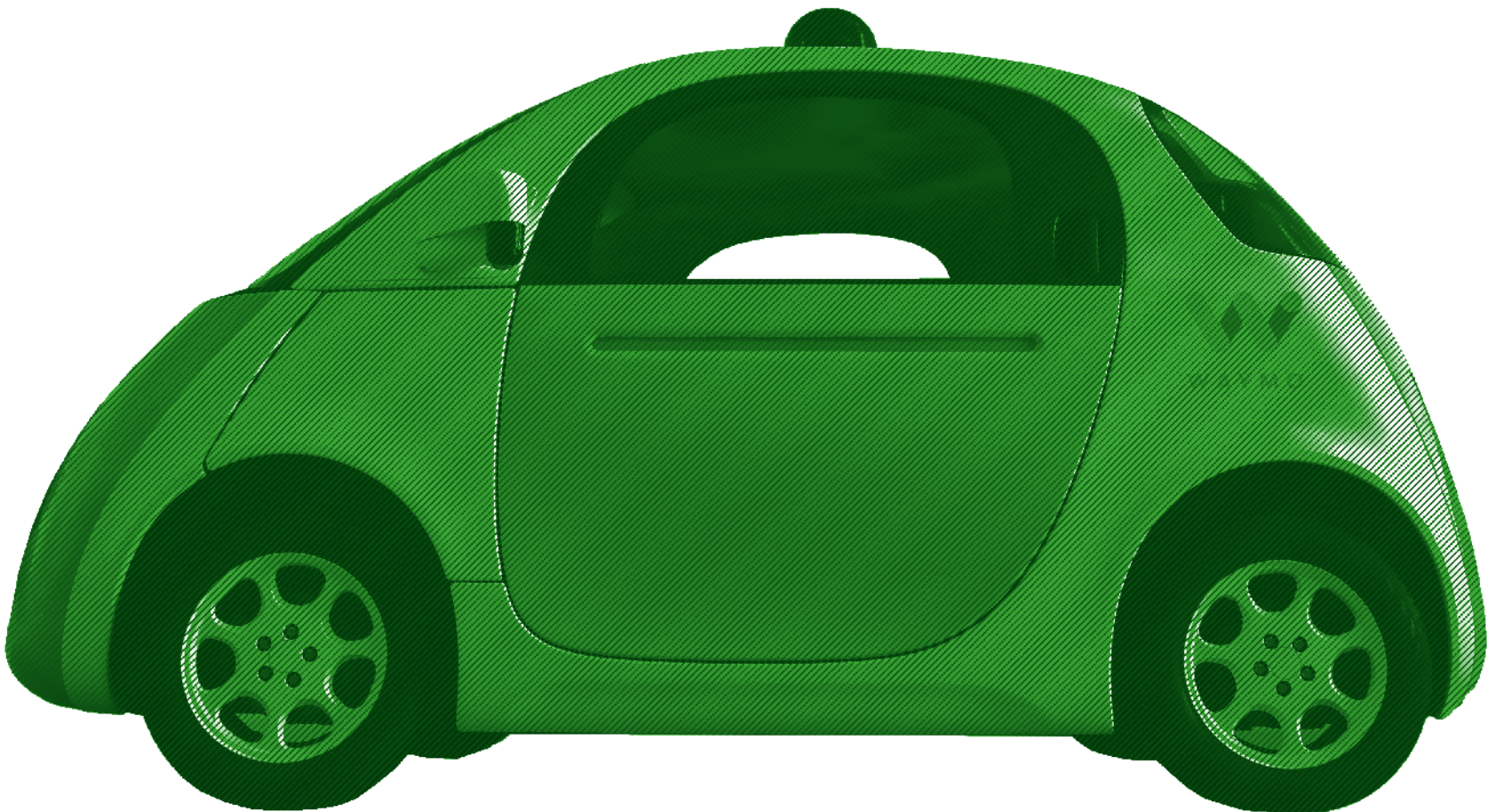
Security risks can also occur in different parts of the transport system for other reasons such as accidents, mental illness or terrorist attacks. Traffic management is one example where robustness and security is essential to running the public transport system. The implication is that public transport needs to investigate and analyse risks concerning a wide range of threats.

One trend in society is that perceived insecurity is rising and the population's concerns have increased as regards crime and aggression as well as threats in the form of potential terrorist crimes, infectious risks and pandemics. The implications for public transport are that inhabitants want a higher level of security in order to feel safe, for example this may mean more staff in the transport network and on board vehicles, especially during evenings and weekends, or other measures that increase the feeling of security.

Another implication for public transport may be that demand for public transport declines when unsafe situations arise. These threats are usually greater in crowded environments, such as during peak periods in public transport. Inhabitants may opt out of public transport as a result of this type of threat. Preventing and counteracting perceived insecurity requires resources and drives costs. <sup>[94]</sup>

### **Digital transformation in organisations**

Digital transformation can, as an adaptation to new conditions caused by digitalisation and digital technology, necessitate an adjustment in order to stay competitive and relevant in a digitalised world. The external world is requiring new skill sets and approaches in existing organisations, and opening up to new players with the necessary skills to establish themselves in the public transport sector.



In order to benefit from the power of digitalisation, many industries have adopted standardised working methods, processes and system solutions. A smooth transition for public transport actors can be implemented in the same way.

Decisions to prioritise technologies that require extensive internal development such as automated customer services or advanced journey planning must be weighed against how the customer experience can be improved. <sup>[95]</sup>

One implication for public transport is that prioritisation between digital development areas will be needed as it would require significant resources and efforts to implement technological advances in all areas. Certain priorities will come naturally when a particular technology is introduced simultaneously across the entire transport sector, for example the trend of electrification, which affects all vehicle types. The introduction of self-driving vehicles could be a future example of this.

The trend in the IT industry is to work in an agile way with high customer orientation, to make frequent deliveries of small functional parts that are tested regularly, and to use cloud solutions to an increasing extent. The implications for public transport are that organisations and working methods will need to be adapted to the digital world, where the pace of technological progress and changing needs is very rapid. It will be necessary to reconcile the new with the more conventional, project-based approach that has been used in the development of the existing infrastructure.



**SUMMARY – How will public transport in the region be impacted by digital acceleration into the future?**

**Increased data volumes and speeds in the mobile network will lead to new opportunities to exploit AI features for data processing and data analysis** – this will provide more opportunities for transport optimisation (on-time performance, attractiveness, robustness), increase control, and facilitate predictive maintenance. The implications for public transport

are that it will lead to an increase and a shift in skills requirements for transport sector actors, with a greater need for analytical expertise.

**Digital platforms will enable Mobility-as-a-Service** – the development of mobility services is uncertain but it has potential. The implications for public transport are that it must actively participate in this market. In order for the services to be successful and sustainable, an increased commitment from regional public transport authorities

may be required to conduct pilot projects and develop them in collaboration with other actors, integrate the service offering, and deliver mobility.

**The new 5G technology and AI will enable the creation of self-driving vehicles** – autonomy will impact the entire transport system once the technology has matured. Openness to the new technologies will allow the Public Transport Authority and the region’s municipalities to achieve positive impacts in collaboration with other actors.

**Digitalisation will mean new approaches** – in order to benefit, public transport can adapt and undergo a digital transformation. Digital tools can offer solutions that provide value to the population.

**Increased digitalisation will lead to new cyber threats and greater vulnerability** – public transport will need to raise threat awareness and central systems will need to be designed in line with the relevant level of cyber security.



# Implications of lifestyle changes in a fragmented future





### **Digitalisation and urbanisation is leading to increased individualisation**

Global digitalisation is accelerating and having a major impact in how inhabitants live their lives and what services they demand. The inhabitants of the region are becoming increasingly individualistic and accustomed to personalised digital systems.

The trend of urbanisation is reinforcing the individualisation of lifestyles. In metropolitan areas, the diversity between people is wider and acceptance of deviations from the norm is greater. Openness and dynamism in urban environments is also leading to increased fragmentation, and uniqueness is becoming the standard.

This trend means that all transport sector actors will need to focus on a customer-centric approach in order to meet expectations for individual-based services. Public transport needs to strengthen customer orientation in every part of the operation in order to succeed with product development and deliver attractive transport services.

Lifestyle changes are increasing the requirements of inhabitants on their travel experience and what defines attractive transport in terms of speed, simplicity, comfort and durability. The implications for the transport industry and public transport are that robustness and transport system capacity are basic, essential factors that need to be met in order to create attractive journeys. In addition, public transport needs to be able to meet the higher expectations of the population in order to remain competitive with other motorised transport.

Digital aids are now considered to be hygiene factors that are expected to work, and people expect robust real-time information that is easy to understand and with which they can plan their activities. This applies to every aspect of daily life: work, school, leisure activities and travel. The implications for public transport are that it needs to meet popular expectations for the highest quality digital tools as regards, for example, ticketing systems, service information and status updates.

The trend of digital platforms and ecosystems is leading to a market in which collaboration and dynamic combinations are essential. One success factor will be to offer residents an ecosystem with options in wide range of areas in a simple and appealing way. In the transport sector, the emergence of new mobility services will become part of the future market. For public transport, it will be vital to play an active role and to participate in development by means of tests and evaluation of platforms, mobility services and ecosystems.

In a fragmented society with an enormous range of channels, service providers need to be active in every arena and provide information in most channels in order to be relevant to as many people as possible. The implications for public transport are that it needs to be active in more channels, both new and old, and to communicate in an appealing tone to a large number of target groups.

### **Lifestyle changes influence transport needs and travel habits**

Changes in working life and our values may influence future travel patterns and transport needs. For example, an increase in telecommuting via digital tools can lead to fewer work journeys overall, which would reduce the pressure on public transport during peak periods, i.e. the times of day for which public transport services are dimensioned.

Increased ambitions and instruments aimed at reducing car transport may mean that many people who currently commute by car switch to public transport, which would lead to more journeys during peak periods.

Peak period travel has an impact on costs because the number and size of vehicles is dimensioned to cope with passenger traffic when it is at its peak, which means that there is an overcapacity during other times of the day. Analysis shows that small shifts in demand can reduce the need for buses, and thereby costs. Shifts like this can be brought about, for example, by changing school start times or differentiating fares so that it is more expensive to travel when demand is high.



How the number of journeys develops as a result of a larger gig economy, i.e. a labour market in which permanent employment is replaced by temporary gigs, in addition to more elderly people in the population is difficult to predict as there is as yet little research in these fields. Many of today's gig services consist of providing taxi or courier services. Other services will likely involve telecommuting, which may reduce the need for commuter travel.<sup>[96]</sup>

One implication for public transport of changing travel patterns may be that demand for peak period services does not increase despite the expected large population growth. The effect may be that the hours of the day during which there is high demand for transport increase significantly and that peak period traffic is replaced by extended high traffic for most of the day.

The increasing realisation of residents of the importance of the shift to a sustainable lifestyle will increase the demand for sustainable journeys, including public transport journeys. This means that public transport will need to respond with increased capacity while maintaining sustainability.

In groups where health is a driver, the proportion of sustainable journeys made on foot or by bicycle is increasing and to some extent by public transport as well. In other groups there is a lack of interest in exercise and the proportion of car journeys is very high. The proportion of overweight and obese people around the world has never been higher than it is at present, and in Sweden the proportion of overweight people is rising. The proportion of young people suffering from mental illness is also increasing. There are no clear patterns as to how this will affect overall demand for public transport services.<sup>[78]</sup>

It is possible that the average distance travelled per person will decrease in comparison to today due to lifestyle changes that require different transport needs. This will be as a result of changed conditions caused by the development of digital tools. One should be aware that behavioural changes take place relatively slowly



and that major changes do not occur with a short time horizon. The implications for public transport of the large number of interests are to follow up the trends and to balance and prioritise between different benefits.

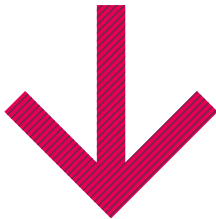
**Increased openness to sharing services**

With the increased focus on sustainability, strong urbanisation trend and rapid digitalisation, views are changing as regards how people travel. Individuals want the opportunity to create their own individual sustainable journeys, but at the same time they are open to a sharing economy in which they do not need to own cars or vehicles.

The implications for public transport are that it will be a challenge to offer individual solutions and options for the travel needs of inhabitants in a good way. For public transport, it is important to participate in testing and developing new transport services so as not to be excluded from a potential market.

How much interest there will be among the population for self-driving vehicles is a largely unexplored issue. Unanswered questions include confidence in the safety and security of the system, and people's openness to travelling in vehicles with real-time monitoring or sharing driverless vehicles with unknown people.

Changing human behaviour is usually a slow and protracted process. Convenience and habits are hard to change. Although attitudes to sustainability are gaining ground, both sticks and carrots will be needed to influence people into changing their choices in everyday life.



**SUMMARY – How will public transport in the region be impacted by lifestyle changes in a fragmented future?**

**The population is becoming more individualised with increased demands for choice, speed, simplicity and sustainability** – public transport needs to develop transport services that meet these changing requirements in order to be competitive. Public transport needs to develop every stage of its customer orientation in order to

succeed with service and product development.

**Lifestyle changes will impact travel** – how travel habits and transport needs develop in the longer term is difficult to predict. Public transport must analyse outcomes and assess developments on an ongoing basis in order to be able to plan for the future. The same applies to any risks related to safety and security that result from the increasing fragmentation of society.

**The experiences of residents regarding climate change and extreme weather are increasing awareness of the importance of adapting to a more sustainable lifestyle, both in terms of climate and social sustainability** – demand is increasing both for sustainable journeys and the means for individuals to live a sustainable lifestyle. The implications for public transport is that it must meet this demand, partly by developing new services that facilitate sustainable travel options and partly by

expanding capacity to meet the demand for sustainable travel.

**Lifestyle changes are leading to more openness to sharing services** – combined mobility services offer individualised trips with shared vehicles presented on a digital platform. The implications for public transport are that it must actively participate in the growth of these new markets in order to increase its market share.

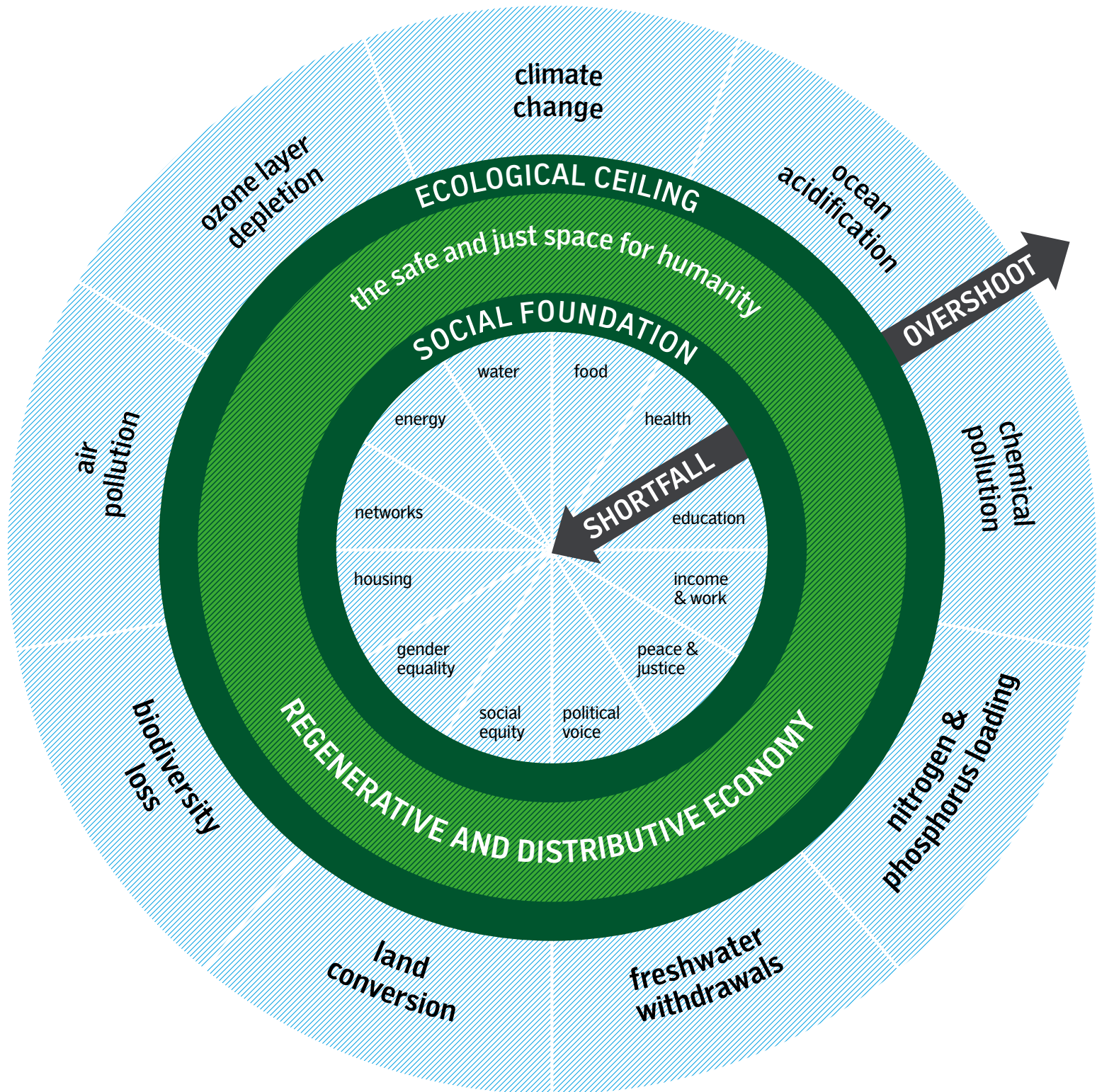


FIGURE 13, KATE RAWORTH 2018/ ECONOMIC EXTERNAL ENVIRONMENT MODEL, KNOWN AS THE DOUGHNUT



# Framework for the work with the trend analysis

In order to describe external trends and illustrate connections and movements, a framework in the form of an external environment model is usually necessary. These illustrate different dimensions and levels in the external world. In previous versions of the Public Transport Administration's trend report – A Changing World, an Epistel+M model was used. The global level is divided into eight dimensions as seen in Figure 14. These describe human and social activities.

An alternative external environment model is the so-called Doughnut model developed by economist Kate Raworth in 2017. Compared to Epistel+M, in her model the ecological level has been shifted to form a natural ceiling for human activity.<sup>[97]</sup>

Raworth claims to have been influenced by and based her own model on the model of the nine planetary boundaries described in the 2009 research report by [www.stockholmresilience.org](http://www.stockholmresilience.org). The model is also said to be based on a description of the basic needs of humanity.<sup>[98][99]</sup>

The inner boundary, the social dimension, illustrates what a stable society should guarantee to all people in terms of basic resources (food, water, health care, energy, etc) in order to ensure that human rights are fully respected. The social dimension represents an inner boundary, and people and society will be adversely affected if they move outside it.

The outer boundary, the ecological boundaries, illustrates how natural resources should be used by humans in order not to disturb the natural processes of the earth. The ecological dimension forms an outer boundary that exceeds the conditions for environmental degradation.

Kate Raworth's Doughnut model can be said to have a more holistic perspective compared to the more traditional Epistel+M model, which is based on the PESTLE model whose dimensions comprise politics, economics, society, technology, law and ecology.

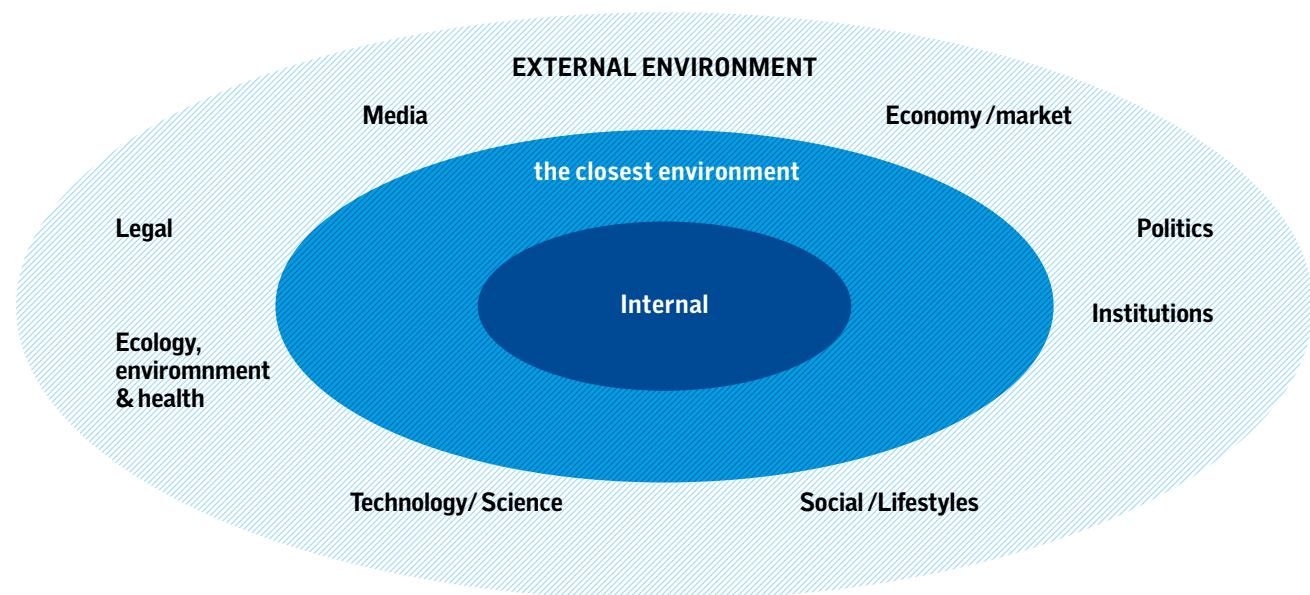


FIGURE 14, CAIRO'S FUTURE/ EXTERNAL ENVIRONMENT MODEL, EPISTEL+M, 2016

A model with a holistic perspective takes more account of ecological dimensions that are not based on humans. Activities that are based on humans, such as economic growth, receive less focus. Raworth embeds humans as social beings and individuals in the earth's system and shows that life is made up of flows of material, energy and activity. A model like this takes into account both the planet and the individuals that not only have roles as workers or consumers.

In a trend analysis, the analyst aims to describe different dimensions and trends. The same basic external environment dimensions are included as in the models. In this report megatrends and subrends have been structured on the basis of the Doughnut model. The Public Transport Administration describes the various identified megatrends and the threats and risks that occur when the trends approach the outer or inner boundary of the model.

In a trend analysis, the analyst is faced with challenges as regards how to arrange and divide between dimensions and underlying factors logically and pedagogically. Every element of the reality that the analyst is attempting to describe is closely interconnected and it is very difficult to draw boundaries.

It may be that the description places a grid on top of reality that affects the reader's interpretation of the trends and implications that are described. The analysis has largely tried to take these challenges into account.

Another challenge is forecasting behavioural changes in time and volume. It is difficult to predict when events will happen in the modern world. The different trends and subrends move at different rates, with the pace of technological progress often moves faster than changes in behaviour on a social level or changes in a complex infrastructure.

A trend analysis is not a foresight study and does not comment in detail on what might happen 30 years from now. The time horizon for this report is 3-5-10 years ahead with an emphasis on shorter periods.

A review of the literature includes a very large number of reports, articles and research materials in the field. The references and sources that have formed the basis for preparations and acted as sources and references in this report are listed in the list of references.

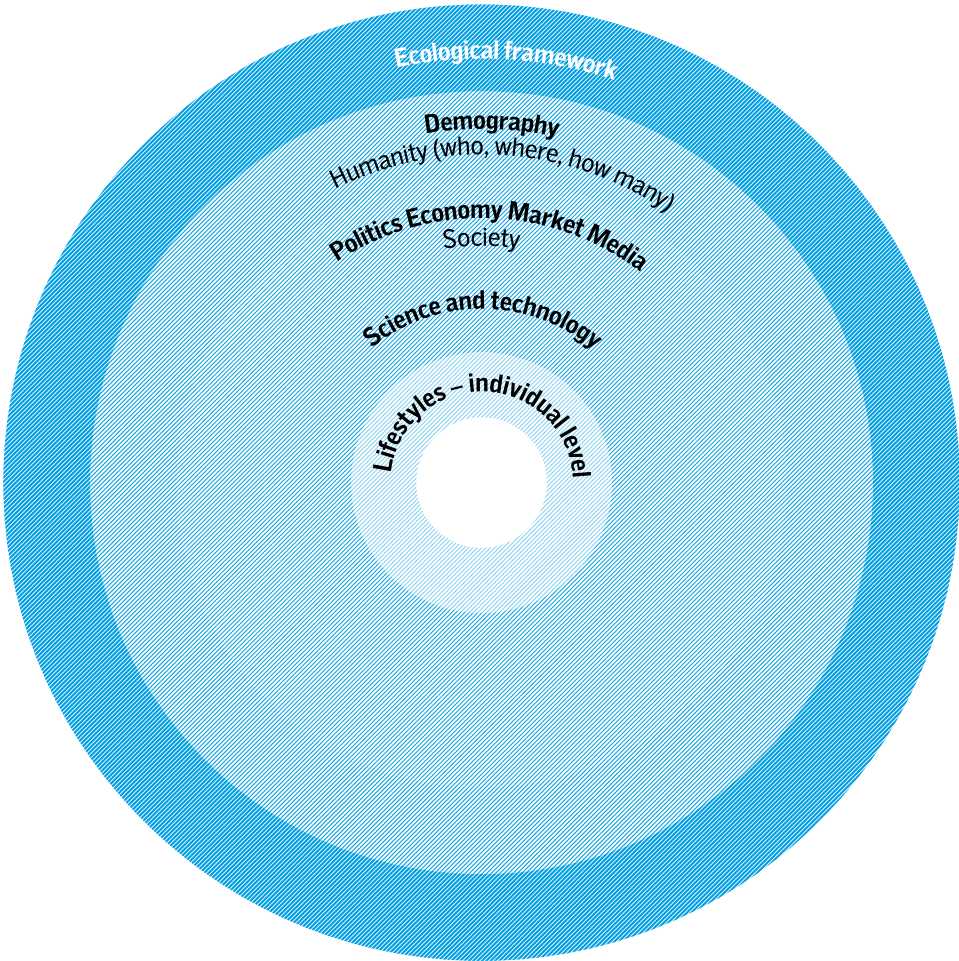


FIGURE 15/ EXTERNAL ENVIRONMENT DOUGHNUT MODEL

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Region Stockholm  
Public transport administration  
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