Sweden's third Biennial Report under the UNFCCC

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Ministry of the Environment and Energy

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ISSN 0282-7298

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Preface

Climate change poses an unprecedented threat to our lives and societies. It has immense consequences for human security across the globe. It is obvious that the way we organise our society and make use of natural resources are having a global long-term impact on the ecosystem of our planet. The old model of achieving wealth through excessive use of natural resources has proved to be outdated. Some may argue that the call for a paradigm shift of development is too challenging. Sweden, however, sees a land of opportunities in transforming Sweden and the world towards sustainable development.

It falls on governments to demonstrate political leadership to realize the Paris Agreement. As governments, we should introduce the necessary legislation to provide a long-term and predictable environment for society. Sweden is willing to show leadership. The policy instruments introduced have had a significant effect so far, and emissions have fallen by around 25 per cent in absolute numbers between 1990 and 2015, while the economy has grown by 75 per cent. That is good, but far from enough. With broad support from the parliament the government introduced a climate policy framework with a climate act for Sweden in June 2017. This framework is the most important climate reform in Sweden's history and sets out implementation of the Paris Agreement in Sweden. The framework contains new ambitious climate goals, a climate act and plans for a new climate policy council. The framework contains the following climate goals for Sweden:

- Net zero emissions of greenhouse gases into the atmosphere by 2045, and thereafter negative emissions. Emissions from activities in Sweden must be at least 85 per cent lower than in 1990. Based on current population forecasts for Sweden, this means that emissions in Sweden will be less than one tonne per person by 2045.
- By 2030, emissions from domestic transport, excluding domestic aviation, shall be reduced by at least 70 per cent compared with 2010.
- Emissions in the sectors outside the EU emission trading scheme should be at least 63 per cent lower in 2030 and at least 75 per cent lower in 2040, as compared to 1990.

These goals mean Sweden undertakes to achieve emission reductions that far exceed Sweden's required emission reductions under EU legislation. Sweden therefore is already moving beyond the commitment by the EU within the Paris Agreement, and encourages other countries to do the same.

In this third biennial report, a comprehensive summary of Sweden's efforts to combat climate change is provided. Emissions and removals of greenhouse gases are reported for each sector and adopted and planned policy measures and their impact on emissions are described. The report contains projections for emissions up to 2020 and 2030. According to these projections, emissions will continue to decrease, and the national target for 2020 is within reach with national measures alone. The biennial report also describes Sweden's contributions to climate finance

The material on which the biennial report is based has been obtained through extensive activity and input from around ten government agencies, led by the Swedish Environmental Protection Agency. The report has been elaborated in accordance with the UNFCCC biennial reporting guidelines for developed country Parties contained in Decision 2/CP.17 as adopted by the Conference of the Parties at its seventeenth session[1].

Stockholm, December 2017.

Isabella Lövin

Minister for International Development Cooperation and Climate

1 Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Actionunder the Convention, Document: FCCC/CP/2011/9/Add.1

Content

1. Information on GHG emissions and removals and trends, GHG inventory including information on national system

The information in this chapter is a summary of the 2017 inventory of emissions and removals of greenhouse gases for the years 1990 to 2015, submitted under the UN Framework Convention on Climate Change and the Kyoto Protocol (National Inventory Report Sweden 2017). The chapter also includes information on national system for GHG inventory and Policy and measures and projections.

1.1. Total emissions and removals of greenhouse gases

In 2015, greenhouse gas emissions (excluding LULUCF) in Sweden totalled 53.7 million tonnes of carbon dioxide equivalents (Mt CO_2-eq.), see Figure 1.1. Total emissions have decreased by 18.2 Mt, or 25 %, between 1990 and 2015. Emission levels have varied between a low of 53.7 Mt CO_2-eq. in 2015 and a high of 77.3 Mt CO_2-eq. in 1996. Annual variations are largely due to fluctuations in temperature and precipitation and to the economic situation. The net sink attributable to the land use, land-use change and forestry (LULUCF) sector has varied over the period. In 2015 it amounted to 50.5 Mt CO_2-eq., which corresponds to 94 % of total greenhouse gas emissions.

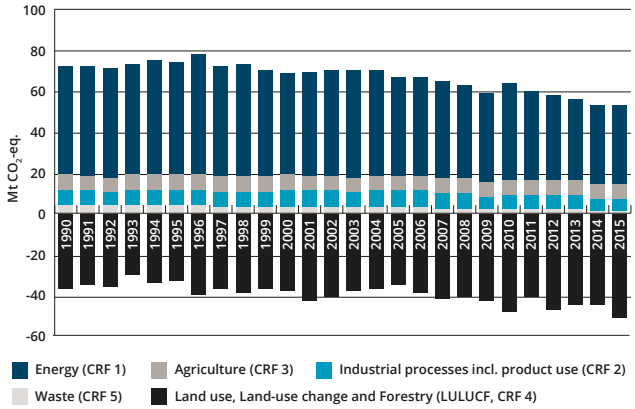


Figure 1.1 Total greenhouse gas emissions from different sectors.

In 2015, emissions (excl. LULUCF) of carbon dioxide (CO_2) amounted to 43.1 Mt CO_2 in total, which is equivalent to 81 % of total greenhouse gas emissions, calculated as CO_2-eq. Emissions of methane (CH_4) accounted for 4.9 Mt of CO_2-eq. (about 9 % of total emissions), emissions of nitrous oxide (N_2O) 4.6 Mt (9 %), fluorinated greenhouse gases 0.9 Mt (2 %), see Figure 1.2. The shares of the different greenhouse gases have remained stable over the period 1990 to 2015.

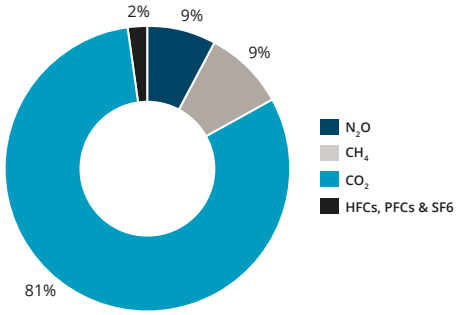


Figure 1.2 Greenhouse gas emissions in 2015 (excl. LULUCF) by gas, in carbon dioxide equivalent.

The largest sources of emissions in 2015 was the energy sector (73 %), agriculture (13 %) and industrial processes and product use (12 %), as shown in Figure 1.3.

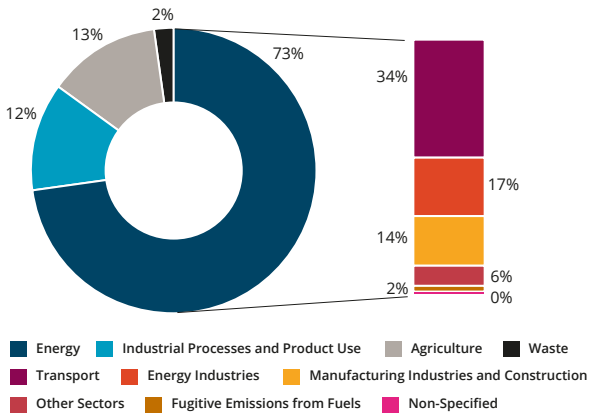
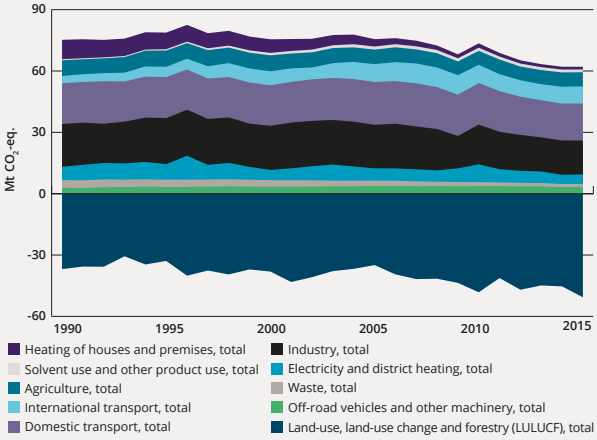


Figure 1.3 Greenhouse gas emissions in 2015 (excl. LULUCF), by sector.

In recent years there has been a downward trend in emissions. The largest reductions in absolute terms are due to a transition from oil-fuelled heating of homes and commercial and institutional premises to electricity, e.g. heat pumps, and district heating. Increased use of biofuels in district heating generation and industry has also contributed to the reductions together with reductions in landfilling of waste. Fluctuations in production levels of manufacturing industries following changes in the economic development of specific industries have also had significant impacts on the national trend.

BOX 1. 1 The Swedish national sectorial breakdown

The Swedish greenhouse gas inventories are published using a national sectorial breakdown for the purpose of tracking progress with national targets, and tracking the effect of implemented policies and measures. The sectorial breakdown is designed to allocate emissions and removals in line with the design of national policies and measures. The aggregation of all industrial emissions in one main sector that is sub-divided by type of industry is the largest difference between the national sectorial breakdown and the IPCC sectors in Common Reporting Format.



The main emission sources in Sweden are domestic transport, industry, and electricity and district heating according to this breakdown.

Emissions from domestic transport respond to one third of Sweden's total emissions (excluding LULUCF and international transport). Although the emissions were 9 % lower in 2015 than in 1990, the decreasing trend seen in recent years has slowed down to a halt. The development in recent years can be explained by increased traffic on Swedish roads and the shift towards biofuels and increased energy efficiency not being strong enough to counteract that trend.

Emissions from industry respond to 31 % of Sweden's total emissions and have decreased by 20 % since 1990, while changes in the economic development of different industries have resulted in annual variations. The emissions reductions are mainly related to decreased use of oil due to shifts towards biofuels, mainly in the pulp and paper industry. New processes in the chemical industry have also contributed to the decreasing trend. Shifting production levels in response to changing economic conditions in certain industries also significantly impacts the trend.

Electricity and district heating shows a trend of decreasing emissions despite the increased demand for district heating due to increased combustion of waste and biofuels. Combustion of industry-derived gases is allocated to the industry.

More information about the national breakdown including how different CRF-categories are allocated is available at:

Description of trends (in Swedish):
http://www.naturvardsverket.se/klimatutslapp

Detailed data and reference to CRF-categories (in English):
http://www.scb.se/mi0107-en

1.1.1. Energy industries

Total emissions from energy industries were approximately 9.0 Mt CO_2-eq. in 2015, a 10 % decrease compared with 1990. Production of electricity and district heating account for the larger part of the emissions with 71 % (6.4 Mt) in 2015. Emissions from refineries and the manufacture of solid fuels totalled 2.6 Mt in 2015.

Energy industries are dominated by electricity and heat production, where emissions fluctuate between the years due to the weather conditions' influence on the electricity and heat production, see Figure 1.4. The fluctuations seen for emission from coke production and refineries are primarily related to changes in production levels in response to the economic development of the industries. Emissions from Sweden's electricity and heat production mainly originate from combined heat and power plants that are to a large extent fuelled by waste and renewable resources with low emission factors, and industry-derived gases from the steel production. The use of coal, oil and gas are decreasing. Despite demand for district heating increasing by over 50 % since 1990, the emissions have remained at a level similar to 1990.

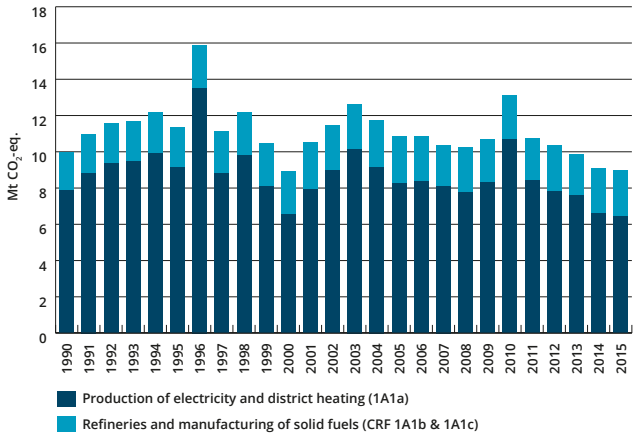


Figure 1.4 Greenhouse gas emissions from the energy industries (CRF 1A1).

1.1.2. Residential and commercial/institutional

Greenhouse gas emissions from fuel combustion in the residential, commercial and institutional sectors were 72% lower in 2015 compared to 1990 due to a strong decrease in combustion of fossil fuels for heating, see Figure 1.5. The emissions primarily adhere to stationary combustion in homes, non-residential premises or within agriculture, forestry and fisheries. Emissions also come from mobile machinery, off-road vehicles and fishing boats. Oil-fuelled furnaces have been replaced by district heating, and electricity, including the increased use of heat pumps. Since emissions from stationary combustion for heating purposes have decreased significantly, the main emissions within the sector now come from working machinery and off-road vehicles.

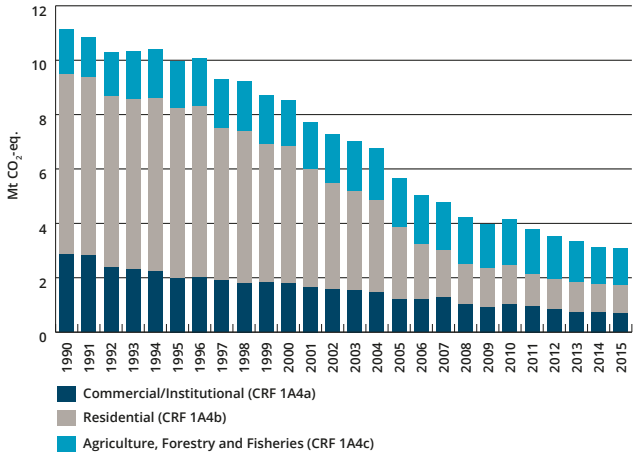


Figure 1.5 Greenhouse gas emissions from combustion in the commercial and institutional, residential, and agriculture, forestry and fisheries sectors.

1.1.3. Industrial combustion

To cover all industry-related emissions, account needs to be taken of process emissions, emissions from combustion and fugitive emissions, which according to UNFCCC guidelines are to be reported under separate CRF (Common Reporting Format) categories.

The mining, iron and steel industries, as well as the pulp and paper industry, are examples of historically important industries for Sweden. Emissions from combustion in manufacturing industries and construction were 7.6 Mt CO_2-eq. in 2015, see Figure 1.6. Emissions in 2015 were 33% lower than in 1990 and close to unchanged compared to 2014. Although increasing slightly up until 1997, the emissions show a decreasing trend since then. The lower emissions in 2009 and higher emissions in 2010 were caused by the impact of the financial crisis on production levels and their subsequent recovery. The decreasing trend is primarily related to a lower use of oil as oil has been replaced by electricity or biomass.

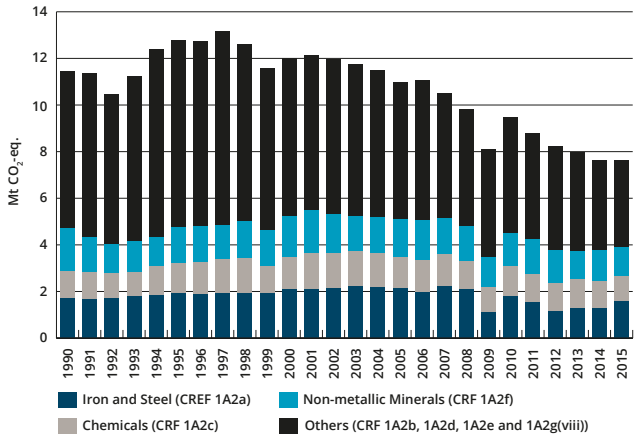


Figure 1.6 Greenhouse gas emissions from industrial combustion.

1.1.4. Fugitive emissions

Fugitive emissions come from sources like processing, storing and using fuels, gas flaring, and the transmission and distribution of gas. Emissions were around 0.9 Mt CO_2-eq. in 2015, see Figure 1.7, and have increased by 125% compared with 1990. The increase of fugitive emissions from oil, observed in the time series from 2006, is related to the establishment of hydrogen production facilities at two oil refineries.

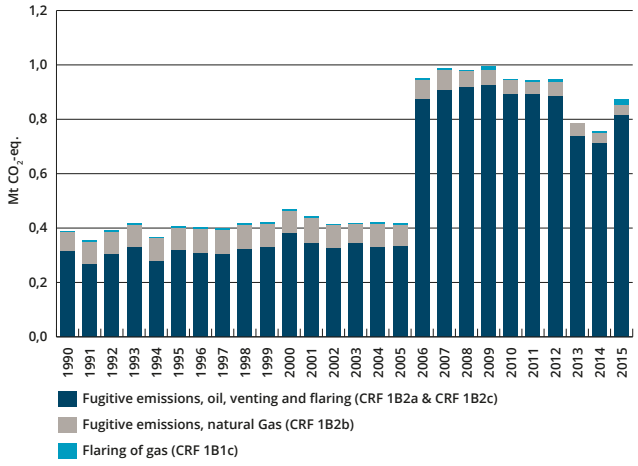


Figure 1.7 Fugitive emissions.

1.1.5. Industrial processes including product use

Emissions from the industrial processes and product use sector represented 12% of total national emissions in 2015. The main sources of emissions in this sector are the production of iron and steel as well as the cement and lime

industries. Greenhouse gas emissions from industrial processes and product use were 10 % lower in 2015 compared with 1990, equivalent to 0.7 Mt CO_2-eq., see Figure 1.8.

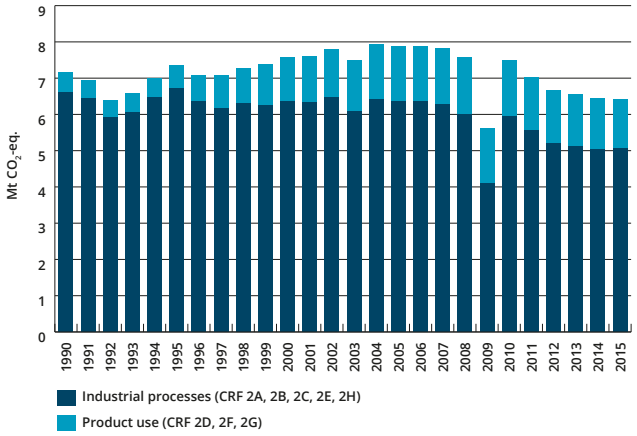


Figure 1.8 Emissions from the industrial processes and product use.

Greenhouse gas emissions from industrial processes and product use show an overall decreasing trend since 1995, with the exception of 2009 and 2010, and were 23 % lower in 2015 compared with 1990. The trend of emissions from product is mainly influenced by products used as substitutes for ozone depleting substances. These emissions show an increasing trend that culminated in 2008–2010 and have been decreasing since 2010. Nevertheless, greenhouse gas emissions from product use were 142 % higher in 2015 compared with 1990. Products used as substitutes for ozone depleting substances responded to 57 % of the total emissions from product use in 2015.

1.1.6. Transport

In 2015, emissions of greenhouse gases from domestic transport totalled 18 Mt CO_2-eq., a third of the national total. The majority of the transport-related greenhouse gas emissions in Sweden come from road traffic, mainly from cars and heavy-duty vehicles. The decrease in emissions from cars, a decrease that started in 2007, has slowed down since 2013, see Figure 1.9. The switch from petrol-powered to diesel-powered cars has led to a more energy-efficient car fleet, which since the mid-2000's has been bolstered by a general improvement in fuel efficiency for new cars.

The emissions from heavy-duty vehicles follow the fluctuations of economic activity, and these emissions increased between 1996 and 2008. The decrease in emissions from heavy-duty vehicles that started in 2010 has slowed down since 2013.

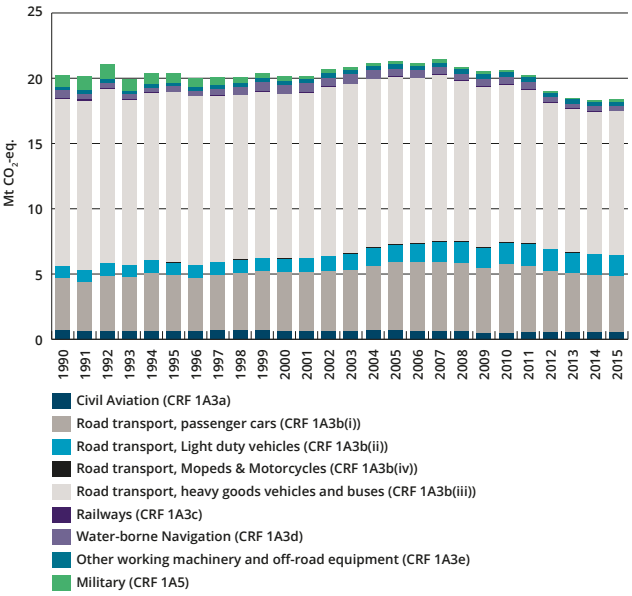


Figure 1.9 Greenhouse gas emissions from transport.

Except for emissions from road transport, emissions from transport include emissions from domestic aviation, railways, national navigation, other working machinery and off-road equipment as well as domestic military operations. In 2015, the greenhouse gas emissions from road transport were 17.0 Mt CO_2-eq., 0.5 Mt CO_2-eq. from domestic aviation, 0.4 Mt CO_2-eq. from domestic navigation, 0.1 Mt CO_2-eq. from railways, and 0.3 Mt CO_2-eq. from working machinery. Emissions from domestic military operations totalled 0.2 Mt CO_2-eq. in 2015.

1.1.7. Waste

Greenhouse gas emissions from the waste sector totalled 1.4 Mt CO_2-eq. in 2015, or about 2.6 % of the national total of greenhouse gas emissions. More than two thirds of the emissions from the waste sector come from solid waste disposal in landfills, which generates methane emissions and responded to 79 % of the sector in 2015, see figure 1.10.

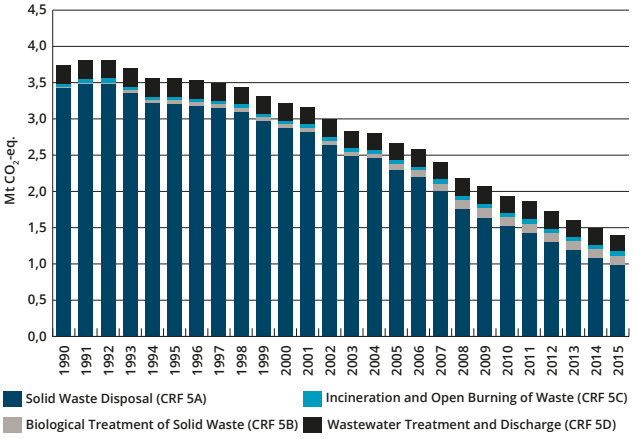


Figure 1.10 Greenhouse gas emissions from the waste sector, per subsector.

Methane emissions have decreased by 68 % in the period 1990–2015. The most important mitigation measures are the expansion of the methane recovery from landfills, the reduction of landfill disposal of organic material, the increased levels of recovery of materials, and waste incineration with energy recovery. The main reasons for the decrease in the quantities of waste sent to landfill are the bans on landfill disposal of combustible and organic material, introduced in 2002 and 2005 respectively. Producer responsibility, municipal waste plans and the waste tax have also contributed to the reduction of the amount of waste deposited in landfills.

1.1.8. Agriculture

In 2015, emissions from the agricultural sector were about 6.9 Mt CO_2-eq., which equals 12.5 % of the total national greenhouse gas emissions (excluding LULUCF).

The main sources of these emissions are nitrous oxide from soil and manure; and methane from cattle. Both gases are almost equal in size, constituting about 51 % and 47 % of the sector's emissions, respectively. The rest of the emission is made up of carbon dioxide that comes from liming and urea application.

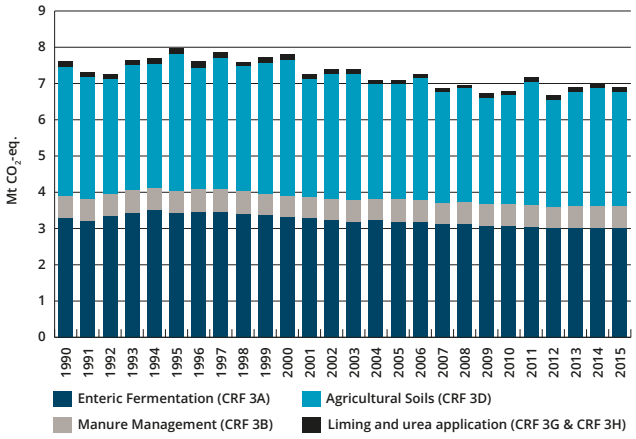


Figure 1.11 Greenhouse gas emissions from agriculture.

The overall decreasing trend in emissions from agricultural sector can be explained by a general decline in livestock numbers and a decrease in emissions from agricultural soils. Although the long-term trend is decreasing, emissions have levelled out over the last few years due to increased use of synthetic fertilisers. In 2015, emissions from agriculture were about 10 % lower compared with 1990, see Figure 1.11.

1.1.9. Land use, Land-use change and Forestry

The largest removals of carbon dioxide in Sweden occur in forest land, totalling about 50 Mt CO_2-eq. in 2015, followed by harvested wood products with removals of nearly 7 Mt CO_2-eq, see Figure 1.12.

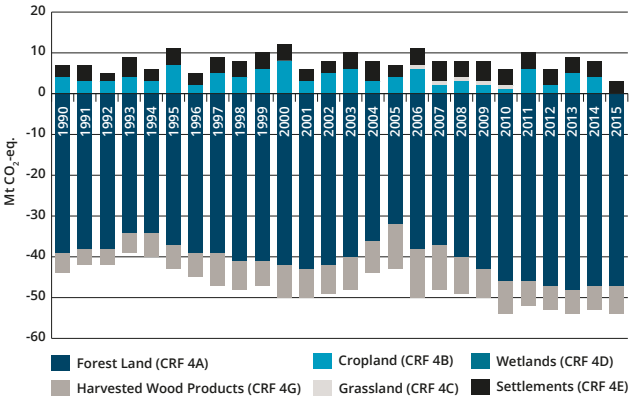


Figure 1.12 Greenhouse gas emissions and removals from land use, land-use change and forestry.

The largest emission in this sector is due to settlements. Usually cropland is also an emitter, but was in 2015 a small sink. The estimated emissions and removals in the mineral soil give the annual variation for cropland. The annual variations depend on what is grown and how large areas of crops that are grown between years, together with the climatic conditions (air temperature and precipitations). The net emissions in 2015 were about 3 Mt of CO_2-eq. as a mean value in these two categories. Sources and sinks in the LULUCF sector as a whole have resulted in net removals since 1990. During the period 1990–2015 net removals varied between roughly 31 to 50 Mt of CO_2-eq. The total size and variation of net removals in the LULUCF sector is mainly affected by the carbon stock change in forest land, and changes in the carbon pool living biomass constitute the major part of these changes in net removals, followed by carbon stock changes in mineral soils. Net removals in this sector are heavily influenced by harvests and natural disturbances such as storms on forest land. Two severe storms, in 2005 and 2007, had significant impacts on the trends of both forest land and harvested wood products. According to the Swedish National Board of Forestry, the felling, including wood felled by storms, was estimated at 122 Mm^3 stemwood 2005. However, the decrease in the living biomass in 2005 resulted in a corresponding increase in the harvested wood products pool in 2006.

1.1.10. International transport

Greenhouse gas emissions from international shipping and aviation, known as international bunkering, are considerably larger than those from domestic shipping and aviation. In 2015 these emissions totalled 8.4 Mt CO_2-eq., a full 132 % higher than in 1990, see Figure 1.12.

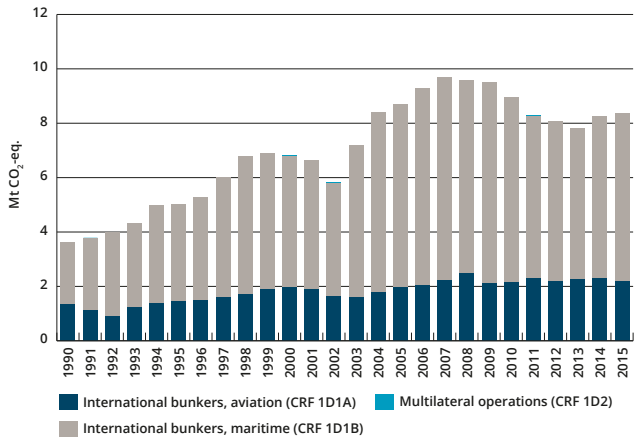


Figure 1.13 Greenhouse gas emissions from international bunkers.

Emissions from international shipping reached a total of 6.2 Mt CO_2-eq. in 2015. This is an increase of 8% compared with 2015 and 173% higher than in 1990. The increase may be a result of the production by Swedish refineries of low-sulphur marine fuels (fuel oil Nos. 2–5), which meet strict environmental standards. As a result, more shipping companies choose to refuel in Sweden. Another explanation may be the globalisation of trade and production systems, which has led to goods being transported over greater distances. Fluctuations in bunker volumes between years are also dependent on fuel prices in Sweden compared with the price at ports in other countries.

The Swedish Armed Forces bunker extremely small quantities of fuel in Sweden for operations abroad.

1.2. The National system for the GHG inventory and for policies and measures and projections

In accordance with the Kyoto Protocol, as well as the associated Decision 24/CP19, as well as EU Monitoring Mechanism Regulation (EU/No/525/2013), Sweden has established a national system for greenhouse gas inventory (see section 1.3). The Swedish national system for policies and measures and projections aims to ensure that the policies, and measures and projections to the Secretariat of the Convention (UNFCCC), the Kyoto Protocol and the European Commission are reported in compliance with specified requirements.

The Swedish national system for GHG inventory came into force on 1 January 2006, and a national system for policies and measures and projections was set up in 2015. In relation to legal arrangements, the information is the same for the two systems.

On 29 December 2014, the Ordinance on Climate Reporting (SFS 2014:1434) came into force in Sweden. The ordinance describes the roles and responsibilities of government agencies in the context of climate reporting and concerns both the GHG inventory and the reporting of policies, measures and projections. This led to several changes in Swedish reporting such as enlarging the national system, adding other agencies, as well as adding responsibilities for agencies already included. The ordinance requires that sufficient capacity be available for timely reporting.

1.3. The national system for GHG inventory

The Swedish national system for GHG inventory was established in 2006 in accordance with 19/CMP.1, 20/CP.7 and decision 280/2004/EC. In 2013, EU decision No 280/2004/EC was replaced by the Monitoring Mechanism Regulation 525/2013/EC. The Monitoring Mechanism Regulation has the same demands for national systems as the Monitoring Mechanism decision. The aim is to ensure that climate reporting to the secretariat of the Convention (UNFCCC), the Kyoto Protocol, and the European Commission complies with specified requirements. The national system for GHG inventory is described in detail every year in Sweden's annual National Inventory Report, submitted to the UNFCCC Secretariat. The KP reporting of LULUCF uses the same institutional arrangements, national system and corresponding QA/QC procedures as for the UNFCCC reporting.

1.3.1. Legal arrangements

The legal basis for Sweden's national system is provided by the Ordinance on Climate Reporting (2014:1434), which describes the roles and responsibilities of the relevant government agencies in this area. The Ordinance ensures that sufficient capacity is available for reporting. Supplemental to the Ordinance on Climate Reporting, formal agreements between the Swedish EPA and the concerned agencies have been signed, detailing the requirements regarding content and timetable from each agency.

Sweden also has legislation which indirectly supports climate reporting efforts by providing a basis for estimating greenhouse gas emissions and removals. Environmental reports are submitted under the Environmental Code (SFS 1998:808), and the Official Statistics Act (SFS 2001:99) imposes an obligation to submit annual data. In addition, government agencies in Sweden must comply by the Information and Secrecy Act[2] (SFS 2009:400).

1.3.2. Institutional arrangements

Preparing the annual inventory and other reports is done in collaboration between the Ministry of the Environment and Energy, the Swedish EPA and other government agencies and consultants. Depending on the role of these agencies in the climate-reporting process, this responsibility may range from supplying data and producing emission factors/calorific values to performing calculations for estimating emissions or conducting a national peer review. Figure 1.14 illustrates the institutional arrangements for the yearly inventory report, as well as for other reporting, to the European Commission and the UNFCCC.

2 Read more at http://www.regeringen.se/informationsmaterial/2009/09/public-access-to-information-and-secrecy-act/

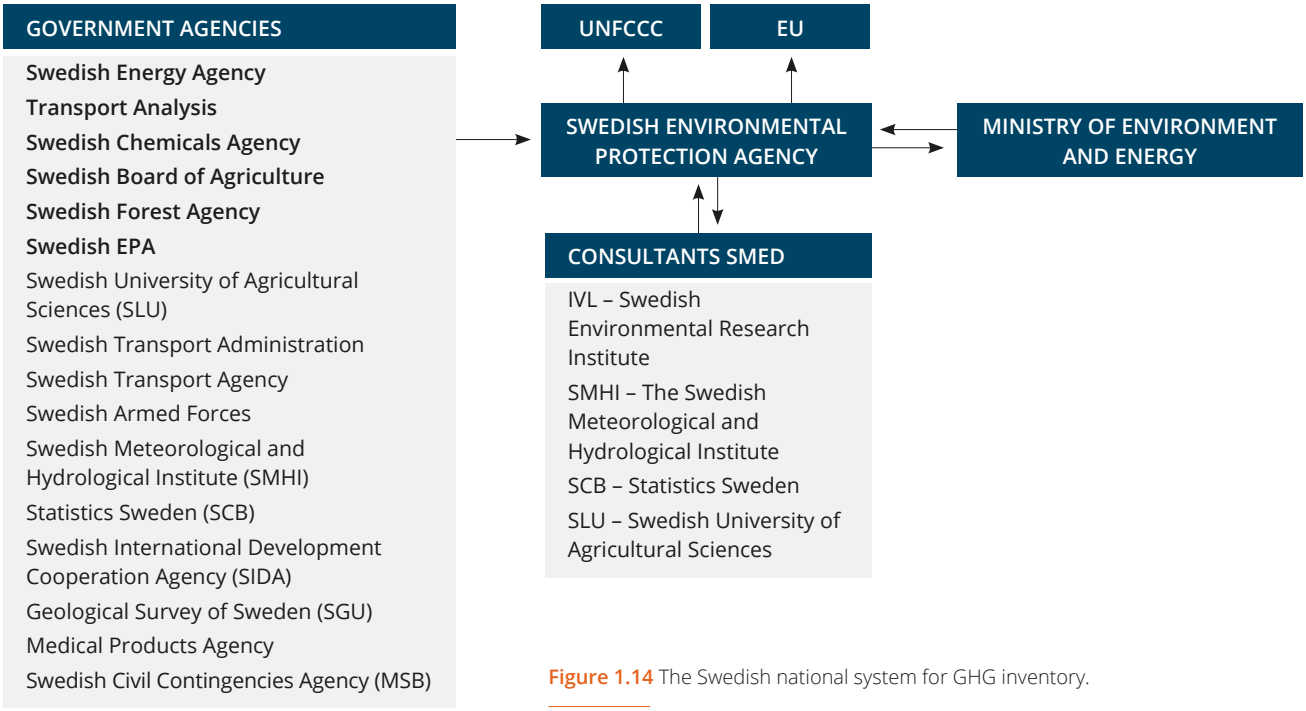


Figure 1.14 The Swedish national system for GHG inventory.

The Ministry of the Environment and Energy is responsible for the national system and for ensuring that Sweden meets international reporting requirements in the area of climate change. The Swedish EPA is responsible for coordinating the national system for climate reporting, for maintaining the necessary reporting system and for producing data and drafts for the required reporting and submitting the material to the Government.

Under contract to the Swedish EPA, the consortium SMED[3] processes data and documentation received from the various government agencies, as well as their own data, to calculate Swedish greenhouse gas emissions and removals.

1.3.3. Contact details of organisation responsible

The Swedish Ministry of the Environment and Energy is the national entity with overall responsibility for the inventory.

Ministry of Environment and Energy
Address: SE 103 33 Stockholm, Sweden
Telephone: +46 8 405 10 00
Contact: Ms. Nilla Thomson
m.climate@regeringskansliet.se

1.3.4. Inventory planning, preparation and management

The Swedish greenhouse gas inventory is compiled in accordance with the various reporting guidelines drawn up by the Intergovernmental Panel on Climate Change (IPCC) and the UNFCCC. The national system is designed to ensure the quality of the inventory, i.e. to ensure its transparency, consistency, comparability, completeness and accuracy. The Swedish quality system is based on the structure described in UNFCCC Decision 20/CP.7 and applies a PDCA (plan–do–check–act) approach.

Planning and development

In any given year, priorities are set on the basis of recommendations received from international and national reviews, the results of key category analysis, uncertainty analysis, ideas for improvements from the Swedish EPA and the SMED consultants, and new requirements arising from international decisions, for example.

Based on these criteria, the Swedish EPA decides on development projects, which are undertaken by the SMED consultants. On completion of these projects, the results are implemented in the inventory.

Preparation

Government agencies supply activity data to the Swedish EPA and SMED, which also gather activity data from companies and sectoral organisations, and from environmental reports. Emission factors may be plant-specific, developed at a national level, or IPCC default factors. Methods used to estimate emissions comply with current requirements and guidelines.

Quality control and quality assurance

All data are subjected to general inventory quality control (Tier 1), as described in the IPCC Good Practice Guidance (2000), Table 8.1. Certain sources also undergo additional checks (Tier 2). All quality control is documented by SMED in checklists. Data are also validated using the checks built into the CRF Reporter tool.

3 SMED = Svenska Miljö Emissions Data (Swedish Environmental Emissions Data), a consortium comprising Statistics Sweden (SCB), the Swedish Meteorological and Hydrological Institute (SMHI), IVL Swedish Environmental Research Institute and the Swedish University of Agricultural Sciences (SLU)

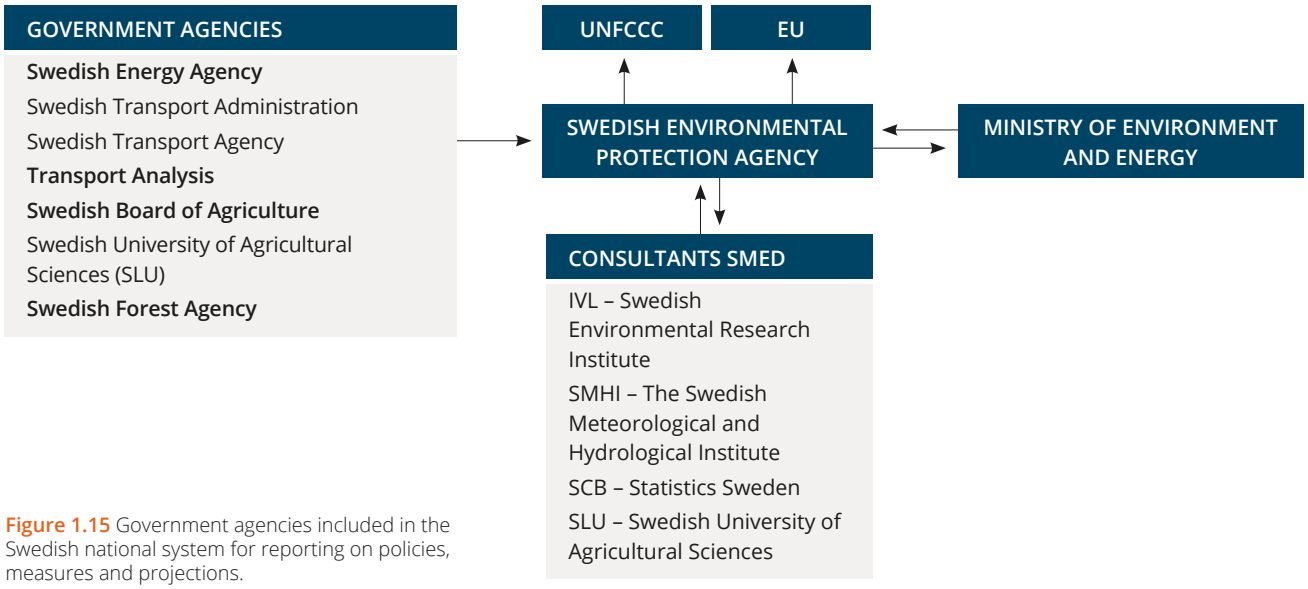


Figure 1.15 Government agencies included in the Swedish national system for reporting on policies, measures and projections.

Quality assurance is carried out in the form of a national peer review by government agencies, as provided in the Ordinance on Climate Reporting (2014:1434). This national review covers choice of methods, emission factors and activity data and is a guarantee of politically independent figures. The reviewers also identify potential areas for improvement in future reporting. Their findings are documented in review reports. The timetables for quality assurance are included in the agreements between the government agencies and the Swedish EPA. The government authorities conducting the national review are marked in bold in Figure 1.19. From the 2016 submission, quality assurance is conducted in two steps, with an annual quality control and verification of the trends, national statistics used and changes in methods, if any. Every year there is also an in-depth review of one sector. In addition, reporting is reviewed annually by the EU and UNFCCC.

An in-depth review of each sector will take place every five years as long as there are no specific recommendations from the EU or UNFCCC reviews, there were no changes in methodology, or the first-step review did not signal any problems. Sweden has also initiated meetings with experts from Denmark, Finland and Norway where GHG inventory compilers discuss problems, the need for revised methods and other relevant matters.

Finalisation, publication and submission

The preliminary results are published nationally in late November or early December each year. The Swedish EPA supplies a draft report to the Ministry of the Environment in the beginning of January. The EPA submits the inventory to the EU on 15 January and to the UNFCCC on 15 April.

Follow-up and improvements

Each year, suggestions for improvements from the national and international reviews, and from SMED and the Swedish EPA, are compiled into a list. Based on this list, priorities are set and development work is carried out in preparation for the next year's reporting. Any suggestions not implemented one year remain on the list for consideration in subsequent years.

1.3.5. Information on changes in the national system for GHG inventory

There have been no changes in the Swedish national system since the previous Biennial Report.

1.4. The national system for policies and measures and projections

According to Article 12 of Regulation (EU) No 525/2013 of the European Parliament and the Council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change every member state needs to have this national system. The Swedish national system for policies and measures and projections was established in 2015. Its aim is to ensure that policies and measures and projections to the Secretariat of the Convention (UNFCCC), the Kyoto Protocol (19/CMP.1) and the European Commission are reported in compliance with specified requirements.

1.4.1. Legal arrangements

The legal basis for Sweden's national system for policies and measures and projections is the same as for the annual greenhouse gas inventory and is provided by the Ordinance on Climate Reporting[4] (SFS 2014:1434). See more information of the Ordinance under section 1.2.1.1. The Ordinance includes all reporting according to (EU/No 525/2013/EC on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information and Union level relevant to climate change (EU/No/525/2013)).

4 http://www.lagboken.se/Views/Pages/GetFile.ashx?portalId=56&cat=24593&docId=22326 59&propId=5

Accompanying the Ordinance on Climate Reporting, formal agreements between the Swedish EPA and the concerned agencies have been established, specifying in detail the content and timetable for each agency for providing information on policies and measures and projections.

1.4.2. Institutional arrangements

To prepare the reporting on policies and measures and projections, cooperation takes place between the Ministry of the Environment and Energy, the Swedish EPA and other government agencies, see Figure 1.15.

The Ministry of the Environment and Energy is responsible for the national system and for ensuring that Sweden meets international reporting requirements in the area of climate change.

The Swedish EPA is responsible for producing the reports for the required reporting. The agency is thus responsible for coordinating Sweden's national system and for maintaining the necessary reporting system.

The other government agencies are responsible for providing the data and documentation necessary for reporting. In some cases, the agencies are responsible for peer review of different sectors.

The same contract to consultants (SMED[5]) as for the GHG inventory is used in the institutional process of policies and measures and projections.

1.4.3. Contact details of organisation responsible

The contact details are the same as for Sweden's national system for the GHG inventory (section 1.3.3).

1.4.4. Inventory planning, preparation and management

The national system is designed to ensure the quality of the reporting on policies and measures and projections, i.e. to ensure its transparency, consistency, comparability, completeness, accuracy and timeliness. The process for reporting applies a plan-do-check-act approach.

Planning and development

The report on policies and measures and projections are planned in due time before reporting. The report is compiled and includes quality control activities.

Work on the report on projections starts one year before submission and includes planning and defining assumptions and sensitive alternatives. Underlying projections on activity data are provided by several government agencies. The projections on emissions are then produced and compiled by the Swedish EPA.

Work on the Policies and Measures (PaMs) report starts one year before submission and includes planning activities. The information on policies and measures is compiled by the Swedish EPA. Government agencies, in accordance with the Ordinance, then perform quality assurance activities.

Preparation

The relevant assumptions, methodologies and models for producing the report on policies and measures and projections, are selected when planning the report. The work is based on established methods and models that have been used for many years and assessed to be the most relevant and suitable. The methodologies and models are continuously assessed and improved. Assumptions are made based on available data and on expert knowledge. Several government agencies are responsible for providing data according to the Ordinance and agreements. The Swedish EPA collects the additional data needed for reporting on policies, measures and projections and produces the reports.

Quality control and quality assurance

To ensure timeliness, transparency, accuracy, consistency, comparability and completeness, quality control activities are performed in parallel with work on projections and compilation of the information on policies and measures. Quality assurance activities are then performed according to the Ordinance before decision and submission of the report.

The timetables for quality assurance are included in the agreements between the government agencies and the Swedish EPA.

All data are subjected to general quality control activities throughout the process before submission. Quality assurance is carried out in the form of a national peer review by relevant government agencies, as provided in the Ordinance. The national review covers transparency, completeness, consistency, accuracy and comparability.

Finalisation and submission

After quality assurance activities and, if needed, adjustments of the report, the Swedish EPA submits the reports to the EU on 15 March biennially, in years when the Biennial Report is not produced.

Follow-up and improvements

The review identifies potential areas for improvement in future reporting. The findings are documented in the review report. For projections, sensitivity analyses are performed by applying a range of lower and higher estimates to the key assumptions.

1.4.5. Information on changes in the national system for policies and measures and projections

There have been no changes in the Swedish national system since the previous Biennial Report.

5 SMED = Svenska Miljö Emissions Data (Swedish Environmental Emissions Data), a consortium comprising Statistics Sweden (SCB), the Swedish Meteorological and Hydrological Institute (SMHI), IVL Swedish Environmental Research Institute and the Swedish University of Agricultural Sciences (SLU).

1.5. References

National Inventory Report Sweden 2017, Greenhouse gas emission Inventory 1990–2015, Submitted under UNFCCC and the Kyoto Protocol.

EU/No/525/2013, Regulation No 525/2013/EC on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information and Union level relevant to climate change and repealing decision No 280/2004/EC

(SFS 2014:1434), Svensk Författnings Samling; Klimatrapporteringsförordning, 2014:1434

SFS 2009:400, Svenska Författnings Samling Offentlighets- och sekretesslag, SFS 2009:400.

19/CMP.1, Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol

24/CP.19, Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention

2. Quantified economy-wide emission reduction target

This chapter explains the pledge of the EU and its Member States under the Climate Change Convention and the Swedish national target for 2020 and 2045.

2.1. The pledge of the European Union and Members States under the Climate Change Convention

The EU submitted a pledge in 2010 to reduce GHG emissions by 20 % compared with 1990 levels by 2020 (FCCC/CP/2010/7/Add.1). Because this target under the Convention was only submitted by the EU and its 28 Member States together (EU-28) and not by each Member State, there are no specified Convention targets for individual Member States. For this reason, Sweden, as part of the EU-28, takes on a quantified economy-wide emission reduction target jointly with all other Member States. See Table 2.1 for key facts of the Convention target of the EU-28. In addition to the Convention target, the EU and its Member States have a commitment under the Kyoto protocol for the period 2013–2020. For the EU as a whole, the Kyoto commitment is the same as the Convention target except that it also includes LULUCF (excluding aviation emissions).

The definition of the Convention target for 2020 is documented in the revised note provided by the UNFCCC secretariat[6]. In addition, the EU provided additional information relating to its quantified economy-wide emission reduction target in a submission as part of clarifying the developed country Parties' targets in 2012[7]. In a workshop that also formed part of this clarification process, the EU gave a presentation of its target in May 2012[8].

With the 2020 climate and energy package, the EU has set internal rules which underpin the implementation of the target under the Convention. The 2020 climate and energy

6 FCCC/SB/2011/INF.1/Rev.1 of 7 June 2011

7 The EU submission is documented in FCCC/AWGLCA/2012/MISC.1 from 24 April 2012 with the title "Additional information relating to the quantified economy-wide emission reduction targets contained in document FCCC/SB/2011/INF.1/Rev.1"

8 Presentation provided by Arthur Runge-Metzger on 'Clarification of developed country Parties' pledges' at UNFCCC Workshop on clarification of the developed country Parties quantified economy-wide emission reduction targets and related assumptions and conditions (AWG-LCA 15) on 17 May 2012, available at: https://unfccc.int/files/bodies/ awg-lca/application/pdf/02_eu.pdf.

Table 2.1 Key facts of the Convention target of the EU-28 and by that also Sweden

Parameters	Targets
Base year	1990
Target year	2020
Emission reduction target	–20 % in 2020 compared with 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF6
Global warming potential	AR4
Sectors covered	All IPCC sources and sectors, as measured by the full annual inventory, partly international aviation.
Land Use, Land-Use Change, and Forests (LULUCF)	Excluded
Use of flexible mechanisms	Possible to certain extent under the EU Emissions Trading System (EU ETS) and the Effort Sharing Decision (ESD).
Others	Conditional offer to move to a 30 % reduction by 2020 compared with 1990 levels as part of a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

package introduced a clear approach to achieving the 20% reduction of total greenhouse gas emissions from 1990 levels, which is equivalent to a 14% reduction compared with 2005 levels. This 14% reduction objective is divided between two sub-targets, where two thirds (21%) of the reduction effort was assigned to the Emission Trading System (ETS EU Directive No 2009/29) and one third (10%) to non-ETS sectors (EU Decision No 406/2009).

Under the revised EU ETS Directive (EU Directive No 2009/29), one single EU ETS cap covers all EU Member States and the three participating non-EU Member States (Norway, Iceland and Liechtenstein), i.e. there are no further differentiated caps by country. For allowances allocated to the EU ETS sectors, annual caps have been set for the period from 2013 to 2020; these decrease by 1.74% annually, starting from the average level of allowances issued by Member States for the second trading period (2008–2012). The annual caps imply interim targets for emission reductions in sectors covered by the EU ETS for each year until 2020. For more information on the EU ETS, see the third Biennial Report from EU.

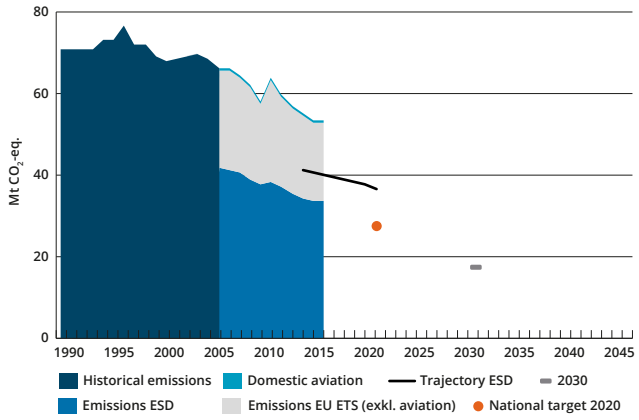


Figure 2.1 Historic and projected GHG emissions, separated into emissions included in the EU ETS and emissions covered by ESD[9,10].

In 2015, verified emissions from stationary installations covered under the EU ETS in Sweden totalled 19.2 Mt CO_2-eq. With total GHG emissions of 53.7 Mt CO_2-eq (without LULUCF), the share of ETS emissions is 36%.

The monitoring process for the ETS is harmonized for all EU Member States,(Commission Regulation No 601/2012). The use of flexible mechanisms is possible under the EU ETS. For more information on the use of CER and ERU under ETS, see the third Biennial Report from EU.

Non-ETS emissions are addressed under the Effort Sharing Decision (ESD) (Decision No 406/2009). The ESD covers emissions from all sources outside the EU ETS, except for emissions from international maritime, domestic and international aviation (which were included in the EU ETS from 1 January 2012) and emissions and removals from LULUCF. It thus includes a diverse range of small-scale emitters in a wide range of sectors: transport (cars, trucks), buildings (heating in particular), services, small industrial installations, fugitive emissions from the energy sector, emissions of fluorinated gases from appliances and other sources, agriculture and waste. Such sources currently account for about 60% of total greenhouse gas emissions in the EU.

While the EU ETS target is to be achieved by the EU as a whole, the ESD target was divided into national targets to be achieved individually by each Member State. In the ESD, national emission targets for 2020 are defined as shares of the emission levels in 2005. These shares have been translated into binding quantified annual reduction targets for the period 2013 to 2020 (EU Commission decision of 26 March 2013) (Commission Implementing Decision of 31 October 2013), expressed in Annual Emission Allocations (AEAs). Sweden has committed to reducing emissions in sectors covered by the ESD by 17% compared with 2005 emissions. The quantified annual reduction target is 41.7 million AEAs for 2013, decreasing to 37.2 million by 2020 (adjusted to 2013–2020 ETS period). The binding quantified annual reduction targets were revised (Commission Decision No 2017/1471), for the years 2017–2020, in August 2017, which means that the allocation for 2020 was reduced from 37.2 million AEAs to 36.1 million AEAs.

The modalities and procedures for monitoring and review under ESD are harmonised for all EU member States by Monitoring Mechanism Regulation (EU/No/525/2013). The use of flexible mechanisms is possible under the ESD.

The ESD allows Member States to make use of flexibility provisions for meeting their annual targets, with certain limitations. There is an annual limit of 3% for the use of project-based credits for each Member State. These are not used in any specific year; the unused part for that year can be transferred to other Member States or banked for own use until 2020. Because Sweden (together with Austria, Belgium, Cyprus, Denmark, Finland, Ireland, Italy, Luxemburg, Portugal, Slovenia and Spain) fulfils the criteria for using additional credits as stipulated in ESD Article 5(5), an additional use of credits is possible from projects in Least Developed Countries (LDCs) and Small Island Developing States (SIDS) up to an additional 1% of their verified emissions in 2005. For Sweden these are 0.456 million ERs and ERUs. These credits are not bankable or transferable.

2.2. Sweden's national emission reduction targets – exceeding European targets

2.2.1. The Swedish target for 2045

In June 2017, the Riksdag adopted a proposal on a climate policy framework for Sweden which will give Sweden an ambitious, long-term and stable climate policy. The climate policy framework consists of a climate act, new climate

9 Note1: GHG emissions (submission 2017) excluding sources and sinks of LULUCF.
10 Note2: ETS emissions are corrected to take into account the extended scope of the EU ETS for the third trading period.

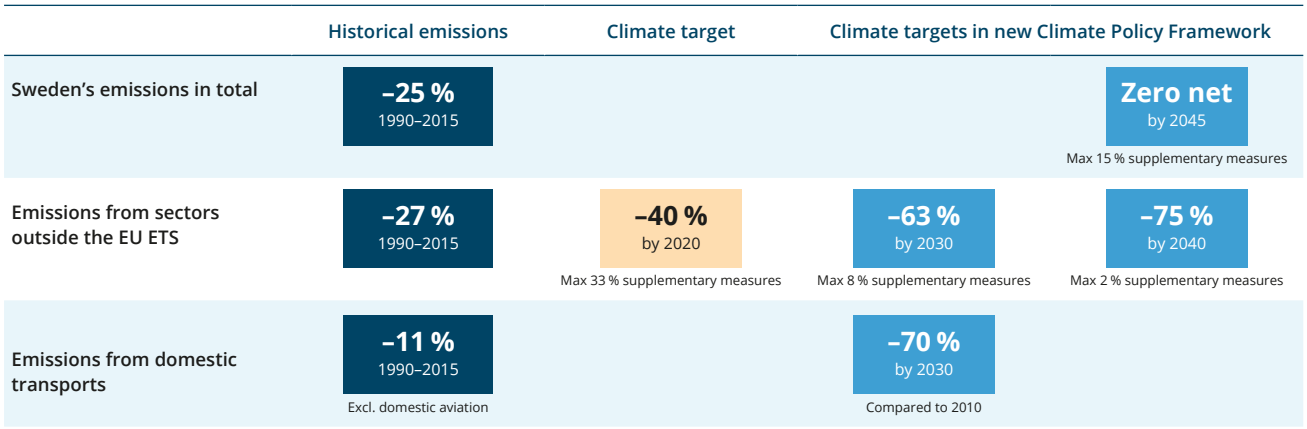


Figure 2.2 – Sweden's national targets

targets and a climate policy council. For more information about the climate policy framework, see Sweden's Seventh National Communication on Climate Change.

Targets

- By 2045, Sweden is to have no net emissions of greenhouse gases into the atmosphere and should thereafter achieve negative emissions. This means emissions from activities in Swedish territory are to be at least 85 % lower by 2045 compared with 1990. Supplementary measures may count towards achieving zero net emissions, such as increased uptake of carbon dioxide in forests and land, and investments in other countries. International accounting guidelines will be followed for this.
- Emissions in Sweden outside of the EU ETS should, by 2030, be at least 63 % lower than emissions in 1990, and by 2040 at least 75 % lower. To achieve these targets by 2030 and 2040, no more than 8 and 2 percentage points, respectively, of the emissions reductions may be realised through supplementary measures.
- Emissions from domestic transport are to be reduced by at least 70 % by 2030 compared with 2010. Domestic aviation[11] is not included in the goal since this subsector is included in the EU ETS.

2.2.2. The Swedish target for 2020

To provide a clear structure for environmental efforts in Sweden, the Riksdag has adopted 16 environmental quality objectives. One of these, Reduced Climate Impact, forms the basis for climate change action in the country. Current climate policy is also set out in two Government Bills, entitled *An Integrated Climate and Energy Policy,* passed by the Riksdag in June 2009 (Govt. Bills 2008/09:162 and 163). The first of these Bills sets a national milestone target for climate, calling for a 40 % reduction in emissions by 2020 compared with 1990. If the target in 2020 is met, greenhouse gas emissions from the non-ETS sector would be around 20 million tonnes of carbon dioxide equivalent lower than in 1990. This target applies to activities not included in the EU Emissions Trading System and does not include the LULUCF sector. In addition, the Bills also set targets for energy efficiency and renewable energy (see Boxes 2.1 and 2.2).

BOX 2.1 Sweden's renewables target for 2020

The EU has adopted a mandatory target requiring a 20 % share of energy from renewable sources in overall energy consumption by 2020. Responsibility for meeting the target has been divided among the Member States. Based on the agreed burden sharing, the target for Sweden's renewable energy share in 2020 is 49 %. The Riksdag has decided that, by that year, renewable sources are to provide at least 50 % of total energy consumed. The share of renewable energy in the transport sector, meanwhile, is according to an EU target to be at least 10 %.

BOX 2.2 Sweden's energy efficiency target for 2020

The EU has adopted a target of a 20 % improvement in energy efficiency by 2020. This target has not been broken down among the individual Member States. Sweden has chosen to express its national target for improved energy efficiency by 2020 as a 20 % reduction in energy intensity between 2008 and 2020, which means that the energy supplied per unit of GDP at constant prices shall decrease over that period.

11 The emissions only includes CO_2.

2.3. Reference

FCCC/SB/2011/INF.1/Rev.1 of 7, June 2011, Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention

EU Directive 2009/29, of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community (OJ L 140, 05.06.2009, p. 63) (http:// eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:00 63:0087:en:PDF).

Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council EU Commission decision of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (2013/162/EU). Commission Implementing Decision of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period 2013 to 2020 pursuant to Decision No 406/2009/ EC of the European Parliament and of the Council (2013/634/EU).

Commission Decision (EU) 2017/1471 of 10 August 2017 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period from 2017 to 2020 (notified under document C(2017) 5556)

EU/No/525/2013, Regulation No 525/2013/EC on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information and Union level relevant to climate change and repealing decision No 280/2004/EC

Govt. Bill 2008/09:162: En sammanhållen klimat- och energipolitik – Klimat. Ministry of the Environment.

Govt. Bill 2008/09:163: En sammanhållen klimat- och energipolitik – Energi. Ministry of Enterprises, Energy and Communications.


EKOLOGISKT
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3. Progress in achievement of quantified economy-wide emission reduction target and relevant information

This chapter provides information on the Swedish climate strategy as well as key policies and measures implemented or decided in Sweden to reduce greenhouse gas emissions. The policies and measures are included in the projections on greenhouse gas emissions reviewed in chapter 4[12]. Further, the chapter includes information on the assessment of economic and social consequences of response measures. At the end of the chapter the policy instruments and their effects are summarized in a table. Institutional arrangements are presented in section 2.

3.1. Swedish climate strategy

Sweden's climate strategy has progressively developed since the late 1980s. It consists of objectives, policy instruments and measures, together with regular follow-up and evaluation. Recently, in June 2017, a new National Climate Policy Framework, ensuring long term order and stability in climate policy, was adopted by the Riksdag (Swedish Parliament).

3.1.1. The Swedish environmental quality objective – Reduced Climat Impact

To provide a clear structure for environmental efforts in Sweden, the Riksdag has adopted 16 environmental quality objectives. One of these, *Reduced Climate Impact*, forms the basis for climate change action in the country. The interpretation of the objective is "Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels. Sweden will work internationally for global work to address this goal." (Govt. Bill 2016/17:146)

3.1.2. Sweden's national climate policy framework

In June 2017, the Riksdag (Swedish Parliament) adopted a proposal on a national climate policy framework for Sweden (Govt. Bill 2016/17:146). The climate policy framework consists of a Climate Act, new national climate targets and a climate policy council. The climate policy framework is the most important climate reform in Sweden's history. It creates order and stability in climate policy and sets long-term conditions for the business sector and society. The climate act will impose responsibility on the current Government, and on future governments, to pursue a climate policy that is based on the national climate targets and to provide clear feedback on the progress. Sweden will have long-term climate targets beyond 2020 and a council that independently reviews climate policy. The reform is a key component of Sweden's efforts to live up to the Paris Agreement.

Climate Act

- The Climate Act legislates that the Government's climate policy must be based on the national climate targets and specifies how the work should be carried out.
- In its Budget Bill, the Government must submit a climate review to the Riksdag every year. The climate review must contain:
  - A report on emissions development.
  - A report on the key political climate decisions taken during the year.
  - An assessment to identify the need for additional policies and measures, and when and how decisions about such policies and measures can be adopted.
- Every fourth year, the Government must develop a climate policy action plan which provides information on planned policies and measures to achieve emission reductions.
- The new Climate Act will enter into force on 1 January 2018.

Climate Policy Council

The climate policy council will provide independent assessments of how the overall policy presented by the Government is compatible with the national climate goals.

National Targets

An overview of the Swedish targets is presented in section 2.2.

12 Some of the policy instruments are, due to recent date of decision, not included in the scenarios in chapter 5. Those are marked with a "*" in the summarizing table at the end of the chapter.

3.1.3. Framework agreement on the Swedish energy policy

In addition, in June 2016, a cross-party framework agreement on the Swedish energy policy was decided. The agreement sets out a target of 100% renewable electricity production in Sweden by 2040. This is a target, not a deadline for banning nuclear power, nor does it mean closing nuclear power plants through political decisions. Moreover, in November 2016 a target of 50% more efficient energy use by 2030 compared to 2005[13] was agreed.

3.1.4. Regional and local action on climate change

Since 1998, Sweden's county administrative boards (CABs) have been tasked with applying the national environmental quality objectives at the regional level. All 21 CABs have adopted regional climate objectives. As of 2005, their role also included developing regional action programs to achieve the environmental quality objectives. Since 2008, they have also been entrusted with strategic coordination and leadership in regional efforts to implement government policies for a transition to renewable energy and reduced climate impact. The CABs develop and implement regional action plans in collaboration with other stakeholders. They support efforts by the business sector and municipalities in the area of climate and energy. Implementation of regional climate and energy strategies include a variety of measures, such as initiating cooperation and transferring knowledge between regional actors.

An evaluation (Swedish Energy Agency 2015) shows that the efforts from regional climate and energy strategies have developed, albeit at different rates, in a positive direction. Concrete results are primarily relatable to methodological development, establishment of cooperative structures, knowledge building and knowledge transfer. Between 200 and 600 measures were implemented each year during 2010–2014 in the context of these strategies, and they exhibit a wide range and variety of initiatives and measures.

Regional energy offices also initiate and participate in a wide range of projects relating to energy efficiency and renewable energy sources, with funding from the Swedish Energy Agency, the EU, CABs, regional development councils and other organisations.

At the municipal level, a wide range of climate activities are being undertaken. Municipalities are obliged to have an energy plan, which is often combined with a climate strategy to reduce greenhouse gas emissions.

Energy and climate change advisory services, which are partly funded by the Swedish state and municipalities, have been provided since 1998. A survey by Statistics Sweden (SCB 2015) commissioned by the Swedish Energy Agency posed a question about the impact of advice received from the energy and climate adviser on single-family house owners' decisions regarding investments. The survey revealed that 36% of the owners themselves considered that the advice had a fairly large impact.

3.2. Policies and measures in Sweden's climate strategy and their effects

3.2.1. Background

Sweden has introduced a range of policies and measures directly or indirectly affecting greenhouse gas emissions. The emphasis in the country's climate strategy is on the use of general economic instruments, but in many cases the general economic instruments are supplemented with targeted measures, for example to support the development and market introduction of technology and eliminate barrier effects. Many instruments which interact with carbon dioxide tax and emissions trading have also been adopted to achieve other policy goals than the climate objective, such as energy policy objectives.

Since the early 1990s, two key instruments in reducing Swedish emissions have been energy and carbon dioxide taxes. These taxes have been supplemented with other instruments, such as technology procurement, information, a differentiated annual vehicle tax and investment grants. Legislation, as those involving prohibitions, standards, and urban planning, also plays a part in curbing emissions. EU-wide policy instruments, in particular emission standards for new vehicles and the Emissions Trading System (EU ETS), also have assumed growing importance in Sweden. At the same time, developments in recent decades have been defined by a framework for spatial planning and other long established instruments in Sweden. Of particular importance are earlier decades' investments in an expansion of district heating networks, public transport systems and carbon-free production of electricity.

Given the large number of policies and measures, many of them introduced with other objectives than climate mitigation, it can be difficult, to evaluate the progress made towards the climate objective. As several instruments interact, it is also hard to distinguish the effect of a single instrument. Furthermore, picking out the effects of policy instruments from the impact of other external changes, such as energy prices, is often complicated.

Yet another difficulty in evaluating policies and measures in Sweden is that instruments which reduce electricity consumption or increase the production of carbon-free electricity have only a limited impact on carbon dioxide emissions inside Sweden's borders, owing to the fact that the electricity market is Nordic/north European and, moreover, has been covered by the EU ETS since 2005.

It should also be noted that, even before 1990, there were instruments in the Swedish energy sector with a similar steering effect to those used after 1990, and through those instruments incentives were created early on for the introduction of bioenergy and an expansion of district heating. For the energy supply sector and the residential and commercial/institutional sector, therefore, it may be difficult to disentangle the additional effects of policy instruments introduced in Sweden after 1990 from the

13 Expressed in terms of primary energy use in relation to gross domestic product (GDP).

effects that might otherwise have arisen if instruments had not been tightened up.

Figure 3.1 illustrates an overall assessment of the impact of economic instruments affecting Sweden's stationary energy system. Forming the basis for the results is the TIMES-NORDIC energy system model, in which a scenario based on policy instruments in place in 1990 has been compared with a scenario reflecting the actual development of instruments (see box 3.3). The different sectors are described in more detail in the relevant sections of this chapter.

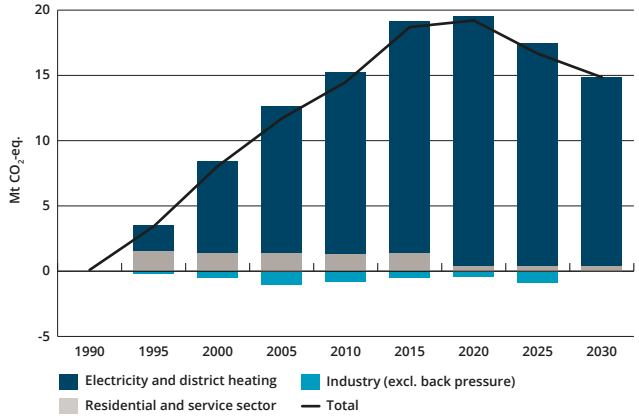

Figure 3.1 Difference in carbon dioxide emissions between a scenario based on 1990 policy instruments and actual development of policy instruments (Profu 2017a)

Box 3.3 TIMES-NORDIC modelling

To assess the effects of economic instruments on Sweden's stationary energy system, results of estimates made with the TIMES-NORDIC energy system model (Profu 2017a). The 'stationary energy system' comprises production of electricity, district heating and process steam, together with final energy consumption in the residential sector, services and industry. The estimates covered two cases:

1. Actual development of policy instruments from 1990 to 2015. Current instruments are subsequently assumed to remain in use up to and including 2030.
2. A '1990 scenario', using the policy instruments in place in 1990 throughout the period studied (1990–2030). In other respects, this case is identical to (1).

Modeling attempts to capture the most important variables that could conceivably influence the outcome we are interested in studying; all modeling therefore necessarily involves a simplification of reality and hence some uncertainty.

3.2.2. Cross-sectoral instruments

EU Emissions Trading System Directive 2003/87/EC

The EU Emissions Trading System (EU ETS) is the EU's most important tool to combat climate change. It was introduced in 2005 and has since been expanded to cover more sectors and greenhouse gases. The rules for monitoring and reporting and for free allocation of allowances have subsequently been improved and harmonized between the EU member states.

The amount of emissions allowed within the system is limited by a cap, which is decreased every year. Approximately half of the allowances are allocated for free to the covered installations, and the rest are auctioned. There is no free allocation for emissions from electricity production.

At the outset, EU ETS covered emissions of carbon dioxide from combustion installations and energy-intensive industries (mineral oil refineries, coke ovens, iron and steel industry, pulp and paper industry, and mineral industry). The scope was extended in 2013 to include new greenhouse gases (nitrous oxide and perfluorocarbons) and some new industrial activities. At present, about 760 Swedish installations are included in the system. At the EU level in total, approximately 11,000 installations are covered.

Emissions from aviation were included in the system in 2012. Because of extensive protests from some countries outside the EU, and pending adoption by the International Civil Aviation Organization (ICAO) of a global market-based instrument, the EU decided on a temporary exemption until 31 December 2016 for flights to and from the EU. This means that the system includes only flights within EU. As ICAO in September 2016 decided to implement a global measure, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), the EU Commission has proposed a continued exemption until the end of the current trading period 2020. Sweden is an Administering Member State for approximately 90 aircraft operators.

Energy tax and carbon dioxide tax

The Swedish system of energy taxation is based on a combination of a carbon dioxide taxan energy tax on fuels, and an energy tax on electricity. The key taxes influencing greenhouse gas emissions in Sweden are the carbon dioxide tax and the energy tax on fuels, which are described below in general and more in detail for each sector.

Carbon dioxide tax

A carbon dioxide tax, based on the fossil carbon content in the fuel, was introduced in 1991 and aims at reducing the emissions of carbon dioxide in sectors outside the EU ETS. The tax has been raised in several steps since it was first implemented. In total, the tax has increased from SEK 0.25/kg (1991) carbon dioxide to SEK 1.13/kg (2017). In addition to specific tax increases stipulated in government bills, a yearly indexation of the tax level is applied.

The tax level is proportionate to the calculated amount of carbon dioxide emissions on the basis of the fuel's fossil carbon content. This means that biofuels currently are not subject to carbon taxation. As regards motor fuels, the Government's budget proposal for 2018 includes changes to carbon dioxide taxation of biofuels (see separate section on carbon and energy taxation in the transport sector).

Due to the risk for carbon leakage, some sectors have a reduced tax or are exempted from the tax.

Energy tax

Taxes on energy have been used in Sweden for a long time.[14] An energy tax on petrol and diesel was introduced in 1924 and 1937, respectively. Fuel used for heating and electricity became subject to an energy tax in the 1950s.

The aim of the energy tax was initially fiscal. In more recent years, the aim has also been to steer energy use towards Sweden's energy efficiency and renewability targets[15]. The energy tax on motor fuels also aims at internalising external costs from the traffic, such as road wear, noise, etc. (National Institute of Economic Research 2013)

The energy tax on fuel varies depending on whether it is used as motor fuel or for heating purposes. The tax level on heating fuels also varies between households, industry and the energy conversion sector.

Carbon dioxide tax and energy tax in the transport sector

Petrol and diesel are covered by both an energy tax and a carbon dioxide tax. In accordance with the climate policy decision in 2009, the energy tax on diesel has been raised in two stages, in 2011 and 2013, by a total of SEK 0.40 per litre (Govt. Bill 2008/09:162). As of January 2016, the energy tax on diesel was increased by another SEK 0.52 per litre and on petrol by SEK 0.47 per litre (Swedish Tax Agency 2016). Since 1994, both energy and carbon dioxide taxes on fuels and electricity are adjusted to changes in the consumer price index (CPI), to take into account inflation. As of 2017, tax rates on petrol and diesel are also adjusted to take into account the development of the gross domestic product (GDP).[16]

Sweden applies tax reductions for sustainable biofuels. The energy tax reduction varies between different kinds of biofuels and is between 36 and 100% compared to fossil counterparts (2017). Since December 2015, sustainable biofuels are fully exempted from carbon dioxide tax. This is a change for blended fuels, such as ethanol blended in petrol and biodiesel blended in diesel, where the previous tax reduction was restricted to no more than 5% by volume.

Ethanol has 88–100% exemption from energy tax depending on whether it is used for low blending in petrol, high blending in petrol (E85) or high blending in diesel (ED95). For FAME in diesel, the deduction is 36% of the normal energy tax. For hydrogenated vegetable and animal oils and fats (HVO) and other biofuels classed as diesel or gasoline, the tax deduction is 100% for both the energy tax and the carbon dioxide tax. This applies to the portion of the fuel made from biomass (Swedish Tax Agency 2017a).

As noted in chapter 4.2.4, the Government's proposal in the Budget Bill for 2018 to introduce an emission reduction obligation scheme is accompanied by a number of tax rule changes for petrol and diesel. In particular, low-blended biofuels that are covered by the reduction obligation scheme will be subject to carbon and energy tax rates that correspond to the rates of their fossil counterparts. At the same time, the carbon tax rates for petrol and diesel are adjusted downwards to take into account the share of low-blended biofuel per litre full blend, following from the emission reduction scheme. In this way, the basic logic behind the carbon tax – to only target *fossil* carbon emissions – is preserved. High-blended biofuels are not covered by the scheme and the proposal is to exempt all high-blended sustainable biofuels from both carbon and energy tax.

Carbon dioxide tax and energy tax for heat production

Heat production is subject to energy tax as well as carbon dioxide tax. Biofuels are exempt from energy tax (Swedish Tax Agency 2017b) and the carbon dioxide tax does not apply since it is based on the fossil carbon content. Since 2013, fuels used for heat production in combined heat and power plants (CHPs) within the EU ETS are no longer subject to the carbon dioxide tax, but pay 30% of the energy tax. Other heating plants within the EU ETS are subject to 100% of the energy tax and 80% of the carbon dioxide tax. CHPs outside the EU ETS pay 30% of the energy tax and 80% of the carbon dioxide tax on fuels used to produce heat (Swedish Tax Agency 2017c). No carbon dioxide tax is charged for fuels used for heat production and supplied to manufacturing processes in industries if the industrial activity is part of the EU ETS.

In the Government's budget proposal for 2018, the carbon dioxide tax on fuels used for heat production in CHP plants within the EU ETS is proposed to be increased from 0% to 11% of the general carbon tax rate. The carbon tax on fuels used for heat production within the EU ETS, other than heat production in CHP plants or in industrial manufacturing processes, is proposed to be increased from 80% to 91% of the general rate. The change is proposed to come into effect on 1 January 2018.

Carbon dioxide tax and energy tax for electricity production

Fuels used for electricity production isexempted from both energy and carbon dioxide taxes, but the use of electricity is subject to energy tax.

Carbon dioxide tax and energy tax in the industrial sector

Industry is subject to some exemptions and reductions in energy and carbon dioxide taxes, basically due to the fact that most of the manufacturing industry is already covered by the EU ETS. One of the main reasons behind the tax reductions is to avoid the application of more than one policy instrument for the same purpose for cost-efficiency reasons. Moreover, reductions and exemptions are applied to avoid carbon leakage. The manufacturing industry covered by the EU ETS pays 30% of the general energy tax and, since 2011, is exempted from the carbon dioxide tax. The manufacturing industry not covered by the EU ETS also pays 30% of the general energy tax on fuels used in industrial manufacturing processes. Earlier, this part of industry had significant reductions in the carbon dioxide

14 Tax on energy is a collective term for excise taxes for fuel and electrical power and is governed by the Act of Excise Duties on Energy (1994:1776).
15 The energy efficiency target and the renewable target for 2020 are part of Govt. Bills 2008/09:162 and 163.
16 This is achieved through a flat-rate increase of 2 percent per year. The combined change in the carbon and energy tax rates is, however, added exclusively to the energy tax rate (i.e. the carbon tax rate is only directly affected by the indexation to CPI).

tax, but in recent years the tax has been raised. In January 2011 the carbon dioxide tax was raised from 21 % to 30 %, in January 2015 to 60 %, and in January 2016 to 80 % of the standard rate of carbon dioxide tax. The carbon dioxide tax reduction will be totally rescinded by 2018.

Carbon dioxide tax and energy tax in agriculture, orestry and aquaculture sectors

Up until 2014 the agriculture, forestry and aquaculture sectors paid 30 % of the general energy and carbon dioxide tax rates on fossil fuels used for heating purposes. Since then, the carbon dioxide tax reduction in the sectors has been reduced in steps. As for industry, the tax was increased to 60 % of the standard rate in January 2015 and to 80 % in January 2016, and the reduction will be totally rescinded by 2018.

A special reimbursement for carbon dioxide tax on diesel for machinery in agricultural, forestry and aquaculture activities was lowered in a stepwise manner from SEK 2.10 per litre (2011) to SEK 0.90 per litre in 2015. However, in 2016 the repayment was increased to SEK 1.70 per litre for the period until the end of 2018, when the repayment will be SEK 1.43 per litre.

In addition to a general relief of the carbon dioxide tax, enterprises could up until 2014 claim a further reduction under what has been known as the 1.2-percent rule. This tax relief has primarily taken effect for enterprises in the greenhouse horticulture sector. This tax relief ended in January 2015.[17]

Local Climate Investment Program

To further stimulate the reduction of greenhouse gas emissions, a program for local investments was introduced in 2015 (the Climate Leap). The Swedish Environmental Protection Agency (Swedish EPA) administers grants for local and regional investments to cut greenhouse gas emissions. Investments in all sectors, except those included in the EU ETS, and all types of organisations are eligible to apply for grants. Investments in sectors included in the EU ETS may still be eligible for grants if these result in an increased utilisation of waste heat. Applicants compete based on the estimated greenhouse gas reduction of each investment.

The program granted approximately SEK 2 billion during 2015–June 2017. The total allocated budget for 2016–2018 was SEK 600 million annually. In 2016 the Government decided to increase the budget and extend the program, totalling SEK 700 million annually for the period 2017–2020. In spring 2017, the budget was increased for the same year with an additional SEK 500 million. In the budget proposal for 2018, the Government proposes to increase the budget with an additional SEK 800 million, and the indicative budget for 2019 and 2020 by SEK 1300 million and SEK 2300 million respectively.

During September 2015 through June 2017, the Swedish EPA made decisions on grants to 1 035 investments totalling ca SEK 4.65 billion, of which 43 % were covered by the grants.

Effects of the Local Climate Investment Program

In total, the investments granted up until 20 June 2017 are expected to generate a reduction of approximately 0.7 Mt CO_2-eq. per year during the technical lifespan of the investments[18]. The total effect of these investments is estimated to be over 10 Mt CO_2-eq. during the technical lifespan of the investments. It should, however, be noted that the measures in the investment program are of different character, including enabling activities for vehicle shifts such as infrastructure investments and supply of biofuel. Hence, all emission reductions cannot not be attributed to this policy instrument alone, as other instruments will also affect the emissions. E.g. the electric vehicles need the infrastructure but are also affected by other national and EU policy instruments.

The Environmental Code and planning legislation

General legislation in the area of the environment has been collected in the Environmental Code since January 1999. Among other aspects, the Environmental Code contains general rules for consideration to be observed in all activities and measures that affect the environment. Significant environmentally hazardous activities require obtaining a permit. Greenhouse gas emissions form part of the permit assessment procedure and the Code also includes requirements to use the best available technology. However, effective 2005, issuing emissions limit values for carbon dioxide or limiting the use of fossil fuels for installations covered by the EU Emissions Trading Scheme is no longer permitted.

Measures in the area of public planning chiefly impact emission trends in the longer term and may have significance from this point of view. Measures in public planning are principally governed by the Planning and Building Act (PBL) (SFS 2010:900), but many measures, as for major infrastructure projects, are also covered by the Environmental Code. Since May 2011, the Planning and Building Act introduced new requirements on considering the environmental and climate aspects of planning. The longer term significance of the development of the built environment for energy and transport needs has been increasingly highlighted, and the PBL also made it mandatory to consider inter-municipal and regional circumstances in planning. To enhance the implementation of the requirements in the PBL, the National Board of Housing, Building and Planning published new guidelines in January 2017 for municipal structure planning, aimed at reducing greenhouse gas emissions.

In December 2016 changes to annual report legislation came into force. Large corporations must now comply with new regulations for sustainability reporting. Sustainability reports must include information needed to understand a company's development, position, earnings and the consequences of their operations that concern the environment.

17 The 1.2-percent rule included businesses for which the carbon dioxide tax exceeded 1.2 % of the company's sales value, despite the general reduction of the carbon dioxide tax taken. For the excess amount of tax, only 24 % of the tax that would otherwise have been paid was paid. (Govt. Bill 2009/10:41)

18 The technical lifespan of the investments is in average 16 years.

Climate change communication

The overall objective of climate communication in Sweden is to provide useful knowledge and tools on how to mitigate climate change and adapt to climate change. Moreover, the communication activities are aimed to enhance other climate policy instruments and measures.

Communication on possible measures in different sectors is disseminated through several channels. The Swedish Environmental Protection Agency and the Swedish Meteorological and Hydrological Institute (SMHI) are responsible for gathering and communicating information on climate change, as mandated by the Government.

The Swedish Government has adopted the objective to make Sweden one of the world's first fossil-free welfare states. This ambition requires a mobilisation of the entire society, not least municipalities, cities and business. To that end the government has launched the Fossil-Free Sweden initiative which mobilises and supports key actors in their climate efforts by providing a platform for dialogue, cooperation and inspiration between themselves and the Government. It is furthermore an arena where difficulties and complications can be discussed and brought to the government´s attention. (Fossilfritt Sverige 2017)

Dialogue and cooperation with stakeholders also take place within other Government initiatives such as the Strategic innovation partnership programs, Smart Industry – a strategy for new industrialisation for Sweden and the National Forest Program.

Furthermore, the Swedish Energy Agency provides financial support to municipal energy and climate advisory services, and to regional energy offices. The local climate and energy advisers, which are present in nearly all Swedish municipalities, aim to provide objective and locally adjusted information and advice about energy-efficiency measures, energy use and climate-related issues in buildings and households.

Moreover, in agriculture and forestry, advice and training for landowners and managers play a major role in, for example, reducing climate gas emissions from manure management and use, and improving energy efficiency. The Swedish Board of Agriculture maintains an informative website covering both global aspects of climate change and issues relating to biodiversity and the individual farmer. The Swedish Forest Agency has a website providing information on the climate and, in particular, guidance on climate adaptation to forest owners.

On a regular basis, the Swedish EPA conducts surveys that measure public awareness and attitudes towards climate change. The 2015 survey found that 8 out of 10 Swedes state that they can contribute to mitigation of greenhouse gas emissions. Swedes demonstrate a very high level of readiness to reduce their own greenhouse gas emissions, and a growing number have done something in their everyday lives to reduce their climate impact.

Research and development

Public investment in climate-related research and development are aimed at creating better prerequisites for achieving the substantial longer term emissions reduction required. Swedish climate-related research covers a broad spectrum, from natural sciences to humanities, but with an emphasis on technical and scientific research and development.

Energy and climate issues are closely linked, and the solutions to the challenge of climate change are largely energy-related. The overall objective of energy research and innovation in Sweden is to contribute to fulfilling the national energy and climate objectives, the long-term energy and climate policy, and energy-related environmental objectives.

In the budget bill for 2017 (Govt. Bill 2016/17:1), which has been approved by the Parliament, the Government proposed an expansion of contributions to energy research and development with funding of SEK 620 million for 2017–2020. This will result in a level of SEK 1.6 billion as of 2020, compared with the earlier level of SEK 1.3 billion.

The Swedish Energy's research and innovation program is based on Government Bill 2016/17:66 (Research and innovation in the energy sector for sustainable ecology, competition and security of supply). It takes its starting point in five different societal challenges:

- A 100% renewable energy system
- A flexible and robust energy system
- A resource-efficient society
- Innovation for jobs and climate
- Collaboration in the energy system

Following these five societal challenges, energy research and innovation is carried out under nine different thematic areas: the transport system, bioenergy, buildings in the energy system, power systems and electricity generation, industry, a sustainable society, general energy system studies, business development and commercialisation as well as international collaboration.

Alongside the Swedish energy research and innovation program, climate-related research is also being financed by other national research funding programs. In Government Bill 2016/17:50 (Knowledge in cooperation – for challenges in the society and strengthened competitiveness), climate is listed as one of several societal challenges that require special contributions. It has therefore been decided to establish a National ten-year Research Program for Climate and to increase funding by SEK 130 million by 2020.

3.2.3. Energy – production of electricity and district heating and residential and service sector

Energy Efficiency Directive 2012/27/EU

The Energy Efficiency Directive came into force in December 2012, replacing the Energy Services Directive and the Cogeneration Directive 2004/8/EC. The Directive establishes a set of binding measures to help the EU reach its 20% energy efficiency target for 2020. Under the Directive, all EU countries are required to use energy more efficiently at all stages in the energy chain from production to final consumption.

To adapt Swedish regulations to the Directive, the following changes were implemented: i) Large enterprises must conduct an energy audit every fourth year; ii) electricity suppliers must invoice customers for the measured consumption of electricity, if the supplier has access to measurements; iii) new requirements are established on the measurement of energy consumption in apartments; and iv) requirements are tightened on authorities to use energy more efficiently. The main part of the new legislation came into force 1 June 2014(Govt. Bill 2013/14:174). Moreover, changes were made in the Electricity Law (Govt. Regulation 2014:1064) requiring network operators to adjust tariffs and other practices to promote energy efficiency.

Renewable Energy Directive 2009/28/EC

The EU has adopted a binding target requiring an increase in the percentage of renewable energy currently at 8.5% to 20% of total energy use over the period 2005–2020. Responsibility for attaining this target has been shared among the Member States. According to this burden sharing, Sweden has to increase its share from just under 44% (2007) to 49% in 2020. This is one percentage point lower than the national target for the same year. With policy instruments already decided upon and planned, and with latest projections, Sweden appears capable of fulfilling its commitment to the EU and meeting the national RES target. In fact, Sweden reached the EU commitment (49%) and the national target (50%) back in 2012. Since then, the use of renewable energy has increased to a level of 54% in 2015.

Production of electricity and district heating

The production of district heating has risen approximately 50% since 1990. At the same time, emissions from this source have remained relatively stable, as the expansion largely has been achieved by the increased use of biofuels, while the use of oil and coal has declined. The carbon dioxide tax is one of the main factors behind this trend, but the electricity certificate system is also important in phasing out fossil fuels in the sector. The low emissions from electricity generation are explained by the fact that nuclear power and hydropower account for a dominant share of production, while additional production of electricity in recent years chiefly comes from biomass-fired combined heat and power plants (CHPs) and wind power.

Electricity certificate system

An electricity certificate system aiming to support electricity based on renewable energy was introduced in 2003. In October 2015, the Swedish Parliament approved a new target; as a result, Sweden will finance more renewable electricity production within the electricity certificate system – totalling 30 TWh by 2020 compared with the 2002 level. In addition, a new target has been set to increase the production with another 18 TWh by 2030. The electricity certificate system was also prolonged up until 2045. (Govt. Bill 2016/17:179) The increase of renewable electricity production through the electricity certificate system is a key element in the Swedish action plan to attain the country's renewables targets for 2020 and 2040.

As of 1 January 2012, Sweden and Norway have a common electricity certificate market. In order to implement Sweden's more ambitious goal, Sweden and Norway reached an agreement in modifying the common target from 26.4 TWh to 28.4 TWh by 2020 compared with the 2012 level. The new target for 2030 has also been agreed with Norway (Govt. Bill 2016/17:187).

Conceptually, the system works as follows. Electricity suppliers are obliged by law to submit electricity certificates corresponding to a certain share, or quota, of their electricity deliveries. The quota is gradually being increased yearly up to 2020. Electricity producers are allocated a certificate from the central government for every megawatt-hour (MWh) of renewable electricity produced. The producers are allowed to sell the certificates in an open market where the price is set by the seller and buyer. The certificates thereby provide extra profit for the producers of renewable energy. (SFS 2011:1200)

Initiatives for wind power

The prospects for additional wind power generation have been improved by increased experience and technical development, which have resulted in lower wind energy costs. Furthermore, different programs have promoted the dissemination of knowledge and information about wind power. An example is the research program Vindval, which aims to collect and provide scientific knowledge about wind power's impacts on humans and on nature (Swedish EPA 2017a).

Since 2004, certain land and water areas in Sweden have been designated as areas of national interest for wind power. There are 313 such areas in Sweden, of which 284 are located onshore and 29 offshore. The most recent update was carried out in 2013 and four areas were added in 2015. The total area of these national interests for wind power is roughly 7,900 km^2, representing about 1.5% of the country's land area, including Swedish waters. (Swedish Energy Agency 2017a)

In the budget proposal for 2018, the government proposes a new initiative for support to municipalities in order to facilitate wind farms.

Support for solar power

A subsidy for installations of photovoltaic cell technology was initiated in 2009.

The budget for this support is set at SEK 1,395 million for the period 2016–2019. In the budget proposal for 2018, the Government has proposed an increased budget for this support, to SEK 3,34 billion for the period 2017–2020. All types of players can obtain financial support for installing grid-connected photovoltaic, solar electricity and solar hybrid systems. The investment aid contributes to the transformation of the energy sector and to business development of solar energy technology.

Tax relief for micro-production of renewable energy

A tax reduction for households and businesses was introduced in 2015 to stimulate investment in the micro-

production of renewable electricity. The income tax reduction is SEK 0.60/kWh renewable electricity fed into the grid in a connection point with a fuse size of up to 100 amperes, but not more kWh than received from the grid in the same connection point. The tax reduction is capped at SEK 18,000 per year.

Effects of policy instruments in the electricity and district heating sector

Estimates using the TIMES-NORDIC modelling tool (see Box 3.1) show that emissions from the electricity and district heating sector (including back-pressure power) could have been 11–18 Mt CO_2 higher per year in the time period 2005–2015 if policy instruments had remained at their 1990 levels (see Table 3.1). The difference in modelled emissions is due above all to significantly greater use of coal in the scenario based on 1990 instruments than in the one based on current levels of instruments, in which fossil fuels have been replaced by renewables.

In summary, the influence of policy instruments in the sector has led to increased costs for fossil fuels at the same time as the conditions for biofuels and wind power for electricity production have improved. After 2005 the impact of the policy instruments on the fossil fuels for CHP has been the same as, or even less than, in 1990. Low prices in the EU ETS strengthen this picture. However, thanks to the electricity certificate system, which is bringing in incentives for renewable fuels, the fossil fuels are kept away. The total effect is thereby, for the period 1990–2030, a strong drive away from fossil fuels. (Profu 2017a)

Table 3.1 Estimated aggregate effects of policy instruments introduced since 1990 on emissions from electricity and district heating production in Sweden, compared with a scenario based on 1990 instruments (Mt CO_2 eq per year) (Profu 2017a)

2005	2010	2015	2020	2025	2030
11	14	18	19	17	14

Residential and service sector

Greenhouse gas emissions from heating individual homes, and commercial and institutional premises (heating other than district heating), have fallen dramatically since 1990. The energy and carbon dioxide taxes are seen as the instruments contributing most to reducing the use of fossil fuels in this sector in recent decades. The aggregate level of taxes on fossil fuel use for heating in the sector has risen steadily since 1990. This has made it considerably more expensive to use these fuels than if energy taxation was kept at its 1990 level (Profu 2017a). Oil prices and the available technologies for fossil-fuel substitutes have also had significant impact on trends in the sector.

Alongside carbon dioxide and energy taxes, there are several instruments targeting energy use in homes, and commercial and institutional premises. Some of the most important ones include building regulations, energy performance certificates, and the Ecodesign, Energy Labelling and Energy Efficiency Directives. In addition, there are instruments such as technology procurement, network initiatives and information campaigns at the local, regional and national levels.

Ecodesign Directive (2009/125/EC), Energy Labelling Directive 2010/30/EU and the Ecodesign Act

Mandatory energy labelling of domestic appliances has been in force in the EU since 1995. Since 2005, energy labelling has been further developed through the Ecodesign Directive (revised 2009/125/EC) and the Energy Labelling Directive (2010/30/EU), which set combined energy efficiency requirements and other environmental aspects for products and energy label requirements. In principle the Directive applies to all energy-related products (except transport) and covers all energy sources.

In Sweden, the Ecodesign Act (SFS 2008:112) came into force in 2008. Under the Act, energy consumption and other environmental factors are important parts of product development when minimum requirements are established. Further, Sweden is particularly active in market surveillance activities, involving laboratory tests of products as well as supervision of distributors.

Energy Performance of Buildings Directive 2010/31/EC

The Energy Performance of Buildings Directive is a framework within which EU Member States have decided on requirements for setting minimum energy performance standards, building energy certificates and inspections or advice on boilers and air conditioning systems. The aim of the directive is to reduce greenhouse gas emissions from the EU Member States and secure the energy supply in the medium and long term.

Energy Performance Certificate Act

Based on the Energy Performance of Buildings Directive, Sweden has implemented a law on energy performance certificates for buildings (SFS 2006:985). The law includes an obligation for owners of single-family and multi-dwelling buildings and of commercial premises to declare the energy use of buildings and certain parameters regarding the indoor environment. The aim is to promote efficient energy use and a healthy indoor environment by requiring property owners to learn more about which measures are cost-effective to implement for improving building energy performance.

Building regulations

Building regulations have been used since the 1960s to set minimum requirements for energy use in new buildings in Sweden. Building regulations for new production underwent a major change in 2006, including stricter requirements for electrically heated buildings effective 2009. The energy requirements for new buildings were revised and took effect in 2012, with a stepwise implementation period. These stricter requirements apply to energy use in buildings with heating systems other than electric heating (for which requirements were made stricter in 2009). Specific energy use (kWh/m^2 and year) and average thermal transmittance (W/m^{2}K) are now nearly 20 % stricter.

Support for renovation and energy efficiency of rental apartments

In October 2016, a new support scheme was introduced to incentivise renovation and energy efficiency of rental apartments in areas with socioeconomic challenges (SFS 2016:837). The Government allocated SEK 800 million to the scheme in 2016, and another SEK 1 billion will be set aside annually for the period 2017–2020. The support for energy efficiency is calculated based on the estimated level of energy efficiency after the renovation. Only cases in which the efficiency is improved by at least 20 % are eligible to receive support, and only projects including both renovation and energy-efficiency measures are approved.

Training programs in building for low energy consumption

Since 2016, the Swedish Energy Agency in cooperation with other actors has been responsible for a set of capacity building programs in the area of building for low energy consumption. The programs target different construction stakeholders, such as architects, engineers, clients, technicians, installers, site managers and teachers in building programs at upper secondary schools. (Swedish Energy Agency et.al. 2016)

Support for market introduction, technology procurement and networks

Technology procurement is an instrument designed to initiate a market transition and disseminate new, more efficient technology, such as new products, systems and processes. Network-based procurement of technology is an approach that encompasses the entire decision-making process, from feasibility study and purchaser group, to requirements specification and dissemination and further development of more energy-efficient technology. It is being used in areas like heating and control, ventilation and lighting. The Swedish Energy Agency coordinates procurement networks for housing (BeBo), commercial and institutional premises (BeLok), small houses (BeSmå), public sector bodies that rent premises (HyLok) and food distribution (BeLivs).

Effects of policy instruments in the residential and service sector

Between the early 1990s and the present day, carbon dioxide and energy taxes have helped to phase out oil-based and electric heating. The aggregate level of taxes on fossil fuel use for heating in the residential and service sector has risen steadily since 1990, making it considerably more expensive to burn these fuels than it would have been if energy taxation had been kept at its 1990 level (Profu 2017a). This is shown in figure 3.2.

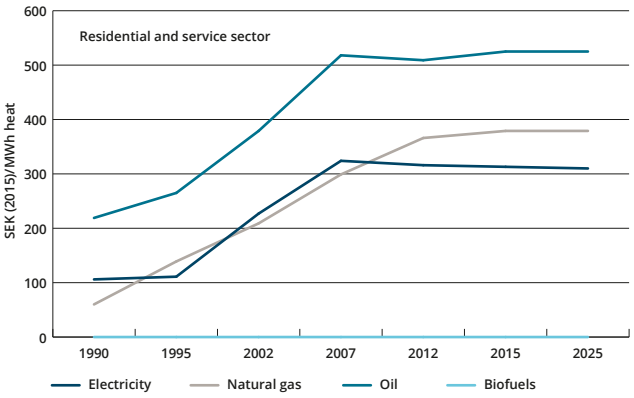

Figure 3.2 Policy instruments affecting light fuel oil, biofuels, natural gas and electricity in the residential and service sector: development between 1990 and 2015, and model assumptions for 2025 (constant 2015 prices) (Profu 2017a).

Analysis of model estimates based on TIMES-NORDIC shows that drivers for a switch to other heating options exist in both the scenario retaining 1990 policy instruments and the one based on current levels of instruments, but that the incentive to replace existing oil-fired heating is greater in the scenario in which taxes have been developed and raised to today's levels. By 2025, according to the model's scenarios, fossil based heating will be phased out altogether in the residential sector with current instruments, whereas there would still have been a certain proportion of fossil fuels left if instruments had remained at 1990 levels (Profu 2017a).

Table 3.2 Estimated aggregate effects of policy instruments introduced since 1990 on emissions from residential and service sector in Sweden, compared with a scenario based on 1990 instruments (Mt CO_2eq per year) (Profu 2017a)

2005	2010	2015	2020	2025	2030
1,4	1,3	1,4	0,4	0,4	0,4

3.2.4. Industrial emissions from combustion and processes (including emissions of fluorinated greenhouse gases)

Industrial emissions from combustion and processes

Total emissions from combustion in manufacturing industries are trending downward. The instruments primarily affecting combustion emissions from the industrial sector are the EU ETS, energy and carbon dioxide taxes, the electricity certificate system and the Environmental Code. Industrial process emissions have come almost entirely within the scope of the EU ETS since its expansion for the third trading period (2013–2020). These processes are also regulated by the Environmental Code's requirement to use the best available technology. Recently the initiative "Hydrogen Breakthrough Ironmaking Technology", was granted support to find solutions to the issue of CO_2 emissions in the steel industry.

HYBRIT – Hydrogen Breakthrough Ironmaking Technology*

The private enterprises SSAB, LKAB and Vattenfall have initiated a project with the aim to solve the issue of emissions of carbon dioxide from the steel industry. A feasibility study for the project was granted SEK 7.7 million and in February 2017 a resolution was passed to finance a 4-year long research project under The Swedish Energy research and innovation program (Govt. Bill 2016/17:66). The Swedish Energy Agency is administering the governmental grants. At the same time, the three companies behind the initiative, SSAB, LKAB, and Vattenfall, have decided to form a corporate joint venture to spur on this initiative.

The research project will investigate processes such as fossil fuel-free pellet manufacturing, hydrogen-based direct reduction, and the use of sponge iron in electric arc furnaces, along with providing an electrical power supply source for hydrogen manufacturing and storage. The research project has been allocated SEK 99 million, with The Swedish Energy Agency providing SEK 54 million of this amount and the three companies contributing the remaining SEK 45 million. (Swedish Energy Agency 2017a)

Industrial Leap*

In the budget proposal for 2018, the Government has proposed the "Industrial Leap". Under the Industrial Leap, the government will invest SEK 300 million a year from 2018 until 2040 to support the development of technologies and processes to significantly reduce process-related greenhouse gas emissions in Swedish industry. Financial support may be provided for feasibility studies, including detailed design studies, and full-scale investments. Companies with process-related emissions are eligible to apply for financial support for particular projects along with universities and research institutes. The aim of this long-term reform is to support Swedish industry to reduce its process-related emissions to achieve Sweden's long term climate targets. The Industrial Leap will be administered by the Swedish Energy Agency.

Energy audit for large enterprises

The law on energy audit in large enterprises aims at promoting improved energy efficiency (SFS 2014:266)[19]. The law requires large enterprises to conduct energy audit, including information of total energy usage as well as proposals of cost efficient measures to improve the energy efficiency. The audit must be conducted at least every fourth year.

Grants for small and medium-sized enterprises for energy audit

To stimulate a more efficient use of energy, small and medium-sized enterprises[20] are since 2010 eligible to apply for financial support to conduct energy audits (SFS 2009:1577). The energy audit should include energy mapping, proposals of measures and an energy plan. Up until 2014 the maximum support per entity was 50%, with a maximum of SEK 30,000. Since 2015 the grant ceiling was increased to SEK 50,000 with the percentage remaining at the same level.

Energy and climate coaches for small and medium-sized enterprises

Since 2016 municipalities are eligible to apply for the cost of one half-duty climate and energy coach (SFS 2016:385). The coach provides targeted advisory services to small and medium-sized enterprises[21]. One round of applications was completed during 2016 and the coaching activities will start in 2017. The support is available until 2019. The coaching activities aim to increase energy efficiency and reduce greenhouse gas emissions. By doing this, the enterprises will benefit from reduced costs, strengthened competitiveness and new opportunities for growth. (Swedish Energy Agency 2017b)

Energy efficiency networks for small and medium-sized enterprises

The Swedish Energy Agency initiated a network project for small and medium-sized enterprises in 2015. The goal is to operate 40 networks with a total of 400 companies, supporting them to introduce energy management principles with the help of regional coordinators and energy experts. Sharing experiences and learning from each other within and between the networks are also important success factors. The aim of the network activities is to reduce the energy use of the participating companies by 15%. By doing this, the enterprises will benefit from reduced costs, strengthened competitiveness and new opportunities for growth. (Swedish Energy Agency 2017c)

Effects of policy instruments in the industrial sector

According to estimates made using the TIMES-NORDIC modelling tool, the effect of economic policy instruments on combustion-related emissions in this sector would have been somewhat greater if 1990 policy instruments had been retained. The difference in emissions between the 1990 scenario and current instruments scenarios is consistently small. This is mainly due to that Sweden already in 1990 applied energy tax in the sector. In 1991, the carbon dioxide tax was added to the tax system by a major tax reform, which included lowered levels of the energy tax and tax reductions for the industry. In 2005, most of the industries became part of the EU ETS in which the allowance prices have been kept at a relatively low level. (Profu 2017a)

Directive and regulation governing emissions of fluorinated greenhouse gases

EU Regulation (No 517/2014) on fluorinated greenhouse gases and BREF

The EU Regulation (No 517/2014) on fluorinated greenhouse gases (F-gases) entered into force on 1 January 2015. The regulation strengthens measures from former EU Regulation No 842/2006 on F-gases, including

19 The law is part of fulfilling the EU Energy Efficiency Directive, EED (Directive 2012/27/EU)
20 Businesses using more than 300 MWh of energy annually, farms with at least 100 livestock units and economical organizations are eligible for the support.
21 Businesses using less than 300 MWh.

hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6). The regulation aims to cut emissions by two-thirds from current levels by 2030; it includes provisions for the use, reuse and destruction of f-gases and imposes conditions on the market introduction of specific products and equipment that contain, or whose function relies upon, F-gases. Most importantly, the regulation includes a mechanism for quantified emission reductions of substances containing HFCs, with a gradual decreasing cap for the total HFC emissions.

The EU adopted a Best Available Techniques reference document (BREF) for the non-ferrous metal industry in June 2016. Within four years of adoption, the specified performance requirements are to be met. These could significantly reduce emissions from aluminium production.

Swedish Regulation 2016:1128 on fluorinated gases

Swedish Regulation 2016:1128 on fluorinated gases, which replaces Regulation 2007:846 (see Swedish second Biennial Report), complements the EU regulation. Provisions in Sweden for cooling and air conditioning and heat pump equipment include:

- Requirements on leak checks in conjunction with installation, conversion and other interventions.
- Requirements on leak checks and certification also apply to mobile equipment containing f-gases.
- Results of periodic inspections must be reported to the supervisory authority.
- The supervisory authority must be informed before the installation of equipment containing more than 14 tonnes of CO_2-eq. refrigerants.
- It is prohibited to sell f-gases as refrigerants to recipients other than those stated in the regulation.
- Importers and those who transfer refrigerants are required to accept delivered refrigerants for disposal and provide containers for this purpose, at no charge to the buyer.
- Equipment manufactured, imported or brought into Sweden must have accompanying operating and maintenance instructions that are accurate and easy to understand.

3.2.5. Transport

Emissions from domestic transport, where road transport dominates, increased after 1990, reaching a peak in 2006–2007, and have been declining as the share of renewables used has risen.

The decrease in emissions since 2006 can be attributed to policy instruments introduced both nationally and at the EU level. The most significant ones include emission performance standards for new vehicles, vehicle taxes and vehicle fuel taxes. These have resulted in more energy-efficient vehicles and a greater use of renewable fuels. The Government notes that reducing transport-related emissions is essential to meet the climate targets set by the Swedish Parliament. Consequently the Government proposes several policies and measures aimed at the transport sector in the budget proposal for 2018. Lately the local climate investment program has granted support for infrastructure for the introduction of electrical vehicles. Further, in the budget proposal for 2018, the Government proposes the introduction of a bonusmalus-system for new light vehicles and an emission reduction obligation for petrol and diesel to further spur emission reductions in the transport sector. Moreover, the Government proposes that a tax on air travel will be introduced with the aim to reduce the climate impact of aviation.

Aviation

Tax on air travel

In the budget proposal for 2018, the Government proposes that a tax on air travel will be introduced with effect from 1 April 2018. A tax on air travel aims to reduce the climate impact of aviation. The proposed tax has been designed as a tax on commercial flights and will be paid for passengers travelling from a Swedish airport. The airline that carries out the flight shall be liable to tax. Various levels of tax (SEK 60, 250 and 400) will be levied based on the final destination. The Swedish Tax Agency will be the competent tax authority.

Aviation in the EU Emissions Trading System

Aviation is included in the EU Emissions Trading System as of 2012 in accordance with EU Regulation No 421/2014 of the European Parliament and of the Council of 16 April 2014 amending Directive 2003/87/EC.

Road transport

Emission reduction obligation (Fuel change)*

In the budget proposal for 2018, the Government proposes the implementation of an emission reduction obligation, planned to go into effect 1 July 2018, called the *Fuel Change*. The emission reduction obligation puts an obligation on petrol and diesel suppliers to reduce carbon dioxide emissions from petrol and diesel, through increased biofuel blending. The Fuel Change makes an important contribution to the phasing out of fossil fuels in transports. The indicative target to 2030 is to reduce emissions by at least 40 percent, which equals a share of biofuels of about 50 percent. The obligation will replace the current tax exemption for low-blended biofuels, i.e. biofuels covered by the scheme will be subject to the same tax rate per litre as fossil counterparts. At the same time, both the carbon dioxide and energy tax rates are reduced. High-blended biofuels are not covered by the scheme and will be completely exempt from both carbon dioxide and energy tax. (More information about the proposed adjustments of the tax rates are presented in chapter 3.2.2 above.)

Requirements for renewable fuels at filling stations

The availability of renewable fuels has been subject to legislation requiring that filling stations with annual sales of petrol and diesel above a specified level must supply at least one kind of renewable fuel. The law became effective 1 January 2006. This requirement has resulted in an increased number of mainly E85 pumps. As of 1 January 2015, the legal requirements were loosened so that filling stations selling more than 1,500 m^3 of petrol or diesel must supply at least one kind of renewable fuel.

EC Fuel Quality Directive

In April 2009, Directive 2009/30/EC was adopted to revise the Fuel Quality Directive (98/70/EC). It amends a number of elements for petrol and diesel specifications and introduces requirements for fuel suppliers to reduce the greenhouse gas intensity of energy supplied for road transport (low carbon fuel standard). In addition, the Directive establishes sustainability criteria that must be met by biofuels if they are to count towards the obligation to reduce greenhouse gas intensity.

Emission performance standards for new vehicles

Manufacturers selling vehicles in the EU are subject to EU regulations (Nos 443/2009, 333/2014, 510/2011 and 253/2014) that set emission performance standards for new passenger cars and vans as part of the Community's integrated approach to reducing CO_2 emissions from light-duty vehicles. Under these regulations, new passenger cars should not emit an average of more than 130 g CO_2/km by 2015 and not more than 95 g CO_2/km by 2021. New vans should not emit an average of more than 175 g CO_2/km by 2017 and 147 g CO_2/km by 2020.

Differentiated vehicle tax

Since 2006, Sweden has differentiated the annual vehicle tax with respect to the vehicle's carbon dioxide emissions per kilometre. The CO_2-related vehicle tax is SEK 22 per g CO_2/km beyond 111 g CO_2/km in mixed driving. This CO_2 component is multiplied by a factor of 2.37 for diesel cars, since diesel fuel has a lower energy tax than petrol. Cars adapted for alternative fuels such as ethanol and gas, except LPG, are taxed at a lower rate of SEK 11 per g CO_2/km beyond the first 111 g CO_2/km. Light trucks, light buses and campers were also brought into the system of CO_2-differentiated vehicle taxation as of 2011. The taxation of older cars and heavy trucks is mainly based on weight. The main purpose of the differentiation is to make car buyers chose cars with a low climate impact.

Super-green car rebate

Buyers of passenger cars that meet EU exhaust requirements Euro 5 or Euro 6 and emit a maximum of 50 grams of carbon dioxide per kilometre are entitled to a super-green car rebate. The rebate is SEK 40,000 for private buyers of electric cars, and on 1 January 2016 was lowered to SEK 20,000 for buyers of hybrid cars. If the owner is a company or another organisation, the rebate is 35 or 17.5% of the cost difference between the price of a super-green car and a non-super-green car of a similar type. The maximum rebate is SEK 40,000. This rebate mainly aims to contribute to technology development and deployment but also to create public awareness in order to lower barriers for a large-scale introduction of electric and hybrid electric cars in the future. In the budget proposal for 2018, the Government proposes that the super-green car rebate is abolished and replaced by a bonus-malus-system for new light vehicles.

Tax exemption for environmentally friendly vehicles

Sweden offers a tax exemption for environmentally friendly vehicles (EFVs) for new vehicles in their first five years according to a certain definition (SFS 2006:27). As of 1 January 2013, the definition of EFV is related to the car's curb weight and allows heavy vehicles to emit more CO_2 than lighter vehicles. According to the new definition, the highest approved emission level for an average-weight petrol or diesel car (average weight of 1,372 kilos) is 95 g CO_2/km. Flex-fuel vehicles (so called FFVs, powered by ethanol or CNG/CBG) are allowed to emit more CO_2 – an average of 150 g/km – and still be counted as EFVs. Electric cars and plug-in hybrids allowed maximum electricity consumption are restricted to 37 kWh/100 km. The new definition also applies to motor homes, vans and small buses, which were previously not included. In the budget proposal for 2018, the Government proposes that the tax exemption is removed when the bonusmalus-system for new light vehicles is approved.

Lower benefit value on cars with advanced environmental technology

Company-registered cars represent about 50% of new car registrations in Sweden. Approximately 50% of these cars are cars that are registered in the name of a company and made available to employees for private use.

The benefits of private use of a company car are subject to personal income taxes. The value of the benefit corresponds on average to the market value of the cost of owning the car.

Fuel provided by the employer is taxed separately. The value of the benefit corresponds to 1.2 times the market value of the cost of fuel. Hence, employees have an incentive to choose more fuel-efficient cars and to limit the private use of company cars. To increase the incentive to purchase company cars that use environmental technologies, green cars receive relatively favourable tax treatment through the reduction of their benefit value. Typically, the benefit value is reduced to the (lower) level of a similar model without the environmental technology of the green car. This reduction is permanent.

In addition to this reduction, the benefit value of electric cars, plug-in hybrids and cars powered by natural gas (other than liquefied petroleum gas) were provided an extra reduction of 40%, up to a maximum of SEK 16,000 annually until the end of 2016. This additional reduction has been lowered to SEK 10,000, starting in 2017 and applied until the end of 2020.

Electrical bus premium*

Regional public transport agencies are eligible to apply for an electrical bus premium as of 30 July 2016 (SFS 2016:836). The premium, which is administered by the Swedish Energy Agency, applies for electrical busses for public transportation use ordered after 31 December 2015. The size of the premium depends on the number of passengers and whether the bus runs on electricity only or is a hybrid. In total, SEK 350 million has been allocated for 2016–2019. The premium aims to contribute to the national environmental objectives 'Reduced climate impact', 'Clean air' and 'Good built environment' by promoting the market introduction of electrical busses.

Bonus-malus-system for new light vehicles*
In the budget proposal for 2018, the Government proposes the implementation of a bonusmalus-system for the purchase of new light vehicles, planned to go into effect 1 July 2018. Vehicles with low emissions of carbon dioxide will qualify for a bonus at purchase, while vehicles with high emissions of carbon dioxide will be taxed at a higher rate for the first three years. The system will replace the current tax exemption for environmentally friendly vehicles and super-green car rebate.

Local Climate Investment Program (Climate leap)*
In the budget proposal for 2018, the Government proposes a strengthening of the comprehensive investment support called the 'Climate Leap'. Municipalities, companies, organisations and others can apply for investment support for measures to reduce climate impact, to a large extent related to the transport sector. Such as investments in biogas plants or the installation of charging points for electric vehicles (more about the Climate leap in section 3.2.2 Cross-sectoral instruments).

Electric vehicle premium*
In the budget proposal for 2018, the Government proposes an 'electric vehicle premium' to improve the possibilities of commuting and transportation with electric bicycles or electric scooters. The Government is allocating SEK 350 million per year 2018-2020 for a premium that covers up to 25 percent of the purchase price. The electric vehicle premium makes it possible to commute longer distances by bike and will make large groups less car dependent.

Charge at home-grant*
In the budget proposal for 2018, the Government proposes a charge at home-grant. Private individuals receive a rebate equalling 50 percent of costs for buying and/or installing charging stations for electric vehicles in their homes. The maximum rebate is SEK 10 000. The rebate is to be administered by the Swedish EPA. The aim of the rebate is to make it easier and cheaper for households to switch to sustainable modes of transportation.

Urban environment agreements
Urban environment agreements are a scheme for investments in public transport and cycling infrastructure at the regional and local level in Sweden. The scheme commenced in 2015 and will continue until 2018. Municipalities are eligible to apply for grants to cover part of the investment costs for public transport infrastructure. The investment should be coupled with other actions aiming at increasing the long-term sustainability of urban areas and the transport system. These actions can include increased accessibility through public transport, urban planning for increased cycling and walking, lower vehicle speeds, parking policies and pricing. The scheme is administered by the Swedish Transport Administration with a total budget of SEK 2.75 billion. About half of that sum has been granted up to the end of 2016.

Research and demonstration
Swedish agencies are financing several large research projects covering the entire chain from cultivation of raw materials for bio-based motor fuels to the use of new fuels. These include:

- FFI – Strategic vehicle research and innovation
- F3 – Collaboration program for renewable fuels and systems
- SFC – Research on biomass gasification
- Battery funding program
- Energy efficiency in the transport sector program
- Demonstration program for electric vehicles
- Vinnova – Innovations for a sustainable society

Sweden is also involved in the EU Refuel project, which aims to develop strategies for introducing cost-effective alternative vehicle fuels. The project is also investigating potential effects on stationary installations using biofuels.

Consideration of climate in long-term infrastructure planning
In 2016, the Riksdag decided on a new national infrastructure plan for 2018–2029, to be implemented by The Swedish Transport Administration with other actors. The Swedish Transport Administration is responsible for long-term planning of all modes of transport. Planning is undertaken in dialogue with local and regional planning bodies. Under the Planning and Building Act(SFS 2010:900), too, there is a clear requirement to take environmental and climate issues into account in planning.

Eco-bonus system for heavy transports*
In the budget proposal for 2018, the Government proposes the introduction of a temporary Eco-bonus system in order to stimulate the transfer of freight transport by road to shipping. The aim of the system is to reduce greenhouse gas emissions from heavy transports.The Government is allocating SEK 150 million for Eco-bonus over the period 2018–2020.

Effects of policy instruments in the transport sector

Carbon dioxide and energy taxes on fuels
Figure 4.5 shows actual emissions from road traffic between 1990 and 2015 and in 2020 scenario. The figure also shows projected emissions trends up until 2020 without the energy and CO_2 tax increases on fuels implemented since 1990. The estimate of fuel tax increases was made on the nominal tax rate that was in effect in 1990, since the decision to adjust inflationary fuel taxes was taken in 1994. The overall emissions impact of tax increases on diesel and petrol is estimated in 2010 to total about 2 million tonnes of CO_2/year and for both years 2015 and 2020 have an effect of approximately 2.3 million tonnes CO_2/year lower emissions compared to a scenario that retained the 1990 nominal tax level.

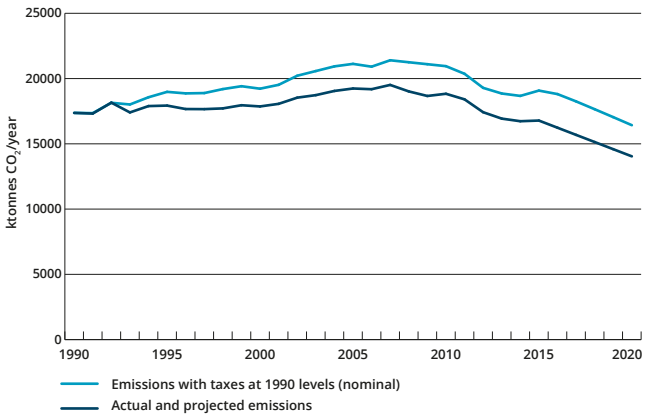

Figure 3.3 Greenhouse gas emissions from road traffic 1990–2015 and projection to year 2020 with fuel taxes decided (nominal prices), compared with estimated emissions if fuel taxes had been retained at 1990 levels.[22] (SPBI 2017) (Swedish Tax Agency 2017b) (Swedish EPA 2017).

Tax exemption for biofuels

Incentives for biofuels have been crucial for their use, since they are more expensive to produce than fossil fuels. Biofuels that are verified as sustainable are not subject to the CO_2 tax. They also enjoy a lower energy tax, the amount of which varies depending on biofuel type (see section 3.2.2). Figure 3.4 shows actual emissions from road traffic 1990 to 2015 and from there a scenario to 2020, and the emissions figures without the use of biofuels. The effect of biofuel use in 2010 totalled about 1 million tonnes of CO_2/year, 2.5 million tonnes CO_2/year for 2015, and for 2020 is estimated to have an effect of about 4.2 million tonnes of CO_2/year[23] lower emissions than if no biofuels had been used.

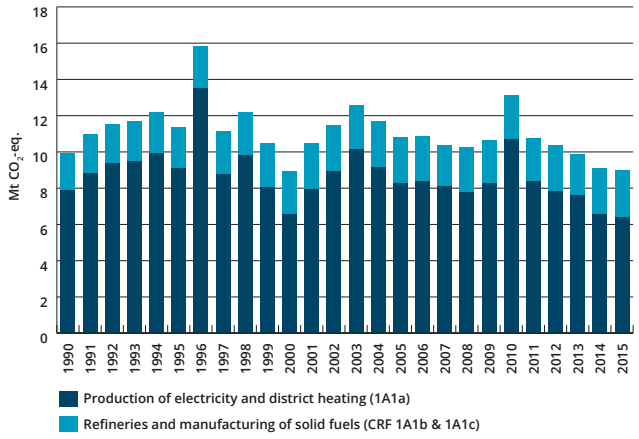

Figure 3.4 Actual emissions from road traffic 1990 to 2015 and from there a scenario to 2020, and the emissions figures without the use of biofuels.

National and EU instruments for energy efficiency

New cars are becoming more and more energy efficient, and emissions from the average car have steadily declined since the mid 1990's with an acceleration around 2005.

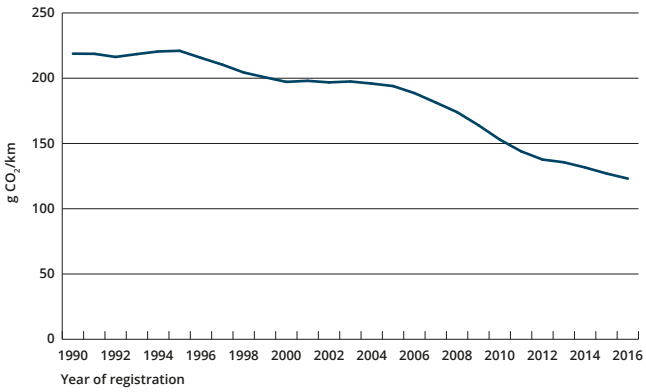

Figure 3.5 Average historic CO_2 emissions from new vehicles

There are several instruments that have interacted to promote the energy efficiency of new cars sold in Sweden. First, several national instruments[24] have been introduced since 2005. Second, the EU has introduced carbon dioxide requirements for new cars. The Swedish Transport Administration has estimated the effect on national emissions of the EU CO_2 requirements for new cars and the national instruments introduced since 2005 that affect car choices. Simplified assumptions have been used to estimate the effect of these instruments. The calculations were made using the HBEFA model, and three different scenarios[25] were analysed from 2005 up until 2035 for the development of the CO_2 emissions of passenger cars and light trucks. The results show that if neither EU requirements nor national instruments were in place and that the efficiency rate of new cars would thus have topped off at 0.5% per year, then 2015 emissions would have been 1.3 million tonnes of CO_2 higher per year. The effect increases over time since EU requirements up to 2021 will have a greater impact and an ever-increasing part of the fleet will be transformed. In 2030, the effect is estimated to have increased to 4.3 million tonnes CO_2/year. The analysis also shows that the short-term impact of emissions is largely due to national incentives, while the long-term impact largely depends on EU requirements.

22 Estimate with sliding elasticities from 0.3 to 0.7 for private transport and from 0.1 to 0.2 for commercial traffic. A simplified method was used that probably slightly overestimates the tax effect.

23 With existing decided policy instruments.

24 CO_2-differentiated vehicle tax, green-car insurance premium, super-green car rebate, tax exemption for environmental friendly vehicles, lower benefit value on cars with advanced environmental technology

25 The first scenario assumes claims from the EU or additional national instruments after 2005 are introduced. The second scenario assumes that only EU requirements were introduced and no other national instruments were introduced after 2005. The third scenario looks at the evolution of EU requirements and national instruments (CO_2-differentiated vehicle tax, green-car insurance premium, super-green car rebate, vehicle tax exemption for green cars, car benefit taxation).

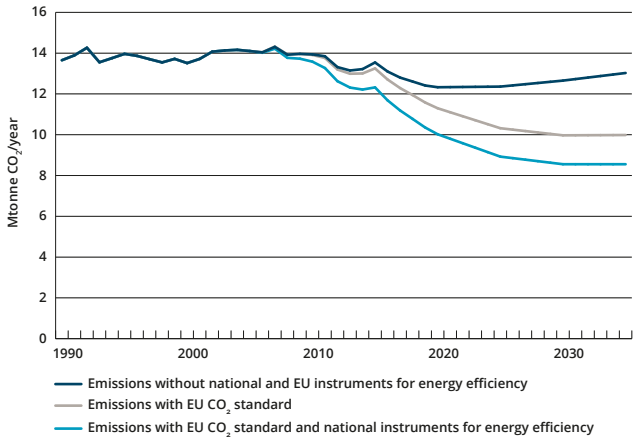

Figure 3.6 Historic and future CO_2 emissions from passenger cars and light trucks in with and without implemented policy instruments

3.2.6. Waste

Methane emissions from landfill sites have declined significantly since 1990 and are expected to continue falling sharply over the next ten years. The factors behind this decline are an expansion of methane recovery from landfills and reduced landfill disposal of organic material, combined with increases in recovery of materials and waste incineration with energy recovery. These measures are a consequence of a series of policy instruments at both national and EU levels. Demand for waste as a fuel for district heating has also strongly encouraged diversion from landfill to incineration.

Landfill Directive (1999/31/EC)

The Landfill Directive requires landfilling of biodegradable waste to be reduced and for methane to be collected from landfills, preferably with energy recovery. Sweden has, however, introduced more far-reaching national instruments resulting in earlier attained emissions reductions.

Landfill tax

In 2000 a tax of 250 SEK per tonne landfilled waste was imposed on waste disposal to landfill(SFS 1999:673). The landfill tax has been increased gradually, and is since January 2015 500 SEK per tonne landfilled waste.

Ban on landfilling combustible and organic materials and methane collection

Under the Swedish Ordinance on the Landfill of Waste (SFS 2001:512), a ban on landfilling combustible materials was introduced in 2002 and a similar ban was imposed for organic material in 2005. The ordinance also regulates the collection and disposal of methane gas from landfills. The ordinance is intended to prevent and reduce adverse effects on human health and the environment from landfilling.

Extended producer responsibility

A set of ordinances mandates extended producer responsibility for producers of eight product groups. Producer responsibility promotes sorting, collection and recycling of certain waste flows[26]. Producer responsibility aims to incentivise producers to develop more resource-efficient products that are easier to recycle and do not contain environmentally hazardous substances. It also aims to reduce the amount of waste. The legislation on extended producer responsibility contains national targets for recycling, and has resulted in increased separated collection of waste fractions and increased recycling (apart from pharmaceuticals and radioactive products, where there are no specific targets).

The municipal waste planning requirement

Since 1991, there has been a requirement that all the municipalities in Sweden must have their own municipal waste plan. A Swedish EPA regulation (NFS 2006:6) sets out the minimum requirements of what each municipality must include in its waste plan, such as a description of the current situation, recycling plants and landfills, environmental assessment, measures and monitoring. Both the national waste plan (Swedish EPA 2012) and the national prevention program (Swedish EPA 2015) act as guidance for the municipalities in developing their local plans and deciding on prioritised actions.

Effects of policy instruments in the waste sector

An analysis of the combined effect of policy instruments influencing methane emissions from landfill sites showed that, in a scenario based on instruments decided on at the time of the analysis, emissions would end up around 1.7 Mt CO_2 eq lower in 2015 than in a scenario based on 1990 instruments. By 2020, the difference was projected to be 1.9 Mt CO_2 eq.

3.2.7. Agriculture

Greenhouse gas emissions from Swedish agriculture have fallen compared to 1990. As yet, there are relatively few economic policy instruments directly targeting greenhouse gas emissions in this sector, other than the general economic instruments. However, the Government has taken several initiatives to reduce fossil fuel use in farming, and to increase awareness and encourage the use of measures to curb emissions of greenhouse gases from manure and fertiliser management and from land use. Apart from using CAP[27]-funding, investments in the agricultural sector have been granted from the Local Climate Investment Program (described in section 4.2.1).

Common Agricultural Policy

In 2013, the Council of EU Agriculture Ministers formally adopted the four Basic Regulations for a reformed Common Agricultural Policy (CAP) as well as Transition Rules for 2014. Based on certain requirements, farmers can receive support for measures aimed at producing non-profitable services delivered to the wider public, such as landscapes, farmland biodiversity and climate change mitigation. Through the CAP's second pillar for rural development member states have access to a wide range of measures to encourage higher environmental performance including climate

26 Extended producer responsibility has been developed for packaging, waste paper, end of life vehicles, tyres, electrical and electronic equipment, batteries, pharmaceuticals and radioactive products.

27 Common Agricultural Policy

mitigation and adaptation. The Policy also requires member states to allocate a minimum share of the second pillar funds to such measures. Rural Development Program 2014–2020.

The Swedish Government decided on a new Rural Development Program in June 2014. The program for 2014–2020 includes investment grants for young entrepreneurs, capacity building, cooperation and innovation, support to areas with natural constraints, animal welfare subsidies, ecological farming, and environmental and climate actions. Measures specifically contributing to climate change mitigation include those aimed at: increasing energy efficiency; production and use of renewable energy (including biogas production and establishment of perennial energy crops); conversion from fossil to renewable energy sources; improved manure handling; more efficient use of nitrogen; climate and energy advice; measures to prevent the risk of nitrogen leakage; restoration and establishment of wetlands; promotion of grass ley and catch crop production in intensive cropping areas; conservation of semi-natural pastures; and other separate projects relating to climate and energy. The program budget totals SEK 36 billion, of which 59 % is financed by Sweden and the remaining 41 % by the EU.

Rural network

The rural network complements the Swedish Rural Development Program, the Ocean and Fishery Program, and the program for local leadership development in the Social fund and Regional fund. The network brings together actors at the local, regional and central levels for exchanging information and experiences. The network is intended to reinforce implementation of these programs.

'Focus on Nutrients' advisory service

Financed by the Swedish Rural Development Program, the Swedish Board of Agriculture offers an advisory service called 'Focus on Nutrients' together with the Federation of Swedish Farmers and the County Administrative Boards of Sweden. The service started in 2001, with an initial focus on advice for higher nutrient efficiency in order to reduce nutrient leaching. Today, it also provides advice specifically targeting GHG emission reductions and energy efficiency as reducing GHG emissions has become one of the main objectives of the service.

Support for biogas production

In January 2015, the Government introduced a support scheme for biogas production through anaerobic digestion of manure. The support aims to increase biogas production from manure and thereby gain two-fold environmental and climate benefits through reduced methane emissions from manure and the substitution of fossil energy.[28] The increased digestion of manure offers several environmental benefits. It reduces both emissions of greenhouse gases and eutrophication of fresh and marine waters as well as produces biogas for energy. The biogas generated can be used to generate electricity or heat, or as vehicle fuel. The subsidy amounts to a maximum of 0.40 SEK/kWh of biogas produced. Between January 2015 and September 2016 a total amount of SEK 69 million was shared among 51 biogas plants. Support for investments in new biogas plants can be granted through the Rural Development Program or the Local Climate Investment Program.

3.2.8. Land use, land-use change and forestry (LULUCF)

Forest Policy and the Forest Act

The Swedish Forestry Act (as of 1993) has two overarching, equal objectives: support production and protect the environment.

The production objective means that forests and forest lands should be used effectively and responsibly so they produce sustainable yields. The direction of forest production should be given flexibility in the use of what the forests produce.

The environmental objective means that the natural productive capacity of forest land should be preserved. Biodiversity and genetic variation in forests should be secured. Forests should be managed in a manner that enables naturally occurring plant and animal species to survive in natural conditions and in viable populations. Threatened species and habitats should be protected. Cultural heritage assets of forests and their aesthetic and social values should be safeguarded.

Under the current Forestry Act, production subsidies are abolished, and forest owners have considerable freedom and responsibility to independently conduct long-term sustainable forest management. The regulations concerning timber production cover the notification of felling, the lowest age for felling, requirements for reforestation, guidelines for thinning and measures to limit damage. Special regulations apply to certain types of forests, such as subalpine forests and deciduous forests. Examples of regulations concerning nature conservation and cultural heritage include not disturbing important biotopes, buffer zones and arable land, and leaving older trees, high stumps and dead wood in situ. Sustainable forest management influences carbon dioxide removals and emissions in various ways, through the production of renewable raw materials that can replace fossil fuels and materials that generate emissions of greenhouse gases while maintaining or increasing carbon stocks in biomass, soils and harvested wood products.

Environmental Code

The Swedish Environmental Code is a coordinated, broad and strict piece of environmental legislation aimed at promoting sustainable development so that present and future generations can live in a good, healthy environment. For example, the Code contains regulations on land drainage. In central parts of the southern Swedish highlands and north of the limes norrlandicus (the biogeographical boundary of northern Sweden), drainage – defined as drainage intending to permanently improve the suitability of a property for a certain purpose – may only be undertaken with a permit. In the rest of the country, and

28 Swedish Board of Agriculture http://www.jordbruksverket.se/amnesomraden/stod/andrastod/godselgasstod.4.ac526c214a28250ac23333e.html

on sites specially protected under the RAMSAR Convention, such schemes are prohibited. Protection and restoration of peatlands with high carbon stocks can reduce emissions of carbon dioxide to the atmosphere.

Provisions on nature reserves and habitat protection in the Environmental Code and nature conservation agreements

Conservation efforts (site protection, nature conservation agreements and voluntary set-aside of land) not only preserve biodiversity, but also positively impact carbon stocks in forest biomass and soil carbon, by allowing them to be maintained or to continue to increase. Protected forest ecosystems, in areas where natural disturbances like forest fires are rare, have a large capacity to sequester carbon, even long after a conservation measure is implemented. There are also targets for the conservation and protection of areas containing both wetlands and forest land. Since such areas are usually excluded from felling, their stocks of carbon in biomass and soil will, in most cases, be larger than those of productive forests.

The Swedish National Forest Program

The supply of sustainable biomass from Swedish forests has an important role to play in the continued transition to a fossil free society. In 2015 the Government initiated a comprehensive dialogue with stakeholders within the Swedish National Forest Program. The program contributes to Sweden's mitigation efforts by establishing goals and actions plans to increase the national supply of bio-based alternatives.

Government advice and training

As part of the 'Forest Kingdom' initiative, the Government allocated SEK 10 million each year during 2012–2015 to strengthen governmental advice and training for increased production and to promote environmental awareness in order to increase the uptake of carbon.

The Swedish Forest Agency provides information to forest owners on how climate change will affect their forests. It also offers guidance adapted to the owners' specific holdings on how to best manage their forests with the owners' specific goals in mind. The Swedish Forest Agency issued a report in 2016 on the effects of climate change on forests and the need for climate change adaptation in forest management. (Swedish Forest Agency 2017)

3.2.9. Shipping and aviation, including international bunkers in Sweden

Tax on air travel

In the budget proposal for 2018, the Government proposes that a tax on air travel will be introduced with effect from 1 April 2018. A tax on air travel aims to reduce the climate impact of aviation. The proposed tax has been designed as a tax on commercial flights and will be paid for passengers travelling from a Swedish airport. The airline that carries out the flight shall be liable to tax. Various levels of tax (SEK 60, 250 and 400) will be levied based on the final destination. The Swedish Tax Agency will be the competent tax authority.

ICAO

Within the ICAO, Sweden and the EU have been pressing for action to limit greenhouse gas emissions from international aviation, using a unified global measure. In September 2016 ICAO decided to implement a global measure, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). Sweden is among the nations that have voluntarily participated in the scheme from its outset.

The EU ETS regulation was amended with an exemption in 2014 so that up until 31 December 2016 the scheme only covered intra-EU/EEA flights. Following the ICAO Assembly in 2016, the EU Commission is revisiting the EU ETS regulation due to the decision on the global market-based measure.

ICAO also adopted a carbon dioxide standard for aircraft in 2017. This new standard consists of a new Volume III in Annex 16 of the Chicago Convention. Implementation of the standard in European legislation is ongoing. The standard includes limits on carbon dioxide emissions from new aircraft (effective 2020) and aircraft in production (effective 2023, production cut-off 2028). Possible savings in the order of 650 million tonnes of CO_2 between 2020 and 2040 due to the new standard have been predicted, but factors like future fuel prices will affect the actual outcome.

In August 2016, Sweden submitted an updated version of its 2015 'State Action Plan on CO_2 Emissions Reduction Activities' to ICAO. The action plan includes a common section for the ECAC area, and a national section dedicated to Swedish initiatives. The action plan describes the measures and policy tools, currently available or planned, to reduce CO_2 emissions from international aviation, including estimated emissions reductions expected.

IMO

In the International Maritime Organization (IMO), Sweden has been one of the countries driving efforts to develop several technical and operational measures aimed at reducing greenhouse gas emissions. An Energy Efficiency Design Index (EEDI) – a standardised way to describe ships' energy efficiency – was made mandatory from 2013 for most (some 85 %) newly built vessels. The EEDI attained by any ship can be compared with a reference level based on an average for existing vessels. Ships whose contracts are placed after 2013 must be at least as energy-efficient as this level. A mandatory Ship Energy Efficiency Management Plan (SEEMP) has also been introduced. This is to be used in ships' management systems to improve energy efficiency in both existing and new ships. In addition, a voluntary Energy Efficiency Operational Indicator (EEOI) has been introduced as a tool and benchmark. This can be used by existing ships.

In April 2015, an EU regulation was adopted on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport. The regulation take effect 1 January 2018 and will apply to all ships above 5,000 gross tonnes in respect to their CO_2 emissions during their voyages to and from ports in the EU. Sweden

is in the process of implementing this regulation. In the IMO, a similar mandatory data collection system for fuel consumption, as well as other additional specified data, was adopted in October 2016. This regulation is expected to enter into force on 1 March 2018 and applies to all ships in the world above 5,000 gross tonnes. These ships account for approximately 85% of CO_2 emissions from international shipping.

The mandatory data collection system is intended to be the IMO's first step in a three-step approach to decrease greenhouse gas emissions from shipping. The second step will be to analyse the data collected, which will provide the basis for the third step: further measures to enhance energy efficiency and address greenhouse gas emissions from international shipping.

In October 2016 the IMO also approved a roadmap (2017 through 2023) for developing a 'Comprehensive IMO strategy on reduction of GHG emissions from ships', which foresees an initial GHG strategy to be adopted in 2018. It contains a list of activities, including further IMO GHG studies with relevant timelines, and provides for alignment of those new activities with the ongoing work on the three-step approach to the ship energy-efficiency improvements mentioned above. This alignment provides a way forward to the adoption of a revised strategy in 2023 to include additional short-, mid-, and long-term measures as required, with implementation schedules. Under the roadmap, and to provide a long-term vision for the shipping sector, the IMO must address several important questions, such as what role the international shipping sector should play in supporting the goals of the Paris Agreement.

In the same October meeting the IMO also agreed to hold an intersessional working group meeting reducing GHG emissions from ships. The first intersessional meeting will be held in June 2017 and a second meeting is planned for autumn 2017. Sweden participates actively and is a member of the High Ambition Coalition for International Shipping.

Sweden also actively promotes the use of alternative fuels, such as LNG and methanol, as well as related infrastructure. Ships using LNG can potentially reduce greenhouse gas emissions up to 30% compared with conventional oil-based shipping fuel. Using LNG also means a low NOx level in the flue gases, and very low sulphur and particulates emissions. The drawback of LNG as a fuel is that it emits a certain amount of methane into the atmosphere. This issue needs to be addressed. In 2015 IMO adopted a regulatory framework for ship operations using gas or other alternative marine fuels with a low flash point, the so-called IGF Code. Sweden is now working to include methanol in this code as another possible marine fuel.

Furthermore, many Swedish ports have invested in infrastructure allowing ships to use shore-side electricity, considerably reducing their emissions. The Port of Stockholm has even introduced attractive incentives for ships using this infrastructure.

All these measures form a part of a national policy framework for development of alternative fuels and related infrastructure, implementing directive 2014/94/EU.

Global warming is driven not only by carbon dioxide, methane and other greenhouse gases. Another type of emissions influencing climate and also having considerable impact on the Arctic environment are emissions of black carbon. The impacts of black carbon emissions from shipping are now under review by the IMO, with a particular focus on the potential impacts of future Arctic shipping. Sweden was one of the countries proposing to set this issue on the IMO agenda and now works actively to identify possible reduction measures.

3.2.10. Efforts to avoid adverse effects of policies and measures introduced as part of the country's climate strategy

Parties under the UN Framework Convention of Climate Change should strive to implement policies and measures in such a way as to minimise adverse effects. These include the adverse effects of climate change, effects on international trade, and the social, environmental and economic impact on other parties, especially developing countries.

Sweden has not made any changes since the sixth National Communication on climate change in the work to avoid adverse effects of policies and measures introduced as part of the country's climate strategy.

Under Sweden's policy for global development (PGD), all policy areas should interact in a coherent way so the country can make an effective contribution to equitable and sustainable global development. When decisions in a given policy area are judged to affect this goal of equitable and sustainable global development, an impact assessment must be carried out. The policy's two perspectives – a rights perspective and the perspective of poor people on development – should serve as a guide. In the framework of the PGD, for example, coordination and collaboration take place through a reference group on trade policy at the Ministry for Foreign Affairs. Regular meetings of this group, which includes representatives of business, the Swedish International Development Cooperation Agency (Sida) and civil society organisations have created a basis for broad consultation on trade policy.

In connection with decision making on policies and measures in Sweden and at the EU level, impact assessments are carried out, including environmental impact assessments. To the extent possible, such assessments include an appraisal of the risk of adverse effects on other countries. Both beneficial and adverse effects need to be taken into account. Sweden is helping to implement a range of measures that could improve the ability of developing countries to adapt to climate change and take action of their own to reduce their greenhouse gas emissions. Finally, Sweden has designed a broad-ranging climate strategy that encompasses many different types of measures and most sectors, both inside and outside the country. This, combined with all the greenhouse gases regulated by the Kyoto Protocol, represents a fundamental effort to minimise the risk of adverse effects.

3.3. Summary of policies and measures

Table 3.3 Summary Policies and measures. Policy/measure marked with '*' are not included in the projections.

Name of policy/measure	Primary objective	Greenhouse gas(es) primarily affected	Type of instrument	Status of instrument	Implementing agency	Estimate of mitigation impact in Mt CO_2 eq per year compared with 1990 instruments			
						2010	2015	2020	2030
Cross-sectoral									
Local climate investment program (Climate leap)	Enhance and speed reduction of greenhouse gas emissions	All	Economic	Ongoing	Swedish Environmental Protection Agency	N.E.	N.E.	N.E.	N.E.
(2015–2020)	Swedish Environmental Protection Agency	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.
Planning and Building Act	Promote sustainable development of society	All	Legislation	Ongoing (2011–	Swedish National Board of Housing, Building and Planning	N.E.	N.E.	N.E .	N.E.
Fossil-Free Sweden initiative	Mobilize efforts from actors to reduce the use of fossil fuels.	CO_2	Information	Ongoing (2015–	Fossilfritt Sverige	N.E.	N.E.	N.E .	N.E.
Climate and energy advice	Greater awareness of possible measures	All	Information	Ongoing (1998–	Swedish Energy Agency	N.E.	N.E.	N.E.	N.E.
Research and development	Development of technology with very low climate impact	All	Economic	Ongoing (1990–	Swedish Energy Agency (mainly)	N.E.	N.E.	N.E.	N.E.
Production of electricity and district heating									
Energy tax	Fiscal, and to improve efficiency of energy use	Carbon dioxide	Economic	Ongoing (1957–	Swedish Tax Agency	14	18	19	14
Carbon dioxide tax	Reduce use of fossil fuels	Carbon dioxide	Economic	Ongoing (1991–	Swedish Tax Agency				
Electricity certificates system	Increase supply of electricity from renewable energy sources	Carbon dioxide	Economic	Ongoing (2003–	Swedish Energy Agency				
EU Emissions Trading System (EU ETS)	Reduce use of fossil fuels in trading sector	Carbon dioxide	Economic	Ongoing (2005–	Swedish Environmental Protection Agency and Swedish Energy Agency				
Initiatives for wind power	Increase supply of electricity from renewable energy sources	Carbon dioxide	Simplifying rules and Information	Ongoing	Swedish Energy Agency	N.E	N.E	N.E	N.E
Support for solar power	Increase supply of electricity from renewable energy sources	Carbon dioxide	Economic	Ongoing (2009–	Swedish Energy Agency	N.E	N.E	N.E	N.E
Income tax reduction for micro production of renewable energy	Increase micro production of renewable energy	Carbon dioxide	Economic	Ongoing (2015–	Swedish Tax Agency	N.E	N.E	N.E	N.E

Name of policy/measure	Primary objective	Greenhouse gas(es) primarily affected	Type of instrument	Status of instrument	Implementing agency	Estimate of mitigation impact in Mt CO_2 eq per year compared with 1990 instruments			
						2010	2015	2020	2030
Residential and commercial/institutional sector									
Energy tax	Fiscal, and to improve efficiency of energy use	Carbon dioxide	Economic	Ongoing (1957–	Swedish Tax Agency	1.3	1.4	0.4	0.4
Carbon dioxide tax	Reduce use of fossil fuels	Carbon dioxide	Economic	Ongoing (1991–	Swedish Tax Agency				
Building regulations	More efficient energy use	Carbon dioxide	Legislation	Ongoing	Swedish National Board of Housing, Building and Planning				
Energy declarations	More efficient energy use	Carbon dioxide	Legislation and information	Ongoing (2006–	Swedish National Board of Housing, Building and Planning				
Ecodesign Directive	More efficient energy use	Carbon dioxide	Legislation	Ongoing (2010–	Swedish Energy Agency				
Mandatory energy labelling	More efficient energy use	Carbon dioxide	Information	Ongoing (1995–	Swedish Energy Agency				
Support for renovation and energy efficiency of rental apartments*	More efficient energy use	Carbon dioxide	Economic	Ongoing (2016–	Swedish Energy Agency	N.E	N.E	N.E	N.E
Training programs in building for low energy consumption*	More efficient energy use	Carbon dioxide	Information	Ongoing (2016–	Swedish Energy Agency	N.E	N.E	N.E	N.E
Technology procurement	More efficient energy use and increased use of renewable energy	Carbon dioxide	Economic	Ongoing	Swedish Energy Agency	N.E	N.E	N.E	N.E
Industrial emissions from combustion and processes									
Energy tax	Fiscal, and to improve efficiency of energy use	Carbon dioxide	Economic	Ongoing (1957–	Swedish Tax Agency	–0.8	–0.5	–0.4	–0.1
Carbon dioxide tax, incl. stepwise reduced carbon dioxide tax relief for industry outside EU ETS	Reduce use of fossil fuels	Carbon dioxide	Economic	Ongoing (1991–	Swedish Tax Agency				
Electricity certificate system	Increase supply of electricity from renewable energy sources	Carbon dioxide	Economic	Ongoing (2003–	Swedish Energy Agency				
EU Emissions Trading System (EU ETS)	Reduce use of fossil fuels in trading sector	Carbon dioxide	Economic	Ongoing (2005–	Swedish Environmental Protection Agency and Swedish Energy Agency				
HYBRIT*	Reduce emissions of carbon dioxide in steel industry	Carbon dioxide	Economic and research	Ongoing (2016–	Swedish Energy Agency	N.E	N.E	N.E	N.E
Energy audit for large enterprises	More efficient energy use	Carbon dioxide	Legislation and information	Ongoing (2014–	Swedish Energy Agency	N.E	N.E	N.E	N.E
Grants for energy audit to small and medium-sized enterprises	More efficient energy use	Carbon dioxide	Economic and information	Ongoing (2010–)	Swedish Energy Agency	N.E	N.E	N.E	N.E
Energy and climate coaches for small and medium-sized enterprises	More efficient energy use and reduction of greenhouse gases	Carbon dioxide	Information	Ongoing (2016–2019)	Swedish Energy Agency	N.E	N.E	N.E	N.E
Energy efficiency networks for small and medium-sized enterprises	More efficient energy use	Carbon dioxide	Information	Ongoing (2015–	Swedish Energy Agency	N.E	N.E	N.E	N.E
Environmental Code	Ecologically sustainable development	All	Legislation	Ongoing (1999-	Swedish Environmental Protection Agency	N.E	N.E	N.E	N.E

Name of policy/measure	Primary objective	Greenhouse gas(es) primarily affected	Type of instrument	Status of instrument	Implementing agency	Estimate of mitigation impact in Mt CO_2 eq per year compared with 1990 instruments			
						2010	2015	2020	2030
Product use									
EU regulation on Fluorinated greenhouse gases and BREF	Reduce use of HFCs	HFCs	Legislation	Ongoing (new directive 2015)	Swedish Environmental Protection Agency	0.2	0.5	0.7	N.E
EU regulation on mobile air conditioning units in cars	Reduce use of HFCs	HFCs	Legislation	Ongoing (2006–	Swedish Environmental Protection Agency				
Swedish regulation on fluorinated gases and ozone depleting substances	Reduce use of HFCs and ozone depleting substances	HFCs	Legislation	Ongoing (new regulation 2016–)	Swedish Environmental Protection Agency				
Transport									
Energy tax, including stepwise increase of tax on diesel and petrol	Fiscal, and to improve efficiency of energy use	Carbon dioxide	Economic	Ongoing (1924–	Swedish Tax Agency	2	2	2.3	N.E
Carbon dioxide tax	Reduce use of fossil fuels	Carbon dioxide	Economic	Ongoing (1991–	Swedish Tax Agency				
Emission performance standards for new vehicles	Reduce carbon dioxide emissions from light-duty vehicles	Carbon dioxide	Legislation	Ongoing (2015, 2017 and 2020)	Swedish Transport Administration	0,4	1.3	2,6	4.3
Targeted instruments: Composition of the vehicle fleet: Differentiated vehicle tax, super-green car rebate, tax exemption for environmentally friendly vehicles, lower benefit value on cars with advanced environmental technology	Increase use of environmental friendly vehicles	Carbon dioxide	Economic	Ongoing	Swedish Tax Agency (mainly)				
Targeted instruments to promote introduction of renewable transport fuels: Energy and carbon dioxide tax reduction for biofuels, Requirements of renewable fuels at filling stations	Increase use of renewable transport fuels	Carbon dioxide	Economic	Ongoing	Swedish Tax Agency (mainly)	1	2.5	4.3	N.E
Local climate investment program (Climate leap)	Enhance and speed reduction of greenhouse gas emissions	All	Economic	Ongoing (2015–2020)	Swedish Environmental Protection Agency	N.E.	N.E.	N.E.	N.E.
Urban environment agreements	Reduce carbon dioxide emissions and incetivise building of public transport	Carbon dioxide	Economic	Ongoing (2015–2018)	Swedish Transport Administration	N.E	N.E	N.E	N.E
Electrical bus premium*	Reduce carbon dioxide emissions and other air polluntants	Carbon dioxide	Economic	Ongoing (2016–	Swedish Energy Agency	N.E	N.E	N.E	N.E
Support for research and demonstration	Develop technology for sustainable growth and reduced fossil fuel dependence	Carbon dioxide	Economic	Ongoing	Vinnova and Swedish Energy Agency (mainly)	N.E	N.E	N.E	N.E

Name of policy/measure	Primary objective	Greenhouse gas(es) primarily affected	Type of instrument	Status of instrument	Implementing agency	Estimate of mitigation impact in Mt CO_2 eq per year compared with 1990 instruments			
						2010	2015	2020	2030
Waste									
Rules on municipal waste planning and on producer responsibility for certain products, landfill tax (2000), bans on landfill of combustible waste(2002) and of organic waste (2005)	Increase recycling and reduce total quantities of waste	Methane	Legislation and fiscal	Ongoing	Swedish Environmental Protection Agency, Swedish Tax Agency (landfill tax)	1,4	1,7	1,9	N.E
Agriculture									
Measures under the Rural Development Program	Reduced Climate Impact, a varied agricultural landscape and zero eutrophication	Nitrous oxide, methane and carbon dioxide	Economic	Ongoing (2014–2020)	Swedish Board of Agriculture	N.E.	N.E	N.E	N.E
Support for biogas production	Reducing emissions of greenhouse gases and production of biogas for energy purposes	Methane	Economic	Ongoing (2015–	Swedish Board of Agriculture	N.E.	N.E	N.E	N.E
The rural network	Reinforce implementation of the Rural Development Program	Nitrous oxide, methane and carbon dioxide	Information	Ongoing	Swedish Board of Agriculture	N.E.	N.E	N.E	N.E
Reduced carbon dioxide tax relief	Reduce use of fossil fuels	Carbon dioxide	Economic	Ongoing (2011, 2013, 2015, 2016, 2018)	Swedish Tax Agency	N.E.	N.E	N.E	N.E
Land use, land use change and forestry (LULUCF)									
Provisions of Forestry Act	Achieve environmental and production objectives for sustainable forest management	Carbon dioxide	Legislation	Ongoing	Swedish Forest Agency	N.E	N.E	N.E	N.E
Provisions of Envionmental Code including land drainage	Biodiversity	Carbon dioxide and methane	Legislation	Ongoing	County administrative boards	N.E	N.E	N.E	N.E
Provisions on nature reserves and habitat protection areas in Environmental Code, and nature conservation agreements	Biodiversity	Carbon dioxide	Legislation	Ongoing	Swedish Environmental Protection Agency and county administrative boards	N.E	N.E	N.E	N.E
Swedish National Forest Program	Increase the national supply of bio-based materials and energy	Carbon dioxide	Information	Ongoing	Swedish Forest Agency	N.E	N.E	N.E	N.E
Advice and training	Increase uptake of carbon	Carbon dioxide	Information	Ongoing	Swedish Forest Agency	N.E	N.E	N.E	N.E

Table 3.4 Policies and measures proposed by the Government in the budget proposal for 2018.

Name of policy instrument	Primary objective	Greenhouse gas(es) primarily affected	Type of instrument	Status of instrument
Cross-sectoral				
Increased budget for the Climate Leap	Reduce greenhouse gas emissions	All	Economic	Planned
Production of electricity and district heating				
Increased carbon dioxide tax for CHP plants within the EU ETS	Reduce greenhouse gas emissions	Carbon dioxide	Economic	Planned
Support to municipalities to facilitate wind farms	Reduce greenhouse gas emissions	Carbon dioxide	Economic	Planned
Increased support for solar power	Reduce greenhouse gas emissions	Carbon dioxide	Economic	Planned
Industrial emissions from combustion and processes				
Industrial Leap	Reduce greenhouse gas emissions	All	Research and market introduction	Planned
Transport				
Tax on air travel	Reduce greenhouse gas emissions	Carbon dioxide	Economic	Planned
Emission reduction obligation	Reduce greenhouse gas emissions	Carbon dioxide	Legislation	Planned
Bonus-Malus system	Reduce greenhouse gas emissions	Carbon dioxide	Economic	Planned
Electric vehicle premium	Reduce greenhouse gas emissions	Carbon dioxide	Economic	Planned
Charge at home grant	Reduce greenhouse gas emissions	Carbon dioxide	Economic	Planned
Eco-bonus system for heavy transport	Reduce greenhouse gas emissions	Carbon dioxide	Economic	Planned

3.4. Progress to quantified economy-wide emission reduction target

This section presents the estimates of emission reductions and removals and the use of units from market-based mechanisms and land use, land-use change and forestry (LULUCF) activities.

For quantification of progress towards the 2020 targets, the change in greenhouse gas emissions is a key indicator. The Convention target for a reduction of emissions by 20% from 1990 to 2020 refers only to emissions of the EU-28 as a whole. Greenhouse gas emissions of the EU-28 are calculated as the sum of Member States emissions. For this, Swedish greenhouse gas emissions are measured as part of the entire EU-28 emissions as a percentage of 1.2% for the year 2015 (submission 2017).

The development of greenhouse gas emissions is reported in CTF Table 4 for Sweden. Emissions in the LULUCF sector are not included under the convention target, and therefore Sweden reports NA in the CTF Tables 4 and 4(a).

Use of flexible mechanisms takes place by operators in the EU Emissions Trading System (ETS) on the one hand, and by governments on the other hand, to achieve the Effort Sharing Decision (ESD) target. More information on use in the ETS is contained in the third Biennial Report of the European Union.

The compliance assessment under the ESD[29] for the years 2013, 2014 and 2015 took place in 2016 and 2017. Sweden did not need to use any units for the compliance since we overachieved our commitment. In CTF Table 4b we report NE.

For the moment, Sweden does not foresee any need to make use of international credits under the ESD. For further information about international credits, see chapter 4.3 in Sweden's seventh National communication.

29 Decision No 406/2009/EC

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4. Projections

This section presents projections of greenhouse gas emissions and removals for various sectors and in total. The information conforms to that submitted in the Seventh National Communication and in Sweden's report to the EU (Ministry of the Environment and Energy, 2017) in accordance with the requirements of the EU decision on monitoring of greenhouse gases (EU Regulation 525/2013). The projections with existing measures are based on the policies and measures currently adopted by the EU and the Riksdag (the Swedish Parliament) up to June 2016.

Model-based calculations and, to some extent, expert evaluations were used to produce the projections. The projections are based on a number of assumptions, all of which are characterised by uncertainty. The results should be interpreted with this in mind. The projections can be mainly regarded as a consequential analysis of the assumptions made. The method for estimating the projections was mainly developed for medium-term or long-term projections, so the projections do not take into account shorter-term variations.

In addition to the projections with existing measures, sensitivity projections have been calculated for emissions in the energy sector and for the road transportation sector. Projections with additional measures are not provided since there were no planned measures in Sweden when producing the projections. However, policies and measures are continuously developed and new measures have been planned since the scenarios were produced, see chapter 3.

4.1. Key parameters and assumptions

In these projections the key parameters and assumptions below are used.

	2013–2035
GDP	2.28
	2035
Crude oil price (USD/barrel)	117
Price of coal (USD/tonne)	110
Price of natural gas (USD/Mbtu)	12
Emissions trading (Euro/tonne CO_2)	42
Electricity certificates (TWh new renewable electricity)	28.4

4.2. Greenhouse gas emission projections

Total greenhouse gas emissions in Sweden in 2015 were 53.7 Mt CO_2-eq. (excluding The Land Use, Land Use Change and Forestry sector) (National Inventory Report, Submission 2017). Total emissions decreased by 25 %, between 1990 and 2015. The projection results point to a gradual decline in total emissions of greenhouse gases

Table 4.1 Historical and projected emissions and removals of greenhouse gases by sector (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Energy excl. transport	33.8	20.8	20.7	20.2	19.3	18.4	-39%	-43%
Transport	19.3	18.2	15.4	14.3	13.6	13.1	-20%	-30%
Industrial processes and product use	7.2	6.4	6.3	6.2	6.1	6.0	-12%	-15%
Agriculture	7.6	6.9	6.4	6.1	5.9	5.4	-17%	-23%
Waste	3.7	1.4	1.1	0.9	0.7	0.6	-72%	-81%
Total emissions	**71.6**	**53.7**	**49.9**	**47.7**	**45.6**	**43.6**	**-30%**	**-36%**
LULUCF	-36.7	-50.5	-43.3	-44.3	-42.2	-40.5	18%	15%

(excl. LULUCF) over the projection period. The projected emissions for 2020 are 30 % below 1990 levels, and by 2030 total emissions are projected to be 36 % below 1990 levels (see Table 4.1).

The LULUCF sector contributed to an annual net removal of carbon dioxide in Sweden during the period 1990–2015 and is expected to continue to do so during the projection period.

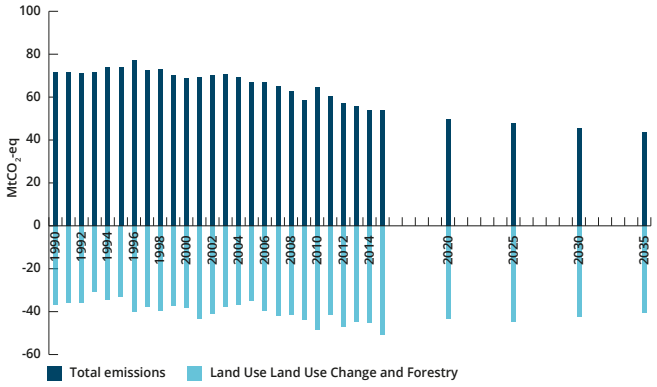

Figure 4.1 Historical and projected emissions and removals of greenhouse gases with existing measures (WEM).

4.3. Projections by gas

In 2015 carbon dioxide emissions accounted for 81 % of greenhouse gas emissions, while methane emissions accounted for just over 9 %, nitrous oxide for almost 9 % and fluorinated greenhouse gases for almost 2 %.

Until 2035, emissions of all gases are projected to decrease. The mix of greenhouse gases is expected to change over the projection period, with a slight increase in carbon dioxide's share of the total (see Table 4.2).

4.4. Projections by sector

The projected trend in emissions differs between sectors. Over the projection period, the emissions from transport, industrial processes and product use, agriculture and waste are expected to decrease until 2035. Emissions from the energy industries increase slightly according to the projection until 2020 and then stabilize and decrease until 2035.

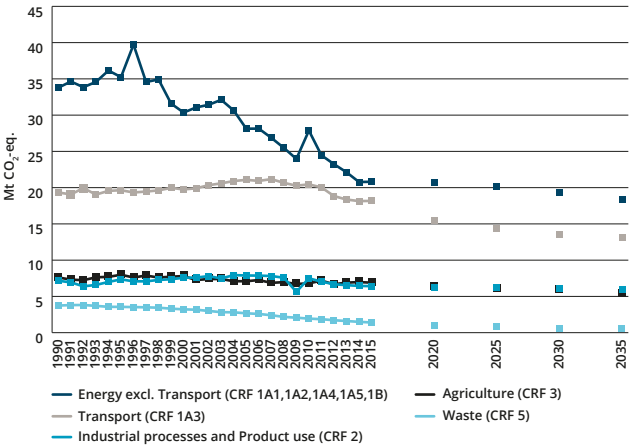

Figure 4.2 Historical and projected emissions of greenhouse gases by sector.

4.4.1. Energy industries (Electricity- and heat production, Refineries, Manufacturing of solid fuels)

Emissions from the energy industries, i.e. production of electricity and district heating, refineries and the manufacture of solid fuels, are projected to increase slightly until 2020 and then stabilize and decrease until 2035. But the projections for the subsectors show differing trends.

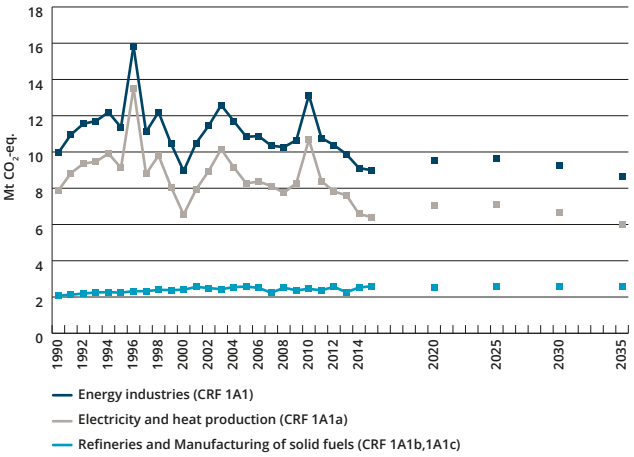

Figure 4.3 Historical and projected emissions of greenhouse gases from energy industries.

The emissions of greenhouse gases from electricity and heat production have varied since 1990, mainly due to temperature variations and precipitation. The production of electricity is expected to increase during the projection period. However, the emissions do not increase to the same extent as production, mainly due to biofuels. The emissions are projected to increase until 2020, then stabilise and decrease from 2030 onwards (see Table 4.3). An increased use of natural gas and waste contributes to the increase in emissions, but the increase is partly offset by increased use of biomass and wind power as well as decreased use of oil and coal. The use of biomass increases in combined heat and power plants especially, which is promoted by the electricity certificate system and the EU ETS. Production of electricity is assumed to grow more than consumption, resulting in a projected export of about 12 TWh by 2020 and 34 TWh by 2030.

Emissions from refineries and manufacturing of solid fuels are projected to continue increasing slightly during the projection period (see Table 4.4). The increase is due to increased production and to increased production emissions due to a shift to products that meet higher quality standards in refineries. The emissions from refineries are also reported in the sector of fugitive emissions.

4.4.2. Residential and commercial

The emissions from households and premises and from combustion in the agricultural, forestry and fishing sectors are projected to continue to decrease (see Table 4.5). The decline is mainly due to a continuing replacement of individual oil-fuelled boilers for heating and hot water purposes in households and premises with district heating, electric heating, heat pumps and biomass. The shift to electric and district heating results in decreased emissions in this sector. On the other hand, emissions from the production of heat and electricity increase. However, since the increased production of electricity and heat is mainly based on biomass and waste and district heating is a more efficient way of heating, the emission increase is limited.

The total emissions from combustion in the agricultural, forestry and fishing sectors are projected to decrease during the projection period. The emissions from energy consumption in the agricultural sector are expected to decrease to some extent during the projection period because of a reduction in the use of diesel fuel for working machinery and a reduction in oil consumption for buildings. The emissions from working machinery in the forestry sector and from fishing are assumed to remain at about the same level as in recent years during the entire projection period.

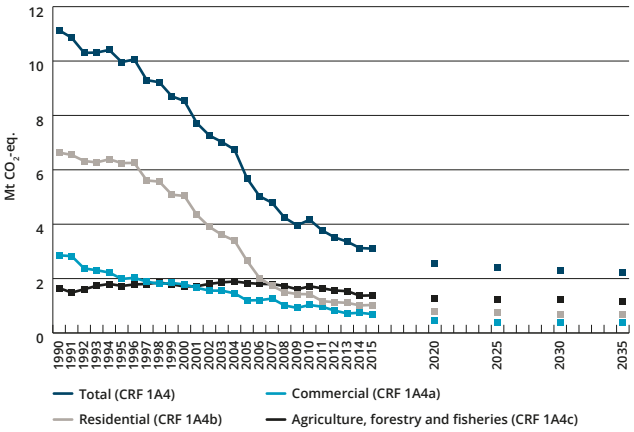

Figure 4.4 Historical and projected emissions of greenhouse gases from combustion in households, premises, agriculture, forestry and fisheries.

4.4.3. Industrial combustion

To cover all industry-related emissions, account needs to be taken of process emissions, emissions from combustion, part of energy industries and fugitive emissions, which according to UNFCCC guidelines are to be reported under separate CRF (Common Reporting Format) categories.

Table 4.2 Historical and projected emissions of greenhouse gases per gas (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	57.5	43.3	40.7	39.1	37.5	36.2	-29%	-35%
Methane	7.6	4.9	4.3	3.9	3.6	3.2	-44%	-53%
Nitrous oxide	5.8	4.6	4.3	4.2	4.1	3.9	-26%	-29%
HFC	0.005	0.8	0.5	0.4	0.3	0.1	11522%	5387%
PFC	0.6	0.04	0.03	0.03	0.03	0.03	-94%	-94%
SF_6	0.1	0.05	0.05	0.05	0.05	0.06	-51%	-51%
Total emissions (excl. LULUCF)	**71.6**	**53.7**	**49.9**	**47.7**	**45.6**	**43.6**	**-30%**	**-36%**

Table 4.3 Historical and projected emissions of greenhouse gases from electricity and heat production (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	7.7	6.1	6.8	6.8	6.4	5.8	-12%	-17%
Methane	0.02	0.04	0.04	0.04	0.04	0.04	174%	155%
Nitrous oxide	0.1	0.2	0.2	0.2	0.2	0.2	66%	62%
Total emissions	**7.9**	**6.4**	**7.0**	**7.1**	**6.7**	**6.0**	**-11%**	**-15%**

Table 4.4 Historical and projected emissions of greenhouse gases from refineries and manufacturing of solid fuels (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	2.1	2.6	2.5	2.6	2.6	2.6	21%	24%
Methane	0.001	0.001	0.001	0.001	0.001	0.001	20%	23%
Nitrous oxide	0.006	0.003	0.003	0.003	0.003	0.003	-49%	-48%
Total emissions	**2.1**	**2.6**	**2.5**	**2.6**	**2.6**	**2.6**	**21%**	**24%**

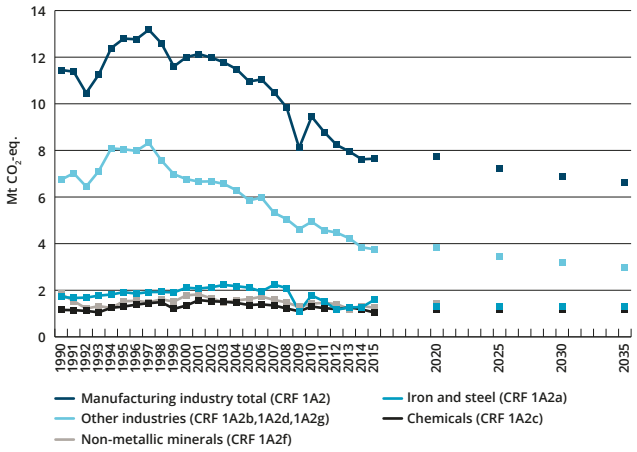

Figure 4.5 Historical and projected emissions of greenhouse gases from combustion in manufacturing industries.

Combustion emissions from manufacturing industries are projected to decrease until 2035, because the use of biofuel and electricity is expected to increase more than the use of fossil fuels (see Table 4.6). The decreasing emissions are mainly explained by the pulp and paper industry's shift from using fossil fuels to biofuels. Emissions from the food processing industry are also expected to decrease, while emissions from the chemical industry and the iron and steel industry remain fairly stable in the projection. Emissions from the mineral industry as well as emissions from working machinery in the industries are projected to increase until 2020 and then decrease. The increase is mainly due to a projected increase in constructing new residential buildings.

4.4.4. Fugitive emissions

The majority of fugitive emissions originate from refineries. The emissions are assumed to remain at the same level as in recent years until 2035 (see Table 4.7).

4.4.5. Industrial processes and product use

The industrial processes and product use sector contributes greenhouse gas emissions from the materials used in industrial processes and the use of solvents and other products, including the use of fluorinated greenhouse gases.

Table 4.5 Historical and projected emissions of greenhouse gases from residential and commercial sectors (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	10.7	2.7	2.2	2.0	1.9	1.9	-80%	-82%
Methane	0.3	0.3	0.3	0.3	0.3	0.3	-1%	-12%
Nitrous oxide	0.2	0.1	0.1	0.1	0.1	0.1	-44%	-47%
Total emissions	**11.1**	**3.1**	**2.6**	**2.4**	**2.3**	**2.2**	**-77%**	**-79%**

Table 4.6 Historical and projected emissions of greenhouse gases from combustion in manufacturing industries (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	11.2	7.4	7.5	7.0	6.7	6.4	-33%	-40%
Methane	0.05	0.05	0.06	0.06	0.06	0.06	3%	3%
Nitrous oxide	0.2	0.2	0.2	0.2	0.2	0.1	-23%	-27%
Total emissions	**11.5**	**7.6**	**7.7**	**7.2**	**6.9**	**6.6**	**-33%**	**-40%**

Table 4.7 Historical and projected emissions of greenhouse gases from fugitive emissions (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	0.3	0.8	0.7	0.7	0.7	0.7	133%	133%
Methane	0.09	0.1	0.1	0.1	0.1	0.1	-29%	-29%
Nitrous oxide	0.0004	0.0007	0.0006	0.0006	0.0006	0.0006	29%	29%
Total emissions	**0.4**	**0.9**	**0.8**	**0.8**	**0.8**	**0.8**	**95%**	**95%**

Table 4.8 Historical and projected emissions of greenhouse gases from industrial processes and product use sector (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	5.5	5.3	5.4	5.5	5.5	5.6	-1%	0%
Methane	0.03	0.01	0.01	0.01	0.01	0.01	-65%	-65%
Nitrous oxide	1.0	0.2	0.2	0.2	0.2	0.2	-76%	-76%
Fluorinated greenhouse gases	0.7	0.9	0.6	0.5	0.3	0.2	-8%	-50%
Total emissions	**7.2**	**6.4**	**6.3**	**6.2**	**6.1**	**6.0**	**-12%**	**-15%**

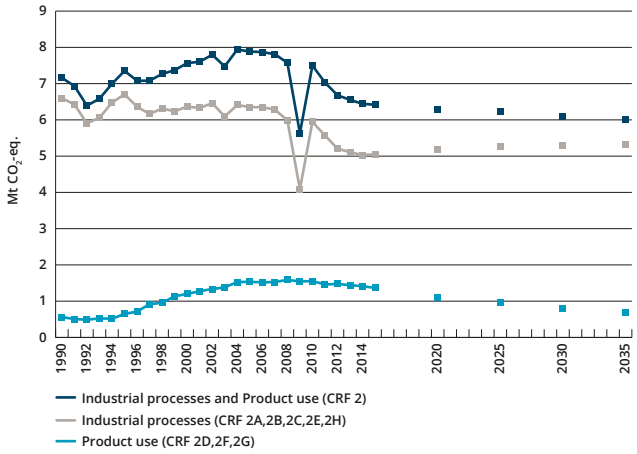

Figure 4.6 Historical and projected emissions of greenhouse gases from industrial processes and product use.

Greenhouse gas emissions from industrial processes and product use are projected to decrease slightly until 2035 (se Table 4.8). The decrease is caused by the decrease in emissions of fluorinated greenhouse gases.

Carbon dioxide emissions are expected to increase slightly until 2035. The increase is mainly due to increased production in the mineral industry. The emissions from the mineral industry are expected to increase due to a projected increase in constructing new buildings. Iron and steel production is expected to increase slightly, which leads to an increase in total greenhouse gas emissions compared with 2015. However, emissions are expected to be lower in 2030 compared with 1990 levels.

Emissions of fluorinated greenhouse gases are expected to decrease until 2035 due to a ban on their use that resulted from EU regulations.

4.4.6. Domestic transport

Emissions from domestic transport, especially from road transport, are projected to decrease until 2035 for several reasons (see Table 4.9 and 4.10). One is an assumed continuous improvement in the energy efficiency of the vehicle fleet due to EU CO_2-requirements that limit emissions from new cars and light-duty vehicles. In the projection the emission requirements are 95 and 147 grams of carbon dioxide per kilometre, respectively, for passenger

Table 4.9 Historical and projected emissions of greenhouse gases from different transport modes (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2035
Road transportation	17.7	17.0	14.2	13.1	12.4	12.0	-20%	-30%
Civil aviation	0.7	0.5	0.5	0.5	0.5	0.5	-25%	-29%
Navigation	0.6	0.4	0.4	0.4	0.4	0.4	-34%	-36%
Railways	0.1	0.05	0.04	0.04	0.04	0.04	-57%	-62%
Other*	0.3	0.3	0.3	0.3	0.3	0.3	-2%	-1%

*includes mobile machinery not used in industry, agriculture, forestry or households

Table 4.10 Historical and projected emissions of greenhouse gases from domestic transport (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2035
Carbon dioxide	19.0	18.0	15.2	14.1	13.3	12.9	-20%	-30%
Methane	0.2	0.04	0.03	0.03	0.03	0.03	-77%	-79%
Nitrous oxide	0.2	0.1	0.2	0.2	0.2	0.2	-9%	-2%
Total emissions	**19.3**	**18.2**	**15.4**	**14.3**	**13.6**	**13.1**	**-20%**	**-30%**

Table 4.11 Historical and projected emissions of greenhouse gases from Other (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	0.8	0.2	0.2	0.2	0.2	0.2	-81%	-81%
Methane	0.001	0.0001	0.0001	0.0001	0.0001	0.0001	-95%	-95%
Nitrous oxide	0.02	0.003	0.002	0.002	0.002	0.002	-85%	-85%
Total emissions	**0.9**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**-81%**	**-81%**

Table 4.12 Historical and projected emissions of greenhouse gases from the waste sector (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	0.04	0.06	0.06	0.06	0.06	0.06	31%	31%
Methane	3.5	1.1	0.8	0.6	0.4	0.3	-78%	-88%
Nitrous oxide	0.2	0.2	0.2	0.2	0.2	0.2	6%	7%
Total	**3.7**	**1.4**	**1.1**	**0.9**	**0.7**	**0.6**	**-72%**	**-81%**

cars and light-duty vehicles in 2021. After 2021 the energy efficiency of new vehicles continues to increase, but at a slower rate. The energy efficiency is expected to be improved due to fewer petrol cars. Another reason for the decrease is a greater use of biofuels. In particular, the low-blend of biofuels in diesel, which is currently subject to tax exemptions and tax reductions, increases compared with the 2015 level in the projection.

Emissions from domestic aviation have fallen in recent years, mostly due to higher efficiency. In the projection, travel is assumed to be constant from today's level over the entire projection period as energy efficiency increases, resulting in decreasing emissions. Emissions from domestic navigation have varied between 0.3 and 0.7 Mt CO_2-eq.The emissions are assumed to be close to 0.4 million tonnes between 2020 and 2035. Emissions from railways are projected to decrease during the projection period.

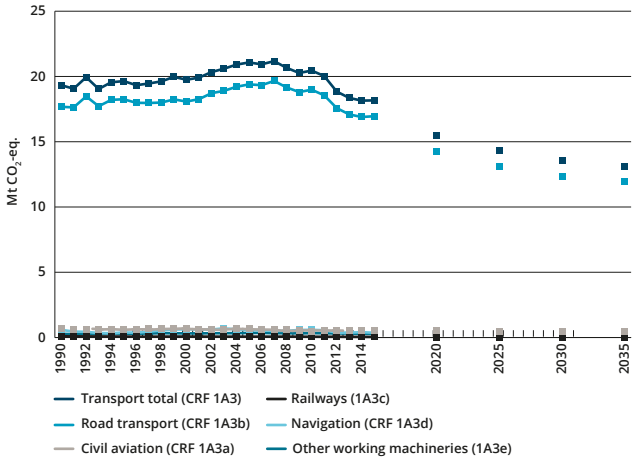

Figure 4.7 Historical and projected emissions of greenhouse gases from the domestic transport sector.

Emissions from the CRF sector 'Other' (mainly emissions from military transports) are expected to remain at around the same level as in recent years during the entire projection period (see Table 4.11).

4.4.7. Waste

Methane emissions from landfills are projected to decrease by 91 % until 2030 compared with 1990 (see Table 4.12). This decrease is mainly due to the 2002 ban on depositing combustible materials in landfills and the 2005 ban on depositing organic materials in landfills. Furthermore, a tax on depositing waste in landfills was introduced in 2000.

Emissions of carbon dioxide from waste incineration and nitrous oxide from wastewater treatment are low and are expected to remain stable during the entire projection period. However, emissions of nitrous oxide and methane from biological treatment of solid wastes are expected to increase slightly during the period due to increased production of biogas.

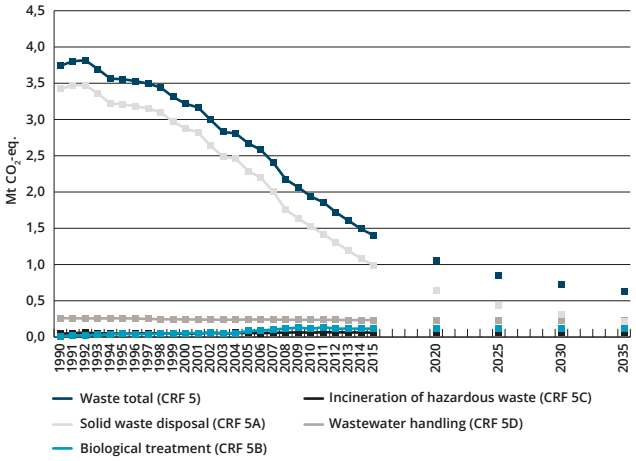

Figure 4.8 Historical and projected emissions of greenhouse gases from the waste sector.

4.4.8. Agriculture

Greenhouse gas emissions from agriculture have decreased since 1990, mainly due to improved production efficiency and fewer cattle. This in turn has led to lower methane emissions from the digestion process in ruminant animals and reduced emissions of methane and nitrous oxide from manure. Emissions of nitrous oxide from agricultural land have also declined as a result of reduced cereal acreage, reduced use of fertilizers, reduced nitrogen leaching and a transition from solid manure to slurry management.

Emissions are estimated to decrease as a result of a continuously declining cattle population. The reduced numbers of dairy cows for 2020 and 2030 are primarily a result of increased productivity, product pricing mechanisms and continuous adaptation to EU agricultural policy regulations. Emissions from agricultural land are also projected to decrease until 2030 (see Table 4.13 and 4.14).

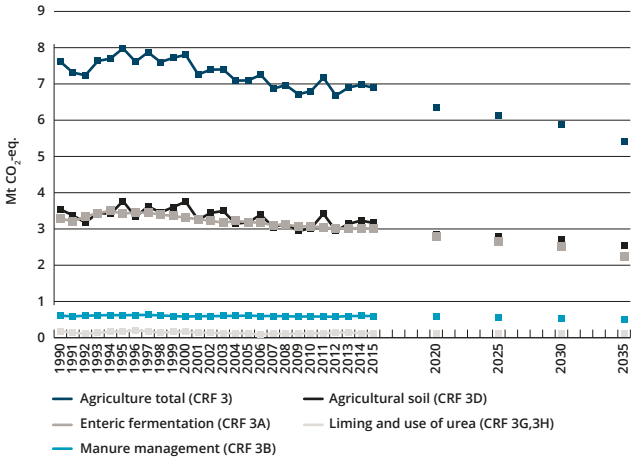

Figure 4.9 Historical and projected emissions of greenhouse gases from agriculture.

4.4.9. Land Use, Land Use Change and Forestry (LULUCF)

The LULUCF sector contributed to the total greenhouse gas budget with an annual net removal of greenhouse gases in Sweden during the period 1990–2015. The net removals for LULUCF are expected to decrease until 2035 (see Table 4.15). The decrease is mainly due to a decrease in removals from forest land. The projected decrease in removals of carbon dioxide from forest land is based on the assumption that the harvest level will continue to gradually increase at about the same pace as in recent years. Continuously increasing harvests have been added to the projections mainly after 2025, since it is foreseen that the demand for biomass will increase over time.

Net emissions from cropland have varied during the period 1990–2015 and these yearly variations are expected to continue. The emissions are projected to be at about the same level as the average for the last ten years. Net emissions

Table 4.13 Historical and projected emissions of greenhouse gases from agriculture per gas (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Methane	3.5	3.3	3.0	2.9	2.7	2.4	-14%	-22%
Nitrous oxide	3.9	3.5	3.2	3.1	3.0	2.8	-18%	-23%
Carbon dioxide	0.2	0.1	0.1	0.1	0.1	0.1	-30%	-30%
Total emissions	**7.6**	**6.9**	**6.4**	**6.1**	**5.9**	**5.4**	**-17%**	**-23%**

Table 4.14 Historical and projected emissions of greenhouse gases from agriculture (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Enteric fermentation	3.3	3.0	2.8	2.7	2.5	2.2	-15%	-24%
Manure management	0.6	0.6	0.6	0.6	0.5	0.5	-5%	-11%
Agricultural land	3.5	3.2	2.9	2.8	2.7	2.6	-19%	-24%
Liming/Use of urea	0.2	0.1	0.1	0.1	0.1	0.1	-30%	-30%
Total emissions	**7.6**	**6.9**	**6.4**	**6.1**	**5.9**	**5.4**	**-17%**	**-23%**

Table 4.15 Historical and projected emissions (+) end removals (-) of greenhouse gases from LULUCF (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Forest land	-38.7	-46.6	-46.3	-46.7	-43.8	-40.9	20%	13%
Cropland	3.5	-0.2	2.8	2.8	2.8	2.8	-20%	-20%
Grassland	0.4	0.1	0.4	0.4	0.3	0.3	-10%	-15%
Wetlands	0.1	0.2	0.2	0.2	0.2	0.2	122%	122%
Settlements	3.0	2.8	4.0	4.0	4.0	4.0	34%	34%
HWP	-5.0	-6.7	-4.4	-5.0	-5.8	-7.0	-12%	16%
Total net removals	**-36.7**	**-50.5**	**-43.3**	**-44.3**	**-42.2**	**-40.5**	**18%**	**15%**

Table 4.16 Historical and projected emissions of greenhouse gases from international bunkers (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Navigation	2.3	6.2	6.5	6.6	6.6	6.6	189%	190%
Aviation	1.4	2.2	2.4	2.5	2.7	2.9	76%	100%
Total emissions	**3.6**	**8.4**	**8.9**	**9.1**	**9.3**	**9.5**	**147%**	**157%**

Table 4.17 Historical and projected total emissions of greenhouse gases for different projections in the sensitive analysis excl. LULUCF (million tonnes CO_2-equivalents)

	1990	2015	2020	2025	2030	2035	1990–2020	1990–2030
Projections WEM	71.6	53.7	49.9	47.7	45.6	43.6	-30%	-36%
Energy sector including transport								
Projection "Higher fossil fuel prices"			48.9	46.5	44.4	42.5	-32%	-38%
Projection "Higher GDP"			50.1	47.9	45.8	43.9	-30%	-36%
Transport sector								
Projections "Higher mileage"			50.2	48.5	46.8	45.2	-30%	-35%

from settlements are caused by felling due to urbanisation and the establishment of power lines and forest roads. These emissions are projected to be at the same level for the entire projection period as the average for the last ten years. The carbon stock changes in grassland and wetlands were small during the period 1990–2015 and are projected to stay low during the projection period.

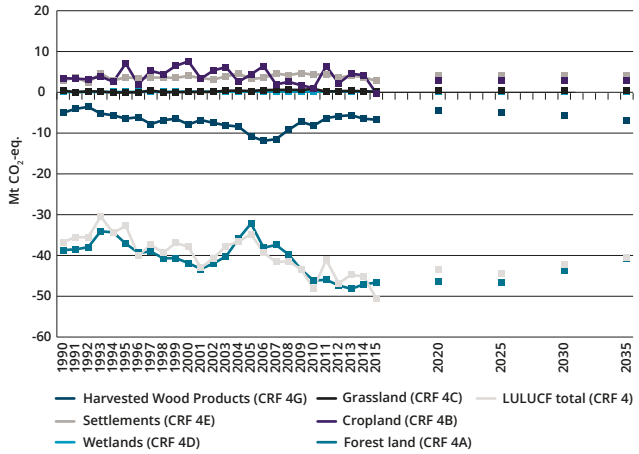

Figure 4.10 Emissions (+) and removals (-) from the LULUCF sector and its subcategories in Mt CO_2-equivalents per year.

4.4.10. International transport

Emissions from bunkers for international transport are projected to increase until 2035, mainly due to increased emissions from international aviation (see Table 4.16). This increase is explained by an expected increase in private consumption during the projection period, resulting in increased travel.

The increased use of fuel for international navigation is due to changes in passenger traffic, growth in the exports of goods and increased refuelling in Sweden. The projection is based on the assumption that transport volumes will increase as transportation becomes more efficient. This leads to projected emissions from international navigation at about the same level during the projection period. The number of international bunkers counted in Sweden also depends largely on where the international ships and airplanes choose to refuel.

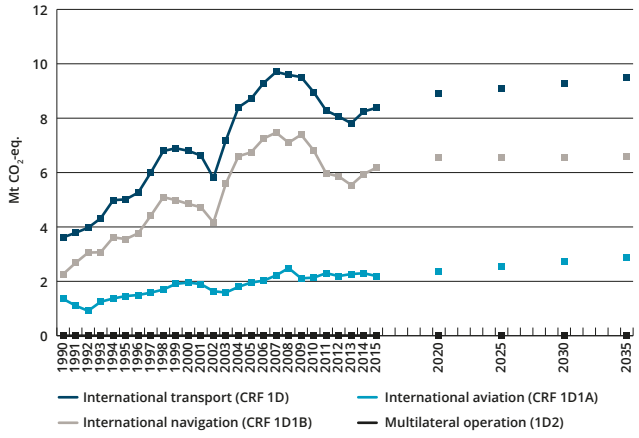

Figure 4.11 Historical and projected emissions of greenhouse gases from international bunkers.

4.5. Sensitivity analysis

Sensitivity calculations were produced by varying some parameters in the energy sector (incl. transport) and one in the transport sector. Aggregated for all sectors, the sensitivity calculations show that the emission level in 2030 may be 35 to 38 % lower than 1990 levels, depending on the sensitivity projection (see Table 4.17). However, this does not include uncertainty in the calculations, which may expand the percentage span between the projections.

Two sensitivity projections were calculated for the energy sector including transport: one projection with 30 % higher fossil fuel prices and one with 30 % higher economic growth than in the reference projections. The higher fossil fuel prices also result in lower economic growth than in the reference projections. All other assumptions are identical to the ones in the reference projection.

The calculations of the sensitivity projections show that the projection with higher fossil fuel prices results in lower emissions than in the reference projection until 2035, as expected. The emissions are approximately 1.2 Mt CO_2-eq. lower than in the reference projection in 2030. A higher fossil fuel price boosts the incentive to replace fossil fuels and increase energy efficiency in industry and reduces the need for transportation, giving lower emissions in the transport sector.

The projection with higher economic growth than in the reference projection results in higher emissions in the energy and transport sectors than in the reference projection. In this case the emissions are close to 0.2 Mt CO_2-eq. higher in 2020 and 2030 than in the reference projection. The main reason for the increased emissions is a higher energy demand due to higher production in the industrial sector. Greater economic growth leads to a higher demand for the transportation of both goods and people.

For the road transportation sector, one additional sensitivity projections were performed separately, one with higher mileage. In the projection, the mileage is assumed to be 10 % higher in 2035 than in the reference projection. The calculations show that the projections with higher mileage result in emissions that are approximately 1.2 Mt CO_2-eq. higher in 2030.

4.6. Comparison with Second Biennial Report

The projections presented in 2016 in Sweden's Second Biennial Report (BR2) showed reductions in total greenhouse gas emissions of 23 % between 1990 and 2020 and of 28 % between 1990 and 2030. The projection set out here, in the Third Biennial report (BR3) uses partly different assumptions and assessments based on trends over the last few years (see Table 4.18). The new projections show a decrease in total greenhouse gas emissions of 30 % between 1990 and 2020 and of 36 % between 1990 and 2030. A comparison of percentage changes in emissions overall and by sector is shown in Figure 4.12.

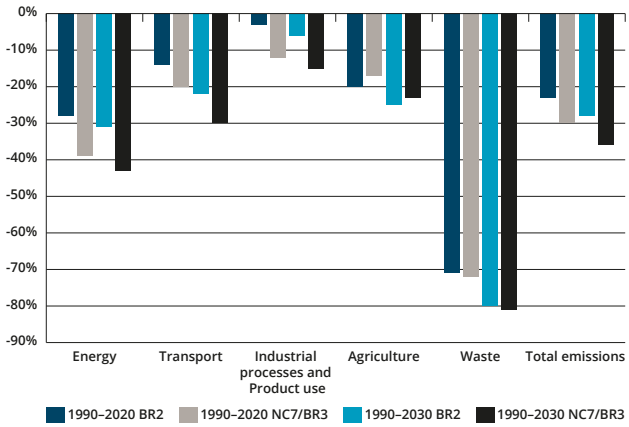

Figure 4.12 Percentage changes in emissions between 1990 and 2020 and 2030 respectively as projected in BR2 and BR3/NC7, overall and by sector.

The projections presented here indicate a larger reduction of emissions by 2020 and 2030 for almost all sectors compared with those in BR2. The difference is mainly due to differing assumptions, for instance regarding emissions trading prices, and assumptions based on the trend over the last few years.

4.7. Progress towards targets under the EU Climate and Energy Package

4.7.1. Sweden's commitment according to the Effort Sharing Decision

Under the EU Climate and Energy Package, greenhouse gas emissions from the EU are to be reduced by 20 % compared with 1990 by 2020. Emissions from installations included in the EU Emissions Trading System (EU ETS) are to fall by 21 % between 2005 and 2020 for the EU as a whole. Emissions not covered by the trading system are to be reduced in line with the Effort Sharing Decision (ESD) (EU Decision 406/2009/EC). For Sweden, this decision means that emissions must decrease by 17 % between 2005 and 2020, in line with a target emissions trajectory. This means that the ESD emissions must decrease linearly from 41.7 Mt in 2013 to 36.1 Mt in 2020[30].

Furthermore, Sweden can use credits from international project activities to meet the target. The annual use is restricted to 3 % of 2005 emissions[31], which equals 10.9 million tonnes for the entire period 2013–2020. In addition, 1 % of 2005 emissions can be used in international projects fulfilling certain requirements. This corresponds to 3.6 million additional tonnes for

Table 4.18 Key assumptions in the Sixth and Seventh National Communication and the Second Biennial Report

	BR2		BR3	
	2011–2035		2013–2035	
GDP (annual change %)	2.0		2.28	
	2020 (2011 prices)	**2030** (2011 prices)	**2020** (2013 prices)	**2035** (2013 prices)
Price of crude oil (USD/barrel)	118	133	109	117
Price of coal (USD/tonne)	110	116	82	110
Price of natural gas (USD/MBtu)	12.1	13.1	12	12
Emissions trading (Euro/tonne CO_2)	8	20	15	42
Electricity certificates (new renewable electricity compared with 2012)	26.4 TWh by 2020		28.4 TWh by 2020	

Table 4.19 Sweden's historical and projected emissions of greenhouse gases (based on National Inventory Report submission 2017) presented as total emissions, ETS emissions, CO_2-emissions from domestic aviation and emissions covered by the Effort Sharing Decision (ESD) in relation to ESD target (scope 2013–2020, excl. aviation). (million tonnes CO_2-equivalents)

	2005	2013	2014	2015	2020	2030
Total emissions	66.9	55.5	53.8	53.7	49.9	45.6
ETS emissions	23.6	20.1	19.3	19.2	19.7	19.2
Domestic aviation	0.7	0.5	0.5	0.5	0.5	0.5
ESD emissions[32 33]	42.6	34.9	34.0	34.0	29.7	26.0
ESD target[34]		41.7	41.0	40.4	36.1	
Overachievement in relation to ESD target		6.8	7.1	6.5	6.4	

30 In 2017 the target for 2020 was adjusted from 37.2 to 36.1 million, because the historical emissions are lower due to methodological changes. Commission Decision 2017/1471 amending decision 2013/162/EU to revise Member States' annual emissions allocations for the period from 2017 to 2020.

31 According to National Inventory Report submission 2012

32 Historical emissions are presented according to National Inventory report submission 2017. The compliance for 2013 and 2014 was based on National Inventory report Sweden, Submission 2016. The emissions in 2013 according to submission 2016 were 35.3 Mt CO_2-eq. which means a surplus of 6.4 million AEAs cancelled. Emissions in 2014 according to submission 2016 were 34.5 Mt CO_2-eq. which means a surplus of 6.5 million AEAs.

33 ESD emissions include emissions that are covered by the Effort Sharing Decision and are calculated as total emissions excl. LULUCF minus CO_2 emissions from domestic aviation minus emissions from EU ETS

34 According to the revised targets in EU decision C(2013) 1708 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC.

the entire period 2013–2020. The maximum possible annual use of international credits thus amounts to a maximum of 1.8 million tonnes. A Member State may transfer up to 5 % of their allocated Annual Emissions Allocations (AEA) for a given year to other Member States. Furthermore, 5 % of the AEAs can be carried over from the following year, and if there is a surplus of allowances it can be banked to following years or transferred to other Member States.

For the year 2013 and 2014 Sweden's ESD emissions were lower than the ESD target. The surplus amount of AEAs was over 6 million per year compared to the Swedish ESD target. The surplus for 2013 was deleted in December 2016 and the surplus for 2014 will be deleted when the Compliance Account for 2014 is closed. Sweden has already taken a decision to delete the ESD surplus for 2015 and the Government has proposed to the Parliament that also the surplus for 2016 shall be deleted.

The target for Sweden is set to 36.1 Mt CO_2-eq. in 2020 (EU Decision C(2013)1708). The projections indicate an overachievement until 2020 in relation to the ESD target. The ESD emissions are projected to decrease to 29.7 million tonnes in 2020. The overachievement in 2020 compared to the Swedish target is estimated to be over 6 million tonnes, without the use of international credits. However, investments in international projects have already been made if such credits would be required to meet the ESD target. The projections also indicate that Sweden will have a yearly surplus of allowances during 2016–2020. Note that these figures are uncertain and preliminary (see Table 4.19).

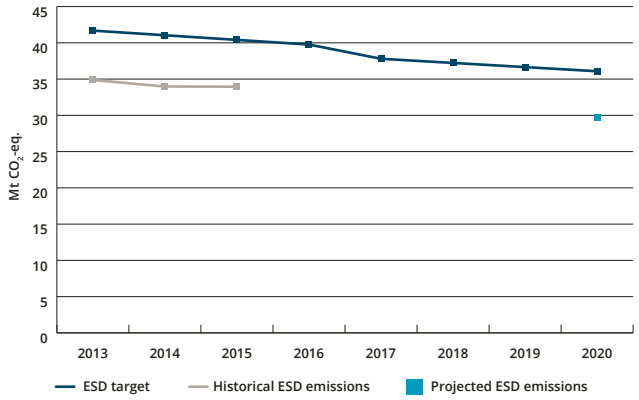

Figure 4.13 The ESD target (scope 13-20), emissions in 2013–2015 and the projected Swedish ESD emissions (scope 13–20).

4.8. Target fulfilment in relation to domestic targets

According to the 2009 climate policy resolution of the Swedish Parliament, the Swedish target for emissions which are not included in the EU ETS, must be reduced by 40 %, or around 20 million tonnes, between 1990 and 2020[35]. One-third of this figure can be reduced through emission reductions in other countries. However, the present government aims to fulfil the emission target with national measures.

In 2020, the national target will preliminary be 28.8 million tonnes. The projections indicate that there will be a gap to target of approximately 0.9 Mt CO_2-eq.in 2020. In addition the uncertainty has to be taken into account. Note that numbers are preliminary until 2022–2023, when a definitive calculation can be done based on reviewed inventory data. If a gap to target still remains, it can be closed by emission reductions in other countries.

Table 4.20 Target fulfilment in relation to the domestic target for ESD emissions (scope 2013–2020, excluding aviation) in 2020.

	2020
Domestic target for ESD emissions	28.8 Mt
Projections ESD-emissions	29.7 Mt
Gap to target	0.9 Mt

In June 2017 the Riksdag adopted a climate policy framework including targets until 2045. By 2045, Sweden is to have no net emissions of greenhouse gases into the atmosphere and should thereafter achieve negative emissions. Emissions outside the EU ETS should be at least 63 % lower by 2030 than emissions in 1990 and at least 75 % lower by 2040. To achieve these targets, no more than 8 and 2 percentage points, respectively, of the emissions reductions may be realized through supplementary measures. A reduction of 63 % means that the target is preliminary set to 17.3 Mt CO_2-eq. in 2030. The emissions outside EU ETS are projected to decrease to 26 Mt CO_2-eq. in 2030, which indicate a gap of around 9 Mt CO_2-eq. In addition emissions from domestic transport are to be reduced by at least 70 % by 2030 compared with 2010. The emissions from domestic transport are projected to decrease by 35 % between 2010 and 2030.

35 This was equivalent to a decrease of 33 % between 2005 and 2020 when the target was adopted in 2009 (EU ETS scope 2008–12). In the third period of EU ETS, 2013–2020, the scope of the EU ETS was extended to include additional sectors. The target was consequently adjusted corresponding to emissions in the transferred sectors.

4.9. References for Chapter 4

Commission decision (EU) (2017/1471) of 10 August 2017 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period from 2017 to 2020

Commission Decision (2013/162/EU) of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council *(notified under document C (2013) 1708)*

Commission Implementing decision (2013/634/EU) of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council

EU Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.

EU Decision C(2013) 1708 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC.

EU regulation No 525/2013 of the European parliament and of the Council Decision on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC

Ministry of the Environment and Energy. 2017. *Report for Sweden on assessment of projected progress,* March 2017. In accordance with articles 13 and 14 under Regulation (EU) No 525/2013 of the European parliament and of the Council Decision on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC

National Inventory Report Sweden, Submission 2017.

5. Provision of financial, technological and capacity-building support to developing country Parties

5.1. Introduction

Climate change is the defining issue of our time and a top priority for the Swedish Government that took office in September 2014. Sweden has a long history of support for work on climate change issues in developing countries, in an array of sectors and on a long-term basis, but has raised its ambitions further since the adoption of the Paris Agreement.

A large number of Swedish actors, such as ministries, government agencies, state-owned companies, non-governmental organisations, universities and the private sector assist in climate change-related cooperative actions and activities such as providing grants and innovative finance, technology transfer, research and various forms of capacity development. There are a number of different forms of cooperation, policy instruments and support.

The continuous progress in the development of methodologies to track climate finance, as well as the efforts within the EU to harmonise methodologies, make it difficult to directly compare the numbers in this report with previous reports.

5.2. Governing policies and principles

5.2.1. Policy framework for Swedish development cooperation and humanitarian aid

In December 2016, the Government adopted a new policy framework outlining the direction of Swedish development cooperation and humanitarian aid. The purpose of the policy framework is to have a knowledge-based, broadly supported framework that is aligned with the internationally adopted 2030 Agenda for Sustainable Development. At the same time, the Swedish policy framework also goes beyond the 2030 Agenda in a number of aspects, such as gender equality, democracy and human rights.

Environment and climate change are one of the key areas of the policy, one of three top priorities of the Government, and in addition an environment and climate change perspective shall be integrated in all Swedish development cooperation. The policy highlights that Sweden will support low and middle-income countries' accession to and implementation of commitments under the climate convention, and the implementation of their Nationally Determined Contributions under the Paris Agreement.

5.2.2. Key principles

The principles contained in the Paris Declaration of 2005, the Accra Agenda of 2008 and the Busan Partnership of 2011 are important to international development cooperation and climate finance. National ownership is also key to securing long-term sustainability of climate change-related initiatives. External actors should seek to improve coordination and alignment to the national systems and processes of developing countries so as to ensure transparency and mutual accountability. Within the multilateral funds Sweden has been a champion for direct access, where national authorities are able to directly access financing and manage all aspects of the projects/programs. In our bilateral work the countries' and organisations' own needs, priorities and strategies are weighed into the strategies, and a fundamental entry point for all of Sida's contributions.

5.2.3. New and additional resources

According to the UN Framework Convention on Climate Change, *"The developed country Parties […] shall provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations"*. 'New and additional resources' is a complex term, used in many multilateral contexts. There is currently no international agreement on how it should be defined. One common definition, supported by many countries, is that climate financing should be additional to the international development aid goal of 0.7% of gross national income (GNI).

Sweden is one of few OECD DAC members to have met, and even far exceeded, the UN target of 0.7 %. There is broad Parliamentary support, to continue delivering 1 % of Sweden's GNI to Official Development Assistance (ODA). Figures for total Swedish ODA 2015–2016 are shown in Table 5.1, together with the share of climate finance compared to total ODA.

Table 5.1 Total Swedish official development assistance (ODA), 2015–2016.

	2015[36]	2016
SEK million	59 780	41 701
USD million	7 092	4 870
% of GNI	1.40	0.94
Climate finance as share of total ODA	5 %	9 %

All exchange rates used in this report are based on the annual average dollar exchange rates for OECD Development Assistance Committee (DAC) members[37]. For Sweden SEK 8.435 (2015) and SEK 8.562 (2016).

In addition to the climate finance within ODA, Sweden has also contributed to international climate finance through Other Official Flows e.g. within the Swedish Program for International Climate Initiatives through the Kyoto Protocol's flexible mechanism. Sweden has chosen to voluntarily cancel purchased emission reduction units and report them as climate finance. The cancelled units cannot be utilised in any way, sold or used to fulfil Sweden's mitigation commitments (see section 5.4.3).

Against this background, all climate finance provided by Sweden during 2015–2016 should be viewed as new and additional.

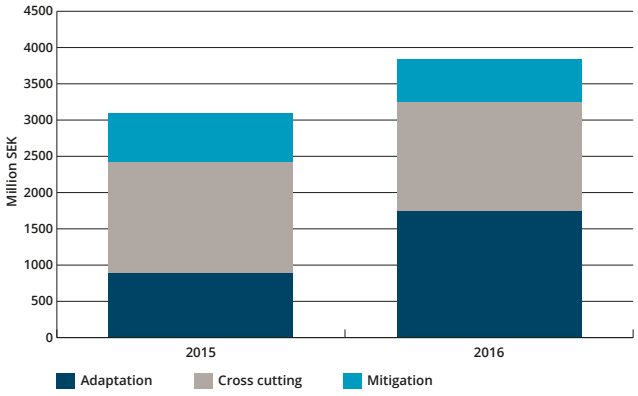

Figure 5.1 Total Swedish climate finance, 2015–2016, excluding core funding to MDBs and UN organisations.

5.3. Multilateral financial support

Sweden is the largest per capita donor in the world to the financial mechanism under the UN Framework Convention on Climate Change – the Green Climate Fund (GCF) and the Global Environment Facility (GEF). In calendar years 2015 70 % of GEF's recorded commitments of funding were climate-related (using the Rio Markers methodology), and in 2016 the equivalent share was 60%. This has been the basis to calculate Sweden's imputed share of climate finance.

In addition, Sweden provided substantial climate finance through a number of other multilateral climate change funds, such as the Adaptation Fund and the Least Developed Countries Fund. In 2016 Sweden was also one of the first donors to provide support to the Capacity Building Initiative for Transparency, established at COP21 in Paris. All of the contributions to multilateral climate funds are accounted as 100 % climate finance.

Multilateral climate finance (presented in Annex 1, CTF Table 7 and 7a) is mainly managed by the Ministry for Foreign Affairs, including core support to Multilateral Development Banks (MDB) and UN organisations.

Sweden considers core funding key for flexibility, rapid response, long-term planning and in line with the principles of aid effectiveness, and has thus chosen to present some of this support in Annex 1, Table 7a (please note that it does not provide an exhaustive list of all of Sweden's multilateral contributions). Final data regarding the climate specific share of core contributions was not available for all years and for all of these multilateral development banks and UN organisations. Some data were however available from MDBs for 2015–2016, summarised in Table 5.2 below. Thus it can be concluded that Sweden's contribution to international climate finance exceeds the total figures presented in Annex 1 and the CTF-tables.

Table 5.2. MDB climate finance as percentage of total MDB operations.

MDB:	ADB	AfDB	ERDB	EIB	IDBG	WBG
2015[38]	15.3%	15.6%	25.5%	26.2%	16.1%	17.9%
2016[39]	22%	9%	28%	21%	22%	18%

The Ministry of Environment and Energy administered support to a number of strategic initiatives linked to the UNFCCC negotiations, such as the UNFCCC Trust Fund, the African Group of Negotiators working with the Africa Renewable Energy Initiative, the New Climate Economy, the Clean Energy Solution Centre and the International Institute for Sustainable Development's work with Fossil Fuel Subsidy Reform. The Swedish Energy Agency, the Swedish Environmental Protection Agency and the Swedish Meteorological and Hydrological Institute were also involved in important climate initiatives, programs and mechanisms, such as the Climate and Clean Air Coalition, and SIDS DOCK.

An overview of Sweden's multilateral support is presented in Figure 5.2 and Table 5.3. As pledged during COP21 in Paris Sweden doubled its multilateral climate finance from 2015 to 2016.

36 In 2015 the levels of Swedish ODA were exceptionally high due to factors such as the following: actual costs for asylum seekers (20.2 bn SEK) exceeded budgeted costs (8.9 bn SEK); the full amount of the promissory note to the GCF 2015–2023 was registered in accordance with the OECD DAC rules; and Sweden made advance payments (for 2016 commitments) of a total of 2.5 bn SEK to CERF, UNHCR, UNWRA, UNDP and EDF.
37 https://data.oecd.org/conversion/exchange-rates.htm
38 2015, Joint Report on Multilateral Development Banks' Climate Finance.
39 2016, Joint Report on Multilateral Development Banks' Climate Finance.

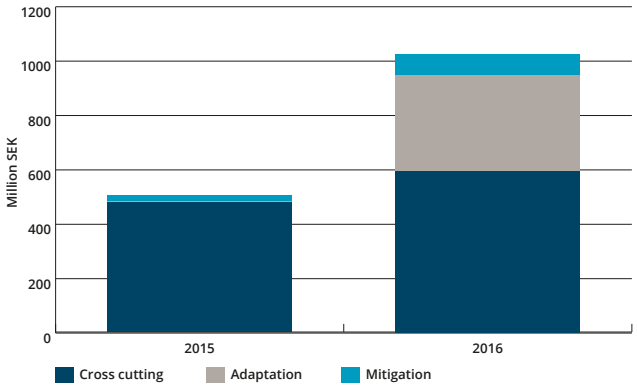

Figure 5.2. Multilateral climate finance provided by Sweden through the Ministry for Foreign Affairs and the Ministry of Environment during 2015–2016, by type of climate action.

More detailed information for each year can be found in Annex 1, CTF Table 7a. For a further analysis of Sweden's climate finance, see also Sweden's 7th National Communication.

Sweden has been a champion of gender integration in the multilateral climate funds, including the promotion of separate gender policies and action plans that support gender-responsive actions. Integration of gender issues is improving, thus also contributing to raising the efficiency and long-term sustainability of the projects and programs funded by multilateral climate funds.

5.4. Bilateral financial support

5.4.1. Methodology for tracking climate-related bilateral ODA

The Swedish bilateral support provided through Sida includes support to bilateral, regional and global institutions and organisations (including so-called 'multi-bi' support), and is reported in Annex 1, CTF Table 7: summary financial information, 7b: details at component level, 8: examples of technology development support, and 9: examples of capacity building support. All tables can be viewed in Annex 1.

Online publishing

Detailed information about Sida's operations is continuously published online according to the internationally agreed International Aid Transparency Initiative (IATI) standard at www.openaid.se. Sida is currently making efforts to enable climate finance reporting through IATI, and aims to present such a pilot in 2018.

Tracking, coefficients and range of countries

Sida uses the OECD DAC Rio markers for climate change mitigation and climate change adaptation to track climate finance. The components are marked using a scale of 0–2, where 2 represents 'principal objective', 1 'significant objective' and 0 'not targeted'. In climate finance reporting, Sweden includes the full amount of finance to components that have climate change as a principal objective, but only 40 % of the finance provided to components with climate change as a significant objective (see Table 5.4). In Annex 1, CTF Table 7 and 7b, the disbursed amounts presented are already weighted with the coefficients. These standard coefficients are relatively simple to apply, while they help avoid over-reporting of finance that does not have climate change as the main objective. This approach is in line with the reporting of several donors including the European Commission. To acknowledge the synergies between mitigation and adaptation, and ensure that there is no double counting, the type of climate change action is determined as mitigation, adaptation or cross-cutting according to Table 5.4.

Sweden reports on the climate finance it provided in 2015–2016 in the form of a National Communication and a Biennual Report (BR) to the UNFCCC, as well as the annual Monitoring Mechanism Regulation (MMR) report to the EU.

Table 5.3 Multilateral climate finance 2015–2016 through the Ministry for Foreign Affairs and Ministry of Environment and Energy.

Year	Mitigation MSEK (% of total*)	Adaptation MSEK (% of total*)	Cross-Cutting MSEK (% of total*)	Total MSEK
2015	22 (4 %)	6 (1 %)	477 (95 %)	504
2016	77 (8 %)	352 (34 %)	592 (58 %)	1 022
	Mitigation MSEK (% of total*)	**Adaptation MSEK (% of total*)**	**Cross-Cutting MSEK (% of total*)**	**Total MUSD**
2015	3 (4 %)	1 (1 %)	57 (95 %)	60
2016	9 (8 %)	41 (34 %)	69 (58 %)	119

*Total contributions through multilateral channels.

Table 5.4 Matrix of how the type of contribution is determined based on the two Rio Markers, climate change mitigation (CCM) and climate change adaptation (CCA), and the application of coefficients.

Rio Marker	CCM 2	CCM 1	CCM 0
CCA 2	Cross-cutting; 100 % of finance	CCA; 100 % of finance	CCA; 100 % of finance
CCA 1	CCM; 100 % of finance	Cross-cutting; 40 % of finance	CCA; 40 % of finance
CCA 0	CCM; 100 % of finance	CCM; 40 % of finance	Not climate finance

To be transparent, the same gross list of contributions that is presented in the Annex 1, CTF Table 7b is used for all three reports. For the National Communication, support to some Annex I Parties to UNFCCC (that are also eligible for ODA) is included in the summarized amounts, while the BR and MMR focus exclusively on support to non-Annex I Parties, in line with the reporting guidelines. Sida's support to Kosovo is included in the gross list for transparency reasons, but is excluded from the summarized amount since Kosovo is not yet a Party to UNFCCC. Support to Palestine is included for 2016, since it became a party to the UNFCCC that year, but excluded in 2015. Some contributions are included in the CTF-table more than once. That is a presentation of different components of a contribution separately that is done because climate change relevance is tracked at the component level (one contribution can have several components). To get a full picture of the climate finance to a contribution, the climate finance to the different components can be added up. There are some differences between the data for 2015 presented in this BR and data reported earlier. This is primarily because the climate relevance of some contributions has been adjusted as a result of actual changes in policy or quality assurance of the tracking. In this report, the figures are based on the most recent and best available data at the time of reporting.

Gender equality integration

The OECD DAC gender policy marker is used to track gender equality integration in climate finance. The climate contributions that are marked with the gender policy marker 1 or 2 are considered gender integrated. Gender integration for Sweden's bilateral support is presented in Annex 1.

Mobilisation of finance

In addition to climate finance in the form of grants, Sida provides guarantees to support actors to mobilise climate finance from private and public sources; see section 5.5.

5.4.2. Bilateral financial support through Sida

The majority of Swedish climate finance to low- and middle-income countries is channelled as bilateral ODA through Sida. It includes support provided to local and national institutions, bilateral support to multilateral organisations[40] and other global and regional organisations. In the area of climate change, Sida provides significant climate change support at several levels. It is provided to partner organisations both with climate change as a main objective ('principal objective' according to DAC terminology), and as a secondary objective ('significant objective' according to DAC terminology), i.e. integrated in contributions that have other main objectives. This is done in cooperation

Table 5.5 Climate finance provided by Sida during 2015–2016.

Year	Adaptation MSEK (% of total)	Mitigation MSEK (% of total)	Cross-Cutting MSEK (% of total)	Total MSEK
2015	879 (35 %)	569 (23 %)	1 044 (42 %)	2 491
2016	1 387 (50 %)	470 (17 %)	919 (33 %)	2 775
Year	**Adaptation MUSD (% of total)**	**Mitigation MUSD (% of total)**	**Cross-Cutting MUSD (% of total)**	**Total MUSD**
2015	104 (35 %)	67 (23 %)	124 (42 %)	295
2016	162 (50 %)	55 (17 %)	107 (33 %)	324

Table 5.6 A summary of the top five countries receiving Sida climate finance during 2015–2016. All the countries are among Sweden's major bilateral development cooperation partners.

2015	Country	Disbursed (MSEK)	Disbursed (MUSD)
1.	Mozambique	212	25
2.	Tanzania	150	18
3.	Kenya	148	18
4.	Zambia	91	11
5.	Bolivia	70	8
2016	**Country**	**Disbursed (MSEK)**	**Disbursed (MUSD)**
1.	Tanzania	196	23
2.	Mozambique	107	12
3.	Kenya	105	12
4.	Mali	82	10
5.	Ethiopia	71	8

40 "Multi-bi" according to OECD DAC definitions.

with actors in low- and middle-income countries, including government institutions, multilateral organisations, research institutions, non-governmental organisations, the private sector and Swedish authorities and municipalities. ODA channelled through Sida is disbursed at national, regional and global levels.

For a further analysis of Sweden's climate finance, please see Sweden's 7th National Communication.

BOX 5.1

Sida supports Tanzania's Productive Social Safety Net (PSSN), which targets one million households that are extremely poor. PSSN provides cash transfers and also has a public works component. People in poverty are hit hard by climate change impacts because they are more exposed, vulnerable and have less support than others. Social safety nets help people in poverty better cope with climate change impacts such as extreme weather events and unpredictable agricultural seasons. Sida's total contribution to PSSN in 2016 was 300 MSEK. Climate change adaptation is not identified as the primary objective of the program but a significant objective and therefore only 40 % of the total disbursement is considered climate specific, that is 120 MSEK (see Section 5.4.1. above for more information about the methodology).

BOX 5.2

Sida supports Tanzania's Rural Energy Agency (REA) during 2015–2019 to scale up modern rural energy access as part of Tanzania's contribution to the SE4All ambition to reach universal energy access by 2030. The objective is poverty alleviation in rural mainland Tanzania through access to modern energy services based on renewable resources. It is achieved through extensive on-grid electrification investments, complemented by private sector led off-grid and mini-grid renewable energy investments

BOX 5.3

The Landscape and Forest Management Multi Donor Trust Fund in Mozambique addresses the alarming levels of deforestation and forest degradation in the country that directly affect the rural population's resilience and cause severe economic, social and environmental consequences. The intervention is implemented at two levels: the national level, with the aim to strengthen the overall national forest management (including institutional capacity building, law enforcement and review of policy framework) and at the local level, focusing on climate-smart agriculture, sustainable use of wood fuels and sustainable forestry. The initiative is considered to have climate change adaptation and mitigation as the primary objectives. Hence, Sida's total disbursement in 2016 of 40 MSEK is identified as climate finance.

BOX 5.4

The Local Government Initiative on Climate Change initiative aims to support the local implementation of Bangladesh's national Climate Change Strategy and Action Plan. Climate adaptation action that is designed and implemented with local ownership can efficiently increase the resilience of vulnerable groups to climate change. The initiative strengthens the capacity of local government agencies to integrate climate adaptation in local development plans, improve national mechanisms for local climate finance and to implement climate adaptation actions identified jointly by local government and local communities. The initiative has climate change adaptation as its primary objective, and Sida's total disbursement in 2016 of 35 MSEK is identified as climate finance.

Since 2014, Sweden has a feminist foreign policy. Equality between women and men is a prerequisite for sustainability and for achieving the goals of UNFCCC and the Paris Agreement. Sida is committed to integrating the gender equality perspective throughout its operations, including the support for climate action. The overall level of gender integration is around 80 %. There is a slightly increasing trend, but a further stepping up of efforts can be sought, in particular in the mitigation portfolio. Within adaptation, the level has in general been higher, but there is scope for improvement here as well. Sida's voluntary reporting of gender integration in the BR and other climate finance reporting is done to track the progress, stimulate further integration and encourage other actors to do the same. Sweden has also been a champion for gender integration in the multilateral climate funds, including the promotion of separate gender policies and action plans. Overall integration of gender issues is improving, thus also contributing to the efficiency and long-term sustainability of the projects and programs funded by multilateral climate funds.

5.4.3. Bilateral financial support through the project-based flexible mechanisms under the Kyoto Protocol

The Swedish Program for International Climate Initiatives through the Kyoto Protocol's flexible mechanism spans for almost 20 years. The objectives of the program have evolved over time in response to the development of the international climate negotiations and the international carbon markets. However, the core mission of the program has remained to support the development of international climate cooperation, to achieve cost-effective greenhouse gas reductions and to contribute to sustainable development in developing countries. Through the program, Sweden supports over 90 bilateral projects through the Clean Development Mechanism (CDM) and Joint Implementation (JI) as well as participation in ten multilateral carbon funds[41] with a total commitment of 2,4 billion SEK Priority project types include renewable energy, energy efficiency and waste management. Priority has been given to bilateral projects in Sub-Saharan Africa (37 % of portfolio emission reduction volume) and

41 Future Carbon Fund (FCF), Asia Pacific Carbon Fund (APCF), Transformative Carbon Asset Facility (TCAF), Carbon Initiative for Development (Ci-Dev), Carbon Partnership Facility (CPF), Pilot Auction Facility for Methane and Climate Change Mitigation (PAF), Umbrella Carbon Facility Tranche 2 (UCF T2), Prototype Carbon Fund (PCF), Multilateral Carbon Credit Fund (MCCF) and Testing Ground Facility (TGF).

South East Asia (16% of portfolio emission reduction volume). Underrepresented developing countries have been of particular interest for the program, Small Island Developing States (SIDS) constitutes 2% of portfolio emission reduction volume, and Least Developed Countries (LDC) 18% of portfolio emission reduction volume.[42]

All emission reduction units delivered to the Swedish holding account generated during the first commitment period of the Kyoto Protocol have been cancelled.[43] Thereby ensuring that the emission reduction units cannot be utilized in any way, sold or used to fulfill Sweden's commitment under the Kyoto protocol.

The financial support is committed through an Emission Reduction Purchase Agreement between the Swedish Energy Agency and the project owner. The commitment is made at an early stage of the CDM- or JI-project in order to enable the development of projects. Through the Emission Reduction Purchase Agreement the Swedish Energy Agency commits to purchase the emission reduction units upon issuance. The actual financial flow is provided once the emission reduction units have been, generated, verified and certified by the UNFCCC and forwarded to Swedens holding account. The cancelled emission reduction units are reported as climate finance the year of the financial flow from the Swedish government to the project owner.

Through the Program for International Climate Initiatives, Sweden has provided result-based climate finance of approximately 86 million SEK over the years 2015–2016.

Table 5.7 Bilateral financial support through the Program for International Climate Initiatives during 2015–2016

	MSEK
2015	72
2016	14
Total	**86**

Since the main objective of the projects and carbon funds is climate change mitigation, the support provided is regarded as 100 percent climate finance according to the Rio markers (climate change mitigation is principal objective). The figures are also included in Annex 1, CTF table 7 and 7b.

5.5. Financial flows leveraged by bilateral climate finance

5.5.1. Mobilisation of capital through Sida

Since 2009 Sweden has an Ordinance for Financing of Development Loans and Guarantees for Development Cooperation. This provides opportunities to expand and leverage available resources for development by linking public measures with market finance. Guarantees stimulate mobilisation of both private and public capital, including partner countries' domestic capital. Sida helps lenders deal with risks by insuring eligible projects against losses relating to the different market risks. A common set-up is that Sida covers part of the loss if the borrower fails to repay its loan to the bank. Sida's guarantees are based on a set of simple key principles and conditions: additionality, risk-sharing, risk reflecting premium, and that it should be non-distortionary. In 2016, Sida had guarantees to climate-relevant initiatives with a total guarantee volume of 3.1 billion SEK, mobilising about 6.9 billion SEK. Note that part of the mobilised capital is provided by Development Finance Institutions (DFIs) that are partly or fully owned by public entities.

5.5.2. Mobilisation of private capital through Swedfund

Swedfund is Sweden's development finance institution. It is owned by the Swedish state through the Ministry of Enterprise and Innovation and the Ministry of Foreign Affairs. Swedfund's mission is to contribute to the goals set out in Sweden´s Policy for Global Development and can be summarized in Swedfund's mission statement: "Contribute to poverty alleviation through sustainable investments". Since 1979 Swedfund has invested in companies and funds located in Africa, Asia, Latin America, Eastern Europe and the Middle East. At the end of 2016 Swedfund had 63 investments in companies and funds in 27 countries, of which more than half were located in Africa.

Environmental and social aspects are of paramount importance in all our investments, as demonstrated in Swedfund's comprehensive Policy for Sustainable Development. In order to measure our performance, Swedfund has adopted four strategic sustainability goals. Indicators have been developed which are carefully measured and followed up during the value-creation phase of each investment.

Swedfund is always a minority investor, thereby ensuring that an investment made by Swedfund is catalytic and leads to financial commitments from both industrial and financial partners. Swedfund views its additionality as an investor not only in financial terms, but also in terms of knowledge transfer, e.g. with respect to climate and environmental impact, social impact and other sustainability criteria such as good governance and anti-corruption

As an example of Swedfund's climate efforts, in 2016 it strengthened its work to develop a method to measure the carbon dioxide emissions of portfolio companies. In addition, Swedfund increased its investments in renewable energy significantly.

Swedfund has also been part of developing the Interact Climate Change Facility (ICCF), a structure which mobilises significant amounts of long-term debt funding for climate change projects in a cost-efficient and innovative manner. The projects to date are primarily focused on electricity generation using renewable resources (e.g. wind, solar, hydro). Swedfund has together with other development finance institutions made several commitments to ICCF over the past few years, with an additional million USD 7.7

42 Can be compared to the CDM-market as a whole where Sub-Saharan Africa represents 3 %, Small Island Developing States (SIDS) represents 0,3 % and Least Developed Countries (LDC) represents less than 1 % (http://www.cdmpipeline.org/ (CDM pipeline overview (20160216))).
43 Reference M2017/00821/KI

committed by Swedfund in 2016, bringing Swedfund's total commitment to ICCF to million USD 24.

In addition to financial commitments, Swedfund continued to contribute to renewable energy in developing countries by, for example, cooperating with the wider European development community within the realm of Electri FI, a facility set up to develop early-stage electrification projects using renewable resources.

In 2016, Swedfund made the investments and helped mobilise the amounts of capital listed below (see Table 5.8), all with the aim to contribute to long-term, concrete results to fight poverty and for financially, environmentally, climatically and socially sustainable development. Swedfund's share for each sector is estimated to an average percentage of the total investments divided over many years, since our non-disclosure provisions give Swedfund a right to publicly disclose only certain key data. Due to the lack of an internationally agreed method for reporting on guarantees and mobilized finance, Sida does not yet include the figures from table 5.8 and 5.9 in the summarized amounts of Sida's and Sweden's climate finance.

5.6. Capacity building

5.6.1. Capacity building through official development assistance (ODA)

Capacity and institutional development is central for development, and is a fundamental entry point in all of Sweden's development coooperation. The majority of the climate finance support that Sweden provides through Sida therefore has capacity building integrated into the core of its operations. Capacity building takes place at the organisational level, individual level, level of institutional frameworks, and often a combination of the three.

Examples of Sweden's support to building climate change capacity are provided in Annex 1, CTF table 9 and the boxes below. The examples represent different types of capacity building support that Sida provides. These include initiatives where building climate change capacity is the main objective, other contributions where climate is part of contributions aiming to develop wider research capacity and scientific knowledge, and contributions where climate change is integrated in operations building capacity in areas such as energy, DRR or water resources governance.

Table 5.8 Guarantees provided by Sida in 2016 for climate-relevant investments.

	Guarantee volume (MSEK)	Mobilised capital (MSEK)	Main source of mobilised capital	Guarantee volume (MUSD)	Mobilised capital (MUSD)
Guarantee BiH Sberbank (formerly Volksbank) in cooperation with USAID	25	42	Private	3	5
5Pakistan – Guar Windpower	480	1 071	Public	56	125
Agri Guarantee USAID Multi Party	37	51	Private	4	6
Agri Guarantee USAID Zanaco	26	46	Private	3	5
Loan Portfolio Guarantee for Sustainable Energy Moldova	9	15	Private	1	2
Conflict-Affected and Fragile Economies Facility (CAFEF/MIGA) – Guarantee	200	684	Private	23	80
Portfolio Guarantee – Asian Development Bank	2 000	4 500	Public	234	526
NEFCO Portfolio guarantee	175	228	Public	20	27
Global Guarantee Facility Household Technologies	117	210	Mixed	14	25
Zambia, bioenergy Madison Finance LPG guarantee	26	33	Private	3	4
Total	**3 093**	**6 880**		**361**	**804**

Table 5.9 Swedfund's investments and contributions

Projects	MUSD	Specifics
IFC Women Entrepreneurs Debt fund*	20	Fund focusing on women entrepreneurs in sub-Sahara Africa
XacBank	10	Bank in Mongolia with focus on minimising climate change. Under the umbrella clean air are companies offered financing to ensure energy efficient systems and production lines.
ICCF	5	Climate facility with focus on renewable energy
DBL Industries	15	Swedfund invests together with Ethiopian Development Bank and company from Bangladesh, DBS, to build textile factory in Ethiopia. Strong focus on sustainability, environment and women.

* Swedfund's share of total amount mobilised amounted to less than 7 percent according to a standardized average percentage.

It often includes support directly to low-income country government institutions. Examples include support to the two government universities in Bolivia and support via multilateral institutions as in the case of the Landscape and Forests Management Multi Donor Trust Fund with the World Bank in Mozambique. It includes support to regionally owned institutions, such as the International Centre for Integrated Mountain Development (ICIMOD) and Western Indian Ocean Marine Science Association (WIOMSA), to civil society based organisations, such as the Huairou Commission, which works with grassroots organisations in the countries, and support through Swedish Authorities, such as the International Training Program on Climate Change held by the Swedish Meteorological and Hydrological Institute.

While there is a high level of knowledge about effective capacity building, there is today no internationally agreed approach to track capacity building in ODA quantitatively.

BOX 5.5

Sida contributes to the Energy Sector Management Assistance Program (ESMAP). ESMAP is a partnership between the World Bank Group and 17 partners to help low- and middle-income countries reduce poverty and boost growth through environmentally sustainable energy solutions. It focuses on SDG 7 and the SE4All goals and has activities in over 130 countries. Situated within the World Bank, ESMAP influences billions in loans for development projects, leverages public and private financing, and shapes global policy.

BOX 5.6

The Huairou Commission is a global membership and partner coalition working with women leaders at the grass roots level. It aims to make concrete improvements on a local level and to strengthen women's collective power on a global level. One of the Commission's key areas is to increase the capacity of its partner organisations within climate change, resilience and disaster risk reduction. Sida supports the Huairou Commission to implement its strategic plan for 2015–2020.

BOX 5.7

In 2016 Sweden was one of the first donors to support to the Capacity Building Initiative for Transparency (CBIT), established at COP21 in Paris. The goal of the CBIT is to strengthen the institutional and technical capacities of developing countries to meet the enhanced transparency requirements of the Paris Agreement.

In summary, Sweden provides extensive support to climate change capacity building, with different approaches and in cooperation with different types of actors. This diversity is needed to respond to different partner countries' or organisations' specific needs and contexts.

5.6.2. Capacity building through other official flows (OOF)

Many of today's environmental challenges are transboundary and cannot be solved only within the borders of Sweden. The major emerging national economies of Brazil, Russia, India, Indonesia, China and South Africa (BRIICS) have extensive manufacturing industries that provide products to both the domestic and global market. These populous countries have a major impact on global resource use and environmental performance, and are therefore key players in global environmental and climate cooperation. Developing relationships with strategic countries is positive for tackling environmental challenges but also in terms of industry, export trade, foreign policy and security policy. The Swedish Environmental Protection Agency (EPA) has a fund totalling 15 MSEK allocated to support countries that have strategic importance to the global environment and climate. Four Swedish government agencies are involved to carry out this bilateral cooperation: the Swedish Agency for Marine and Water Management, the Swedish Chemicals Agency, the Swedish EPA and the Swedish Meteorological and Hydrological Institute (SMHI).

BOX 5.8

SMHI has collaborated with the city Curitiba in Brazil with local and regional environmental authorities and universities. In this project, particpants are developing a method to determine the emissions of particles and their impact on the city's air quality. The first phase of the project was initiated in 2016 and includes an inventory of the existing sources and emissions from air pollutants. As a result of this project, the city's department of urban planning and mobility has taken an interest in the environment impact of air pollutants and how to reduce the pollutants through urban planning.

BOX 5.9

In accordance with the Paris Agreement and Montreal Protocol to phase out hydrofluorocarbons (HFCs) the Swedish EPA organised a workshop in Stockholm to initiate cooperation with China aimed at promoting an elimination of HFCs and energy efficiency through district cooling systems. This is an area that Sweden prioritises also by strengthen the Swedish export opportunities. This collaboration is between the Swedish EPA and the Foreign Economic Cooperation Office (FECO), an office under the Chinese Ministry of Environmental Protection. The project has resulted in a roadmap for future work and collaboration.

5.7. Technology development and technology transfer

5.7.1. Technology development through official development assistance (ODA)

A large proportion of Sweden's development cooperation includes development of climate-friendly technology or technology transfer. Transfer of technology is often combined in an integrated way with capacity building to ensure long-term sustainability. Examples are presented in the Annex 1, CTF Table 8. The examples represent different types contributions, including mitigation and adaptation technologies, and are from a range of actors and contexts in Africa, Asia and Europe and global partnerships, soft as well as hard technologies, and within a number of different sectors, including energy, agriculture and disaster risk reduction. Note that these are examples only and not an exhaustive list.

BOX 5.10

The Consultative Group for International Agricultural Research (CGIAR) is a global research partnership for improved food security. A tangible example of technology development in their work is the story of scuba rice – a rice variety that survives better in flooded areas than other rice varieties and at the same time has a high nutritional value. Scuba rice was developed by CGIAR's rice research institute from a traditional Indian rice variety. It is today grown by millions of people in Asia, improving food security.

BOX 5.11

To increase access to clean electricity, Sida supports the rehabilitation of two old hydro-electric power stations with a total capacity of about 100 MW along Rio Revué in the central part of Mozambique using modern technology. This rehabilitation contributes to the country's development by securing energy access with continued low greenhouse gas emissions. The repair works have been financed by a development loan supplied as a grant portion and a commercial loan.

5.7.2. Technology development through other official flows (OOF)

BOX 5.12

Within the framework of the Swedish-Indian cooperation in the field of energy, the Swedish Energy Agency (SEA) has been active since 2009. Its overall objective is to build long-term relationships based on trade, research cooperation and knowledge development from the Swedish side. This will contribute to the agency's mission of developing the energy system and achieving climate commitments. In line with this objective the Energy Agency has, since 2013, developed the program India-Sweden Innovations Accelerator (ISIA). This program supports business-oriented innovation development and dissemination by promoting networking, knowledge sharing and development of relations between Swedish and Indian actors active in innovative energy technologies.

BOX 5.13

The Swedish-Indian cooperation has also included a number of research-oriented activities supported by the SEA. At the Andaman & Nicobar Islands three consortiums of Swedish Small and Medium Enterprises (SMEs) together with academia and research institutes have analysed the pre-conditions and developed project design for pilot projects based on hybrid solutions based on local renewable resources and circular economy.

BOX 5.14

In Indonesia, the Swedish Energy Agency has a cooperation with the Indonesian Secretariat of the National Energy Council (NEC) since 2013, called the Indonesian Swedish Initiative on Sustainable Energy Solutions (INSISTs). It encompasses bilateral work that focuses on renewable energy and energy efficiency promotion. It also encompasses joint R&D efforts, e.g. in the form of a bioenergy roadmap for Indonesia. SEA also works closely with Business Sweden to assist SME:s to enter the Indonesian market, with a focus on innovative companies in the renewables and energy efficiency sector. Another long-term area for cooperation with Indonesia is the waste management and waste-to-energy sector, where SEA together with Business Sweden and NEC in 2016 conducted field visits to two cities in Indonesia, Payakumbuh in West Sumatra, and Balikpapan in East Kalimantan. Starting in 2017, SEA aims to facilitate consortia building in the field of waste management and waste-to-energy solutions for Indonesia.

6. Other reporting matters

6.1. Domestic monitoring and assessment

6.1.1. Monitoring under the new climate policy framework

In June 2017, the Riksdag (Swedish Parliament) adopted a proposal on a national climate policy framework for Sweden (Govt. Bill 2016/17:146). The climate policy framework consists of a Climate Act, new national climate targets and a climate policy council. The climate policy framework is the most important climate reform in Sweden's history. It creates order and stability in climate policy and sets long-term conditions for the business sector and society. The climate act will impose responsibility on the current Government, and on future governments, to pursue a climate policy that is based on the national climate targets and to provide clear feedback on the progress. Sweden will have long-term climate targets beyond 2020 and a council that independently reviews climate policy. The reform is a key component of Sweden's efforts to live up to the Paris Agreement.

Climate Act

The Climate Act legislates that the Government's climate policy must be based on the national climate targets and specifies how the work should be carried out.

In its Budget Bill, the Government must submit a climate review to the Riksdag every year. The climate review must contain:

- A report on emissions development.
- A report on the key political climate decisions taken during the year.
- An assessment to identify the need for additional policies and measures, and when and how decisions about such policies and measures can be adopted.
- Every fourth year, the Government must develop a climate policy action plan which provides information on planned policies and measures to achieve emission reductions.
- The new Climate Act will enter into force on 1 January 2018.

Climate Policy Council

The climate policy council will provide independent assessments of how the overall policy presented by the Government is compatible with the national climate goals.

6.2. Additional monitoring

In addition to the institutional set up under the new national climate framework, monitoring takes place at both the EU and the national level. Under the EU's monitoring mechanism (Regulation (EU) No 525/2013), Sweden reports every two years on policies and measures implemented and planned to achieve the climate target for 2020. At a national level regular evaluations have been performed of the country's climate policy. The first was a 'checkpoint' review that started in 2004 (leading to a climate policy decision in 2006), and the second was initiated in 2007 (resulting in the 2009 climate policy decision). To analyze progress towards the objectives, as well as the state of knowledge, a further checkpoint review was undertaken in 2015.

The Swedish domestic institutional arrangement for self-assessment is using the national system for the GHG inventory and policies and measures and projections, as described in section 1.3 and 1.4 above.

Annex 1
Financial, technological and capacity-building support

See the Additional tables to Sweden's Seventh National Communication (NC) on Climate Change and third Biennial Report (BR) under UNFCCC – Annex 6 (NC) and Annex 1 (BR); Provision of financial, technological and capacity-building support.

2018

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