

Climate Action Plan

2020–2023

For a fossil-free and climate-positive Stockholm by 2040

Adopted by the City Council 25 May 2020



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During the development of the plan, **a city-wide coordination group** for climate work has also met and harmonised the material under the leadership of Chief Climate Officer Björn Hugosson.

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Foreword

The City of Stockholm has for many years had a high ambition to reduce greenhouse gas emissions. The work started as long ago as 1996, a time when few other cities gave attention to this global issue. Since then, the city has almost halved its annual greenhouse gas emissions, while the population has greatly increased.

Understanding the seriousness of the climate issue and the immediate need for action has characterised the development of the Climate Action Plan. Compared to previous plans, the reduction of emissions is accelerated. A climate budget has been worked out with the ambition to limit the remaining emissions to 19 million tonnes by 2040 and that thereafter Stockholm will have no net greenhouse gas emissions. This is the part of the global climate budget that emerged from the Paris Agreement that the City intends to take on. In addition, clear conditions and concrete measures are set out for how great a reduction different committees and companies in the City need to achieve by 2023. The impact of consumption on the climate is great but this is not included in the City's system limits. However, as a procuring organisation, the City can contribute and inspire a reduction in the carbon footprint, for which reason a greater focus has been placed on the importance of consumption for global emissions and what the City can do to counter them.

The City's **Environment Programme 2020–2023** sets out the City of Stockholm's climate goals. The **Climate Action Plan 2020–2023 – for a fossil-free and climate-positive Stockholm by 2040** provides concrete examples of what measures can be implemented to achieve the goals.

Our hope is that this action plan will lead to the City of Stockholm achieving the ambitious climate goals that have been decided, in addition to which we want it to be an example of how cities, in collaboration with trade and industry and with academia, can lead the way and be a global role model in the transition that is required.

Anna König Jerlmyr
Mayor of Stockholm

Katarina Luhr
Vice Mayor for Environment
and Climate

Summary

The City of Stockholm's Climate Action Plan 2020–2023 sets out how the city intends to achieve its ambitious climate goals, which have been determined in the Environment Programme 2020–2023.

These goals are:

1. A fossil-free and climate-positive Stockholm by 2040
2. A fossil-free organisation by 2030

The action plan deals with how the city shall achieve fossil freedom by 2040:

- The plan expresses the City's climate budget up to 2040 in the form of an ambition of a maximum permitted amount of 19 million tonnes of greenhouse gases over the period 2020–2040. This is the part of the global climate budget that the City intends to take on.
- Concrete measures to reduce greenhouse gas emissions are presented for the period 2020–2023. These measures are specified as stipulated conditions for various designated municipal committees and company boards. These stipulated conditions will be followed up annually by the City Executive Board.
- The plan sets out how the City could have zero net emissions by 2040. This can be done, for example, by the City actively taking measures to increase the production of biochar. The city can also drive forward efforts to capture and store carbon dioxide. In this way, remaining emissions from plastics in waste incineration, for example, can be compensated.

The long term aim is to work towards the city becoming climate-positive by 2040.

To achieve this, technology and business models need to be developed. The City cannot achieve such an ambitious goal by itself and we therefore need to join forces with the government and the EU. New innovative solutions need to be developed in collaboration with academia and trade and industry.

The action plan also sets out the processes that need to be started in order for the City's organisation to become fossil-free by 2030, as well as to meet the City's commitment to reach the national goal of reducing greenhouse gas emissions from transport by 70 per cent by 2030. The plan indicates the responsible committees and companies.

The City of Stockholm is raising its ambition by also presenting how the City can work on climate measures regarding consumption of air travel, food and building materials, for example. In this work, the City can take the lead and inspire others.

Structure of the action plan

The introductory section describes defined goals, system limits and Stockholm's climate work to date. Section two describes what Stockholm needs to do by 2040, as well as a description of the city's climate budget.

Sections 3 to 6 describe the different areas for action and related conditions:

- transport (section 3)
- energy use for heating and cooling in buildings (section 4)
- electricity production and use (section 5)
- gas production and use (section 6)

For each action area, there is a description of current greenhouse gas emissions and what processes the city needs to start in order to become fossil-free by 2040. There is then a statement of what needs to be done during the 2020–2023 programme period in order to start this reduction and who is responsible for implementation and follow-up. The plan represents a faster reduction rate than in previous climate strategy.

In spite of the City becoming fossil-free by 2040, there will be residual emissions in the form of carbon dioxide emissions from the combustion of fossil plastics in waste, for example. Section 7 describes how the city can further reduce emissions through carbon capture and storage. The City has already successfully started techniques for the production of biochar. Another technology that is ready for testing is BECCS (bio-energy with carbon capture and storage). Biochar and BECCS are technologies that can be used to take care of the remaining emissions so that by 2040 the city will reach zero net emissions. The goal is to achieve negative emissions by 2040.

The City has an ambition to reduce emissions within its own organisation ten years earlier and become fossil-free by 2030. This is described in section 8.

The plan presents emission calculations for energy used for heating buildings, transport, electricity and gas within the city's geographical area.

The plan also includes measures to reduce emissions resulting from long-distance air travel and the production of food and building materials. This is dealt with in section 9.

How this plan is to be implemented is set out in section 10.

Through the Climate Action Plan, the ambition is that the City will be able to greatly reduce greenhouse gas emissions. It is also the City's ambition to continue to be an international example that inspires other cities to go further in their climate work with the goal of creating communities that do not have a harmful impact on the climate.

1. A fossil-free and climate-positive Stockholm by 2040

Increased ambition in Stockholm's climate work

With this action plan to reduce Stockholm's climate impact, the City is raising the level of ambition so as to meet the commitments of the Paris Agreement.

Stockholm is one of Europe's fastest growing and most innovative cities. The City's close collaboration with industry and academia is one of the prerequisites for achieving the City's ambitious climate goals, with economic growth based on renewable energy. The City, with its infrastructure and ownership of about ten per cent of Stockholm's buildings, provides a unique platform for the development of industry's smart environmental technology solutions. Development of technologies that can help to reduce climate impact, both in Stockholm and the rest of the world, as well as the development of new and existing environmental technology companies on the market. Investment in climate-efficient technologies can also help to promote the growth that is a prerequisite for addressing the climate challenge.

In the plan, the City sets out a climate budget with the ambition of reducing emissions as quickly as possible, which is intended to lead to both fossil-freedom and zero net greenhouse gas emissions by 2040. The plan outlines measures to reduce emissions by 2040. This level of ambition requires several measures over which the City has no immediate control. In the field of transport, the City is dependent on international and national regulations that need to be changed in order for the City to take effective action. In the electricity sector, the city can only directly control its own electricity use, which accounts for about ten per cent of all electricity used in Stockholm. The level of ambition of the Climate Action Plan may be tested in any revision of the Action Plan. The climate budget therefore expresses a focus for the year 2040. It covers approximately 19 million tonnes of carbon dioxide equivalents and represents the level of ambition for the ceiling on the greenhouse gases that can be emitted by 2040. This is the part of the global climate budget that the City intends to take on.

During the 2020–2023 programme period, the City is increasing the pace of emission reductions compared to the period from 1990 to the present. The target is that emissions shall not exceed 1.5 tonnes per resident by the end of 2023. This is to be achieved by clearly identifying the conditions set out in the Action Plan for committees and companies that will implement the measures to reduce emissions. The respective committees and companies are also responsible for monitoring and annually reporting the implementation of the measures.

In order to achieve zero net emissions, local carbon sinks will be needed. This can be done through increased biochar production, but mainly by capturing and storing carbon dioxide from heat and power plants in geological cavities in the bedrock. If large-scale carbon capture and storage begins around 2030, and to such an extent that the amount of stored carbon dioxide exceeds remaining emissions, Stockholm has the opportunity not only to achieve zero net emissions but also to become a climate-positive city.

The City of Stockholm's climate goals

The City's climate goals for reducing greenhouse gas emissions have been determined in the City of Stockholm's Environment Programme, which has been decided by the City Council. This Climate Action Plan aims to define the City's activities for achieving the climate goals of the Environment Programme. The Environment Programme has adopted two long-term priority goals for reducing climate impact. These goals are:

1. A fossil-free and climate-positive Stockholm by 2040
2. A fossil-free organisation by 2030

In order to achieve the priority goals, fuels and electricity need to be 100 per cent renewable in all sectors. Fuel and electricity to replace fossil fuels may in future become limited resources. Energy efficiency is therefore an important piece of the puzzle whereby the City helps to release resources for use in other sectors.

In addition to the priority goals, the Environment Programme also has four milestones for 2023. These milestones are:

- Reduced greenhouse gas emissions – maximum 1.5 tonnes CO₂e per resident
- Reduced climate impact from consumption
- Reduced greenhouse gas emissions – maximum 105,000 tonnes CO₂e from the City's operations
- Effective energy consumption

The goals have been set with the ambition that Stockholm shall take the lead in the development of climate activities. The City's actual work for the climate shall set an example for other cities. One challenge, however, is that most measures that provide significant emission reductions, and over which the City has influence, are have already been largely implemented. Further challenges are to reduce the emissions that the City does not control and that arise in other parts of the world, partly as a result of Stockholmers' consumption and air travel.

The city shall be completely fossil-free by 2040. This means that no fossil fuels shall be used within the geographical boundary of the City of Stockholm. However, the City judges that it may be difficult to replace all use of fossil fuels in aviation and international shipping, and also that plastics derived from fossils may remain in waste incineration in 2040. There may also be emissions that come from fossil fuels used in the production of biofuels, for example. Through compensatory measures for these emissions, for example with carbon sinks, the city can reach zero net emissions or climate positivity. Net zero and climate positivity mean that carbon dioxide emissions are offset by measures that in various ways bind carbon or carbon dioxide. This is further described in section 7.

Since large emissions occur as a result of Stockholmers' consumption, it is important that the City also works to try to reduce emissions from consumption, in spite of the lack of complete control over the possibility of reducing these emissions. The City's work on reducing consumption-based emissions are described in more detail in section 9.

Action plan to achieve defined goals

This action plan shows how the City shall be able to reach the milestone for 2023 and lead the way towards the City's long-term climate goal of a fossil-free and climate-positive Stockholm by 2040 with zero net emissions. The action plan begins with the present use of fossil fuels and then goes through trends, forecasts and potentials for fulfilment of 2040 targets and 2023 milestones, sector by sector. The action plan leads on to the City's climate budget.

The action plan presents estimates of the emission reductions needed to achieve the climate goals. Some reduction can be attributed to the measures already adopted that are now being implemented. It is important to ensure that planned and decided measures have the intended effect. By being part of the action plan, they are incorporated into the City's integrated system for governance and follow-up, where those responsible for implementing the actions are also responsible for reporting on the monitoring of the impact of the actions. The actions presented under the Action Plan are an inventory of actions that have been identified.

The conditions for reaching the 2023 milestone are more action-oriented. Fossil freedom efforts towards 2040 are of a more strategic nature, but the processes leading to action should begin within the programme period. A large number of strategically important challenges to fossil freedom by 2040 that the city needs to address have been identified. Instruments to address these challenges are completely or partially outside the City's control, for which reason a broader approach is needed to pave the way for fossil freedom. The action plan therefore sets out how the city can work towards the EU, government and Riksdag taking the decisions necessary to enable the city to achieve its goals. This applies in particular to the transport sector and the goal of a 70 per cent reduction in carbon dioxide emissions from the sector by 2030.

It is important that the measures taken for a fossil-free Stockholm do not lead to emissions being transferred to other municipalities.

Strong regional collaboration

Many of the challenges involved in climate conversion are regional in nature. This applies in particular to the development of public transport and buildings that promote efficient travel, infrastructure for electrification and other renewable energy supplies, as well as the work to strengthen the attractiveness of the region through strategic research and innovation. Region Stockholm's Climate Roadmap 2050 is an important starting point, as is the County Administrative Board's Climate and Energy Strategy. The City of Stockholm can be an important player in Sweden's concrete climate work.

The City of Stockholm should take the initiative for a strengthened regional cooperation that includes industry and academia. A "handshake" between the region's actors can generate the necessary determination. Joint innovation projects can show new ways towards the goal. New digital support can visualise the effects of successful solutions. This can provide the support needed for decisions on scaling up solutions. Stockholm City's climate ambitions thus have greater opportunities to be realised in a strengthened regional arena.

System limits

The climate goal for 2040 includes all energy use, and thus greenhouse gas emissions, within the city's geographical boundary from:

- heating, domestic hot water and cooling of properties
- road transport regardless of who performs it
- rail traffic and shipping within the city limits and take-offs and landings at Bromma Airport up to 915 metres
- all other gas and electricity usage for households and businesses

The greenhouse gases included in the calculations are carbon dioxide, methane and nitrous oxide.

The goal does *not* include greenhouse gas emissions from:

- Stockholmers' travel outside the municipal border
- production of food or other goods or services consumed by Stockholmers but produced outside the municipal border
- freons in refrigerants and nitrous oxide in health care
- short-lived climate pollutants (SLCP), with the exception of methane and nitrous oxide emissions from combustion of fuels
- direct emissions of methane gas from the city's gas pipeline network

Greenhouse gas emissions are calculated according to the City's present calculation-method, which has followed the international calculation protocol GPC since 2015¹. Emissions from energy use are calculated on the entire life cycle of the fuel and also include emissions from the production and distribution of fuels. Electricity usage is calculated on the basis of the Nordic electricity mix. District heating is calculated using the emission factor for regional district heating production.

¹ <https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities>

The City of Stockholm as an organisation aims to take the lead in the work and shall be fossil-free by 2030. The system limit for calculating the organisation's emissions is the same as for the geographical city. However, with the difference that only emissions from the City's companies and committees are included.

Stockholm's fossil fuel use and climate impact

Of the total energy use in Stockholm in 2018, 54 per cent was renewable energy, 12 per cent recycled energy, 9 per cent nuclear energy (nuclear power in the Nordic electricity mix) and 25 per cent fossil energy.

The fossil energy consists mainly of:

- petrol for vehicles in road traffic
- diesel for vehicles in road traffic, work machinery and ships
- aviation fuel for aircraft
- coal for the combined heat and power plant in Värtan (KVV6) for the production of district heating and electricity
- fossil-based plastics in waste incineration in heat plants for the production of district heating and electricity
- fossil oil for boilers in buildings, heat plants for the production of district heating and industrial contexts, as well as ships
- natural gas in the city gas for boilers in buildings, ovens and for vehicle gas

According to preliminary statistics for 2018, total emissions amounted to 2,110,000 tonnes of CO₂e, of which energy use in buildings accounted for 684,000 tonnes of CO₂e, electricity and gas use 407,000 tonnes of CO₂e and transport 1,019,000 tonnes of CO₂e (see Figure 1.1). The City of Stockholm as an organisation accounts for approximately 7 per cent of total emissions.

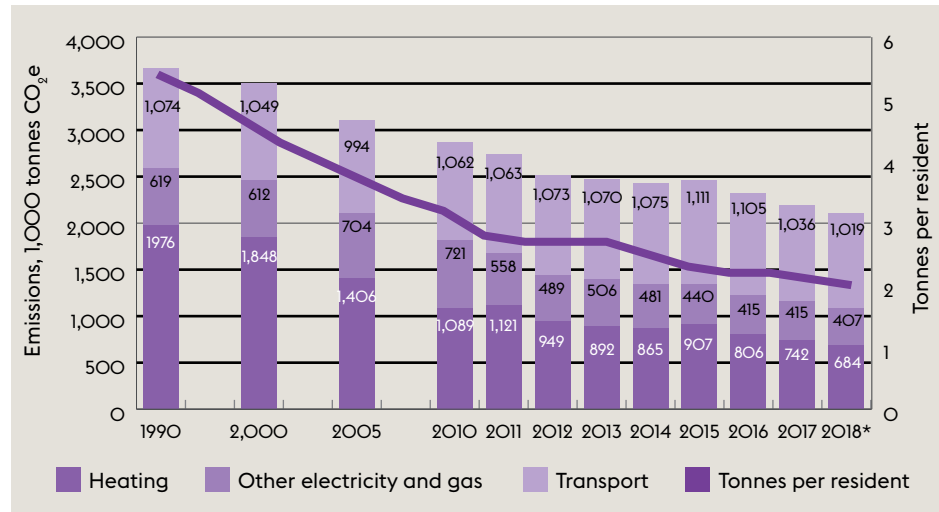
Stockholm's climate work to date

The City of Stockholm's calculations of emissions date back to 1990 and since then have fallen by almost 40 per cent² by 2017. At the same time, Stockholm's population has increased. Emissions per inhabitant have thus decreased by around 60 per cent over the same period. The main reduction has been in the heating sector, where emissions have more than halved due to the phasing out of oil boilers, an increase in the proportion of renewables in district heating and a reduction in energy needs in the sector. Emissions from other electricity and gas use have decreased by about one third, while emissions from the transport sector remain at roughly the same level.

Greenhouse gas emissions in 2017 have been estimated at 2.3 tonnes of CO₂e per resident. The calculations include the sectors heating, other use of electricity and gas and transport. The 2018 preliminary emission estimates for the same sectors are 2.2 tonnes CO₂e per resident (see Figure 1.1 and Table page 12). In the absence of statistics for parts of the 2018 figures, emissions have been estimated on the basis of preliminary assumptions.

² City of Stockholm, *Reporting of energy consumption and greenhouse gas emissions 2018* (Stockholm, 2018).

Figure 1.1 Total greenhouse gas emissions and emissions in tonnes of CO₂e per resident).



* Emissions for 2018 are partly based on preliminary forecast figures and are subject to change when complete statistics are obtained.

Emission values 2015–2018, total and per resident.

	2015		2016		2017		2018*	
	Thousand tonnes CO ₂ e	Tonnes per resident	Thousand tonnes CO ₂ e	Tonnes per resident	Thousand tonnes CO ₂ e	Tonnes per resident	Thousand tonnes CO ₂ e	Tonnes per resident
Heating	907	1.0	806	0.9	742	0.8	684	0.7
Other electricity and gas use	440	0.5	415	0.4	415	0.4	407	0.4
Transport	1,111	1.2	1,105	1.2	1,036	1.1	1,019	1.1
Total	2,457	2.7	2,326	2.5	2,193	2.3	2,110	2.2
Residents	923,516		935,619		949,761		962,154	

* Emissions for 2018 are partially based on forecast values.

2. What Stockholm needs to do by 2040

A prerequisite for the City of Stockholm to become fossil-free and climate-positive by 2040 is close collaboration with residents, industry and public operations. This includes, for example, the phasing out of fossil plastics and switching to fossil-free technologies in the transport sector. The City can initiate innovation collaborations that develop both businesses and the technical solutions. Industry-wide efforts, such as the realisation of the roadmaps of the government initiative Fossil-Free³ Sweden, make it easier for the City to achieve the goal by 2040. The City is also dependent on Nordic electricity becoming fossil-free and that international shipping is powered by renewable fuels. It is crucial for becoming fossil-free in the transport sector by 2040 that decisions are taken within the EU and nationally that support increased production of renewable fuels, among other things. The City therefore needs to actively participate and influence national and EU regulations. The development of the region and what efforts are made in the areas of physical planning and the range of public transport also have a major impact on the attainability of the goal.

Reduction potential by 2023

The City of Stockholm aims to phase out fossil fuels by 2040 with the new milestone of no more than 1.5 tonnes of CO₂e per resident by 2023. In 2018, emissions were 2,110,000 tonnes of CO₂e and these shall be down to net zero by 2040. Estimates of reduction potential have been made for 2020–2023 and are based on the 2018 emission calculations, assuming that ongoing measures during 2019 reduce emissions by a further 100,000 tonnes of CO₂e.

The measures proposed in the 2020–2023 Action Plan are expected to lead overall to a reduction of around 474,000 tonnes of CO₂e. The milestone has taken into account that the city's population is projected to increase from 962,000 in 2018 to 1,024,000 in 2023.

The most significant reduction potentials that have been calculated are:

- increased proportion of renewable fuels in light and heavy vehicles
- increased proportion of electric vehicles
- public transport, parking and cycling measures
- requirements for climate-efficient transport in procurement
- phasing out fossil fuels in district heating
- improved energy efficiency in the existing building portfolio

Other emission reductions will occur without the intervention of the City, such as:

- the emission factor for the Nordic electricity mix is expected to be lower, i.e. a larger proportion of renewable electricity generation in the Nordic region
- the area devoted to housing and premises is not expected to increase at the same rate as the city's population is growing, thus leading to the population living and working in a more area-efficient way

Increases in emissions:

- electricity use is expected to increase by 2 per cent per year
- road transport is expected to increase by approximately 4.5 per cent by 2023 compared to 2018⁴

³ <http://fossilfritt-sverige.se/>

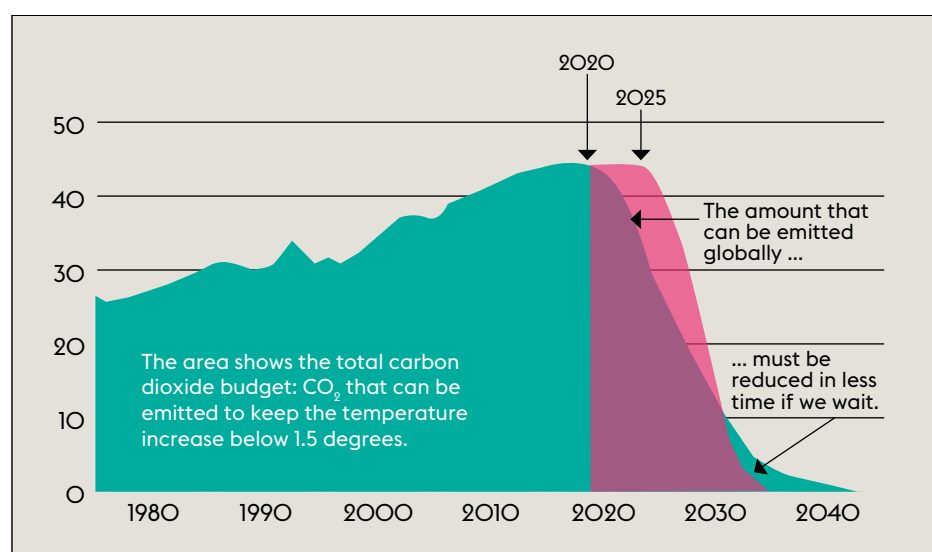
⁴ The forecast is based on the outcome over the last 10 years. There has been no increase in traffic since 2017.

The Paris Agreement emission reduction goal

In December 2015, the countries of the world agreed on a new climate agreement, the Paris Agreement. The agreement means that the global temperature increase shall be kept well below 2°C and that the aim should be to stay at 1.5 degrees compared to pre-industrial levels. In October 2018, the the UN's climate panel IPCC presented its special report on 1.5 degrees of global warming. It points to large differences in the consequences at 1.5 compared to 2 degree global warming. The main message is that even a 1.5 degree global warming has serious consequences for many people, for the environment and for ecosystems. In order to achieve the Paris Agreement's 1.5 degree goal, global emissions need to be between 0.6 and 1.2 tonnes of CO₂e per person as a global average by 2050. Global greenhouse gas emissions amounted to just under 50 billion tonnes of CO₂e in 2017, which represents a global average of 6.6 tonnes per person⁵.

It should be added that, according to IPCC's assessment, substantial emission reductions are required as soon as possible, otherwise negative emissions will be required (CCS⁶ /BECCS⁷) earlier and to a greater extent. There is so far no accepted methodology for allocating the required global emission reduction between countries, but there is a consensus that the OECD countries should reduce their emissions at a faster rate than non-OECD countries. Major efforts and adjustments are therefore needed to manage a climate budget that is in line with IPCC's scenarios in order to meet the Paris Agreement (1.5 degree goal).

Figure 2.1 It is the total amount of greenhouse gases in the atmosphere that is crucial for climate change. To avoid temperature increases, it is therefore important to reduce global emissions quickly now. A later reduction would need to occur much more quickly and would have greater consequences for society.



Sources: Global Carbon Project, IPCC, Nature

The EU's climate goals

The EU has adopted climate goals for 2020 and 2030. Emissions in the EU shall be reduced by 20 per cent by 2020 and by 40 per cent by 2030 compared to 1990. The European Commission's long-term climate strategy⁸ includes the ambition to achieve zero net emissions by 2050. That target will be translated into legislation in 2020. As part of this work, the European Commission is also expected to propose a revision of the EU's climate goal for 2030 and present a plan to reduce the EU's emissions by 50–55 per cent by 2030.

⁵ Swedish Environmental Protection Agency, In-depth analysis of Swedish climate statistics 2018.

⁶ CCS means Carbon Capture and Storage.

⁷ BECCS means Bio-Energy with Carbon Capture and Storage.

⁸ EU proposal 2018/19:FPM19 COM (2018) 773.

Sweden's climate goals

The Swedish Riksdag decided in 2017 on a new climate policy framework that includes new climate goals, a climate act and a climate policy council. Sweden's overall climate goal is to achieve zero net greenhouse gas emissions by 2045 at the latest, and thereafter achieve negative net emissions. The Swedish climate goals are based on territorial emissions, which are calculated on the basis of activities that take place within Sweden's geographical borders, where international shipping and aviation are excluded. If Sweden is to be able to achieve a zero net greenhouse gas emissions by 2045, emissions must be reduced by approximately 85 per cent compared to the 1990 level.

We can compensate the remaining emissions to zero by means of complementary measures. Complementary measures today include BECCS, net capture in forests and land and verified emission reductions in other countries⁹, as well as biochar. These measures can also contribute to negative net emissions after 2045. By 2045, the emission level per Swedish inhabitant needs to be between 0 and 0.9 tonnes of CO₂e¹⁰, depending on the extent to which complementary measures such as carbon storage are used. Road traffic accounts for more than 90 per cent of the transport sector's emissions. Among other things, the Climate Policy Council has identified the transport sector as particularly critical for achieving the Swedish goals. With the present conditions and decisions, the transport sector will only get halfway to Sweden's interim target of reducing emissions by at least 70 per cent by 2030. According to the Climate Policy Council, this calls for strong political action during this mandate period¹¹.

The City's climate budget

The City of Stockholm's budget for 2019 states that Stockholm needs to produce a local carbon dioxide budget that shows how much emission Stockholm, and above all our planet, can withstand.

What is a climate budget?

One way to make a climate budget is to start with an estimate of the maximum quantity of greenhouse gases that could be emitted globally to achieve a temperature rise of no more than 1.5 degrees. Moving from a global climate calculation to a climate budget for a smaller region means it must be adapted in both time and in space using different distribution principles¹².

Climate and carbon dioxide budgets can also be found in contexts where the amount of permitted emissions is not directly linked to the ambitions of the Paris Agreement, but rather is about the desire to limit the remaining emissions to a certain amount. The maximum accumulated emissions that may be released to reach the target may vary depending on the path taken to achieve it.

However, there is no accepted method for the design of a climate or carbon dioxide budget. Different climate budgets may have different boundaries, system limits and assumptions, making it difficult to compare budgets between countries, regions and municipalities. What is more important then is to ensure that the climate budget is complied with, followed up and evaluated.

The City of Stockholm's climate budget

The proposal is that the City of Stockholm's climate budget is calculated based on the 2020 preliminary emissions, achieving 1.5 tonnes per resident by 2023 and achieving fossil freedom and with negative emissions (BECCS, biochar etc.) achieving zero net emissions by 2040. The climate budget begins with the City of Stockholm's goal of fossil freedom and climate positivity by 2040 and with a faster reduction in emissions than the city's previous climate strategy. The ambition for the climate budget is that the city shall emit a maximum of 19 million tonnes of carbon dioxide equivalents by 2040. Any emissions shall be compensated so that net emissions are zero by 2040 within the system limit.

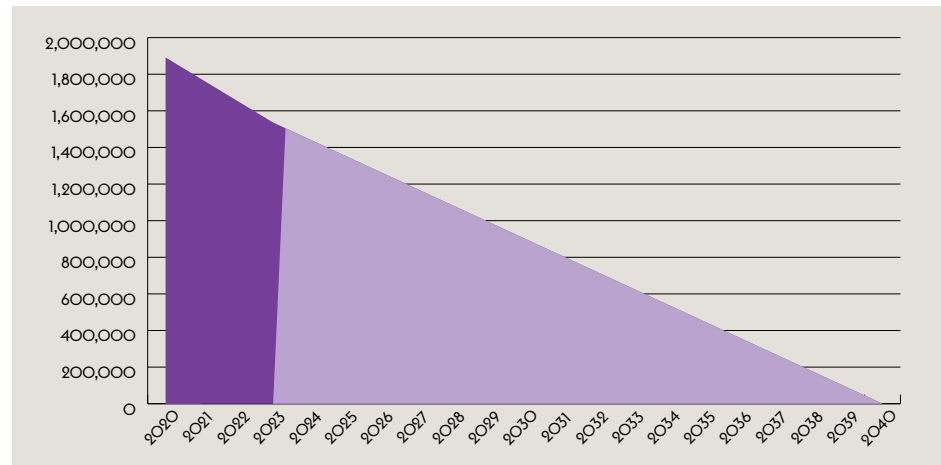
9 The Swedish Environmental Protection Agency's report 6879 Basis for the government's climate policy action plan – short version.

10 Swedish Environmental Protection Agency, *In-depth analysis of Swedish climate statistics 2018* (Stockholm, 2018).

11 2019 Climate Policy Council report.

12 Carbon Tracker Initiative, *Carbon Budgets Explained*, 2018.

Figure 2.2 The starting value for 2020 is calculated on the basis of an estimate of the rate of emission reduction in Climate Strategy 2016–2019. The dark purple area shows the years 2020–2023 where the measures and responsibilities for implementation are defined in the Climate Action Plan. The lighter area shows the goal for 2040 for completely removing fossil fuels and where the remaining emissions are handled with negative emissions. The target for 2020–2040 comprises 19 million tonnes of carbon dioxide equivalents.



3. Measures in the transport sector

This section is divided into four subsections: road transport, work machinery, shipping and aviation. The subsection on road transport is in turn divided into traffic and fuels and vehicles.

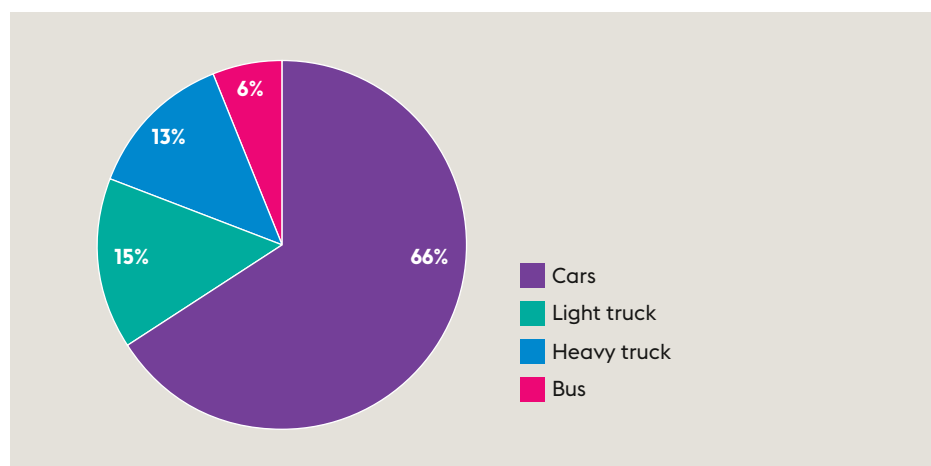
Road transport – introduction

Road transport accounted for 39 per cent of total greenhouse gas emissions within the City of Stockholm's geographical boundary in 2017. In terms of tonnes, this meant 863,000 tonnes. Vehicle use has increased in the growing city despite a decrease in use per resident. On the other hand, emissions have remained virtually constant since 1990, as vehicles have become more energy efficient and the use of biofuels has risen to just over 30 per cent.

Greenhouse gas emissions from road traffic

In the City of Stockholm, most emissions are from private car traffic, but as the population increases, it is emissions from goods traffic that are primarily expected to increase. In order to reduce emissions, it is important to change vehicle technology to electric vehicles and vehicles powered by renewable fuels, as well as to avoid traffic growth.

Figure 3.1 Distribution of road traffic greenhouse gas emissions within the City of Stockholm in 2017.



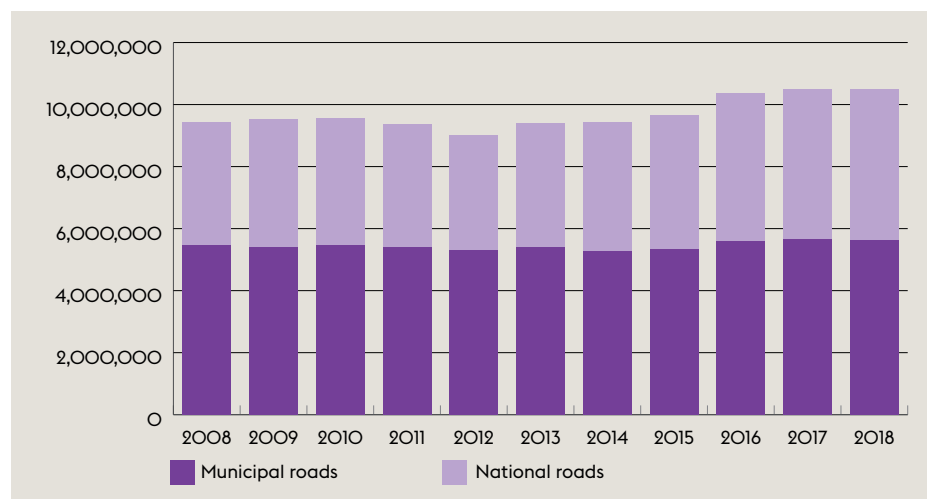
Traffic – background

This section deals with how reducing traffic can reduce greenhouse gas emissions. Traffic here refers to how and how far people and goods travel. The next section describes trends, developments and measures to reduce emissions from the use of fuels and vehicles.

Traffic developments

Emissions from vehicular traffic must be reduced in order for Stockholm to achieve its climate targets. This is done through technological development, expanded public transport and reduced vehicular traffic. It is difficult to reduce traffic in a growing city with only the measures that a municipality can take. For a few years after the financial crisis of 2008, vehicular traffic growth slowed, but it has now picked up again, despite increasing public transport and a great increase in cycling. As the population and thus consumption increase, traffic is expected to increase¹³, but to a slightly lower extent than the population increase. This is partly due to the fact that some roads have in principle reached their maximum capacity during parts of the day, and partly because of a well-developed public transport system and an increasing proportion of cycling. Further national measures would therefore be needed to achieve the emission reduction target.

Figure 3.2 Traffic within the City of Stockholm – 24-hour weekday average



Vehicular traffic within the city limits has grown by 1.15 per cent per year in recent years. If this rate of increase continues, it will mean emissions of a further 40,000 tonnes of CO₂e by 2023 and a further 150,000 tonnes of CO₂e¹⁴ by 2040. A transition to other fuels is therefore needed. At the same time, the Swedish Transport Administration's calculations indicate that within the framework of the milestone of reducing emissions from the transport sector, more than 20 per cent of traffic in Stockholm should disappear by 2030.¹⁵

¹³ This assessment is based on official forecasts from standard models in Sweden (the Sampers models). The calculation models are based on the development of the economy, population and historical travel patterns.

¹⁴ Calculated with the same type of vehicles and fuel usage as today (2018).

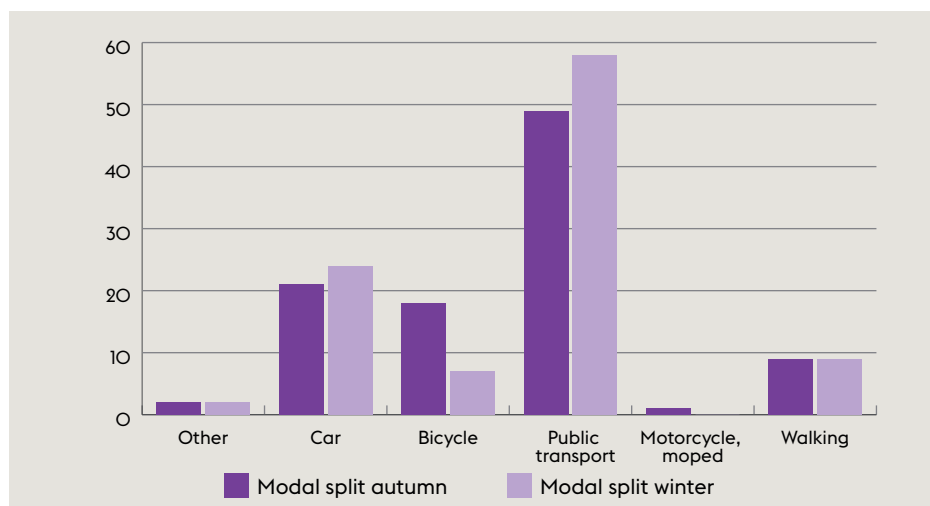
¹⁵ The assessment is based on what remains to be done after other measures such as energy-efficient vehicles, new fuels and other transport solutions have been implemented. If the development of technology or the fuel transition is significantly faster than projected, the need for traffic reduction decreases. See the report Stockholm's road to fossil fuel freedom, reported to the City Executive Board on 11/04/2018.

Most commuting is done by public transport, bicycle and walking

Stockholm has been very successful in reducing car use for commuting over the last 25 years, especially through well-functioning public transport. About 75–80 per cent of commuting is currently by public transport, bicycle or walking. Car commuting varies between 21 per cent in autumn and 24 per cent in winter. According to travel surveys, about half of car commuters report that they use the car for business purposes during the day.

A new and strongly increasing trend is working remotely. As many as 21 per cent¹⁶ said that in 2016 they worked remotely at least one day a week.

Figure 3.3 Stockholmers' commuting (2016).

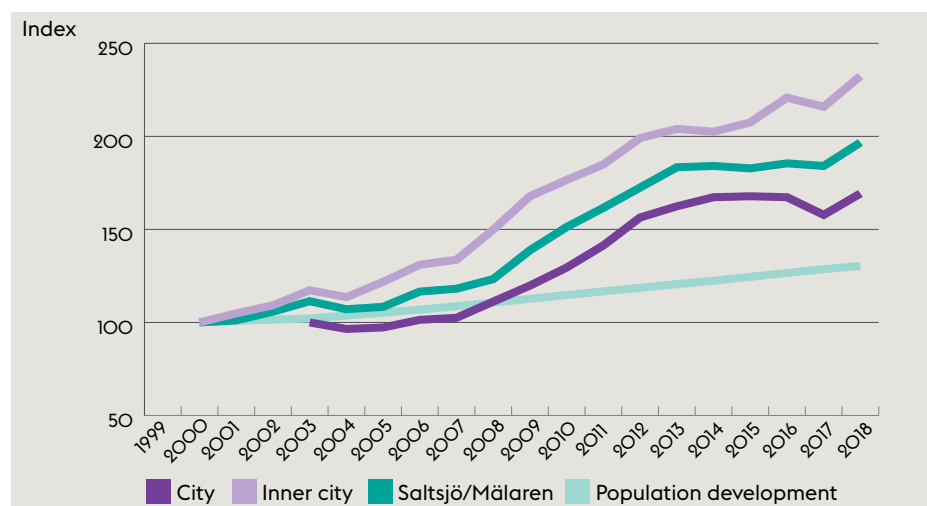


The congestion tax introduced in 2007 after a test period in 2006 also led to a 20 per cent reduction in traffic to and from the inner city and around 10–14 per cent within the inner city during the daytime. This result has stood despite the fact that the population of the county increased by 20 per cent during the same period and the regional economy grew by 33 per cent.

The expansion of cycle lanes and other cycling measures in recent years has led to a strong increase in cycle commuting.

¹⁶ The City of Stockholm's travel survey 2016.

Figure 3.4 Development of cycle passages per day as three averages and population development in the county, 2000–2018, rolling 5 year figures, index = 2000.



Sources: City of Stockholm 2019.

Leisure travel within the city can be reduced by car sharing, urban planning and cycle lanes

Nearly 70 per cent of the number of car trips in Stockholm occur during leisure time. The purpose of these trips is shopping, leisure activities and other matters. These travel needs are fragmented in both time and space and therefore difficult to meet using public transport that is based on many people traveling simultaneously along much the same route.

However, there is some potential to meet the need for short leisure trips through car sharing, car pools and the transition to cycling, including freight cycles. Although car pools do not reduce car traffic for these particular journeys, people who have opted out of their own car ownership and instead use a car pool, taxi or one of the new sharing services also have a tendency to reduce their overall car travel.

Car and bicycle pools, freight cycle pools and other fossil-free modes of transport need to be connected to each other and to public transport to make it easier to choose the optimal transport service for the individual occasion. Today, these services compete with each other for the same user. The City needs to take the lead and support a synergy between public transport and these services, for example by developing green parking spaces, i.e. where new buildings can be permitted to build fewer parking spaces in return for the residents being offered mobility services¹⁷. These can be located in the property or combined with easily accessible mobility service centres, known as mobility hubs¹⁸, nearby that offer car hire, cycle pools, scooter pools etc.

A major reason for car use in leisure time is the long distances to destinations and the need to transport things (food and other goods, exercise equipment etc.). In order to reduce car use, urban planning needs to be better at integrating area-intensive destinations such as shopping centres, parks, wooded areas, ball courts, riding stables, pleasure boat marinas etc. within cycling or walking distance from residential or public transport hubs.

Coordination and logistics centres can restrict the growing goods traffic

An increasing population automatically generates a higher demand for the supply of goods and the outward transport of waste. It is difficult to determine exactly how changing consumption patterns such as increased online shopping etc. affect delivery traffic.

¹⁷ Mobility services allow travellers to combine a wide range of transport services, such as public transport, car pools, cycle hire systems and taxis to offer the traveller a comfortable journey.

¹⁸ A mobility hub is a station or focal point where different shared mobility solutions are gathered together.

In some cases, delivery traffic can be optimised through so-called last mile initiatives, where suitable goods are brought in a coordinated way in large vehicles to transshipment centres outside the city centre and then distributed with smaller electric vehicles and cycles. Trials of this are in progress. This requires that suitable areas are allocated in the vicinity of working and residential areas. One example is the project Ålskade Stad (beloved city) which was launched in Stockholm in spring 2017. Electric vehicles collect and deliver goods to shops and offices in central Stockholm, while collecting waste and thereby reducing traffic. At the groupage centre, outgoing deliveries are coordinated and incoming waste fractions are compacted for coordinated onward transport out of the city.

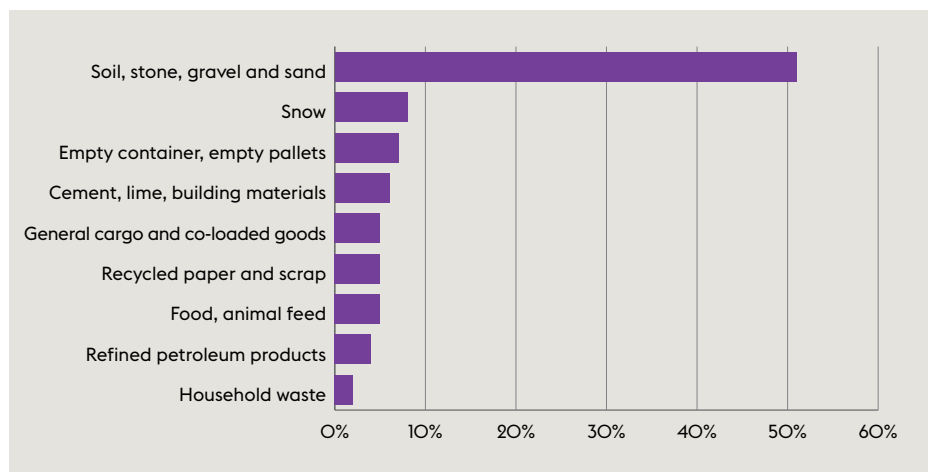
There is a strong trend for more and more goods to be delivered with small, light trucks instead of heavy ones. This trend risks increasing traffic as there are more vehicle movements and also more empty return journeys. The number of light trucks in use is increasing by 1.5 per cent per year and is expected to account for the entire increase in goods deliveries. The City can reduce the negative effects by offering and singling out places for logistics centres in strategic locations.

Another trend is increasing online shopping based on the goods being delivered home to the customer. Home deliveries should be able to reduce shopping trips, but it has not been possible to confirm this in Stockholm. The City can work with e-commerce distributors to optimise goods flows and routes so that neutral delivery boxes and delivery rooms are installed where goods can be delivered when the customer cannot accept delivery personally.

Transportation of excavated material and building materials can be made more efficient

Around 50 per cent of the goods transported in Stockholm are gravel, sand, stone and soil. In addition, there are other low-value goods such as cement, waste, recycled glass, scrap metal, snow etc.

Figure 3.5 Goods transport by Swedish trucks, loaded and unloaded within Stockholm County. Proportion of goods by type of goods (2010).



Source: Transport Analysis Goods transport in Sweden. Report 2012:7

In developing the underground and the new sewage tunnel between Åkeshov and Henriksdal, part of the excavated rock could be transported out by boat instead of truck. This could reduce carbon dioxide emissions by 2,000 tonnes of CO₂e throughout the construction period. Further construction of a similar nature has not been investigated, but the industry believes that significant volumes of rock and gravel will come. However, managing the material at shoreline locations competes with other uses such as recreation, residential development etc.

Excavated rock from construction projects needs to be refined (crushed and in some cases also washed) before it can be reused. Today, there is generally no space for dealing with this material, which is why it has to be transported out of the city to nearby quarries. If the City can offer places for such intermediate storage, transport can be significantly reduced. How-

ever, such storage areas require a lot of space and compete with other land uses. There is also a risk of dust and noise from crushers and storage.

Traffic – the road to 2040

During the programme period and beyond, the City needs to run a variety of processes that lead to important decisions being taken, with a view to achieving a 70 per cent reduction in transport emissions by 2030 and fossil freedom in the transport sector by 2040. This requires national decisions, such as an environmentally differentiated congestion tax, which makes this aspect uncertain within the programming period. In addition, continued expansion of public transport, cycle lanes and various measures to improve mobility services such as car pools, bicycle borrowing pools and new free-flowing sharing services can slow the increase in traffic in the growing city. In goods transport, the city can reduce goods flows through better handling of excavated material and by promoting different logistics solutions. On the road to 2040, comprehensive and thorough action is needed, including in the following areas:

- Expansion of public transport
Responsible: Transport Committee and City Development Committee in collaboration with Transport Administration Region Stockholm
- Expansion of cycle lanes
Responsible: Transport Committee
- Promotion of new mobility solutions
Responsible: Transport Committee, City Development Committee and Stockholms Stads Parkerings AB
- Setting up mobility hubs
Responsible: City Planning Committee, Transport Committee, City Development Committee and AB Stockholm Parkering
- Work to develop local transshipment centres for goods
Responsible: Transport Committee with the support of the City Planning Committee
- Handling and transport of excavated material
Responsible: City Development Committee, Transport Committee and City Planning Committee

Traffic – measures 2020–2023

In the short term, during the 2020–2023 programme period, the City shall implement the following measures:

Measures 2020–2023 for reducing traffic	Reduction in tonnes CO ₂ e	Responsible for implementation and follow-up
Parking measures	1,000	Transport Committee , supported by the City Planning Committee and the City Development Committee
Cycle measures	1,000	Transport Committee , supported by the City Planning Committee and the City Development Committee
Better accessibility for bus services	1,000	Transport Committee , supported by the City Planning Committee and the City Development Committee
Denser building near public transport	3,000	City Development Committee , supported by the City Development Committee.
Transport of excavated material by boat instead of truck	1,000	City Development Committee
Total	7,000	

The committee with primary responsibility is marked in bold.

The above measures provide small reductions by 2023, but have a greater potential by 2030 and 2040.

It is unlikely that traffic-limiting measures will completely halt the increase in traffic and lead to a sufficient reduction in traffic and thus sufficient emission reductions in the short term. The City currently lacks direct control over the most powerful measures. At the same time, the levels of emission reductions that need to be reached through reduced traffic depend on what conversion it is possible to carry out in the fuel sector. If a powerful transition could be made to electric power, for example, the estimated need for reduced mileage in the city could be significantly adjusted. This means that the question of what the city's vehicles are running on is a central development area.

Fuels and vehicles – background

In order to achieve fossil freedom, a change of vehicle technology must take place. Electricity, biogas, ethanol and biodiesel are the options available today. Electric vehicles are more energy efficient than equivalent fossil-powered vehicles. Electric vehicles produce no local exhaust emissions or carbon dioxide emissions and are significantly less noisy than equivalent fossil-powered vehicles, both inside and outside the vehicle.

At present, vehicles that can be powered by renewable fuels often have lower purchase costs and longer range than electric vehicles. However, the fuels are more expensive compared to the cost of electricity for an electric vehicle.

The climate benefits of different fuels depend not only on the emissions that arise when the fuel is consumed, but also on how the fuel has been produced. When using electricity from renewable sources, carbon dioxide emissions from electricity generation are very low. Biogas, ethanol and biodiesel have slightly less exhaust emissions and are less carcinogenic than the exhaust gases from petrol and diesel vehicles.

Biogas, biodiesel and ethanol basically produce the same emissions as fossil fuel powered vehicles from combustion in the engines. These fuels, on the other hand, are based on plants that have taken carbon out of the atmosphere and are part of the natural cycle of carbon. Nevertheless, with regard to the production and distribution of fuels, which is partly done with fossil fuels, biofuels do give a small surplus of carbon dioxide. Ethanol for cars currently contains 85 per cent ethanol and 15 per cent petrol and from the petrol part there are of course carbon dioxide emissions. Heavy vehicles powered by biogas have an otto engine¹⁹, which is less noisy than diesel-powered trucks. None of the options alone can meet all transport needs, so instruments and investments are therefore needed for all technologies. In the longer term, technologies such as hydrogen and DME²⁰ may also be possible alternatives.

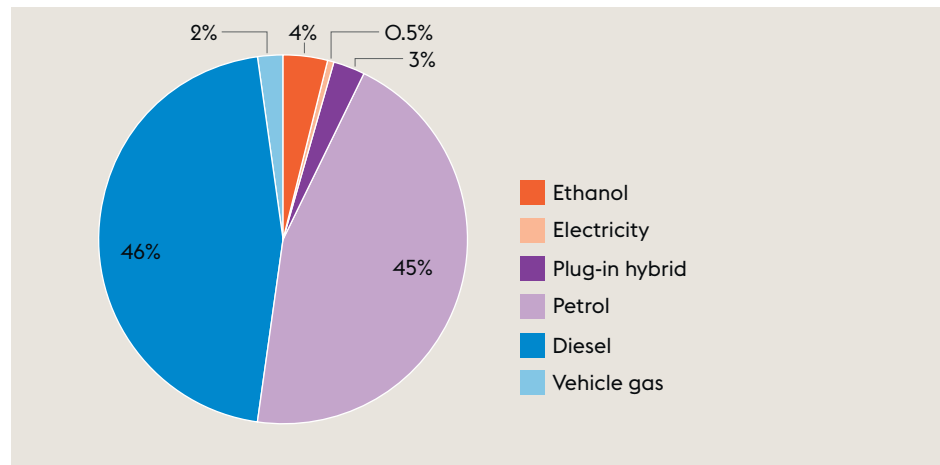
Stockholm has the highest proportion of biofuel in road traffic in Europe

Stockholm has gone further than most other cities in the world, but still has a long way to go to become fossil-free. Only 9 per cent of Stockholm's cars can be run on renewable fuels alone. This compares with Oslo, where as many as 22 per cent of all vehicles can do this because of the high proportion of electric vehicles.

¹⁹ Otto engines are the type of engine used in petrol and gas vehicles.

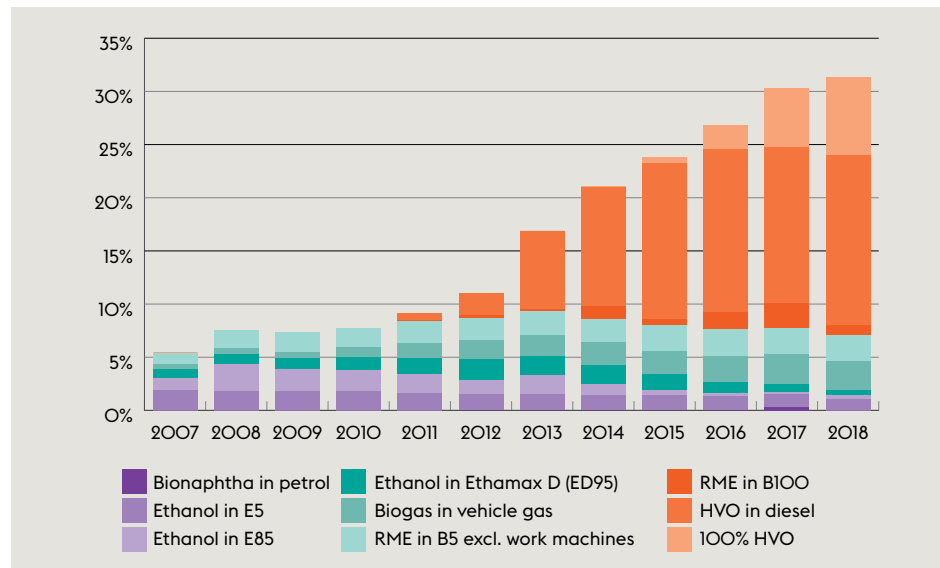
²⁰ Dimethyl ether, a gas that like LPG can be liquefied thus become as energy-dense as diesel. Pilot production from cellulose is already available in several locations, but only a few vehicles have been manufactured.

Figure 3.6 Fuel distribution in Stockholm's vehicle fleet (2017).



So-called low blending²¹ together with bus traffic and some carriers account for the majority of the reduction in Stockholm's vehicle fleet. This means that Stockholm, with more than 30 per cent fossil-free fuel, has come the furthest in Europe, while cities such as Oslo and Amsterdam have only about 5 per cent fossil-free energy²² in road transport.

Figure 3.7 Proportion of renewable fuels sold in Stockholm County.



Measures for fuel and technology changes by 2040 require vigorous action

In order to change vehicle technology and achieve a 70 per cent reduction in emissions by 2030 and fossil freedom by 2040, effective instruments must be used. The following instruments can be used separately but support each other.

However, the instruments referred to below are essentially outside the City's control and require national decisions and sometimes even decisions at EU level.

In Sweden, cars stay in use for about 18 years on average, so it is important that the transition begins as soon as possible. Car manufacturers, fuel producers, industry and residents need to see signals right now that the technology shift will have to take place in the next few years.

²¹ Low blending refers to about 30 per cent HVO and RME in diesel and 5 per cent ethanol in petrol. This high proportion of blended fuel is due to the fact that oil companies prefer to mix in a little more renewable in the large depots in Stockholm and instead mix in less in other parts of the country. A more accurate figure would be to use the national average plus local sales of pure biofuels in Stockholm. With this way of counting, Stockholm has about 21 per cent renewable in the fuel mix.

²² Electric cars are not only fossil-free, but also reduce energy consumption. A more accurate comparison is therefore to multiply electric power by 2.5. Oslo then has 14 per cent fossil-free energy in road traffic – half of what Stockholm has.

Increased electrification

The proportion of electric vehicles is increasing today, albeit from low levels. If electric vehicles were to be the main alternative for new vehicle sales, a rapid change in the vehicle fleet to fossil freedom could occur. The replacement of existing cars by new ones in Stockholm is very fast by national standards and here there is an important potential to take advantage of. Measures to promote electric car introduction exist but could become more powerful. The city has set a goal of building at least 4,000 public charging points by 2022. There are programmes for support for tenant-owner associations for the installation of charging equipment. The City's own housing companies have targets for charging infrastructure and the parking company has incentive systems. One opportunity for the City is to tighten up these goals and develop new instruments. Among other things, there is the possibility of working towards an emission-free inner city, which would give development a further boost. The extent to which this is feasible and the extent to which it affects the period of this Action Plan would need to be analysed in more depth. Not least in light of the fact that the area of electric cars is currently undergoing a transformation that could not really have been foreseen. Work to increase electric car use, which points the way towards a sharp increase in the proportion of electric cars by 2030, will be investigated in 2020.

There are currently (2019) approximately 20,000 electric cars and plug-in hybrids in the City of Stockholm. One third are electric cars and two thirds are plug-in hybrids.

The City is working in several areas to increase electrification in the transport sector. Some examples of this are:

- 4,000 public charging points in Stockholm by 2022.
- The Information campaign Fix charging sites, aimed at tenant-owner associations and homeowners.
- The Älskade Stad project with goods deliveries and collection of sorted fractions of waste with electric trucks in the city.
- Testing of electric trucks for night deliveries to restaurants in the inner city (the Eccentric project).
- Demonstrations of light electric trucks at a number of different private companies in Stockholm for goods deliveries and services etc. (Eccentric project).
- Electric vehicles have the highest priority in connection with the City's procurement of its own vehicles and are increasingly given priority in procurements involving transport services.
- Participation in the Transport Administration's work on electrification of bus traffic in the inner city.
- Requirements for charging equipment at car parks and car pool parking in Stockholm Royal Seaport and other developments where the City owns the land.
- The City's housing companies prepare for and install charging equipment for new construction and rebuilds.

Recent studies show that municipalities' own purchasing of electric vehicles and investments in public charging can have a positive impact on the purchase of rechargeable vehicles by local residents.

In order to estimate the possible development of the electrification of the private car fleet, two different scenarios have been studied. Scenario Low follows an almost linear development from 2019. A more ambitious proportion of rechargeable vehicles, 30 per cent of new car sales by 2023, is reported in Scenario High. Scenario Low has the assumption that plug-in hybrids run on 50 per cent electricity and Scenario High has the assumption that plug-in hybrids run on 75 per cent electricity. The development by 2040 in Scenario Low (linear development) means that 46 per cent of the vehicle fleet consists of electric cars or plug-in hybrids. Scenario High (exponential development) is estimated to have a private car fleet with 80 per cent electric cars or plug-in hybrids by 2040. Scenario High is an optimistic assumption.

Revised Bonus-Malus taxation

Bonus-Malus taxation was introduced in mid-2018 and provides an extra high vehicle tax for 3 years for vehicles with high greenhouse gas emissions – so-called Malus. The proceeds

from this are transferred as a bonus to new car buyers of vehicles with extra low emissions and the system is thus self-financing. Today, electric vehicles, plug-in hybrids and biogas vehicles receive bonuses.

Bonus-Malus is a strong instrument for initially directing new car purchases to cars with low greenhouse gas emissions. The system has meant that sales of fully electric cars and plug-in hybrids skyrocketed in late 2018 and 2019, while the range of electric car models is now growing strongly.

The Bonus-Malus system does not give any bonus to ethanol cars. There is a well-developed network of ethanol filling stations across the country and it is a relatively simple technology. In the past, ethanol cars had various incentives such as environmental car premiums and exemptions from congestion tax. Then there were a number of different ethanol models on the Swedish market, which should be able to be launched again if the right signals are given. Today there is one ethanol vehicle model on the Swedish market.

Bonus-Malus, however, is not a system that leads all the way to fossil freedom. The more car buyers choose bonus cars, the fewer malus car buyers are left to fund the bonus payments. Finally, the system is unable to be self-financing. A Bonus-Malus system that leads all the way is therefore not considered a sustainable instrument, unless the state can find additional revenue. The government has announced a review of the Bonus-Malus system in 2020, to strengthen and simplify the system.

Increased reduction obligation for fuels for road traffic vehicles

The reduction obligation requires fuel suppliers to mix renewable raw materials in such quantities and of such climate performance that greenhouse gas emissions are reduced by 20 per cent for diesel and 2.6 per cent for petrol. In 2020, the obligation will be increased to 21 per cent for diesel and 4.2 per cent for petrol. No values have been set for the years thereafter²³.

The reduction obligation needs to be increased without having any negative impact on the sale of pure biofuels or biofuels with low fossil content. In order to achieve fossil freedom, all fossil fuels need to be phased out by 2040 and only renewable fuels used.

Ethanol campaigns and conversion grants reduce emissions from petrol cars

There are about 40,000 E85 cars in Stockholm County. However, these are estimated to only fill with about 15 per cent E85, partly because the price per kilometre differs only marginally and the service intervals are more frequent for ethanol cars. Swedish ethanol reduces emissions by over 95 per cent. A campaign to raise awareness of the climate benefits of refuelling these cars with ethanol could reduce emissions. This also assumes that the price at the pump is competitive.

State aid for converting petrol cars into ethanol (E85) is a quick and inexpensive way to reduce emissions without scrapping cars prematurely. France has introduced such a scheme and around 70,000 petrol cars have been converted to ethanol in just six months, with the driving force being a low ethanol price and a high petrol price. A prerequisite is that the ethanol price makes it cheaper to use E85 than petrol. However, the exemption from EU rules that has allowed the Swedish tax exemption for biofuels is to end at the end of 2020. In 2020, discussions are ongoing at EU level on how to deal with biofuel subsidies in the future.

The City should work with the government and also lobby the European Commission and parliamentarians for a solution. A campaign to increase the refuelling rate of E85 among car owners can then be carried out.

²³ Diesel can be mixed with up to 70 per cent renewable raw materials, while under EU directives petrol may contain a maximum of 10 per cent ethanol by volume, corresponding to a maximum 7 per cent reduction if the most climate-efficient ethanol is used. This means that diesel will continue to have significantly higher renewable content. The estimated reduction in emissions presupposes that there is no transition from diesel to petrol.

Increased proportion of renewables through procurement etc.

Electric and biogas vehicles are more expensive than other technologies. Private cars today receive a climate bonus that covers part of the additional cost of these vehicles. They are suitable for many of the City's own and procured transportation needs. The City can accelerate the development of the market by consistently requiring high proportions of renewables in all procurements of transport services (both light and heavy).

The City can facilitate more renewable fuel stations and promote more incentives to benefit vehicles with renewable fuels.

Emission-free inner city

In connection with the City Council's 2019 and 2020 budgets for the City of Stockholm, an assignment was formulated to investigate what is needed to implement an emission-free inner city. This assignment aims to obtain fresh air, reduce noise and limit carbon dioxide emissions. The electrification of the car, bus and truck fleet will be difficult to achieve in terms of capacity in the short term. SL's contractors are only expected to be able to have an electric bus fleet by 2026. Converting the vehicle fleet needs a long preparation time because the cost consequences are higher with a rapid conversion. The time aspect is an important question of confidence for the City as a decision maker.

However, the consequences need to be assessed in an in-depth investigation as it is difficult to predict behavioural changes and how the dynamics of the automotive market develop. In order to have an impact during this programme period, the investigation work should proceed urgently and a comprehensive action plan for the transport sector, which takes into account measures for a strong electric car introduction, will be developed in 2020.

Environmentally differentiated congestion tax

Today, congestion tax amounts are the same for all types of cars and even heavy vehicles. The City can promote a differentiation of congestion tax amounts, with respect to vehicle CO₂e emissions (as a climate measure) and NOX emissions (as an air quality measure). This would effectively steer the market towards an electric car introduction. However, the measure requires the Riksdag to take a decision on the matter.

Fuels and vehicles – the road to 2040

Achieving a fossil-free transport sector requires a transition to vehicles running on electricity or renewable fuels. In the next few years, it is likely that the vehicle fleet will increasingly consist of electric cars and plug-in hybrids. The City has few instruments other than environmental zones to bring about this change, which therefore largely requires government action. Therefore, during the programme period and beyond, the city needs to run a number of processes that lead to important decisions on appropriate instruments, with a view to achieving fossil freedom by 2040. Cooperation between the city, the state and the EU is required here.

The instruments below overlap to some extent and should be seen as a list of possible measures. Through the City Executive Board with the support of the Transport Committee and the Environment and Health Committee, the City can:

- promote increased electrification and expanded charging infrastructure
- promote a 100 per cent reduction obligation
- promote the possibility of dynamic application of environmental zones and a change in environmental zone type 3 to make the tool more useful in the conversion process by including plug-in hybrid vehicles

Since cars are normally used for 18 years, it is important that the signals about which instruments are to be introduced come early. Otherwise, there are risks of misinvestments among residents and companies in Stockholm. However, the City can support national efforts, for example through procurement requirements and information for residents. Investments in electric power can also be promoted by the City by facilitating the expansion of charging infrastructure on both streets and city blocks.

Fuels and vehicles – measures 2020–2023

In the short term, during the 2020–2023 programme period, the City shall implement the following measures:

Measures in the field of fuels and vehicles 2020–2023	Reduction in tonnes CO ₂ e	Responsible for implementation and follow-up
Promote an increased reduction obligation (fuels) for road traffic vehicles	42,000	City Executive Board with the support of the Environment and Health Committee
Conduct ethanol refuelling campaign	23,000	Environment and Health Committee
Promote subsidies for conversion of petrol cars to ethanol power	55,000	City Executive Board with the support of the Environment and Health Committee.
Increased electrification according to Scenario High (Scenario Low saves 7,000 tonnes)	16,000	Environment and Health Committee with the support of the Transport Committee and Stockholms Stads Parkerings AB
Increased proportion of renewable fuels	18,000	City Executive Board with the support of the Environment and Health Committee.
Require climate-efficient heavy transport in procurement	8,000	City Development Committee (4,000 tonnes) Service Committee (1,000 tonnes) Transport Committee (3,000 tonnes)
Promote the environmental differentiation of the congestion tax	24,000 (not included in the total due to duplication*)	City Executive Board with the support of the Transport Committee and the Environment and Health Committee
Total (taking duplication into account)	162,000	

The committee with primary responsibility is marked in bold.

*The environmentally differentiated congestion tax measure stimulates the increased use of vehicles powered by renewable fuels and electricity, i.e. the measures increased electrification and increased share of renewable fuels. In order to avoid duplication, the reduction of greenhouse gases is calculated only for these two measures.

Conclusions for road transport – fossil freedom requires collaboration between the city, state and EU

The city can slow down some of the traffic growth through balanced urban planning with target points within walking distance of public transport hubs or cycling distance from housing and investments in new mobility areas. In order to achieve fossil freedom, a transition to fossil-free fuels is also required. This transition requires collaboration at both national and European levels. The City should step up efforts to influence national and European decisions towards fossil freedom.

With a clear objective as a policy instrument and an action plan adopted in 2020 for a successful and powerful electric car introduction by 2030, governance can have a sufficient impact on emissions even during this programme period.

Measures aimed at the whole of Sweden are very effective, but this requires that the state acts and the City has no immediate control. The City, through the City Executive Board with the support of the Environment and Health Committee, should lobby the government, preferably together with SKR (Swedish Association of Local Authorities and Regions) and other municipalities in order for government instruments to be developed and any obstructive laws changed so that Sweden can achieve a fossil-free vehicle fleet. This includes:

- the formulation of the reduction obligation after 2021
- environmentally differentiated congestion tax

The City of Stockholm, through the City Executive Board and with the support of the Environment and Health Committee, also needs to participate actively in the EU work. Above all, it is a question of driving advocacy work regarding the work of the European Commission and

the European Parliament, where the government's capacity to influence is small. This should be done both through Eurocities and with its own resources, but also with other ambitious cities and regions that are active in Brussels.

Remaining emissions after 2023

Action plan for traffic 2030

Many of the measures in the action plan concern regulatory changes in the area of traffic and most of these measures are outside the City's control. The City Executive Board, supported by the Transport Committee and the Environment and Health Committee, shall, according to the City Council's budget for 2020, produce an action plan for reducing carbon dioxide emissions for road traffic by 2030. It shall describe how the City shall contribute to the national climate goal for transport of achieving at least a 70 per cent reduction in greenhouse gas emissions from domestic transport (excluding aviation) by 2030, compared to 2010. During the programme period, additional measures to reduce greenhouse gas emissions by 80,000 tonnes need to be implemented by 2023. It is these 80,000 tonnes that the action plan needs to address by 2023 and is a first step towards the national 2030 goal.

Given the need for an in-depth action plan that steers towards and takes into account a stronger electric car introduction to be produced in 2020, which will affect the figures, a final level for 2023 cannot be included in this plan. However, if all the measures described can be implemented and have the intended effect, despite the fact that in several cases national decisions are required, and traffic increases continue at the same rate as in the 10 years before 2018, when they stopped, a net reduction in emissions of 208,900 tonnes is achieved.

Remaining emissions in 2023	Tonnes CO ₂ e
Emissions 2019	863,000
Traffic reduction measures 2020–2023	-7,000
Fuel replacement measures 2020–2023	-162,000
Sub total	694,000
Action plan for traffic by 2030 (measures 2020–2023)	-79,900
Traffic increase 2020–2023	+40,000
Emissions 2023	654,100
Net reduction	208,900

Work machines

Here, work machines refers to machines used in the construction of infrastructure and buildings, street and park work and, for example, snow removal. Work machines produced greenhouse gas emissions of approximately 100,000 tonnes of CO₂e in 2017. This represents just under five per cent of total emissions in the city's geographical area.

Work machines – background

Work machines are powered almost exclusively by diesel that is subject to a reduction obligation, i.e. that fuel suppliers have to mix in sufficient renewable diesel that the total reduction is 20 per cent (in 2019) compared to fossil diesel. In 2020, this obligation is increased to 21 per cent. The reduction obligation is counted at national level and suppliers have chosen to blend a higher proportion in Stockholm and less in other parts of the country. The reduction in Stockholm diesel was therefore approximately 24 per cent in 2017.

Increasing volume of biofuel through procurement requirements

The City of Stockholm sets environmental requirements in the procurement of contracts (street works and civil engineering works) according to *Common environmental requirements for contracts*²⁴ which have been applied since the end of August 2012 and which have been updated in 2018. The requirements mean that at least 20 per cent of the total energy

²⁴ Common environmental requirements for contracts, a collaboration between the City of Stockholm, the City of Gothenburg, the City of Malmö and the Swedish Transport Administration.

consumption, in respect of vehicles and work machines, shall consist of electricity from renewable energy sources and/or sustainable high-blend and sustainable pure biofuels in addition to the current reduction obligation.

The use of work machines is expected to remain relatively unchanged in the Stockholm geographical area for a long time to come.

Work machines – the road to 2040

In order for the city to achieve the goal of fossil freedom for work machines by 2040, all work machines must be powered by renewable fuels. This can be achieved by starting the following processes:

- the City works to increase the reduction obligation for fuels
Responsible: City Executive Board with the support of the Environment and Health Committee
- the City imposes further stricter requirements in the procurement of contracts for renewable fuels in work machines
Responsible: City Development Committee together with other relevant committees and companies
- the City imposes requirements for land designation and agreement on the development of renewable fuels in work machines
Responsible: City Development Committee
- the City promotes technology conversion and initiates pilot projects to test new and untested technology
Responsible: City Development Committee

Work machines – measures 2020–2023

During the 2020–2023 programme period, the City can further tighten the requirements, in addition to those resulting from the agreement on common environmental requirements, for the procurement of contracts, street works and machines used in park management and snow removal. This could reduce emissions by twice as much as the national agreement. The City can also work to increase the reduction obligation for all diesel. This would reduce emissions from both work machines and road traffic vehicles. The assessment is that an increased reduction obligation can reduce emissions from work machines by 20,000 tonnes of CO₂e by 2024. See also under section “Increased reduction obligation reduces emissions from diesel vehicles.”

Measures 2020–2023 for work machines	Reduction in tonnes CO ₂ e	Responsible for implementation and follow-up
Increased proportion of renewable fuels in work machines through increased reduction obligation	20,000	City Executive Board with the support of the Environment and Health Committee
Climate-efficient contracts through procurement requirements	10,000	City Development Committee , Transport Committee, Svenska Bostäder, Familjebostäder, Stockholmshem, SISAB – Skolfastigheter i Stockholm AB and Micasa Fastigheter i Stockholm AB
Total	30,000	

The committee with primary responsibility is marked in bold.

Conclusions work machines

By 2024, greenhouse gas emissions from work machines are estimated to be 70,000 tonnes of CO₂e. Measures that could further reduce emissions include continuing to increase reduction obligations, further stricter requirements for City procurement, as well as the introduction of requirements for work machines and transport in connection with land designation and agreement on development on the City’s land. In order to facilitate the follow-up of requirements, a register of work machines would be an important instrument. Given today’s

machines and fuels, requirements for work machines and transport with land designation and agreement on development are expected to reduce emissions by approximately 30,000 tonnes of CO₂e over a programme period of four years.

	Tonnes CO ₂ e
Emissions 2017	100,000
Measures 2020–2023	-30,000
Emissions 2023	70,000

Shipping

Emissions from ship traffic represent 4 per cent of total emissions, or about 80,000 tonnes of CO₂e in 2018. Emissions come from traffic on the shipping lanes and that ships need to have engines running at the quayside so as to get electricity and heat in the ships.

Shipping – background

Most of the traffic in Stockholm consists of regular Baltic Sea traffic to Finland and the Baltic states. In addition to the ferry terminals, freight handling takes place at the container port in Värtan, the oil port in Loudden and at the energy ports of the combined heat and power plants.

Shipping – the road to 2040

In order for the city to achieve the goal of fossil freedom for shipping by 2040, all ships must be powered by renewable fuels within the city’s geographical area. When ships are at the quayside, they should be connected to electricity from land or district heating in the case of heating in winter. This can be done with the following measures:

- the City applies stricter differentiation of port charges that benefit ships with renewable fuels
Responsible: Stockholms Hamn AB
- the City builds electrical connections at all port locations
Responsible: Stockholms Hamn AB in collaboration with other Baltic Sea ports and shipping companies, as well as network owners
- the City builds connections to district heating at port locations used in winter
Responsible: Stockholms Hamn AB in collaboration with Stockholms Exergi AB and shipping companies
- the City works to ensure that archipelago traffic and other local maritime traffic is powered by renewable fuels
Responsible: City Executive Board with the support of the Environment and Health Committee

Shipping – measures 2020–2023

The container port in Värtan and the oil port of Loudden shall eventually be decommissioned. Traffic will be moved to other ports outside the city, including to Norvik harbour in Nynäshamn, which will be operational in 2020. In terms of calculation, greenhouse gas emissions in Stockholm will thus decrease by approximately 5,000 tonnes per year (but in practice emissions are moved to Nynäshamn).

Currently, one passenger ferry is powered by LNG²⁵. Within a few years, another ferry will be powered by LNG. These ferries can also be powered by liquid biogas if this is produced in sufficient quantities. At Stadsgården, Viking ferries are already connected to electricity. In 2019, four vessels (Tallink-Silja) will have an electricity connection in Värtahamnen.

In the archipelago traffic operated by the Transport Administration, increased use of HVO is planned. According to plan, 90 per cent of vessels will run on HVO by 2021. In a pilot carried out in cooperation between the Transport Administration and Stockholm Exergi,

²⁵ LNG (Liquid Natural Gas) produces lower emissions of greenhouse gases compared to oil.

a ship will be connected to district heating. If the experiment goes well, more vessels will be connected in the longer term.

During the period 2019–2023, maritime transport measures as a whole are expected to reduce greenhouse gas emissions by 18,000 tonnes of CO₂e per year in the Stockholm’s geographical area. However, it should be noted that of this, 5,000 tonnes of CO₂e is only due to the fact that traffic has moved beyond the geographical boundary of the city and therefore does not reduce emissions globally.

Measures 2020–2023 for shipping	Reduction in tonnes CO ₂ e	Responsible for implementation and follow-up
Electrification of ships at the quayside	8,000	Stockholms Hamn AB
Increased use of HVO in the archipelago fleet and connection of an archipelago ship to the district heating system (Transport Administration Region Stockholm)	5,000	City Executive Board with the support of the Environment and Health Committee
Total	13,000	

The committee with primary responsibility is marked in bold.

Remaining emissions from shipping 2024–2040

By 2024, emissions of approximately 70,000 tonnes of CO₂e are estimated to come from shipping. Measures to reduce these emissions may include electricity connections for further regular ferries and connecting the archipelago ships to district heating. District heating connection of ferry traffic is likely to be considered only if district heating is also available in the other Baltic Sea ports where the ships call. Other measures include increasing the amount of renewable fuels in shipping, shipping companies investing in technological development in battery operation and fuel cells and in the longer term connecting cruise ships to electricity at the quayside.

Aviation at Bromma Airport

Emissions from aviation according to the city’s calculation method represent one per cent of total emissions, or approximately 20,000 tons of CO₂e in 2018. The city’s system limits for climate calculations include emissions from take-offs and landings at Bromma Airport. The airport mainly handles domestic and business aviation.

The city’s direct control over the aviation sector is small. The agreement between the state-owned Swedavia and the City of Stockholm expires in 2038. What will happen thereafter is being investigated both nationally and regionally.

The aviation industry globally aims to improve energy efficiency by two per cent per year. Since last year, Bromma Airport has been used by an increasing number of new aircraft which use approximately 25 per cent less energy than older aircraft. Work is also underway to use more renewable aviation fuel. The *Roadmap for fossil-free competitiveness – The aviation industry* has a goal that all domestic flights shall be fossil-free by 2030. At present, the use of renewable fuels is limited to 50 per cent due to certifications of engines and fuels. Technically, emissions could therefore be halved during the programme period. High costs and a lack of suitable biofuels are obstacles that must first be overcome.

4. Measures for energy use for heating and cooling in buildings

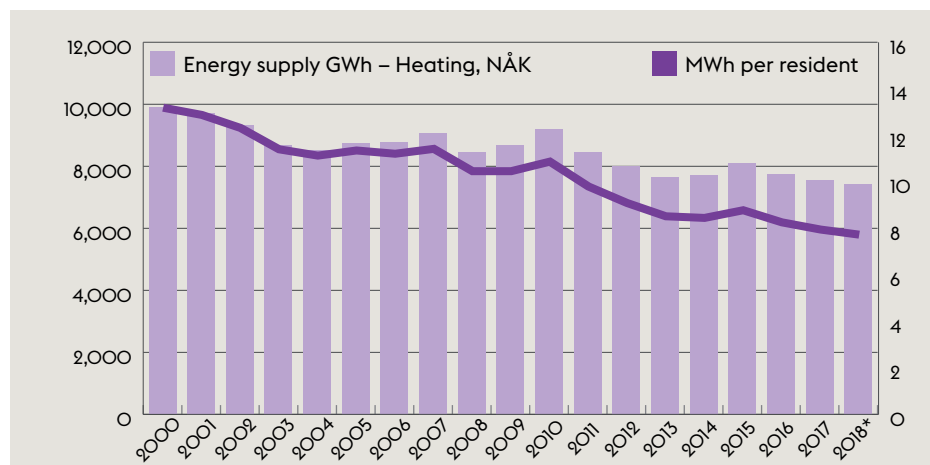
This section covers energy use in buildings and commercial activities and contains subsections on energy efficiency in buildings, heating (district heating and oil-fired heating) and cooling.

In 2018, heating and comfort cooling in buildings accounted for more than 30 per cent of total greenhouse gas emissions within the City of Stockholm's geographical boundary. In terms of tonnes, this meant 684,000 tonnes of CO₂e. Since 2000, when emissions from the buildings sector were 1,848,000 tonnes, emissions have fallen by around 60 per cent.

Energy use in buildings – introduction

The decrease is mainly due to the fact that oil boilers have been replaced with district heating in apartment buildings and other large buildings, as well as an increased proportion of renewable fuels in district heating. In private houses, oil burning has been largely replaced by various forms of heat pumps. The reduction in greenhouse gas emissions is also due to energy efficiency improvements in heating systems and buildings. Between 2000 and 2018, the energy supply used for heating has decreased from approximately 9,900 GWh to approximately 7,400 GWh – a decrease of 25 per cent. However, energy drawn from the bedrock and the air with heat pumps must be added to this. For 2018, this energy is estimated to be approximately 700 GWh. Since 2000, the use of heat pumps has increased significantly, mainly in private houses.

Figure 4.1 Total energy supply used in the heating sector in Stockholm. District heating approximately 6,200 GWh, electricity approximately 900 GWh and oil approximately 300 GWh. Energy consumption per resident of Stockholm for heating, NÅK = normal year adjusted values, *partly based on forecast figures. Geoenery and heat from the air to heat pumps are not included. For 2018, this energy is estimated to amount to approximately 700 GWh.



The energy demand for heating and cooling in buildings is expected to remain fairly unchanged for a long time to come. New building increases energy use to a similar extent to the existing buildings being made more energy efficient. For this to happen, all new buildings must comply with the same energy requirements as the City of Stockholm imposes for building on the City's land (55 kWh per m² or less) and that existing buildings are continuously made more energy efficient. Energy for cooling is expected to increase as extended periods of heat waves may become more common.

Energy efficiency in buildings – background

As district heating and electricity become increasingly fossil-free, the climate effects of increasing energy efficiency decrease. But continuing to improve energy efficiency is important, not only from a climate point of view, but above all from a resource management perspective. The same types of energy as are used to replace fossil fuels in buildings – biofuels and electricity – will also be sufficient to change fuel use in road transport, aviation and shipping. Also, the use of bio-based raw materials for building materials, replacing plastics etc., is increasing. Energy efficiency improvements are also in line with the Swedish energy efficiency goal²⁶. The City needs to continue to drive energy-efficient new production and ensure that new production complies with the defined energy requirements. Energy efficiency improvements also lead to reduced operating costs for property owners.

Since 2012, the city has had a requirement for a maximum of 55 kWh per m² Atemp²⁷ for new buildings on the City's²⁸ land, with a view to 45 kWh/m². This means that the energy demand will be about 30 per cent lower than the Swedish National Board of Housing, Building and Planning's building regulations (BBR). Despite high ambitions, the building industry has great difficulty in achieving the energy requirements that are set. The City therefore needs to increase its collaboration with the industry in order to develop procedures in production, follow-up and feedback in order to meet the defined requirements.

Within the existing building stock, energy efficiency improvements are continuously carried out. But for several reasons to a lesser extent than could be possible. The reasons include lack of knowledge, low or non-existent profitability, other priorities etc. Through energy and climate advice, the City can provide impartial advice to assist property owners. So far, unfortunately, it has been shown that advice does not lead to measures, other than to a modest extent.

In the City's companies and departments, approximately 1,200 GWh of heat and approximately 700 GWh of electricity were used in 2018. Total energy consumption has decreased by 7 per cent since 2011. Due to redistribution the companies' assignments, with increased investments in new production, funds for maintenance and energy measures in the existing buildings have decreased.

The milestone for energy consumption for the 2020–2023 programme period represents a 5 per cent lower relative energy consumption in the City's operations.

Energy efficiency – the road to 2040

Continued energy efficiency improvements in the property portfolio by 2040 will be needed from a resource management perspective. New control and adjustment technologies are continuously being developed to optimise buildings' energy systems in line with increased digitalisation. In connection with major renovations and rebuilds of older buildings, more extensive energy efficiency improvements can also be carried out. The following work can be performed by Stockholms Stadshus AB and the Real Estate Committee:

- continuous optimisation of buildings' energy systems
- energy efficiency improvements of buildings during major renovations and rebuilds

²⁶ By 2030, Sweden shall have 50 per cent more efficient energy use compared to 2005. The goal is expressed in terms of energy added in relation to GDP.

²⁷ Atemp is the internal area of the floors, attic and basement levels that are heated to more than 10°C in the building.

²⁸ The requirement is defined in the City's budget for 2013.

Energy efficiency – measures 2020–2023

The city’s five property companies AB Familjebostäder, Micasa Fastigheter i Stockholm AB, SISAB – Skolfastigheter i Stockholm AB, AB Stockholmshem and AB Svenska Bostäder, as well as the Real Estate Committee and the Sports Committee are actively working to improve the energy efficiency of buildings during the programme period 2020–2023. In large-scale rebuilding work, the goal shall be to reduce the purchased energy for heating, cooling, property electricity and hot tap water by at least 30 per cent. During the programme period, pilot projects are also being conducted that achieve 10 per cent energy efficiency improvement in existing properties that are not being rebuilt by developing new innovative methods and ways of working, with a view in the long term to developing methods, technologies and ways of working to enable more comprehensive measures.

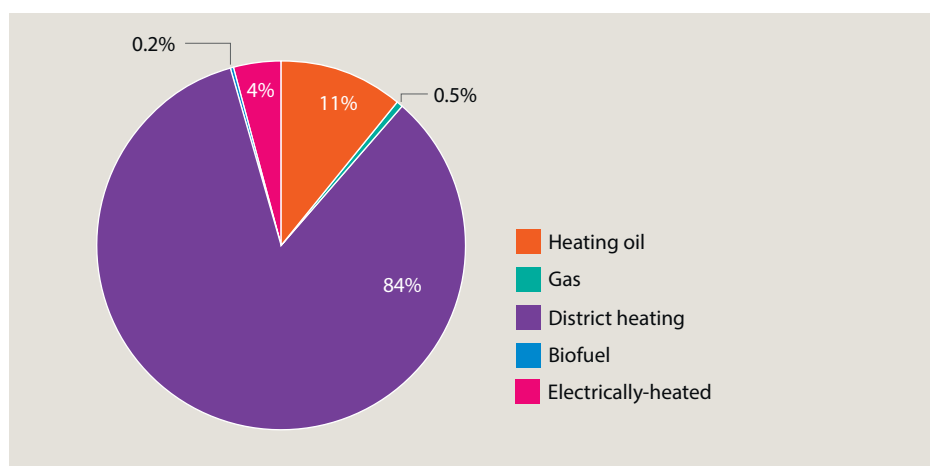
Measures 2020–2023 for energy efficiency in buildings	Reduction in tonnes CO ₂ e	Responsible for implementation and follow-up
Requirement for 55 kWh per m ² Atemp for land designation and agreements for development on land owned by the City, with a view to 45 kWh/m ²	7,500	City Development Committee
The City’s energy advice to private property owners	marginal	Environment and Health Committee
Energy efficiency enhancement in the City’s operations	9,000	Svenska Bostäder, Familjebostäder, Stockholmshem, SISAB – Skolfastigheter i Stockholm AB, Micasa Fastigheter i Stockholm AB and the Real Estate Committee and the Sports Committee
Total	16,500	

The committee with primary responsibility is marked in bold.

Heating – background

In the city of Stockholm, heating is mainly by district heating and various types of heat pumps. Oil burning only occurs in just over a thousand buildings, but still generates about 11 per cent of greenhouse gas emissions.

Figure 4.2 Distribution of greenhouse gas emissions (%) from the heating sector in 2018. Note that there is uncertainty regarding oil usage.

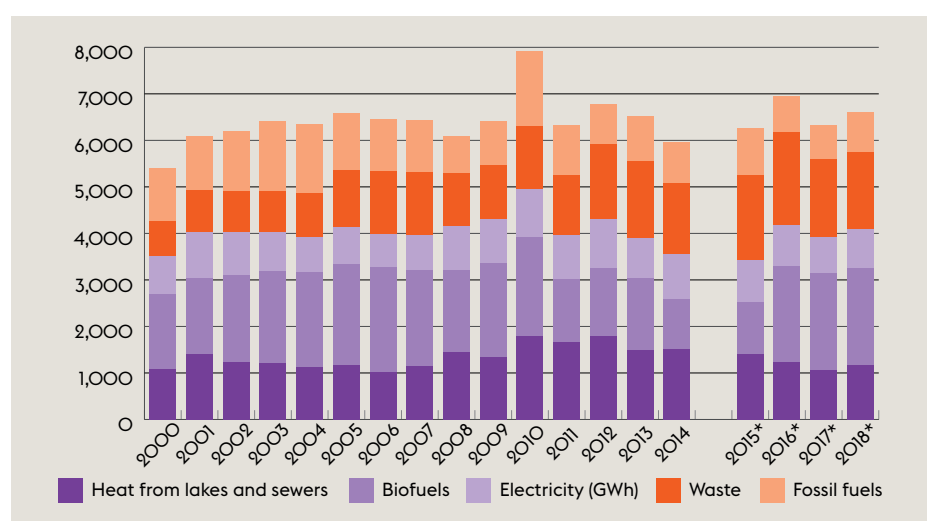


District heating

More than eighty percent of all buildings in the city of Stockholm are connected to the district heating system. District heating is mainly produced at four plants within the city's geographical boundary: Värtan, Högdalen, Hässelby and Hammarby. Stockholm Exergi's integrated system also includes Bristaverket in Märsta. In addition to these main plants, there are smaller plants in the system that add energy, especially during extremely cold days. In order to achieve high efficiency and flexibility, there is also collaboration with district heating systems in the neighbouring municipalities around Stockholm.

Since 2001, Stockholm Exergi (formerly Fortum Värme) has delivered more than 6,000 GWh of district heating per year within the geographical area of the city of Stockholm. The variations between the years are mainly due to weather conditions. Stockholm Exergi's forecast is a slight decrease in district heating demand in the future.

Figure 4.3 Fuels and energies (not normal year corrected values) used in district heating systems for production plant within the geographical boundary of the city of Stockholm 2000–2014, *2015–2018 refers to production installations for Stockholm Exergi's regional district heating network.



Oil burning in buildings

A small number of apartment buildings have oil boilers that account for the building's entire heating needs. In other apartment buildings, which have geothermal heating, there is in some cases an oil boiler that is used only on cold days when the capacity of the heat pump is insufficient. Stockholm Exergi estimates that there are few oil boilers left in the district heating network's coverage area.

Of the approximately 45,000 private houses in the city of Stockholm, about a third are heated with geothermal heating, a third with electricity and air heat pump and a third with electricity alone. Oil burning is estimated to be found in about 700 private houses. As the houses change ownership or the oil boiler wears out, the heating is usually replaced by geothermal heating. A conversion costs about SEK 200,000.

Cooling

There is a need for cooling both for comfort cooling and for various processes. Comfort cooling refers to cooling buildings to provide a comfortable indoor climate. Today it occurs almost exclusively in offices and commercial premises. With an increasingly warmer climate, however, we can expect that comfort cooling may also be in demand in homes, retirement homes etc. Process cooling is used, among other things, for cooling in data centres, in food processing and for ice rinks at sports facilities.

Cooling can be obtained in two different ways: as so-called free cooling, which means cooling from cold water or cool air, or by producing refrigeration with electric chillers. In buildings, the need for comfort cooling can also be reduced by means of sun shielding. Cooling is produced centrally at Stockholm Exergi's facilities and distributed through the local cooling network and also locally in buildings with different types of cooling equipment. Stockholm Exergi delivered 470 GWh of cooling in 2018, which it is estimated to cover half of the cooling requirements of the city.

Since cooling in practice means that heat is removed, cooling systems can be integrated with heating systems and thus save energy. With the development of low-temperature district heating, district cooling and energy-efficient buildings, very energy-efficient systems can be created in entire districts.

Given a warmer climate, more data centres, etc., it is likely that demand for cooling will increase in the future. Therefore, in order to meet the future cooling demand, it is very probable that electricity used for refrigeration will increase.

Heating – the road to 2040

In order for the city to become fossil-free by 2040, the fossil fuels used in district heating must be replaced by other fuels. The fossil fuels are coal, which is mainly used at the KVV6 combined heat and power plant in Värtan, and fossil oil which is used to a limited extent in various plants. Various types of materials of fossil origin, such as plastics in combustible waste at Högdalen and Brista, are also incinerated. Oil burning in individual properties needs to be converted to other heating. Fossil freedom by 2040 can be achieved with the following measures:

- fossil oil and coal are phased out from Stockholm Exergi's district heating plants
Responsible: Stockholm Exergi AB
- Stockholm Exergi sets requirements in the procurement of biofuels. Requirements are set for biofuels that provide low climate impact (LCA) in production
Responsible: Stockholm Exergi AB
- the City works to ensure that fossil oil is phased out from heating plants in buildings²⁹
Responsible: Environment and Health Committee through supervision and energy advice
- the City sets procurement requirements for renewable and recyclable plastic
Responsible: Service Committee
- the City works to ensure that plastics of fossil origin are not put on the market
Responsible: City Executive Board with the support of the Environment and Health Committee

District heating – measures for the period 2020–2023

Over the next few years, significant measures will be taken by Stockholm Exergi to reduce greenhouse gas emissions. The measures include stopping the use of the coal-fired combined heat and power plant in Värtan, phasing out the burning of fossil oil and reducing the amount of plastic in waste incineration. At the waste facility in Högdalen, there is a collaboration with Stockholm Vatten och Avfall AB (SVOA) with the construction of a waste sorting facility.

²⁹ According to the budget decision 2019, oil in buildings in Stockholm shall be phased out by 2025 at the latest.

Measures in district heating 2020–2023	Reduction in tonnes CO ₂ e	Responsible for implementation and follow-up
The coal-fired combined heat and power plant (KVV6) in Värtan is to be closed in 2020. In order for the plant to be closed, a number of measures are being taken within Stockholm Exergi's district heating network, such as Open District Heating ³⁰	105,000	Stockholm Exergi
Plastic sorting plant in Brista will be operational in 2023	13,000	Stockholm Exergi
Plastic sorting plant in Högdalen will be operational in 2023	13,000	Stockholm Vatten och Avfall AB
Total	131,000	

The committee with primary responsibility is marked in bold.

When sorting waste in Brista and Högdalen, plastic and food waste will be separated from other waste. In this way, recycling of plastics can increase and food waste can be used for biogas production. The sorting out of plastic reduces the amount of plastic in waste incineration, which leads to a reduction in greenhouse gas emissions. However, there is a great deal of uncertainty as to what can happen to that part of the sorted-out plastic that cannot be recycled. The reason why certain plastics cannot be recycled is usually that the plastic contains toxic substances or other substances that cannot be identified. The alternative to incineration of this type of plastic is landfill, but that could well be worse than burning the plastic under controlled conditions in the combined heat and power plants.

An important prerequisite for achieving climate and environmental goals is that there is a transition in the market from plastic production with fossil raw materials to recyclable plastic products. The City can be active in this direction by setting requirements when procuring plastic products.

Remaining greenhouse gas emissions from district heating 2024	Tonnes CO ₂ e
Waste incineration and recycled fuels. A great deal of plastic is estimated to remain in waste and recycled fuels since the sorting plants in Högdalen and Brista will not handle the entire amount collected.	265,000
Solid biofuels. Emissions are mainly due to the use of fossil fuels in forestry machinery. As alternative fuels become increasingly used in forestry in Sweden and other countries, these emissions are reduced.	25,000
Bio-oils. Emissions derive from the production of bio-oils in the same way as solid biofuels.	16,000
Electricity for heat pumps and operation of plants. Emissions are calculated on the basis of Nordic electricity and derive from how the production of electricity takes place within the countries that are part of Nordic electricity. These emissions will decrease at the same rate as Nordic electricity is produced with more renewable energy.	52,000
Fossil oil. The oil is used to obtain the correct temperature for waste incineration and for the start-up of bio-fired combined heat and power plants.	8,000
Total	366,000

In 2024, a new combined heat and power plant is planned to be put into operation in Lövsta. At that time the Hässelby plant will be closed and demolished to make room for housing. The plant in Lövsta is a prerequisite to enable the coal-fired combined heat and power plant KVV6 in Värtan to be completely closed.

³⁰ Open District Heating means that district heating customers can supply excess heat back to the district heating system.

The biggest challenge in district heating and waste management is the management of plastics of fossil origin. Even if the market for new plastic production is converted, large quantities of old plastic will remain that will gradually become waste. The City needs to follow developments closely. There is a risk that the plastic waste will be sold and then only partially recycled. The rest is burned or sent for landfill, which is probably worse than if the plastic had been burned in the City's technologically advanced facilities.

The *Roadmap for Fossil-Free Competitiveness – The food industry* has goals for all plastic food packaging to be recyclable by 2022. The industry plans to introduce differentiated packaging charges so that non-recyclable packaging will cost more than recyclable. A longer-term goal is for all food packaging to be produced from renewable or recycled materials by 2030.

Oil burning – measures 2020–2023

It is difficult to estimate how much oil burning could be phased out in the period 2020–2023, as it is unclear how much oil is used for heating. Statistics from Statistics Sweden (SCB) on oil use have probably registered oil in the municipality of Stockholm, but which has been delivered outside the municipality. This also makes it difficult to assess the extent of emissions remaining in 2024. It is estimated to amount to approximately 60,000 tonnes of CO₂e.

Oil use for heating is estimated to be a total of 247 GWh (see table below).

Operation	GWh	Tonnes CO ₂ e
Housing	17	5,000
Industry and building	11	3,000
Public activities	79	23,000
Other services	140	40,000
Total	247	71,000

Preliminary breakdown of oil use in the City of Stockholm 2017 according to statistics from Statistics Sweden. The climate impact is calculated by the Environmental and Health Department on the assumption that the oil is combusted.

In 2018, there was oil burning equivalent to 2 GWh within the City's organisation.

Through energy advice and supervision according to the Environmental Code, the City can accelerate the phasing out of oil boilers. In apartment buildings where the oil boiler is used as peak demand heating to supplement geothermal heating, the oil boiler can be replaced with an electric boiler, or alternatively the heat pump can be changed to one of higher capacity.

Measures in oil burning in buildings 2020–2023	Reduction in tonnes CO ₂ e	Responsible for implementation and follow-up
The City phases out all oil burning in its own buildings	628	SISAB – Skolfastigheter i Stockholm AB , Stockholm Vatten och Avfall AB, Micasa Fastigheter i Stockholm AB, Cemeteries Committee and Real Estate Committee
The City performs supervision and gives energy advice to property owners who have buildings with oil burning	9,000	Environment and Health Committee
Total	9,628	

The committee with primary responsibility is marked in bold.

5. Measures in electricity generation and use

Electricity is used in all sectors. This section deals with all electricity used in households and activities of various kinds. That is to say, all electricity that does not go to transport or heating. Electricity for road vehicles, trains and trams is dealt with in the Transport section. Electricity for heating and comfort cooling in buildings is covered in the section on Energy for heating and cooling in buildings.

Emissions from electricity use were approximately 400,000 tonnes in 2018, calculated on the basis that all electricity was produced according to the Nordic electricity mix. The Nordic electricity mix refers to calculation of the total greenhouse gas emissions that occur during electricity generation in Denmark, Finland, Norway and Sweden. Due to weather conditions, auditing of nuclear power plants etc., the emission factor for electricity varies greatly from year to year.

Annual and five-year averages for the emission factor for the Nordic electricity mix (grams of CO₂e per kWh of electricity) for 2011–2017. The emission factors are calculated by the City of Stockholm's Environment and Health Department.

Year	2011	2012	2013	2014	2015	2016	2017
Annual value	80.6	50.0	70.5	73.2	58.0	62.9	55.6
Five-year average	89.7	83.3	85.3	81.0	66.5	62.9	64.0

The Nordic countries have high ambitions to achieve zero net greenhouse gas emissions within the coming decades. This means that great efforts are being made to switch electricity generation to only use renewable energy. During the programme period, lower emissions linked to electricity use in the city of Stockholm's geographical area are thus expected to lead to a decrease of 60,000 tonnes of CO₂e.

Electricity generation and use – background

Unchanged electricity use for many years

Since 2011, the emission factor has decreased on average by 3.5 grams of CO₂e per year. If this trend continues, as several reports suggest, the emission factor for Nordic electricity will be close to zero around 2035.

Electricity use in Stockholm has remained largely constant for the past decade. Total electricity use per resident has decreased by 20 per cent and household electricity per resident has decreased by 15 per cent. This is mainly explained by the fact that industries have been removed from Stockholm and that new lighting and household appliances are much more energy efficient than older ones. Electricity use has gone up in services and offices.

However, it is unclear why.

Several of the measures describing how fossil energy can be phased out in the buildings and transport sectors involve converting to electricity as an energy carrier, such as the replacement of oil boilers in private houses with heat pumps, electric vehicles and electrical connections for ships at the quayside. As a result, total electricity consumption is likely to increase in the future.

Close to electricity shortage for a few hours a year

There is currently a limit on how much electricity can be fed into Stockholm. According to Svenska Kraftnät, which distributes electricity in Sweden's national grid, the input is limited to 1,525 MW. In addition to this electricity, Stockholm Exergi can deliver 320 MW. So far, this has been enough to supply the city with electricity at all hours of the day, all year round. However, during periods of severe cold, consumption of electricity has approached the maximum possible for a few hours in the afternoons. As the city grows and with the electrification of road vehicles, among other things, the risk of this happening on more occasions per year increases. However, there are different assessments of the risk of electricity shortages. New technology in the form of so-called Vehicle to Grid technology (V2G technology) is under testing around the world, where electric vehicles that are not being used or charged can supply the electricity system with electricity locally at peak times, which could serve as load balancing. This would allow the electrification of road vehicles to be a partial solution to the problems that they are feared to cause. Vehicle models adapted for this technology are available today on the Swedish market.

Charging electric vehicles should take place as far as possible at night. Fast charging of electric buses will require large amounts of electricity in a short time, which today's electricity grid is not designed for. Electrical connections for ships at the quayside also put a strain on capacity.

Work is ongoing in a collaboration between the City, Ellevio, Stockholm Exergi AB and Svenska Kraftnät to find solutions for future electrical power issues. Currently, what can be done to limit the power consumption of buildings and activities is being inventoried.

Electricity generation and use – the road to 2040

In Stockholm there are opportunities to produce electricity using solar panels on buildings. Estimates indicate that, from a technological potential, electricity could be produced equivalent to over 10 per cent of the city of Stockholm's electricity needs, which are currently about 700 GWh per year³¹.

A complement to installing solar panels could be that the City invests in buying electricity from wind turbines in the regional grid. Such plants are not built within the city's geographical boundary, but if they are established in the local region, they could help to strengthen electricity capacity. Svenska Kraftnät expects that there will be a shortage of transmission capacity from the national grid to the regional grid until the end of the 20s. Thereafter the input from Svenska Kraftnät to the regional grids in Greater Stockholm will be almost doubled. If wind power production is established within the regional grid, the need for power transfer from the national grid decreases while the share of renewable power increases. The investment in wind power can be done, for example, through the Power Purchase Agreement (PPA).

The business concept of the PPA means that an electricity company owns, builds, installs and manages the operation and the plant and that the counterparty, in this case the City, signs long-term contracts for the purchase of the electricity produced by the plant.

For example, if 10 per cent of the city's electricity use were to come from newly established wind power, instead of electricity from the Nordic electricity mix, it would reduce greenhouse gas emissions by about 3,400 tonnes of CO₂e per year. A rough estimate is that the price of electricity from wind power with PPA contracts is approximately equal to the price the city pays for electricity today, including today's additional cost for eco-labelled electricity.

³¹ The Strategy for a Fossil Fuel-Free Stockholm 2040 defines a measure for electricity generation: The City shall achieve its own electricity production based on solar electricity which represents 10 per cent of Stockholm's electricity use. The strategy was decided by the City Council on 28/11/2016.

Electricity generation and use – measures 2020–2023

The City can further expand its own electricity production with solar energy within the City's organisation. The goal for the programme period is that production of electricity and heat from solar energy will increase by 100 per cent compared to the corresponding production in 2018.

Measures for 2020–2023 in electricity generation and use	Emissions, tonnes CO ₂ e	Responsible for implementation and follow-up
Production of solar energy within the City's organisation	100	Stockholms Stadshus AB, Real Estate Committee and Sports Committee
Total	100	

The committee with primary responsibility is marked in bold.

6. Measures in gas production and use

The use of gas in the city can be divided into gas for buildings and activities, so-called city gas, and gas for vehicles and buses, so-called vehicle gas. Gas is also currently used on one ship (Viking Grace). The ship is powered by liquefied natural gas (LNG). This section deals only with city gas. Vehicle gas is dealt with in the subsection Road transport and gas for ships in the section Shipping.

Gas production and use – background

The use of city gas is low in the city and has decreased somewhat in recent years. The gas used in the city gas network is a mixture of natural gas and biogas mixed with air. The proportion of biogas was 69 per cent of the energy content in 2018. In the combustion of city gas, greenhouse gas emissions of approximately 4,000 tonnes of CO₂e occurred in 2018. This represented two parts per thousand of the city's total emissions. Leakage of methane gas from the pipe network resulted in emissions of approximately 30,000 tonnes of CO₂e. This leakage is not included in the City's greenhouse gas emission calculations, but produces significant emissions.

Gas production and use – the road to 2040

According to Gasnätet Stockholm AB, city gas will be completely replaced by biogas mixed with air by 2030.

Gas production and use – measures 2020–2023

At the district heating plant in Högdalen, organic material will be sorted out. The material will then be digested into biogas at a plant outside the city's geographical area. Similarly, organic matter will be sorted out and produce biogas at Brista. The biogas produced in these two plants does not affect emissions per se, but it is only when the consumption of biogas replaces a fossil fuel that emissions are reduced. The reduction in carbon dioxide emissions is calculated as the biogas that replaces diesel in road vehicles.

Measures for 2020–2023 in gas production and use	Emissions, tonnes CO ₂ e	Responsible for implementation and follow-up
Phasing out fossil gas in the city gas network	1,500	City Executive Board
Total	1,500	
Biogas production from Brista (outside the city's geographical area)*.	6,000	Stockholm Exergi AB
Sorting out of organic material in Högdalen (and biogas production outside the city's geographical area)*.	6,000	Stockholm Vatten och Avfall AB

The main board is highlighted in bold. *Biogas production from Brista and biogas production from substrates from Högdalen take place outside the city's geographical area and there is no guarantee that the gas will be used within the city. Therefore, they are not included in the calculation of Stockholm's greenhouse gas reductions.

The use of city gas is expected to remain at around today's level in the future. The trend is that gas stoves in households are becoming fewer and fewer while gas to restaurant kitchens increases.

In 2002, leakage of city gas from the network amounted to just over 60,000 tonnes of carbon dioxide equivalents. According to the conditions for the city gas network imposed by the Environmental Court and the Environmental Court of Appeal, leakage of gas from the city

gas network must have been reduced by successive measures by the end of 2022 to just over 22,000 tonnes of CO₂e. However, the leakage of methane gas is still many times greater than the carbon dioxide emissions from the combustion of gas. It is therefore important that work to prevent leakage of gas continues until leakage is zero or insignificant.

7. Climate-positive city by 2040

The goal for the City of Stockholm is to become a fossil-free city by 2040. According to the instruction in the City Council's Budget 2019, there shall be investigations of how the city can become climate positive by 2040. This means that, in the first place, greenhouse gas emissions shall be reduced by phasing out all fossil fuels. The goal is also that the City of Stockholm aims to become a climate-positive city by 2040.

Background

Measures to reduce greenhouse gas emissions can reduce the city's emissions to around 500,000 tonnes by 2040. The remaining emissions are estimated to come from international shipping, take-offs and landings at Bromma Airport, incineration of non-recyclable plastics and LCA additives in the production of biofuels. In order for the city to achieve zero net emissions or go even further and have negative emissions, known as climate positivity, carbon dioxide must be captured instead of released into the atmosphere. This can be done by carbon capture and storage (CCS or BECCS) or by the production of biochar.

Possible measures – CCS and BECCS

CCS (Carbon Capture and Storage) captures carbon dioxide produced in the combustion of fossil oil, fossil coal and natural gas. The captured carbon dioxide is then stored in geological formations underground. The use of this technology can reduce carbon dioxide emissions to zero, since no carbon dioxide is released into the atmosphere. Instead, the carbon dioxide is pumped into cavities in the bedrock beneath the sea. Due to the high pressure created in the cavities, carbon dioxide is considered to be able to remain for centuries. Due to relatively high costs, the technology applies only to larger plants such as combined heat and power plants, steel plants and refineries.

In the city of Stockholm, only the combined heat and power plants for district heating would be suitable for carbon capture, primarily the bio-fired plant KVV8 in Värtan and the planned plant in Lövsta. In the longer term, also the plant in Högdalen where waste and recycled fuels are used for combustion. Since the combined heat and power plants in Stockholm are not fired with fossil fuels, but mostly with biofuels, the capture and storage of carbon dioxide is called BECCS (Bioenergy Carbon Capture and Storage). Because it is carbon dioxide of biological origin, storage means reducing the amount of carbon in the natural cycle of coal and thus creating a so-called carbon sink. If the carbon sink is greater than greenhouse gas emissions of fossil origin, the city can be called climate positive.

The potential for capture of greenhouse gases from the combined heat and power plants is estimated by Stockholm Exergi at approximately 1,300,000 tonnes per year. The annual cost of capture, transport and storage of carbon dioxide is estimated at approximately SEK 1,000 per tonne. Depending on how Stockholm Exergi formulates the business concept for selling carbon offset district heating, the potential may be available to different buyers of Stockholm Exergi's district heating. As a result, carbon dioxide may be booked by other operators outside the city of Stockholm and thus not available for compensation of emissions within the city's geographical boundary. There is no business model for how a BECCS facility can be financed. Stockholm Exergi is currently investigating the matter.

International calculation protocols specify how cities shall calculate and report emissions of climate gases. There are currently no rules on how to calculate and report carbon capture and storage. In the present calculation methodology, the City of Stockholm's system limit is set to include only the use of fossil fuels. Thus, it is not self-evident that the city can offset emissions from the use of fossil fuels with the capture of carbon dioxide from the combustion of bioenergy.

Rules

The Environmental Code regulates waste management. When carbon dioxide is captured from flue gases, carbon dioxide is classified as waste. In order for it to be possible to store carbon dioxide for onward transport, the law needs to be reviewed. *Regulation (2014:21) on geological storage of carbon dioxide* regulates how transport and storage of carbon dioxide across borders shall be handled. A Bill *Safety in Geological Storage of Carbon Dioxide, Prop. 2018/19:64* has proposed legislative changes for carbon dioxide storage.

Measures – biochar

Biochar is produced by heating organic matter, such as branches and twigs or food waste, to between 300 and 1,000 degrees in a furnace that does not allow oxygen in (so-called pyrolysis or dry distillation). During the process, the material decomposes into various gases, tar and charcoal. The technique utilises the fact that plants store carbon via photosynthesis and that the carbon is accessed during dry distillation. The biochar can then be used to improve topsoils. Studies have shown that about 80 per cent of the carbon remains bound in the soil even after a hundred years.

Today there is a pilot plant to test the technology in the Recycling Centre (ÅVC) Trädgård in Högdalen. The experimental facility uses shredded garden waste to produce biochar, which is then used as a soil improver in the city's soils. About 1,300 tonnes of garden waste per year is turned into 300 tonnes of biochar. The heat generated, a total of about 1 GWh per year, is discharged into the district heating network. Biochar production thus helps to reduce other energy needs.

Stockholm Exergi is investigating the possibility of increasing the volume of biochar production, where 500,000 tonnes of biomass is converted annually into 10,000 tonnes of biochar. This corresponds to a total carbon dioxide reduction of 120,000 tonnes of CO₂e per year.

Stockholm – a climate-positive city by 2040

If BECCS and biochar production are realised on a larger scale, with negative emissions exceeding the 500,000 tonnes of carbon dioxide projected to remain in place by 2040, Stockholm could become a climate-positive city. The time at which the city can become climate positive depends partly on how quickly greenhouse gas emissions can be limited and partly on when the technical and economic conditions for the storage of carbon exist. The sooner this happens, the more the City of Stockholm will contribute to limiting global warming.

Some things about BECCS are still uncertain. Costs, rules and potential have not been fully investigated. However, there is much to suggest that the city can achieve zero net emissions, i.e. climate compensate the remaining emissions through BECCS and biochar. A trial plant is planned to be built at the bio-fired combined heat and power plant KVV8 in Värtan.

The City's long-term goal is to work for the city to be climate-positive by 2040. To achieve this, technology and business models need to be developed. The City cannot achieve such an ambitious goal by itself and we therefore need to join forces with the government and the EU.

8. Milestone 2030 for the City's own operations

The City of Stockholm's organisation shall be fossil-free by 2030 within the same system limits as the City's other emission goals. For the City taking the lead and becoming fossil-free as early as 2030, greenhouse gas emissions from energy use in the City's organisation need to be reduced at a faster rate than the corresponding emissions in the geographical city.

The City's own vehicle fleet today consists of environmental vehicles and a change to fossil-free vehicles is continuously carried out within the framework of the City's own vehicle purchasing. Climate requirements are set for purchased transport within the Service Administration's procurements. Purchasing of services where transport is included outside the Service Administration's procurements, for example for home care, work machines etc., needs to be examined in order for purchasing requirements to be imposed on these transports as well.

The City retains a few oil-fired boilers in some of the operations. These will be phased out during the programme period as part of the City's goal that all oil-fired boilers in Stockholm shall be decommissioned by 2025. The city gas that is used mainly by the Cemeteries Administration currently contains fossil natural gas. Otherwise, fossil fuel use for heating by district heating and electricity use follows the same decommissioning path as for the geographical city.

Estimated greenhouse gas emissions from the City's organisation in 2018 amounted to 149,000 tonnes of CO₂e from energy for heating, use of electricity and gas, as well as from the City's own and leased vehicles. By 2023, emissions are estimated to have fallen to 105,000 tonnes. During the programme period, all remaining oil-fired boilers for heating will have been phased out and by 2030 all City vehicles are expected to run on electricity and renewable fuels. After 2030, the remaining fossil fuels are estimated to consist of fossil plastics in district heating, remaining fossil gas in the gas mix and fossil fuel elements in Nordic electricity production.

The road to a fossil-free organisation by 2030

During the programme period and beyond, the City needs to run a large number of processes that lead to important decisions, with a view to achieving fossil freedom within the City's organisation by 2030. Areas and measures that the City needs to work on:

- all of the City's vehicles are environmental vehicles
Responsible: Environment and Health Committee
- 100 per cent refuelling of environmental fuels in vehicles
Responsible: Environment and Health Committee
- requirements for environmental vehicles and fuels in the procurement of services involving transport
Responsible: All procuring committees and company boards with the support of the Environment and Health Committee
- requirements for environmental fuels in the procurement of contracts
Responsible: City Development Committee, Transport Committee and other relevant committees and companies
- Identify which lease agreements within the City's committees and company boards are best suited to be green lease agreements and initiate pilot projects.
Responsible: Real Estate Committee

- Identify buildings with oil-fired heating that have special needs for investment in equipment to enable the phasing out of fossil oil, including in buildings rented exclusive of heating and hot water.
Responsible: Stockholm Stadshus AB, Real Estate Committee, Stockholm Vatten och Avfall AB
- Introduce a procedure to evaluate a transition to fossil-free oil or alternative heating for all buildings intended to be in operation for more than three years after the City acquired them
Responsible: Stockholm Stadshus AB and the Real Estate Committee
- Expand our own electricity or heat production based on solar energy and investigate the conditions for increasing the share of electricity from wind power.
Responsible: Stockholms Stadshus AB
- the city sets requirements for biogas in the procurement of gas in order to increase the share of biogas in the gas mix
Responsible: Stockholms Stadshus AB

The City's entire organisation needs to contribute

The City of Stockholm is a large organisation with over 40,000 employees, all of whom can help make a difference. The Climate Action Plan has clearly identified conditions. In addition to these conditions, there are further measures where the City's companies and administrations can contribute to achieving the City's goal of a fossil-free organisation by 2030 and a fossil-free Stockholm by 2040.

The main challenge is to reduce greenhouse gas emissions from procured transport services. By systematically identifying the procurements involving transport, such as the procurement of home care by the districts, requirements can begin to be made for climate-adapted transport. The operations' own transport can often be made more energy-efficient by moving to greater use of electric vehicles and bicycles.

In contract procurements involving work machines, for example in construction and snow removal, there are opportunities to require an increased proportion of biofuel and electrification. Climate requirements can also be imposed when procuring less energy-intensive contracts, for example for the management of parks and nature reserves. Electrified work tools for park management also help to reduce noise disturbance in disturbance-sensitive areas such as cemeteries.

Many employees in the City's organisation travel on business by air at some point. For travel within the country as well as to Copenhagen and Oslo, trains can usually be chosen instead of flights. Increased digitalisation opens up opportunities to replace travel-intensive physical meetings with meetings via digital media that also save time and travel costs.

The introduction of LED technology has enabled greatly reducing electricity used for lighting while creating better lighting environments with fewer lighting points. All operations in the City can review the possibility of switching to LED lighting in their own premises, but also ask landlords to switch to LED if the business is conducted in rented premises. In order to further reduce the use of electricity for lighting, motion detection control may be introduced where appropriate.

White goods and kitchen appliances can account for a high degree of energy use if old and outdated equipment is used. All operations can review the equipment used and replace with more energy-efficient equipment.

However, equipment shall not be replaced prematurely, so as to reduce the abstraction of natural resources and the occurrence of waste. All the City's operations can help reduce resource use by not replacing office equipment early and striving for reuse. The City's recycling service Stocket is available as a support where used office equipment can be left for reuse within the City.

Those of the city's property owners who still have oil boilers for heating buildings, including in buildings rented exclusive of heating and hot water, shall replace these boilers with alternative forms of heating such as district heating or geothermal heating by 2025.

The Service Committee can require a reduction in the amount of fossil plastic in central procurements.

The City's organisation can also take the lead in reducing the climate impact of consumption. In pre-schools, schools and care for the elderly, dietary planning tools can be introduced that calculate the climate impact so that meals are both nutritious and have a reduced climate and environmental impact.

The extensive new production of buildings and installations has a climate impact from the construction process and building materials. It has been shown to be about the same as the climate impact of energy use in the finished buildings over 50 years³². A couple of the City's own property owners are currently (2019) calculating climate impact from the construction stage. Once more data has been compiled, there is knowledge of how the Development Administration can make requirements in land tenure agreements based on climate calculations. In the long run, the City can set requirements for reduced climate impact when building on the City's land.

Energy efficiency in the city's existing building stock remains an important area for the City to work on, not least from a resource management perspective. Digitalisation opens up new possibilities for control and operational optimisation of the buildings' energy systems.

The City has set aside investment funds for climate improvement measures. The City's committees can apply for investment allocations for investments that will help achieve the City's goal of a fossil-free organisation by 2030 and a fossil-free Stockholm by 2040.

The Environment and Health Committee has specialist functions that can assist the City's other activities in achieving the goal of fossil freedom. Green Vehicles in Stockholm provides support in the area of transport and construction machinery. Energy centres help with energy efficiency.

In addition to the City's climate investment funds, there are various types of government project support such as Klimatklivet to apply for further development of the City's operations towards a fossil-free organisation.

³² When buildings are built according to the City's energy requirements of 55 kWh/m² Atemp per year. Erlandsson, M. et al. (2015) IVL B 2217 – The climate impact of construction — Life cycle calculation of climate impact and energy use for a newly produced energy-efficient concrete apartment building.

The table below compiles measures within the system limit for the City's greenhouse gas emission calculations, to be performed by its own organisation. The effect of the measures is included in the calculations in previous sections of the Action Plan and should not be added to them.

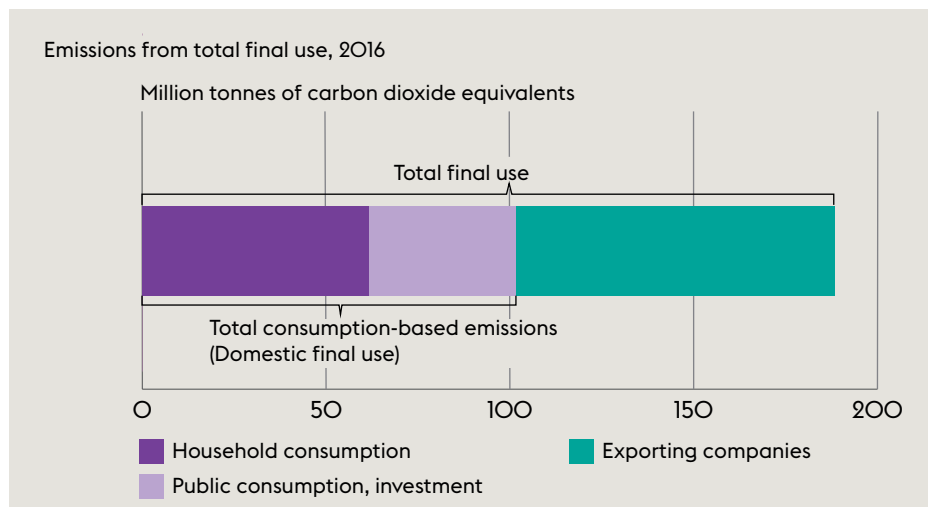
Measures for 2020–2023 within our own organisation	Emissions, tonnes CO ₂ e	Responsible for implementation and follow-up
Transport of excavated material by boat instead of truck	1,000	City Development Committee
Require climate-efficient heavy transport in procurement	8,000	City Development Committee, Service Committee, Transport Committee
Climate-efficient contracts through procurement requirements	10,000	City Development Committee, Transport Committee, Svenska Bostäder, Familjebostäder, Stockholmshem, SISAB – Skolfastigheter i Stockholm AB and Micasa Fastigheter i Stockholm AB,
Plastic sorting plant in Högdalen will be operational in 2023	13,000	Stockholm Vatten och Avfall AB
The City phases out all oil burning in its own buildings	628	Real Estate Administration, Cemeteries Administration, Micasa Fastigheter i Stockholm AB, SISAB – Skolfastigheter i Stockholm AB, Stockholm Vatten och Avfall AB
Reduced quantity of fossil plastics through procurement requirements	3,000	Service Committee
Energy efficiency enhancement in the City's operations	9,000	Svenska Bostäder, Familjebostäder, Stockholmshem, SISAB – Skolfastigheter i Stockholm AB, Micasa Fastigheter i Stockholm AB and the Real Estate Committee and the Sports Committee
Production of solar energy within the City's organisation	100	Stockholms Stadshus AB, Real Estate Administration, Sports Committee
Total	44,728	

9. Consumption-based greenhouse gas emissions

The City of Stockholm's greenhouse gas emissions calculations include energy use for heating/cooling, transport and emissions from the use of electricity and gas within the city's geographical boundary. This means that emissions that occur in the manufacture of goods outside the municipal border but that are consumed in Stockholm are not included in the calculations. The calculations also do not include emissions from travel outside the municipal border.

At a national level, Statistics Sweden calculates Sweden's greenhouse gas emissions from a consumption perspective on behalf of the Swedish Environmental Protection Agency. Calculations from a consumption perspective include national emissions excluding emissions from national production for export. Emissions from the manufacture of goods imported into Sweden are included in the calculations. The principle of calculation from a consumption perspective is set out in Figure 9.1.

Figure 9.1 Principle for calculating greenhouse gas emissions from a consumption perspective.

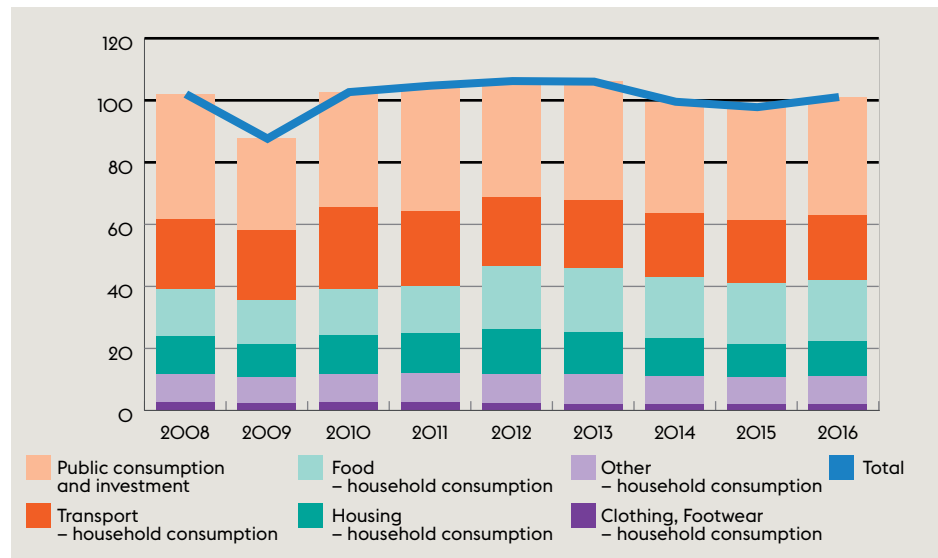


Source: Swedish Environmental Protection Agency/SCB

Greenhouse gas emissions calculated according to the Climate Convention and from a consumption perspective

Greenhouse gas emissions in Sweden were estimated at around 10 tonnes per inhabitant from a consumption perspective in 2016. About 60 per cent of these emissions occur abroad³³. By comparison, Sweden's reported emissions under the Climate Convention were 5.2 tonnes per inhabitant in 2017. Figure 9.2 shows that public consumption and investment account for a large proportion, almost 40 per cent, of consumption-based emissions.

Figure 9.2 Greenhouse gas emissions per area from a consumption perspective.



The Climate Convention – UNFCCC-United Nations Framework Convention on Climate Change
Source: Swedish Environmental Protection Agency

At regional and municipal level, there are no statistics to calculate and monitor the climate impact of consumption. The possibility of further developing the statistics is only expected in the longer term³⁴. However, the lack of statistics does not mean that a city cannot work to reduce consumption-based emissions.

The City of Stockholm has identified a number of priority areas to work on to reduce climate impact from a consumption perspective.

Reducing the city's carbon footprint requires continuous and further development of work until 2040, which needs to begin during the programme period.

- Develop climate performance requirements in land allocation agreements for buildings built on City land

Responsible: City Development Committee with the support of the Environment and Health Committee

- Develop climate performance requirements for meals served in pre-schools, schools and nursing homes

Responsible: District Councils, Education Committee and Elderly Services Committee with the support of the Environment and Health Committee

New production of buildings and installations

The City of Stockholm places far-reaching requirements for energy efficiency for newly built buildings on the City's land. As buildings become increasingly energy efficient and more renewable energy sources are used during operation, the climate impact moves from the operational stage to the construction process, i.e. the construction of the building and the climate impact of the building materials. Studies³⁵ have shown that energy-efficient buildings

³³ <http://www.naturvardsverket.se/Sa-mar-miljon/Statistik-A-O/Vaxthusgaser-konsumtionsbaserade-utslapp-Sverige-och-andra-lander/>

³⁴ Final report for the research project PRINCE (2018) – Policy Relevant Indicators for Consumption and Environment (<https://www.prince-project.se/>)

³⁵ Erlandsson, M. et al. (2015) IVL B 2217 – The climate impact of construction — Life cycle calculation of climate impact and energy use for a newly produced energy-efficient concrete apartment building.

(with requirements equivalent to those found in Stockholm) have about the same climate impact in the operational stage over 50 years as the climate impact from the construction process.

The Swedish Transport Administration has developed a climate calculation³⁶ that the agency uses to calculate the climate impact of installation construction. The calculation tool contains climate impact data for different types of road surfaces, aggregates and construction materials, work machines, land use etc. The climate calculation is available in an open version for external users.

Ongoing and forward-looking work

The City of Stockholm has for several years actively participated in national development work on the climate impact of the construction process. In Norra Djurgårdsstaden, requirements for reporting of climate impact have been tested and a calculation tool³⁷ for calculating the climate impact from the construction process has been developed in collaboration with IVL and KTH.

The calculation tool is now being tested in new production by the City's housing companies and by the City Development Administration in the role of employer. Parallel tests are being carried out in Gothenburg. The results of the tests will be used for further development of the tool. Requirement specifications to reduce the climate impact of the construction process in new production shall be developed during the programme period. By 2023, requirements shall be set for the calculation of the climate impact of the construction process and analysis of the possibility of reducing climate impact. The requirements apply in connection with land tenure agreements for new production on the City's land and agreements on development.

During the programme period, the City's committees and companies will take the lead and develop their own requirement levels for climate impact, for installation construction and buildings, as a basis for procurement requirements. For installation construction, the Swedish Transport Administration's Climate Calculation can be used.

Measures 2020–2023	Responsible for implementation and follow-up
Development of requirement specifications for land allocation before new construction of buildings	City Development Committee with the support of the Environment and Health Committee
LCA requirements in the procurement of new production of buildings and installations	Stockholm Stadshus AB, Sports Committee, Real Estate Committee, Transport Committee and City Development Committee with support from Environment and Health Committee

The committee with primary responsibility is marked in bold.

Rules and initiatives

The National Board of Housing, Building and Planning has been commissioned by the government to propose methods and rules for accounting for the climate impact of buildings, taking into account a life cycle perspective. In the National Board of Housing, Building and Planning's reporting³⁸ of the assignment, proposals are made for legislation for climate declaration of buildings. According to the National Board of Housing, Building and Planning's assessment, a legislative requirement for climate declarations can be introduced by 2021.

As part of the construction sector's roadmap in Fossil-free Sweden³⁹, priority development work is underway to produce building materials with reduced climate impact⁴⁰.

36 <https://www.trafikverket.se/tjanster/system-och-verktyg/Prognos--och-analysverktyg/Klimatkalkyl/>

37 BM, the Building Sector's Environmental Calculation Tool.

38 National Board of Housing, Building and Planning report 2018:23 – Climate declaration of buildings – Proposal for method and rules. Final report.

39 <http://fossilfritt-sverige.se/verksamhet/fardplaner-for-fossilfri-konkurrenskraft/>

40 Erlandsson, M. (2017) IVL C 250 – Blå Jungfrun version 2017 with new cement.

Climate impact from food

According to the Swedish Environmental Protection Agency, food consumption accounts for 20 per cent of the national climate impact calculated from a consumption perspective⁴¹. The issue of the environmental and climate impact of food consumption is very complex. In addition to providing a nutritious dietary intake, food needs to be taken into account for several other factors in addition to climate impacts, such as the need for open landscapes with grazing livestock, biodiversity, reduced nutrient leakage, pesticide use, land and water use. Choice of foods should therefore not be based only on isolated analyses of climate impact. A study from KTH⁴² concludes that a food system with only arable or one with mainly livestock increases land use and most types of environmental impact compared to a system where livestock and arable are combined in an optimal way.

According to the Swedish Board of Agriculture's report 2019:9, Swedish food production is relatively resource-efficient and environmentally- and climate-friendly compared to the production of corresponding food in other countries. Increasing the share of Swedish food to replace imported food, as part of the work to choose food produced with high environmental and climate considerations, can therefore contribute to lower climate impact.

A great potential for reducing climate impact, but also other environmental impacts, lies in opportunities to reduce food waste in society. Waste occurs throughout the food production, sale and consumption chain. According to the Swedish Environmental Protection Agency⁴³, waste varies depending on the product between 10 and 50 per cent throughout the food chain.

Ongoing and forward-looking work

The City has developed a common food strategy – Strategy for good, healthy and climate-smart food – based on the National Food Administration's meals model – safe, nutritious, sustainable, pleasant, integrated and tasty meals⁴⁴. The food strategy aims to provide better public health and reduce the climate and environmental impact of food consumed within the city. It shall guide the procurement, purchase, preparation and serving of food in all the City's operations. Food served in the City's operations shall be good, nutritious and safe, as well as environment and climate smart.

The City of Stockholm is a major food buyer and buys food and meals for SEK 406 million per year⁴⁵. In Stockholm's public schools alone, 100,000 portions of lunch are served per day⁴⁶. The City's work to set environmental and climate requirements in procurement is therefore important to influence towards a more sustainable food production. During the programme period, the proportion of organic food procured shall increase while goals and requirements are formulated to reduce the climate impact of procured food. Here the City needs to deepen its knowledge and competence so as to make wise choices.

Replacing imported food with a higher impact on the climate and environment with food produced with a high regard for the environment and climate and that delivers ecosystem services is an important way for Stockholm to take global responsibility. Sweden is among the best in the world at using few antibiotics in animal production and at the same time having healthy animals, which means a lower risk of development of antibiotic resistance and fewer emissions of antibiotics into the environment. The City of Stockholm's activities shall have a high level of ambition when it comes to restrictive requirements for antibiotic use and animal welfare. The City shall develop its work of imposing such requirements and, in line with this work, products that do not comply with these requirements shall be phased out.

41 <https://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Uppdelat-efter-omrade/Konsumtion-och-produktion/Hallbar-mat/>

42 Rundgren G, (2019) Dairy products and vegetable alternatives to dairy products – environment, climate and health.

43 <https://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Uppdelat-efter-omrade/Avfall/Matsvinn/>

44 <https://www.livsmedelsverket.se/matvanor-halsa--miljo/maltider-i-vard-skola-och-omsorg/maltidsmodellen>

45 Information from Service Administration. Data from 2017.

46 Information from Education Administration in February 2019.

Development work for climate calculations of the menus and meals served will be started during the programme period. The City will also develop methods to reduce food waste from food handling in the City's pre-schools, schools and upper secondary schools, as well as in nursing homes, through pilot projects and good practice.

Measures 2020–2023	Responsible for implementation and follow-up
Development of climate calculations of the menus and meals served in pre-schools, schools and nursing homes	Education Committee , District Councils, Elderly Services Committee with the support of the Environment and Health Committee
Calculate and monitor the climate impact of the city's food purchases	Service Committee with the support of the Environment and Health Committee
Monitor the proportion of organic products in the City's food purchases	Service Committee

The committee with primary responsibility is marked in bold.

Rules and initiatives

The national food strategy⁴⁷ towards 2030 was adopted by the Riksdag on 20 June 2017. The strategy's national focus is that 30 per cent of Swedish farmland will consist of certified organic agricultural land by 2030 and 60 per cent of public sector food consumption will consist of certified organic products by 2030.

The Swedish Board of Agriculture⁴⁸ is continuing to specify milestones, establish a coordination function and implement measures to increase the production and consumption of organic food. The Swedish Board of Agriculture proposes that the action plan be evaluated and updated in the years 2022, 2026 and 2030.

The climate impact of aviation

Flights by Stockholmers resulted in emissions of approximately 1 million tonnes of greenhouse gases in 2018,⁴⁹ which corresponds to approximately 1,100 kg of greenhouse gases per resident. This compares with emissions from road traffic of approximately 900 kg per resident within the city's geographical boundary. If other emissions, such as nitrogen oxides and condensation trails and flight-induced cloudiness (so-called high-altitude effect), are included, the effect becomes even greater. Research⁵⁰ suggests that climate impact needs to be multiplied by a factor of 1.9 for international travel and 1.4 for domestic travel if the high-altitude effects are also to be taken into account.

Total emissions from Stockholmers' flights remained largely unchanged between 2016 and 2018. Emissions decreased by around three per cent per resident. Air travel within the City's organisation accounts for less than one per cent of the total climate impact from Stockholmers' air travel.

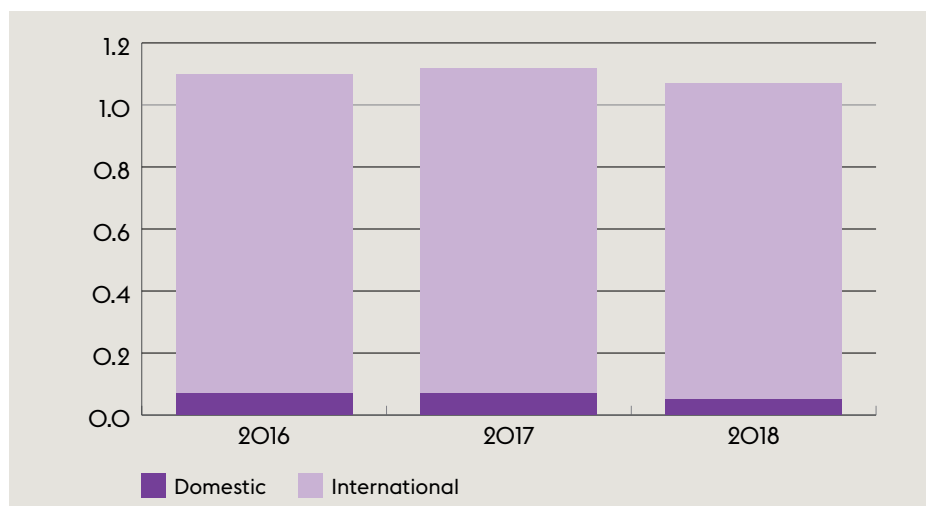
47 A food strategy for Sweden – more jobs and sustainable growth throughout the country.

48 Swedish Board of Agriculture Report 2018:16 Action plan to increase production, consumption and export of organic food.

49 <http://miljobarometern.stockholm.se/klimat/utslapp-av-vaxthusgaser/utslapp-fran-flygresor/>

50 Swedish Environmental Protection Agency 2015, Sustainable consumption patterns.

Figure 9.3 Greenhouse gas emissions from Stockholmers' air travel.



Ongoing and forward-looking work

The City of Stockholm has little influence over Stockholmers' air travel. Through *Climate-smart Stockholmers* of the Environment and Health Committee, the City communicates the climate impact of aviation and alternatives to air travel to Stockholmers. Within the City's own organisation, more and more meetings are conducted via digital media instead of physical meetings that require travel. A city-wide travel policy is being developed to reduce the climate impact of the City's travel, as well as a model for offsetting the climate impact of air travel.

Measures 2020–2023	Responsible for implementation and follow-up
Minimise the number of flights by means of digital meetings	All committees and boards
Follow the City's travel policy	All committees and boards

Rules and initiatives

The climate impact of national and European aviation (take-offs and landings within the EU) is part of the EU emissions trading scheme, while international aviation is regulated by the UN International Civil Aviation Organisation (ICAO).

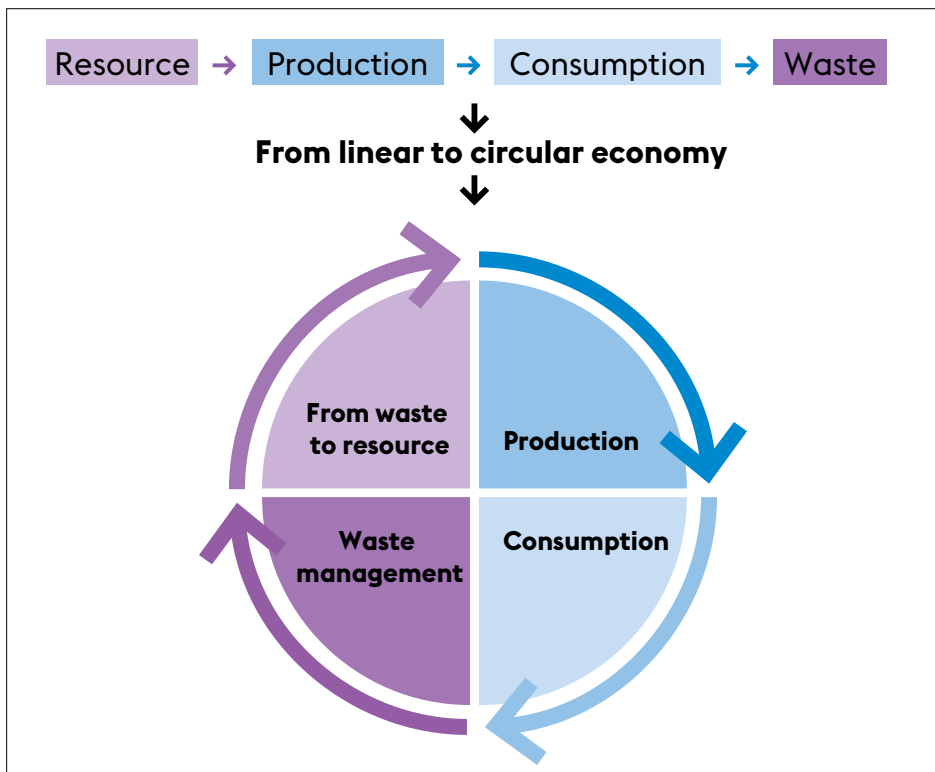
In the aviation industry's flight plan in Fossil-free Sweden⁵¹, the goal is fossil-free domestic aviation by 2030 and fossil-free aviation both domestic and international by 2045. At international level, the UN agency ICAO has initiated the CORSIA instrument to reduce aviation emissions. This is mainly based on climate compensation. In order to achieve fossil-free aviation, the flight plan identifies a number of obstacles and proposes measures that can contribute to removing them. As far as central government is concerned, barrier removal includes investment aid for renewable fuel production facilities, the creation of a long-term national objective for the transition to fossil-free aviation, including electric flights, the allocation of research funds for improving the efficiency of large-scale production of fossil-free fuel and the procurement of fossil-free fuel for public sector travel.

Circular economy

The EU and Sweden's environmental and waste policies have a clear direction to move towards a society with higher resource efficiency and a more circular economy. We need to do more with less. By reusing and recycling products and materials, economic values can be maintained in a cycle. The earth's resources can then be saved at the same time as waste decreases.

⁵¹ http://fossilfritt-sverige.se/wp-content/uploads/2018/04/ffs_flygbranschen.pdf

Figure 9.4 Circular economy.



Source: Swedish Environmental Protection Agency.

Ongoing and forward-looking work

The City of Stockholm operates several recycling operations where Stockholmers can hand in material for reuse and recycling, collect materials for repair and recycling projects and repair broken products in workshops. The city plans to develop a digital system to make the operation more accessible. Examples of recycling activities are the city's Mobile Pop-Up Recycling, which travels around to increase accessibility for Stockholmers, and Skärholmen's Reuse, which will be put into operation during the year. At the city's recycling centres, there is constant work to increase the proportion of incoming materials for recycling. The division into fractions is continuously refined to increase the recycling rate, as well as development to find better ways to extract resources from the incoming material. To increase service to residents, a concept for mini-recycling centres in each district is under development.

The City of Stockholm operates Stocket Återbruk, which is the City's internal service for reuse. Using a digital platform, the City's operations can leave and order furniture and fixtures that would otherwise have been discarded. In Jobbstart Ulvsunda, the City receives participants for work training. Among other things, spare parts are produced for items that would otherwise have been disposed of.

During the programme period, city committees and companies will take the lead in preventing waste generation and increasing reuse and recycling according to the EU waste hierarchy, thereby showing the way in which Stockholm can be converted into a more resource-efficient city.

The city's waste management programme in public outdoor environments can be further developed.

Measures 2020–2023	Responsible for implementation and follow-up
Further develop the City's waste management programme in the city's public outdoor environments	Transport Committee with support from Stockholm Vatten och Avfall AB and Environment and Health Committee
Investigate the possibility of introducing mini-recycling centres in all districts	Stockholm Vatten och Avfall AB

Rules and initiatives

Legislation in the field of waste is based on the waste hierarchy common to the EU as a whole. The aim of the legislation is to move from waste management to resource management. At the top of the hierarchy, that is the highest priority of legislation, is prevention of the generation of waste.

Figure 9.5 EU waste hierarchy.



In recent years, the EU has carried out an audit of its waste legislation, the so-called waste package. The amendments will promote a more circular economy and set higher standards for preventive measures, recycling and separate waste collections. The new rules enter into force on 5 July 2020⁵².

The 2015 EU Circular Economy Action Plan was in its final year of implementation in 2019. Two important initiatives are the launch of an EU-wide strategy on plastics, and the development of an ecodesign work plan with measures to promote repair, sustainability and the recyclability of products⁵³.

In 2018, the government set up a Circular Economy Delegation. The Circular Economy Delegation aims to strengthen society's transition to a resource-efficient, circular and bio-based economy both nationally and regionally. The delegation's priority areas are plastics, public procurement and design for circularity.⁵⁴

The Swedish Environmental Protection Agency document "Doing more with less – Sweden's waste plan and waste prevention programme 2018–2023" describes Sweden's work to prevent waste and achieve more resource-efficient and non-toxic waste management in accordance with the waste hierarchy⁵⁵.

52 <https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/uppdelat-efter-omrade/Avfall/naturvardsverket-avfallspaketet.pdf>

53 <https://www.naturvardsverket.se/Miljoarbete-i-samhallet/EU-och-internationellt/EUs-miljoarbete/Plast-internationellt/>

54 <https://tillvaxtverket.se/amnesomraden/affarsutveckling/delegation-cirkular-ekonomi.html>

55 <https://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Uppdelat-efter-omrade/Avfall/Avfallsplanen/>

Collaboration with the city's business community, Stockholmers and networks for urban climate work

The Climate Pact

The City of Stockholm and industry work together for the climate with the Climate Pact, which is a collaboration between the City of Stockholm and companies and organisations that want to reduce their climate impact. The Climate Pact started in 2007 with seven members. Today the network has over 250 members from all over the Stockholm region.

In 2016, the Climate Pact PLUS was formed. To become part of the Climate Pact PLUS, the company or organisation must share and adopt the City's goal of being a fossil-free organisation by 2030, i.e. ten years faster than Stockholm's goal of becoming fossil-free by 2040. At present, the Climate Pact PLUS consists of some 30 member companies.

Members of the Climate Pact act on their own terms with the common goal of reducing their energy use and greenhouse gas emissions. Here, the Climate Pact plays a role as an arena for the exchange of knowledge and experience between the City and the members.

Climate Pact: <https://foretagsservice.stockholm/natverk-moten/klimatpakten/>

Climate Smart Stockholmers

Stockholmers' knowledge, commitment and action on the climate issue is a prerequisite for achieving the City's climate goals. This is achieved through communication and dialogue with the city's residents.

The function of Climate Smart Stockholmers is to engage Stockholmers to make climate-smart choices through innovative thinking and positive communication. The three main purposes of the function are to:

- spread knowledge about what Stockholmers can do to reduce their and the City of Stockholm's total greenhouse gas emissions
- communicate the City of Stockholm's climate work to Stockholmers
- create commitment to the transition to a fossil-free Stockholm

By communicating Stockholm's extensive climate work in a clear and concrete way, and illustrating good examples in the city, Stockholmers are further inspired. To draw attention to employees of the City of Stockholm who work to reduce the City's energy use and climate impact, a climate-smart example of the month is chosen.

Networking

In its climate work, the city participates in many networks for cities, nationally and internationally. The international networks consist of Eurocities, C40, Carbon Neutral Cities Alliance (CNCA) and ICLEI – Local Governments for Sustainability. Work within Eurocities is focused on influencing the EU's work on climate issues, mainly regarding the drafting of directives that are later implemented in Swedish legislation. Within C40, CNCA and ICLEI, the City participates in several networks on the development of climate-smart neighbourhoods, energy efficiency, transport, work machines and the climate impact of consumption. The networks conduct joint projects to develop cities' climate work and policies. International collaboration also occurs through the City's participation, together with other European cities, in projects funded by the EU.

Nationally, the City participates in the Climate Municipalities network, with national advocacy work for cities' climate work, as well as in the government's collaboration platform Fossil-free Sweden.

Ongoing and forward-looking work in collaboration

The Climate Pact grows by around 40-50 new member companies and organisations per year. Examples of activities among members of the Climate Pact are active measures to reduce the use of fossil fuels in transport, heating, electricity or manufacturing processes and to make goods and services that are purchased fossil-free.

The City arranges thematic seminars for members based on their wishes. From initially dealing with energy use and transport, the level of ambition has been raised to now also include themes about the climate impact of consumption and long-distance travel. Together with the members of the Climate Pact PLUS in particular, the City is further developing the level of ambition for climate work. In order to bring together all the companies in the Climate Pact, the city organises an annual conference for inspiration and exchange of experience between its members.

An important part of the City's business community is the event industry. Both the City and private actors organise major events in Stockholm. To support businesses and the City's own operations, the City has developed a *Guide to Sustainable Events*, <https://foretagsservice.stockholm/evenemangsarrangor/guide-for-hallbara-evenemang/>

The Guide to Sustainable Events helps organisers to conduct events with special attention to sustainability, in terms of both responsible social and environmental requirements, and is a further development of ISO standard 20121 *Standard for Sustainable Events Management*.

Climate-Smart Stockholmers' communication work helps to reinforce the measures described in the City of Stockholm's Climate Action Plan, which in turn links to the climate goals of Stockholm's Environment Programme. For example, the handbooks *Climate-Smart in the Home*, *Climate-Smart in the Office* and the cookbook *The Smart Kitchen* have been produced to inspire residents and workplaces in the city of Stockholm to make climate-smart choices in their everyday lives.

Other communication tools are Climate Tours that are carried out to show how the city of Stockholm is affected by climate change and what is being done to deal with the effects of this climate impact. The Climate Scales is an interactive exhibition where the visitor weighs the different parts of their consumption. This enables dialogue about the climate impact of the entire consumption and what Stockholmers themselves can do to change over to more sustainable consumption.

The Climate Scales



Climate-Smart Stockholmers also works with study circles and focus groups to strengthen and develop households' interest in and knowledge about how their consumption and life-style affect the climate.

Communication work in future will focus more on transport and consumption that is outside the system limits of the City's climate action plan. For example, the opportunities for increased sharing and the circular economy.

Stockholmers' participation in climate issues can be captured as a force in the implementation of climate work. Commerce and industry, the civil society and the NGO sector are important parties both for implementation and for bringing together social and environmental sustainability.

In order to increase the benefits of the resources used, Climate-Smart Stockholmers can complement, scale up and further develop efforts already made on communication activities.

Measures 2020–2023	Responsible for implementation and follow-up
Operate the Climate Pact	Environment and Health Committee
Communicate about the City's climate work	Environment and Health Committee and City Executive Board

10. Implementation

The decision on the action plan will mean that the City will move its climate work forward to once again be at the international forefront.

- The introduction of a climate budget, with a ceiling of 19 million tonnes of future greenhouse gas emissions from the City, means that the City can demonstrate in an exemplary way how cities can contribute to the fulfilment of the Paris Agreement.
- The City's Action Plan to 2023 clearly identifies those responsible for different emission reductions. Stockholm's Action Plan thus has an operational focus – something that is required if the climate work is to be credible.
- The City's tightened milestone by 2023 from 1.8 tonnes per resident to 1.5 tonnes per resident also shows that the City is increasing the pace of climate action.

Many of the measures in the Action Plan concern regulatory changes in the area of traffic and most of these measures are outside the City's control. The City Executive Board, in consultation with the Transport Committee and the Environment and Health Committee, shall produce an action plan for reducing carbon dioxide emissions from road traffic by 2030. It describes how the City shall contribute to the national climate goal for transport of achieving at least a 70 per cent reduction in greenhouse gas emissions from domestic transport (excluding aviation) by 2030, compared to 2010. During the programme period, measures to reduce greenhouse gas emissions by around 80,000 tonnes need to be implemented by 2023.

Implementation of the Action Plan

The Action Plan for the period up to 2023 shall be implemented by the designated committees and boards.

Committees and companies that have emission conditions in the Action Plan shall incorporate these into their operational plans and describe the activities/measures to be implemented, so that monitoring can take place of measures and conditions.

Committees and boards with emission conditions shall formulate committee and company indicators where annual emission targets are formulated. The committees and companies that do not have conditions shall describe in the business plan the measures they intend to take in their respective operations on the basis of advice.

The City's Climate Action Plan also requires cooperation with other actors:

- with central government, since several measures require changes in national regulations, mainly in the field of transport,
- with the region, so that the measures can be coordinated with measures developed by other municipalities, the County Administrative Board and the Stockholm Region,
- with industry to reduce emissions in transport, building, energy use and consumption, for example.

The implementation of the Climate Action Plan also requires strong City lobbying work to ensure that regulations and instruments are formulated so as to support implementation.

The City Executive Board shall monitor the implementation of the measures so that the conditions set for the committees are completed and to evaluate the Climate Action Plan before a revision in 2023.

The Environment and Health Committee reports annually in collaboration with the City Executive Board on the City's total estimated emissions so that it is possible to follow up how the work as a whole is working towards the milestone of 1.5 tonnes per resident by 2023.

The table below summarises the measures of the Action Plan with conditions and implementation responsibilities broken down by committee and board.

Condition in tonnes CO ₂ e	Responsible for implementation and follow-up
1,800	AB Familjebostäder
2,300	AB Stockholmshem
2,600	AB Svenska Bostäder
16,500	City Development Committee
829	Real Estate Committee
300	Sports Committee
221,400	City Executive Board
31	Cemeteries Committee
1,315	Micasa Fastigheter i Stockholm AB
48,372	Environment and Health Committee
4,000	Service Committee
2,327	SISAB – Skolfastigheter i Stockholm AB
3,000	Urban Planning Committee
100	Stockholms Stadshus AB, Real Estate Committee, Sports Committee
118,000	Stockholm Exergi AB
8,000	Stockholms Hamn AB
13,126	Stockholm Vatten och Avfall AB
10,000	Transport Committee
60,000	Reduced emissions for electricity generation in the Nordic region
514,000	Total all measures
-40,000	Increased traffic 2020–2023
474,000	Total all measures including traffic increase

Figure 10.1 The figure shows international and national climate objectives, as well as the City of Stockholm’s climate goals.

