SWEDISH ENVIRONMENTAL
PROTECTION AGENCY

Government Offices of Sweden
Ministry of the Environment and Energy

Sweden's Second Biennial Report under the UNFCCC

Preface

Climate change is upon us. It is serious and it affects everyone – those of us living now and future generations. It is the critical issue of our time. Global warming must be kept as far below two degrees as possible to avoid the most serious climate impacts. Sweden welcomes the historic outcome reached in Paris where the world adopted a global and legally-binding climate agreement with the aim to put it on track to limit global warming to well below 2°C (above pre-industrial levels) and pursuing efforts to limit the temperature increase to 1.5°C. It is possible, if we are determined in our efforts.

Sweden is accelerating the pace of its climate change actions because it is essential for the future of the planet and because it enhances our own competitiveness and quality of life. Sweden has introduced a range of policies and measures directly or indirectly affecting greenhouse gas emissions. The emphasis in our climate strategy is on the use of general economic instruments. Key instruments have been the energy and carbon dioxide taxes. These taxes are supplemented with a range of other instruments, such as technology procurement, information, specific tax instruments such as a differentiated annual vehicle tax. At the same time, the developments of recent decades have been defined by a framework for spatial planning and a key role for municipalities and county administrative boards. Of particular importance are investments over a significant period of time in an expansion of district heating networks, public transport and carbon-free production of electricity.

The current government took office in October 2014 and has since declared its ambition that Sweden is to become one of the world´s first fossil free welfare countries. Investments for 100 per cent renewable energy will lead the way. The government has launched a number of grants to enhance investments that contribute to combat climate change. These include a broad program for investments in new climate friendly solutions and additional funding for subsidies to electric vehicles and several programs for support of public transport.

The EU and its Member States, have a joint quantified economy-wide emission reduction target of 20 per cent by 2020, compared to 1990 levels under the UN Framework Convention on Climate Change (UNFCCC) and a commitment to reduce GHG emissions by 20 per cent during the second commitment period under the Kyoto Protocol. Therefore, Sweden and other Member States of the EU,

have no individual economy-wide emission reduction targets to the UNFCCC[1]. This biennial report provides information on progress made in relation to Sweden's contribution to the joint EU target, including historical emissions and projected emissions. In addition, it contains information on the development of greenhouse gas emission levels and of the significant number of policies and measures in place to curb the emissions. The information provided also describes progress towards Sweden's target under the second commitment period under the Kyoto Protocol to the UNFCCC, as well as towards the domestic target for 2020, agreed by the Swedish Parliament, of reducing emissions in non-trading sectors by 40 % compared to 1990. Furthermore, the report includes information on Sweden's substantial provision of financial, technological and capacity-building support to Parties not included in Annex I to the Convention.

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[2].

Åsa Romson
Minister for Climate and the Environment, Deputy Prime Minister
Ministry of the Environment and Energy

1 The details of the EUs´ joint target are outlined in the document Additional information relating to the quantified economy-wide emission reduction targets (FCCC/AWGLCA/2012/MISC.1). http://unfccc.int/resource/docs/2012/awglca15/eng/misc01.pdf

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

Content

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

1

This chapter summarizes trends in the National Inventory Report for Sweden 2015, submitted to the UN Climate Convention on inventory of emissions and removals of greenhouse gases. For more detailed information of emissions see CTF Table 1 or the National Inventory Report for Sweden 2015[3]. The chapter also includes information on Sweden's national system for GHG emissions, for policies and measures and projections and for changes to these arrangements since Sweden's first Biennial Report.

1.1 Greenhouse gas emissions from 1990 to 2013

This section summarizes trends in the National Inventory Report for Sweden 2015, submitted to the UN Climate Convention and the Kyoto Protocol on inventory of emissions and removals of greenhouse gases. The information is reported electronically in the Common Tabular Format (CTF) and submitted separately to the UNFCCC using the CTF software.

1.1.1 Total emissions and removals of greenhouse gases

1.1.1.1 OVERVIEW OF TOTAL EMISSIONS

Total greenhouse gas emissions in Sweden, calculated as carbon dioxide equivalents (CO_2-eq.), were 55.8 million tonnes (excl. LULUCF) in 2013, see Figure 1.1. Total greenhouse gas emissions were less than 1990 level for all years from 1999 onward, despite annual variations. Emissions have decreased 16 million tonnes or 22 per cent from 1990 to 2013. Apart from significant fluctuations in recent years, there is a clear downward trend in emissions as seen in Figure 1.1.

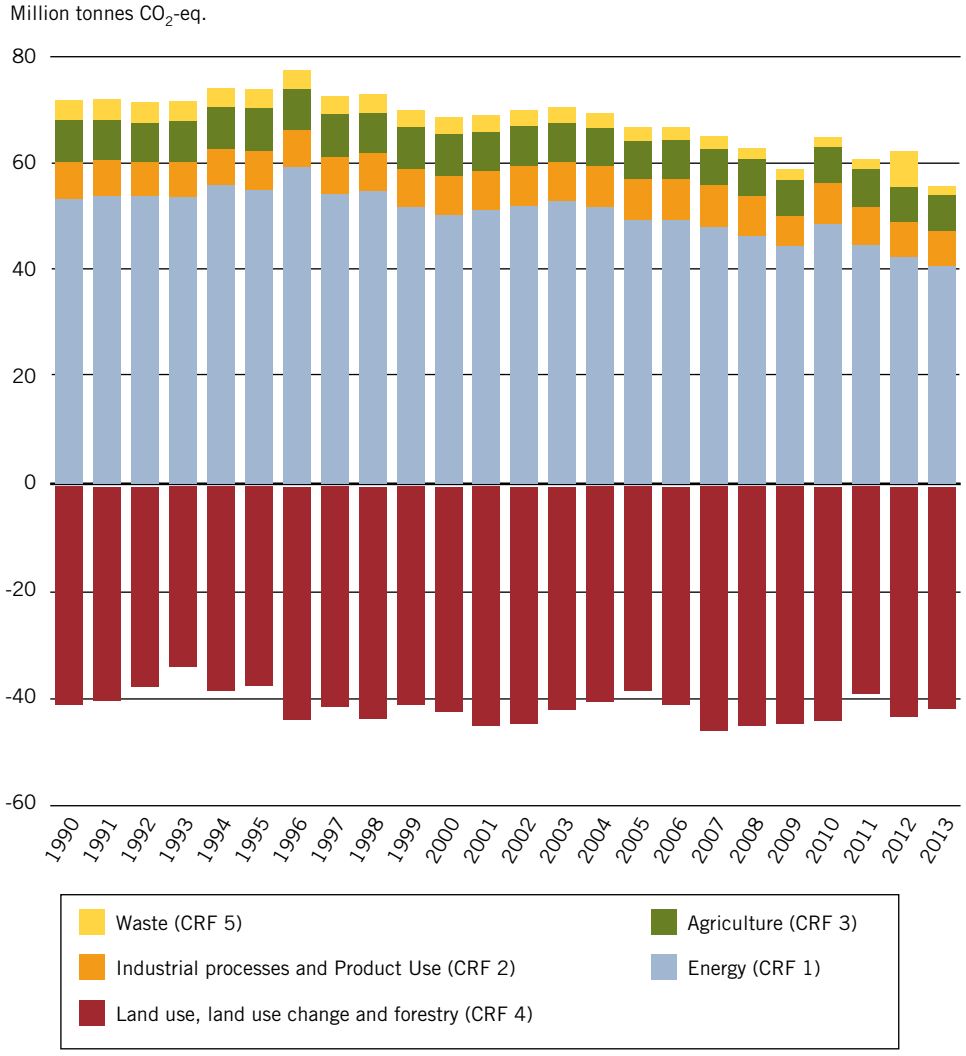
Sweden also reports carbon stock changes from managed land use categories such as Forest land, Cropland, Grassland and Settlements. This sector is called the Land Use, Land-Use Change and Forestry sector (LULUCF). Sweden chooses to report on the LULUCF sector for transparency and consistency reasons even though this sector is not included in the EU's and member states' pledge under the Climate convention for pre-2020. It generated annual net greenhouse gas removals

3 National Inventory Report for Sweden 2015. http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php

throughout the inventory period (1990–2013) as seen in Figure 1.1. However, the size of the sink has varied.

A global economic downturn started in the autumn 2008, affecting several sectors in the Swedish economy. The economic recession deepened in 2009 leading to lower production in many of Sweden's industrial sectors. Consequently, greenhouse gas emissions plunged in 2009. In 2010, most of these industries started to recover. Furthermore, the cold winters in 2010, at the beginning and end of the year, resulted in greater heating needs. In combination with lower nuclear production, this led to increased use of fossil fuels in the electricity and heat production sectors. In 2011, emissions returned to a level similar to 2009 and continued decreasing in subsequent years. Warmer winters may have contributed to this trend. Between 2012 and 2013, total greenhouse gas emissions decreased by 3 per cent.

FIGURE 1.1 Total emissions and removals of greenhouse gases calculated as carbon dioxide equivalents from Land use, land use change and forestry (LULUCF, CRF 4) and the other CRF sectors (1, 2, 3 and 5), 1990–2013

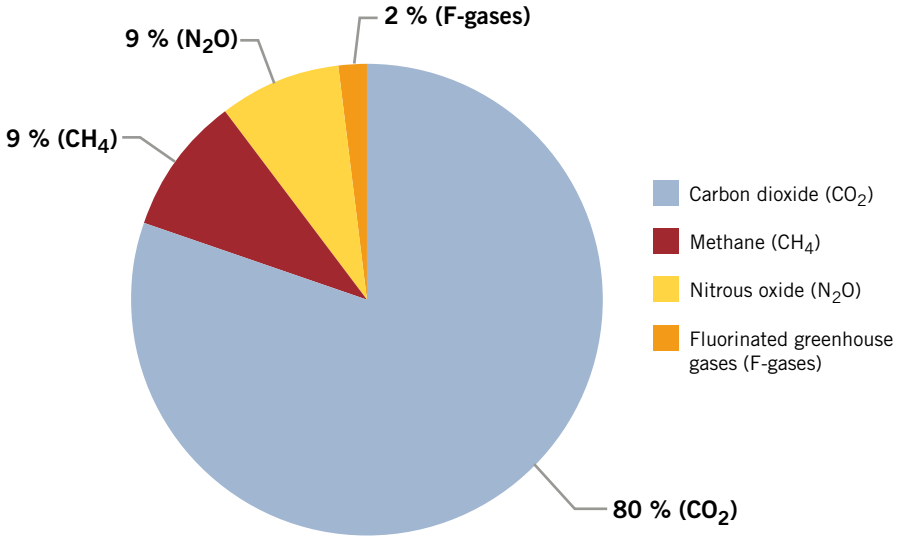


The energy sector (CRF 1) includes both domestic transports as well as combustion in industry other than production of electricity and district heating. Around 75 per cent of total emissions (exclusive LULUCF) came from this sector in the period 1990–2013 as seen in Figure 1.1. The industrial processes and Product use sector (CRF 2) includes emissions from industrial processes, from the use of products, and emissions of fluorinated gases. These emissions have been quite stable at around 10 per cent of total emissions (excluding LULUCF). The share from agriculture (CRF 3) has also been stable during the period, around 10 per cent, as well as in the waste sector (CRF 5) with around 3 per cent of total emissions. Figures for each sector are broken down further later in the chapter.

1.1.1.2 TOTAL EMISSIONS BY GAS

Figure 1.2 illustrates the breakdown of greenhouse gas emissions for 2013. The shares of each remained stable through the period from 1990 to 2013.

FIGURE 1.2 Greenhouse gases as shares of total emissions in carbon dioxide equivalents (excl. LULUCF, CRF 4), in 2013



Emissions of carbon dioxide (CO_2) totalled 44.8 million tonnes in 2013, equal to 80 per cent of aggregated greenhouse gas emissions calculated as carbon dioxide equivalents. The majority of the CO_2 emissions come from the energy sector, representing 88 per cent in 2013.

Emissions of methane (CH_4) accounted for 5.3 million tonnes of carbon dioxide equivalents, just over 9 per cent of the total. 64 per cent of methane emissions in 2013 originated in the agriculture sector and 25 per cent came from the waste sector. Emissions of methane have decreased 35 per cent since 1990, mainly due to measures taken in the waste sector.

Emissions of nitrous oxide (N_2O) totalled 4.7 million tonnes, for a share of almost 9 per cent of the total. Nitrous oxide emissions are primarily in the agriculture sector, which accounted for 72 per cent of the total for 2013. Emissions of nitrous oxide decreased by 17 per cent during the period, primarily due to decreased emissions from industrial processes and product use.

Emissions of fluorinated greenhouse gases (f-gases) include emissions from use of these in various applications and from emissions of PFC, primarily from aluminium production processes. Emissions of f-gases amounted to nearly 2 per cent of the total. Emissions of f-gases have increased 77 per cent since 1990, though with this increase trending slower from 2010 where the increase in f-gases is mainly due to increased emissions of hydrofluorocarbons (HFCs) used as refrigerants in refrigerators, for example. Ozone depleting substances are very often replaced by HFCs. The f-gases are regulated in the new EU Regulation 517/2014 on Fluorinated Greenhouse Gases which applies from 1 January 2015 and replaces the previous EU Regulation No 842/2006 on certain fluorinated gases[4].

1.1.2 Emissions and removals of greenhouse gases by sector

1.1.2.1 OVERVIEW OF TOTAL EMISSIONS BY SECTOR

Emissions of greenhouse gases have developed differently between Swedish sectors from 1990 to 2013. As seen in Figure 1.3, the energy sector (CRF 1) is further broken down by subsector.

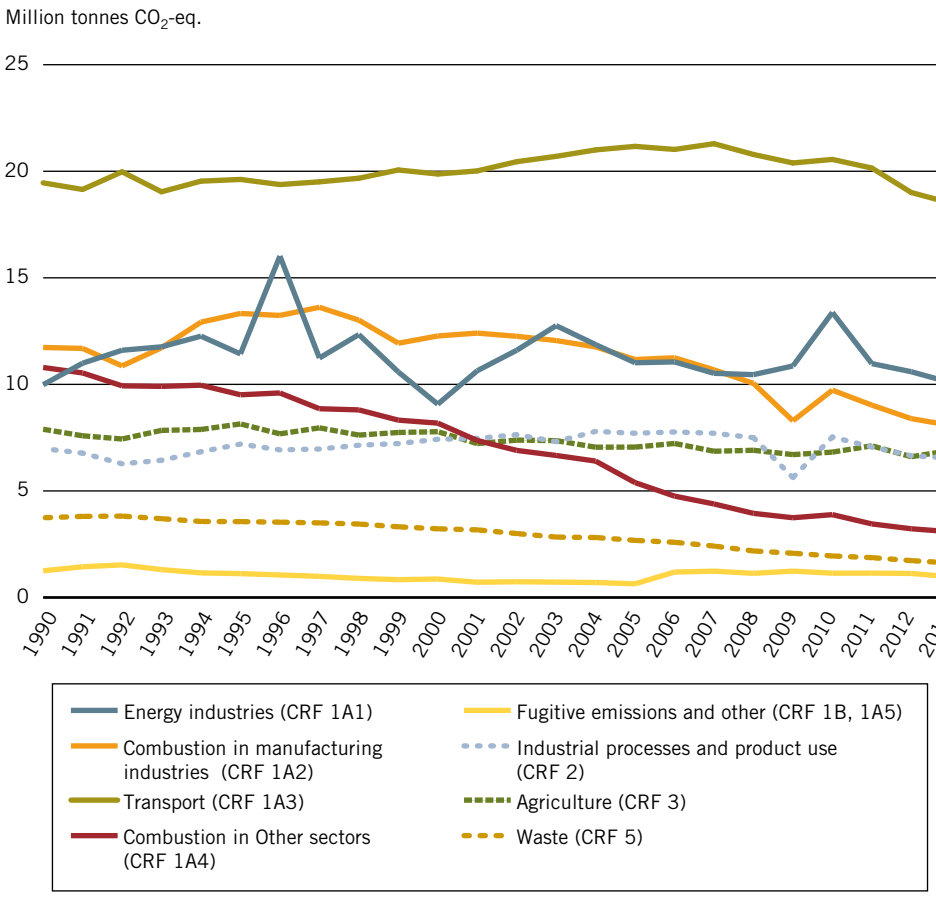
The sectors that contributed most to the overall decrease, 16 million tonnes of greenhouse gases in the period, were subsectors in the energy sector (CRF 1). Fuel combustion in Residential, commercial/institutional and agriculture, forestry and fisheries (CRF 1A4) is the subsector that contributed the most, with a decrease of 7.7 million tonnes between 1990 and 2013, mainly due to the replacement of oil heating with district heating and electricity for the heating of homes and commercial and institutional premises. Emissions from the energy industries (CRF 1A1) come mainly from the production of electricity and district heating and have varied from year to year. The fluctuations between years are large, due to the influence of weather conditions on electricity and heat production.

Emissions from industry are from several sectors, the majority in the two subsectors Combustion in industries in the energy sector (CRF 1A2) and in the Industrial processes and product use sector (CRF 2). Combustion in industries (CRF 1A2) have decreased 3.7 million tonnes since 1990 or 31 per cent. But these emissions have varied upwards and downwards over the years due to economic fluctuations and replacement of oil with electricity or biofuels.

Waste decreased its emissions by 2.1 million tonnes, *agriculture* by 1 million tonne and *transport* by another 1 million tonne carbon dioxide equivalent.

4 http://ec.europa.eu/clima/policies/f-gas/legislation/index_en.htm

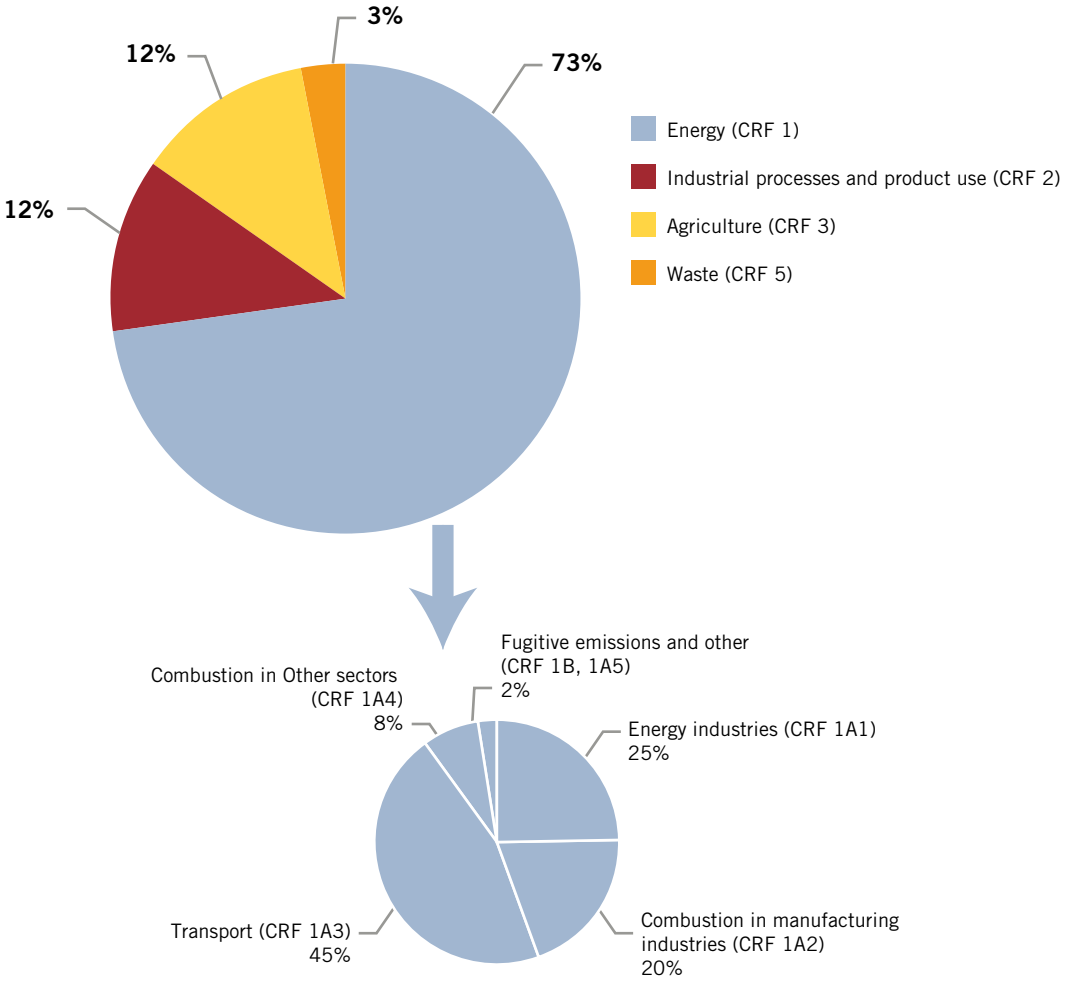
FIGURE 1.3 Greenhouse gas emissions (excl. LULUCF, CRF 4), by sector and with CRF 1 by subsectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



In 2013, the energy sector (CRF 1) represented 73 per cent of total emissions (see Figure 1.4). The industrial processes and product use sector (CRF 2) stood for 12 per cent of total emissions, agriculture (CRF 3) accounted for 12 per cent and waste (CRF 5) for 3 per cent.

When the energy sector is broken down into subsectors, this shows that emissions from transport (CRF 1A3) represent 45 per cent of the total in the energy sector (33 per cent of total emissions in Sweden). The subsector energy industries (electricity and heat production, refineries and manufacture of solid fuels, CRF 1A1) account for 25 per cent of the total emissions from the energy sector (and 18 per cent of total emissions in Sweden). Combustion in industry (CRF 1A2) accounts for 20 per cent of the emissions from the energy sector (and 14 per cent of the total emissions). Emissions from combustion in other sectors (1A4) consist of Heating in the residential and commercial/institutional sectors and the Agriculture, forestry and fisheries sector.

FIGURE 1.4 Share of greenhouse gas emissions in carbon dioxide equivalents (excl. LULUCF, CRF 4), with CRF 1 by subsectors, 2013



The smallest subsectors in the energy sector are fugitive emissions (CRF 1B) and the other which includes emissions from military activities (CRF 1A5). Military activities were less than 0.5 per cent of the emissions in the energy sector in 2013.

1.1.2.2. ENERGY SECTOR (CRF 1)

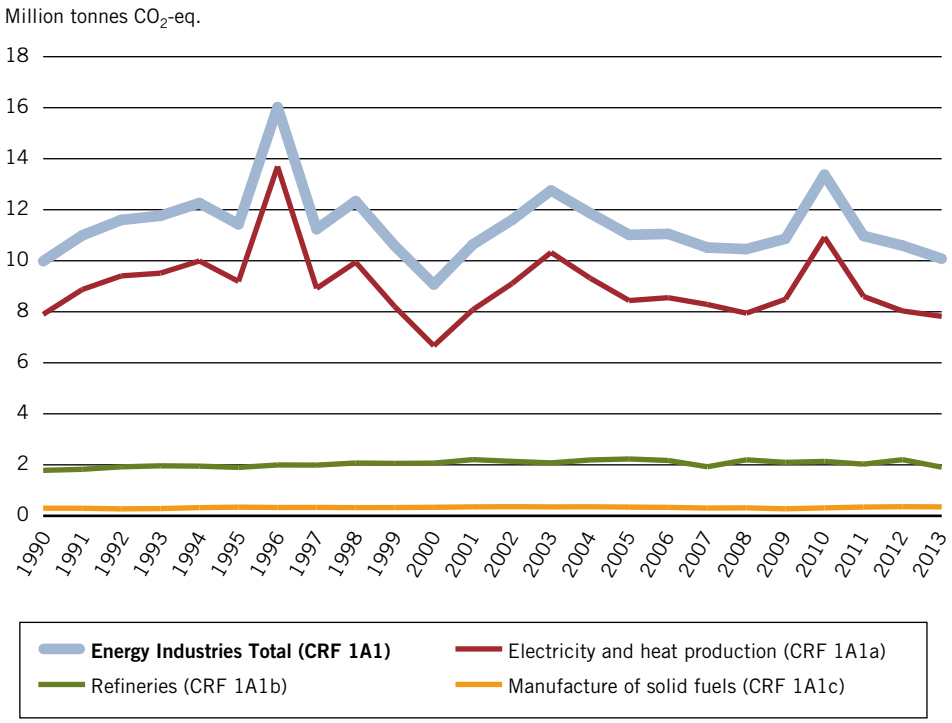
Emissions from the energy sector accounted for 73 per cent of the total emissions in Sweden in 2013 (as seen in Figure 1.4), at approximately 40 million tonnes, and includes emissions from Production of electricity and district heating, refineries and manufacture of solid fuels (in CRF 1A1), combustion in manufacturing industries (CRF 1A2), transports (CRF 1A3), combustion in commercial/institutional, residential, agriculture, forestry and fisheries (other sectors, CRF 1A4), as well as in military transports (CRF 1A5) and fugitive emissions (in CRF 1B).

1.1.2.1.1 Energy industries (CRF 1A1)

The energy industries sector (see Figure 1.5) includes production of electricity and district heating, refineries and the manufacture of solid fuels. Sweden's production of electricity and district heating is based largely on hydropower, nuclear power, and biofuels. Fossil fuels serve as a complement, often as a marginal fuel for cold weather. Total emissions for energy industries are approximately 10.1 million tonnes carbon dioxide equivalents in 2013 which is slightly higher than in 1990. However, fluctuations between years are large, due to the influence of weather conditions on electricity and heat production.

Emissions from Production of electricity and heat (CRF 1A1a) account for the larger part of emissions, nearly 7.8 million tonnes of carbon dioxide equivalents in 2013, a decrease of 3 per cent compared to 2012. Emissions for 2013 are near the 1990 level, only 1 per cent lower. Emissions from electricity and heat production vary over time and no apparent trend can be seen between 1990 and 2013.

FIGURE 1.5 Greenhouse gas emissions from the energy industries (CRF 1A1), 1990–2013 (million tonnes of carbon dioxide equivalents)



Sweden's electricity and heat production are based largely on hydro and nuclear power, and biofuels. Fossil fuels serve as a complement, often as a marginal fuel in cold weather. Temperature and precipitation conditions vary between years, impacting hydropower production and heating needs from year to year, thus leading to annual variation in emissions. This is illustrated by the high emissions

in 1996, which was a cold and dry year, and by low emissions in 2000, which was warm with heavy precipitation – which also provided good availability of hydropower. 2010 was also a very cold year. In years of low hydropower production, emissions are affected by the kind of electricity production used to offset the shortage. Emissions in this sector are also affected by iron and steel production, as residual gases from this industry are used to produce electricity and district heating.

Production of district heating accounts for the largest share of greenhouse gas emissions in this sector. Since 1990, the supply of district heating has increased by some 50 per cent[5]. On the other hand, emissions have not increased significantly as the expansion has principally taken place through increased use of biomass fuels and the use of coal has decreased. Energy and carbon dioxide taxes and the electricity certificates system have contributed to this trend[6]. District heating is the most common form of heating in households and the service sector, with a 58 per cent share of total energy use in 2013[7].

Emissions from Refineries (CRF 1A1b) totalled 1.9 million tonnes and from manufacture of solid fuels around 0.4 million tonnes in 2013.

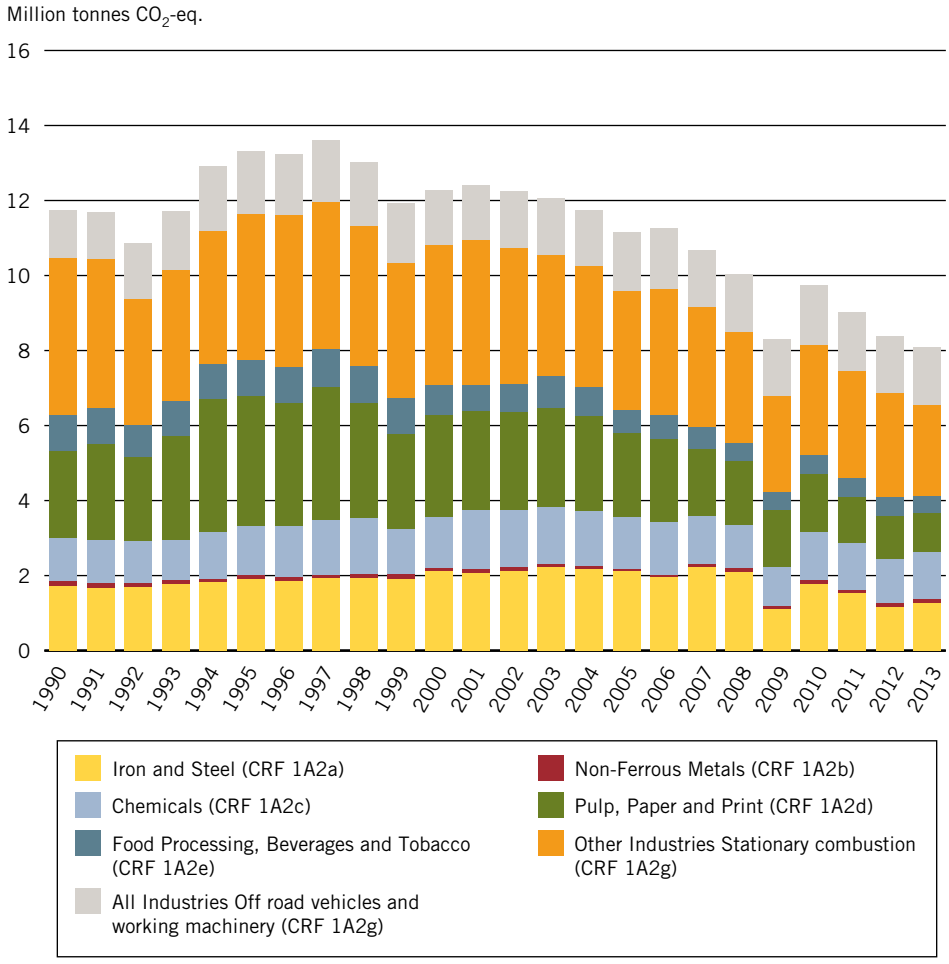
1.1.2.1.2 Combustion in manufacturing industries and construction (CRF 1A2)
Emissions from combustion in the industrial sector were around 8.1 million tonnes carbon dioxide equivalents in 2013, see Figure 1.6. Emissions in 2013 were 31 per cent lower than in 1990, but they have varied upwards and downwards over the years. The reasons for this are principally due to economic fluctuations and replacement of oil with electricity or biofuels, partly depending on the difference in relative prices between electricity and oil. However, there is a decreasing trend. Emissions have decreased 4 per cent between 2012 and 2013.

A small number of energy-intensive industries account for a large proportion of carbon dioxide emissions in this sector. The iron and steel industry and the chemical industry account for around 15 per cent each. Viewed over a longer period, from 1970 forward, these industries have reduced their use of oil and increased use of electricity. In 2012, oil represented 9 per cent of the total energy used in the industry compared to 48 per cent in 1970[8]. Use of biofuels has also increased. Biofuels and electricity are now the main energy sources within the industry and represented 40 per cent and 36 per cent, respectively, of the final energy use in 2012.[9] Another reason for the reduction of emissions is increased energy efficiency[10]. The economic recession in 2008 and 2009 also affected emissions.[11]

5 Swedish Energy Agency, 2012b
6 Swedish Energy Agency, 2013b
7 Summary of energy statistics for dwellings and non-residential premises 2013
8 Swedish Energy Agency, 2013b
9 Swedish Energy Agency, 2014c.
10 Swedish Energy Agency, 2013b
11 Swedenergy, 2014

There is a downward trend in total emissions from combustion in manufacturing industries, where one reason is reduced emissions from the pulp, paper and print industry, mainly due to fuel substitution from fossil fuels to biofuels. The pulp and paper industry has the highest energy use within the sector (around 50 per cent) and therefore substitution has had a significant effect on emissions, resulting in a reduction of more than 50 per cent compared to 1990[12]. Other manufacturing industries have also made transitions from fossil fuels to electricity and/or biofuels, leading to reduced emissions. Stationary combustion in the sectors *other industries* and *food processing, beverages and tobacco* also show decreasing trends. However, emissions from stationary combustion in the iron and steel industry and the chemical industry increased slightly compared with 2012 levels..

FIGURE 1.6 Greenhouse gas emissions from industrial combustion within manufacturing industry (CRF 1A2), by subsectors 1990–2013 (million tonnes of carbon dioxide equivalents)



12 Swedish Energy Agency, 2013b

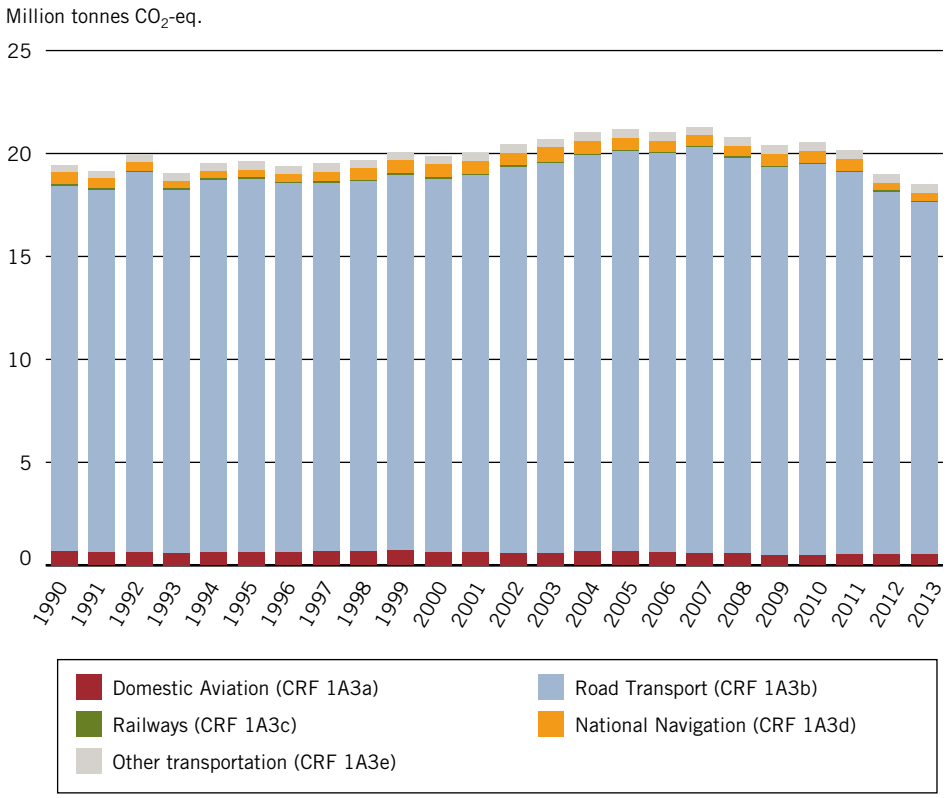
1.1.2.1.3 Transport (CRF 1A3)

Emissions from the transport sector include emissions from domestic aviation, road transport, railways, national navigation and other working machinery and vehicles. It does not include working machinery and vehicles found in agriculture/forestry/fisheries or residential, these are found in the energy sector.

Greenhouse gas emissions from total domestic transport totalled 18.5 million tonnes of carbon dioxide equivalents in 2013, as seen in Figure 1.7. This is slightly lower than in 1990. After a peak around 2005, the trend is slowly decreasing emissions after 2008. In 2013 the greenhouse gas emissions from road transportation were 17.1 million tonnes, from domestic aviation 0.5 million tonnes, from domestic navigation 0.4 million tonnes, from railways 0.06 million tonnes, and from other machinery 0.4 million tonnes.

Carbon dioxide accounts for the largest share of greenhouse gas emissions from the transport sector, methane and nitrous oxide for a small share.

FIGURE 1.7 Total greenhouse gas emissions from the Transport sector (only domestic) (CRF 1A3), 1990–2013



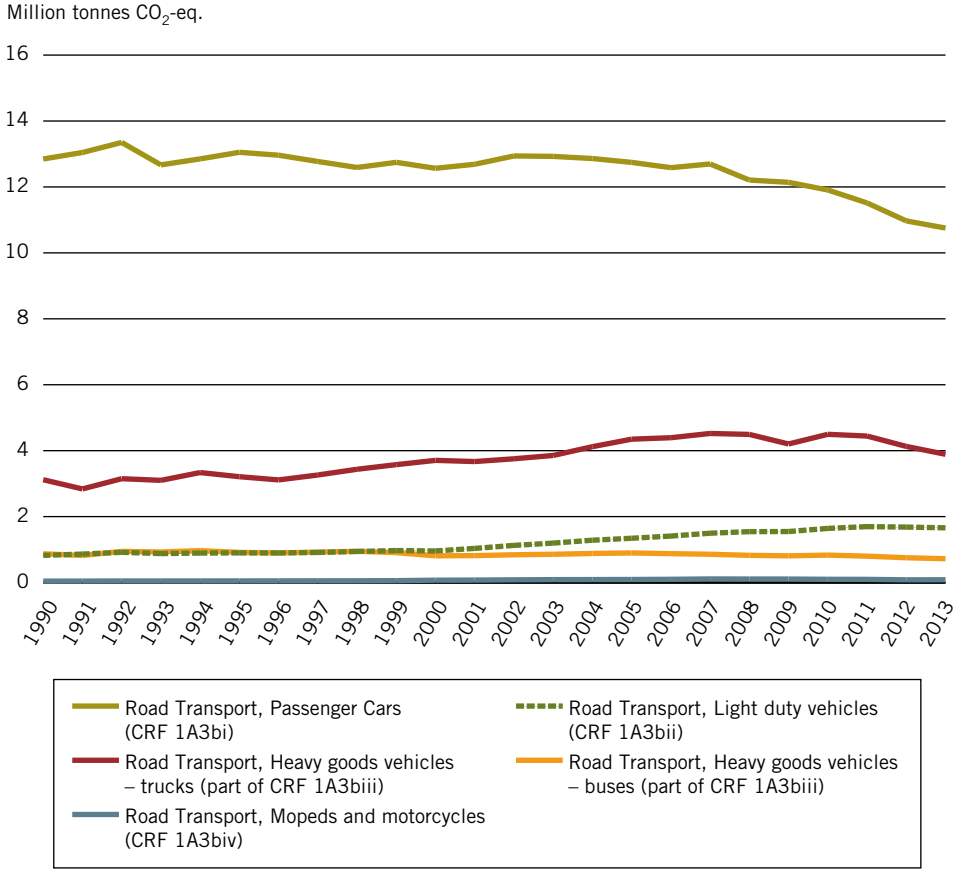
International transport

Greenhouse gas emissions from international shipping and aviation, also known as international bunkers, include refuelling in Sweden by international shipping and aviation. These emissions are *not* included in the reporting of the national total emissions from Sweden, but are added as a memo item. These emissions are considerably larger than those from domestic shipping and aviation. See section 1.1.2.5 for further details of these emissions.

Road transport (CRF 1A3b)

Emissions from road transport totalled 17.1 million tonnes of carbon dioxide equivalents in 2013, a decrease of 3 per cent since 2012. Total emissions from road traffic increased from 1990 to 2005 before levelling out, and have been decreasing since 2008. The majority of emissions from road transport come from cars and heavy-duty vehicles. See Figure 1.8.

FIGURE 1.8 Greenhouse gas emissions from road traffic (CRF 1A3b), by subsectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



Emissions from passenger cars remained quite constant between 1990 and 2007 and then started to decrease, resulting in 2013 emissions being 16 per cent lower than in 1990. The constant levels in emissions between 1990 and 2007 took place despite a growth in passenger transport. The trend in transport is that passenger traffic increased from 1990, but started to level off around 2007, and were quite constant until 2012. Between 2012 and 2013, passenger traffic decreased. The growth in traffic by passenger cars, driving increasing emissions, was however offset by a greater use of renewable fuels, more energy efficient vehicles and reduced fuel consumption. After 2008, traffic started to decrease leading to a decrease in emissions. The decreasing emissions is also driven by a greater use of renewable fuels, more energy efficient vehicles, and reduced fuel consumption in combination with the economic downturn starting in 2008. Emissions from heavy-duty and light-duty vehicles increased show a different trend, with increasing emissions. The amount of freight transport is linked to the economic activity. In 2008 the increase of emissions from heavy-duty ceased and has since 2010 started to decrease. Emissions from light-duty vehicles leveled out from 2010 and onwards. In the last years, the development of emissions from light-duty and heavy-duty vehicles is due to the economic downturn during 2009, fluctuating price on fossil fuels and that emission regulations and a differentiated fleet tax are implemented for light duty vehicles.

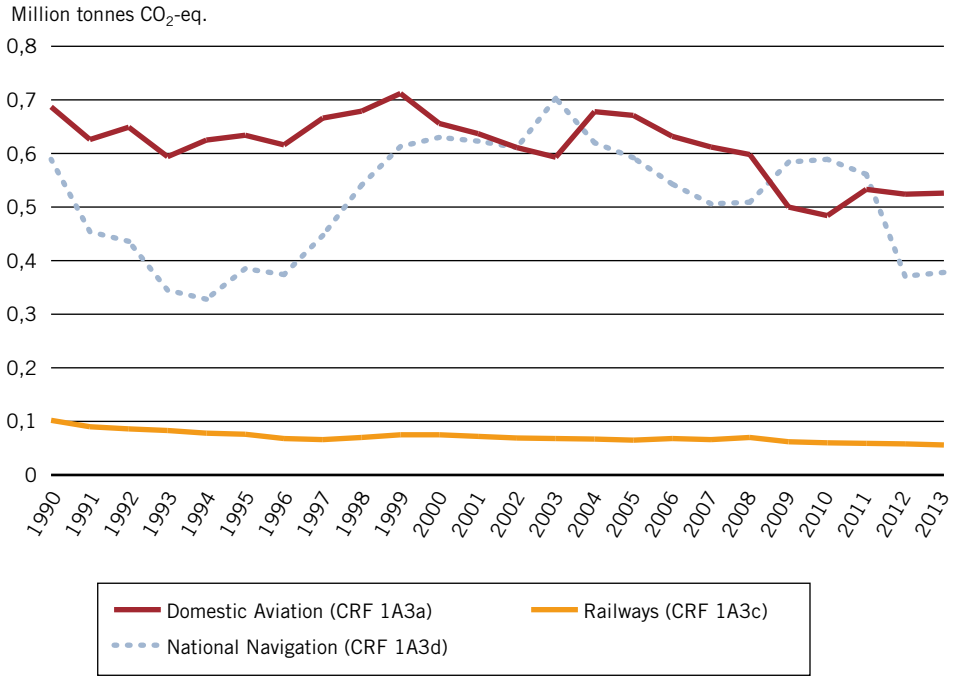
Domestic aviation (CRF 1A3a)

In 2013, emissions from domestic aviation totalled 0.5 million tonnes of carbon dioxide equivalents, see Figure 1.9. This is 23.5 per cent lower than the level in 1990. In 2013 the emissions increased slightly compared to 2012, by 2 per cent. However, these emissions varied during the period. Travelling with domestic aviation has fluctuated over the time period, but has never reached the level of 1990. The decrease in domestic aviation is among other due to that the share of train and, to some extent, car journeys have increased. The reason why people choose train or car rather than flying for domestic travel, is thought to be due to that domestic aviation has become less attractive compared to trains or cars.

National navigation and railways (CRF 1A3c, 1A3d)

Emissions from national navigation were 0.4 million tonnes of carbon dioxide equivalents in 2013 as seen in Figure 1.9. This is 36 per cent lower than in 1990, but emissions have varied over the period. Sweden's railways are largely electrified, with only a few smaller lines served by diesel-hauled trains. Emissions from railways have been almost halved since 1990 and now stand at almost 0.06 million tonnes of carbon dioxide equivalents.

FIGURE 1.9 Greenhouse gas emissions from domestic aviation, navigation and railways (CRF 1A3a), 1990–2013 (million tonnes of carbon dioxide equivalents)



1.1.2.1.4 Other sectors – Combustion in households, residential, agri-culture, forestry and fisheries (CRF1A4)

Other sectors include combustion in the residential, commercial/institutional and agriculture, forestry and fisheries sector. Emissions from working machinery and off road vehicles are also included in the sectors.

Combustion in the *residential sector* (CRF 1A4b) and in the *commercial/institutional sector* (1A4a) includes stationary combustion and emissions from working machinery and off road vehicles. Emissions from the combustion in residential and commercial/institutional sectors have decreased over 80 per cent between 1990 and 2013, as seen in Figure 1.10. The reduction in emissions is due to a large decrease in total use of fossil fuels which is explained by several causes: The shift from oil to district heating, electricity heating and bio-fuels, and also increased use of heat pumps.[13] The most common source of heating in these sectors is district heating, followed by electric heating[14] and these emissions are included in the electricity and heat production sector. The number of heat pumps has increased considerably and about half of all single and double dwelling buildings had some

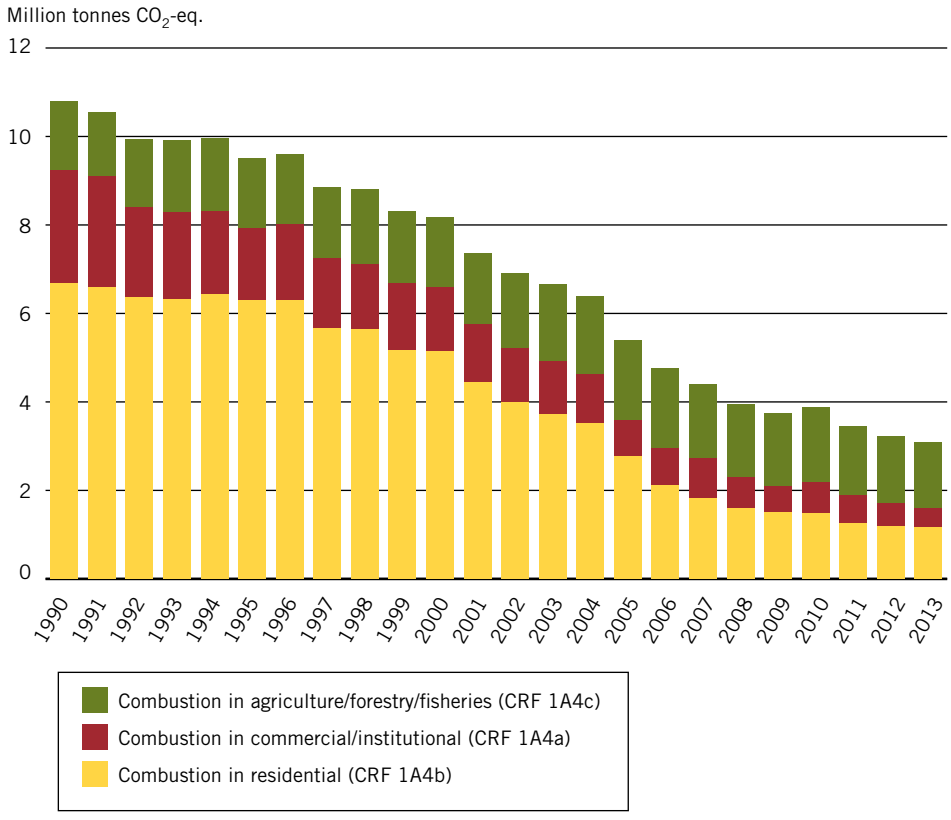
13 Swedish Energy Agency, 2013b

14 Swedish Energy Agency, 2014

kind of heat pump in 2013[15]. Another contributing factor to the favourable development has been the generally warm weather since 1990. The outdoor temperature affects the need for heating, which lead to variations in energy usage between years[16]. More information about the weather and normal corrected emissions can be found in the National Inventory Report for Sweden 2015[17].

Compared with 2012, emissions from the *commercial/institutional sector* continued to decrease, for a total of 19 per cent. In the *residential sector*, the reduction was 2 per cent. Today, less than 1 per cent of all single and double dwelling buildings have oil as their sole source of heating[18]. There is also a continued decrease in energy consumption for heating per unit of floor space area in these types of dwelling buildings.[19] The share of biofuel and district heating has increased somewhat in single and double dwelling buildings during 2013.

FIGURE 1.10 Greenhouse gas emissions from combustion in other sectors (CRF 1A4), by subsectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



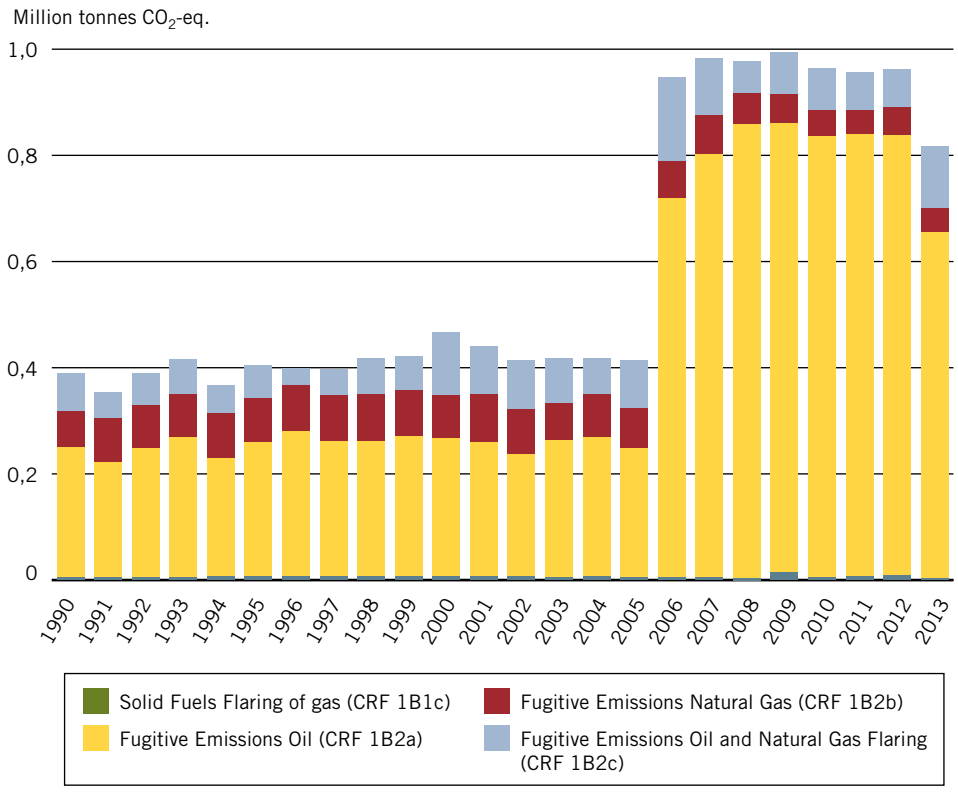
15 Swedish Energy Agency, 2014d
16 Swedenergy, 2014
17 National Inventory Report for Sweden 2015
18 Swedish Energy Agency, 2014d
19 Swedish Energy Agency, 2014d

Combustion in the *Agriculture, forestry and fisheries sector* (CRF 1A4c) includes stationary combustion and emissions from working machinery and off road vehicles. In this sector, total emissions have been quite stable, with a decrease of only 3 per cent since 1990. Total emissions where 1.5 million tonnes carbon dioxide equivalents in 2013. Emissions from stationary combustion in this sector fluctuate over the years, but show a decreasing trend. Emissions from working machinery and off-road vehicles in agriculture increased while mobile emissions from forestry have been stable. In fisheries, there is instead a slight decrease in emissions. However, emissions from working machinery and off-road vehicles are model-based and there is a high uncertainty related to these emissions figures.

1.1.2.1.5 Fugitive emissions (CRF 1B)

Fugitive emissions come from processing, storage and use of fuels, flaring of gas, transmission and distribution of gas. Emissions were around 0.8 million tonnes of carbon dioxide in 2013 (1 per cent of total emissions in Sweden), which is a decrease of 15 per cent compared to 2012 (Figure 1.11). The recent increase in fugitive emissions is due to the establishment of new hydrogen production facilities at two oil refineries. Emissions have increased 110 per cent compared to 1990.

FIGURE 1.11 Fugitive Emissions of Greenhouse Gases (CRF 1B), by subsectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



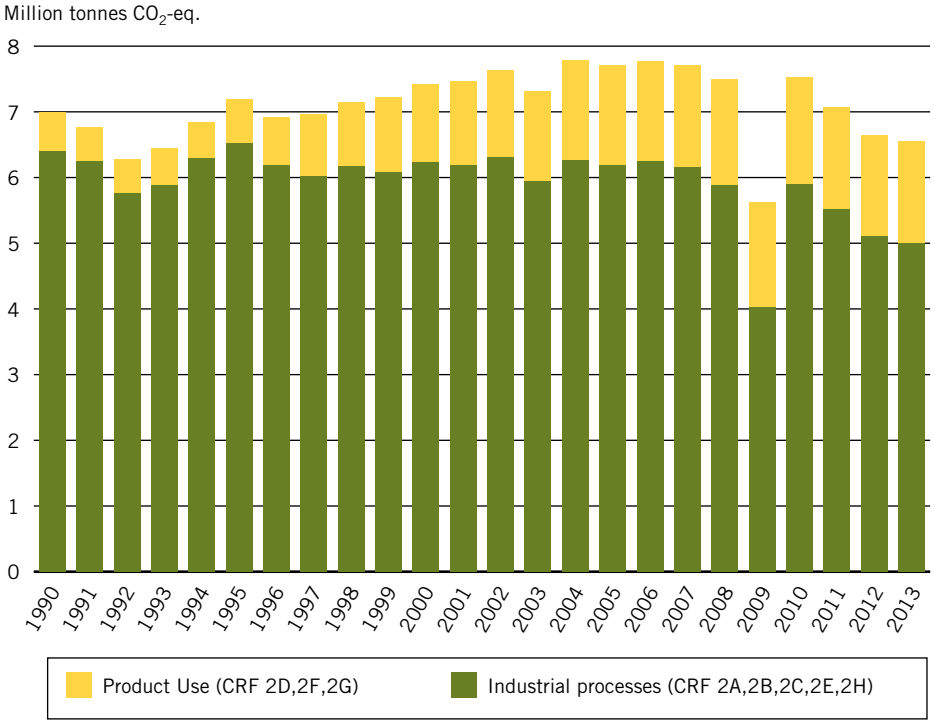
1.1.2.3. INDUSTRIAL PROCESSES AND PRODUCT USE SECTOR (CRF 2)

This sector comprises greenhouse gas emissions from industrial processes, including emissions from materials in the processes and from product use, involving the use of solvents and other products. Emissions from this sector accounted for 12 per cent of total emissions in Sweden in 2013. One fifth of emissions in this sector come from product use and the rest from industrial processes (see Figure 1.12).

Emissions from product use increased vy approximately 1 million tonnes carbon dioxide equivalents during the period 1990–2013.

Greenhouse gas emissions from industrial processes decreased 22 per cent between 1990 and 2013, 1.4 million tonnes carbon dioxide equivalents. This sector mainly emits CO_2, which accounts for 82 per cent of the total greenhouse gas emissions from this industrial processes and product use sector.

FIGURE 1.12 Greenhouse gas emissions from industrial processes and product use (CRF 2), by subsectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



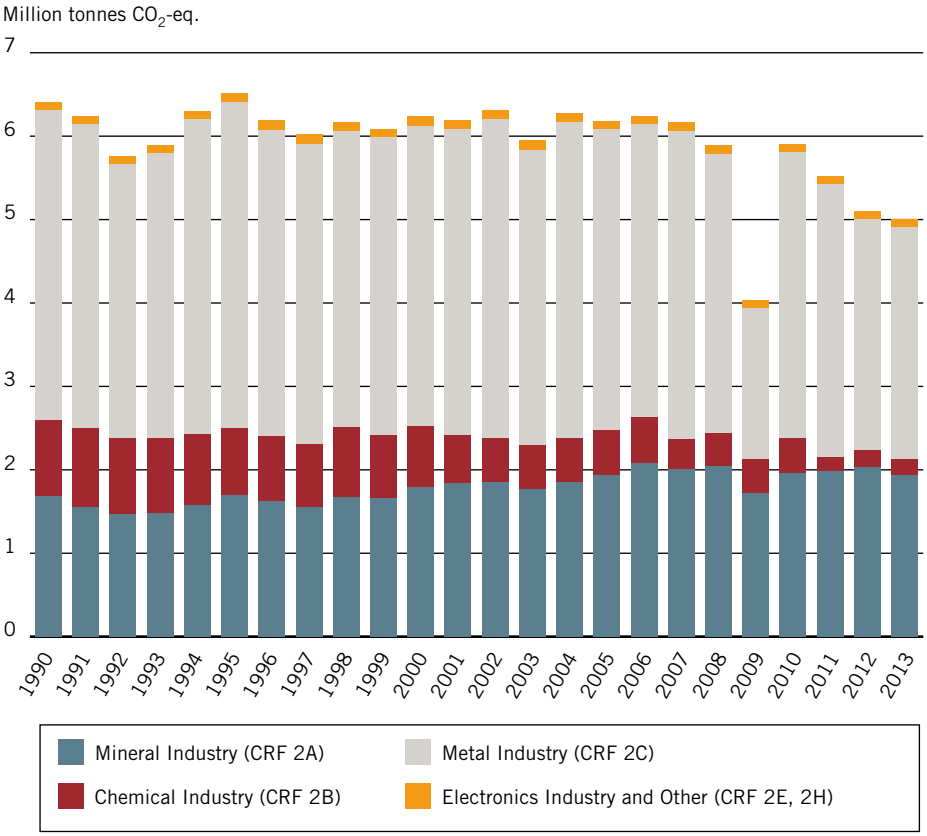
1.1.2.1.6 Industrial processes subsectors (CRF 2A, 2B, 2C, 2E and 2H)

Many of Sweden's most important industries are basic materials industries, producing such products as metals, pulp and paper, and chemicals. The mining, iron and steel, and pulp and paper industries are examples of industries of historical importance for Sweden. Total greenhouse gas emissions in industrial processes have varied somewhat since 1990, mainly due to variation in production volumes

and economic fluctuations. From 2006, the trends show a slow decrease, with few exceptions (see Figure 1.13). In 2009, the global economic recession caused production to slow down and hence emissions to plunge. The trend recovered in 2010 and then continued decreasing. The largest decreases in absolute values compared to 2006 were observed in the subsectors of chemical and metal industries. However, the trends vary between industries. For example, emissions from the minerals industry increased, while emissions from the chemical and the metal industries decreased over the same period..

The subsector with the largest emissions is the metals industry (CRF 2C) with 43 per cent of the sector's total emissions in 2013. Within this subsector, the underlying category of iron and steel production has the largest emissions, equivalent to 80 per cent of total emission from the metals industry subsector in 2013, followed by aluminium production. Emissions from the metal industry were 25 per cent lower in 2013 as compared to the 1990 level.

FIGURE 1.13 Greenhouse gas emissions from Industrial Processes (part of CRF 2), by subsectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



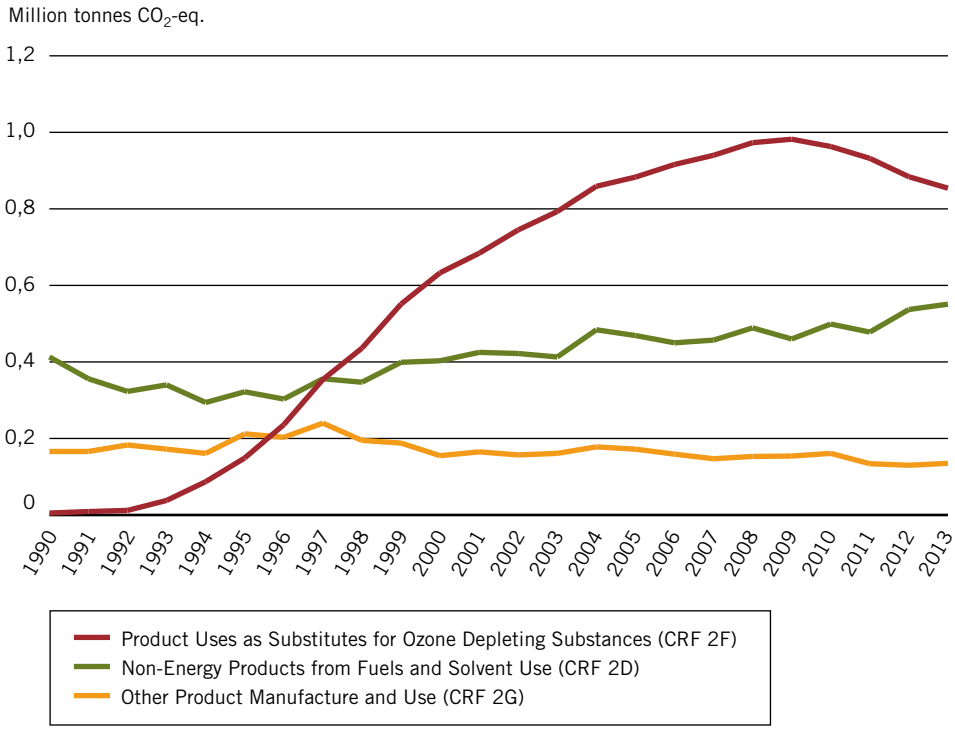
The mineral industry (CRF 2A) is the second largest subsector, emitting 30 per cent of total emissions within industrial processes and product use in 2013. The production of cement, lime and glass is included in this subsector. Cement production represented more than 70 per cent of emissions within this subsector in 2013. Emissions from the minerals industry showed an rising trend (15 per cent) for the period from 1990 to 2013, mainly due to improving economic conditions in the building sector, both in Sweden and in other countries to which cement is exported (which increased the production of clinker, used in the production of cement).

Emissions from the chemical industry (CRF 2.B) decreased 0.7 million tonnes during the period 1990 to 2013, an 80 per cent decrease. The decrease from 2007 is primarily a result of a new treatment technology that has been installed.

1.1.2.1.7 Product use subsectors (CRF 2D, 2F and 2G)

The largest subsector within product use is product used as substitutes for ozone-depleting (CRF 2F). This is the third largest subsector within the sector and accounted for 13 per cent the emissions in 2013, see Figure 1.14.

FIGURE 1.14 Greenhouse gas emissions from product use (part of CRF 2), by subsectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



Emissions of greenhouse gases from the subsector products used as substitutes for ozone-depleting substances (CRF 2F) have increased considerably since 1990, approximately 0.85 million tonnes carbon dioxide equivalents. This includes use of HFCs (a fluorinated gas) which stands for almost all of the increase in carbon dioxide equivalents. HFCs have replaced the use of ozone-depleting substances in products like refrigerators and air-conditioning equipment.

The emissions of fluorinated greenhouse gases (f-gases) are primarily found in this subsector (CRF 2F) but also in *other product manufacture and use* (2G) and in *metal production* (2C), under industrial processes. Total f-gases in 2013 amounted to almost 1 million tonnes, calculated as carbon dioxide equivalents. This accounted for nearly 2 per cent of total emissions in Sweden in 2013. Although these f-gases are emitted in relatively small amounts compared to carbon dioxide, they have a much higher global warming potential (GWP) due to their chemical structure, whereby they contribute significantly to global warming. Today, most emissions of f-gases in Sweden come from leakage in the refrigeration sector, from stationary and mobile refrigeration equipment and heat pumps. Other smaller sources are foam manufacturing, medical inhalers, aluminium production and magnesium foundries. A small part of f-gas emissions emanates from another subsector within the industry, in the process of metal production.

The subsector non-energy products from fuels and solvent use (CRF 2D) accounted for 8 per cent of the total greenhouse emissions from industrial processes and product use in 2013. The emissions trend has been increasing, by 33 per cent since 1990. The increase is mainly in the subsector lubricant use. The estimated greenhouse gas emissions from other product manufacture and use (CRF 2G) consist of fluorinated greenhouse gases from electrical equipment and sound-proof windows as well as nitrous oxide (N_2O) from product use.

1.1.2.2 AGRICULTURAL SECTOR (CRF 3)

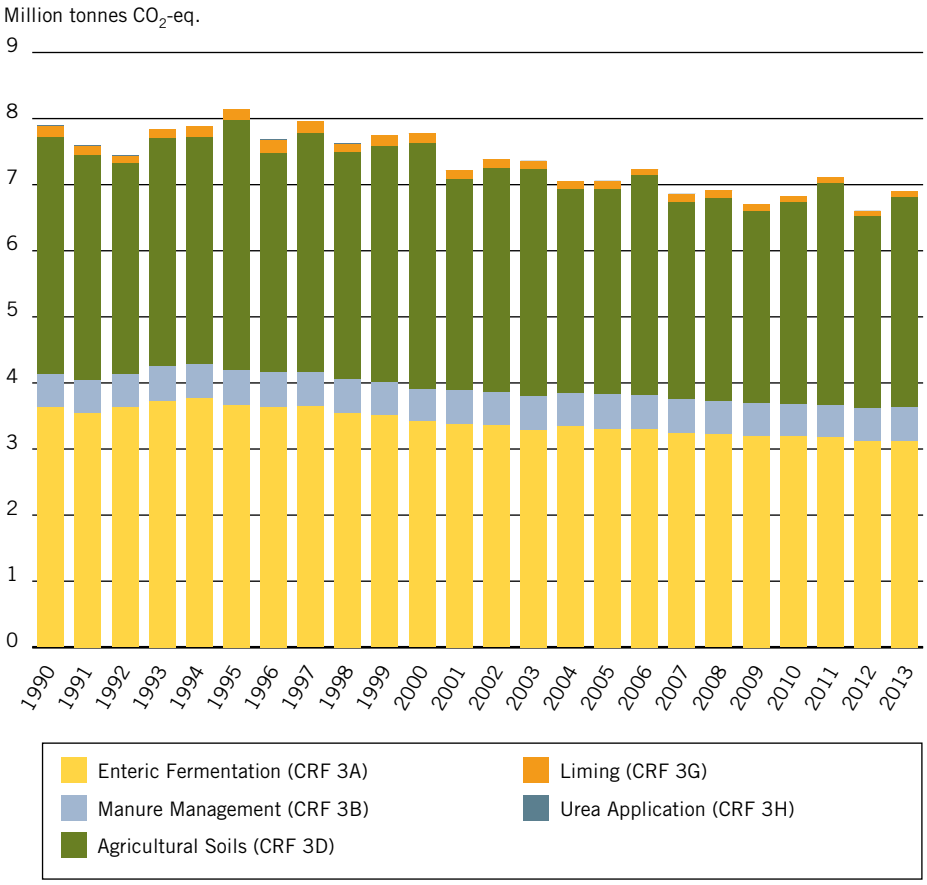
Agriculture is the largest source of emissions of methane (CH_4) and nitrous oxide (N_2O). In 2013, aggregated emissions were about 6.9 million tonnes of carbon dioxide equivalents, of which about 50 per cent was nitrous oxide, about 49 per cent methane, and 1 per cent carbon dioxide (CO_2).

Emissions from agricultural activities have decreased more than 12 per cent since 1990, but increased by 4.4 per cent between 2012 and 2013 (see Figure 1.15). The rise occurred mostly in agricultural soils due to an increase in the use of mineral fertilizers. The most important reasons for the reduction in emissions since 1990 are reduced livestock keeping activities, i.e. a decline in the number of animals, as well as reduced application of mineral fertilisers in agriculture. Nitrous oxide emissions have declined 11 per cent compared to 1990 due to reduced application of mineral fertilisers in agriculture.

The main sources of methane and nitrous oxide gas emissions in Sweden are domestic livestock activities with enteric fermentation in domestic livestock,

livestock manure management and agricultural soil management activities, such as fertilizer application. Cattle produce the major part of methane emission through enteric fermentation, while emission of methane from other types of livestock has relatively little significance in Sweden. Activities related to agricultural soil management are the major source of N_2O emissions.

FIGURE 1.15 Total emissions of greenhouse gases from agriculture (CRF 3), by subsectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



1.1.2.3 LAND USE, LAND USE CHANGE AND FORESTRY SECTOR (CRF 4)

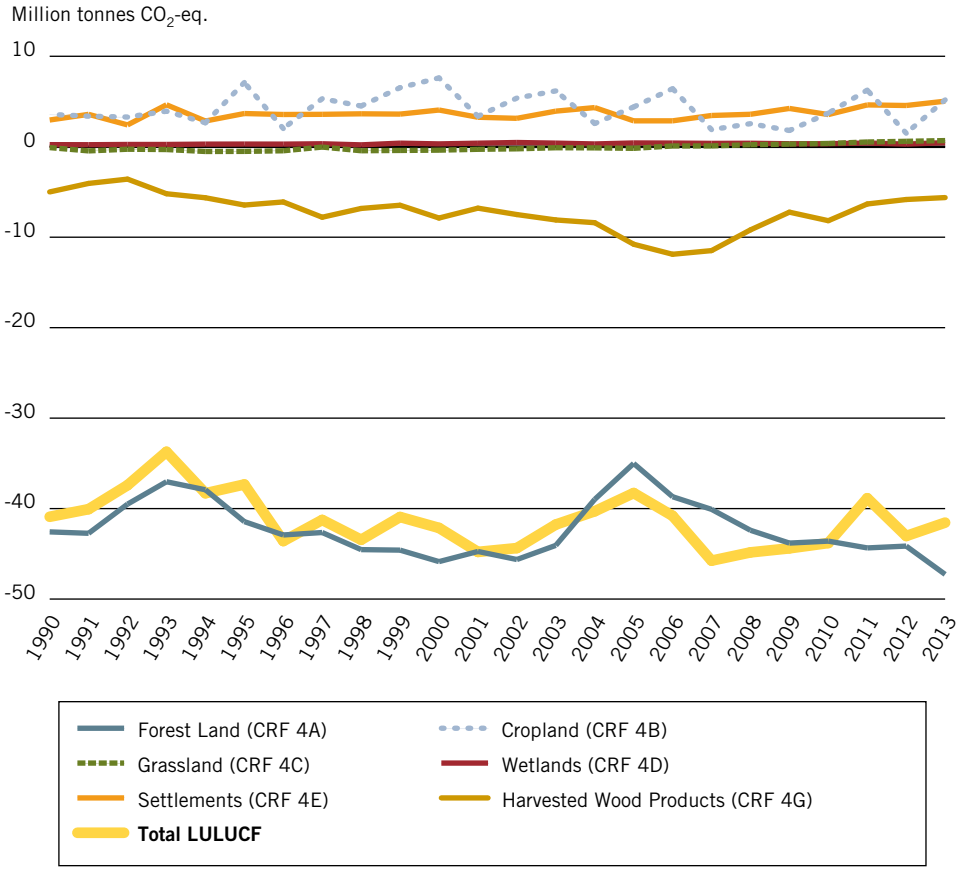
Sweden chooses to report on the sector LULUCF in trends for transparency and consistency (with the greenhouse gas inventory) reasons even if this sector is not included in the EU and member states' pledge under the Climate convention for pre-2020.

Sweden reports carbon stock changes from forest land, cropland, grassland and settlements and associated land-use transfers, and a small part of wetlands, where peat extraction occurs. These land use categories are considered managed. From submission 2015 the calculation of emissions and removals in the Land Use, Land

Use Change and Forestry (LULUCF) sector now also includes additional activities, as for example, Harvested Wood Products (HWP).

The LULUCF sector constituted an annual net removal in Sweden during the entire period 1990–2013, see Figure 1.16. In 2013, the total net removal from the LULUCF sector was estimated at just over 41 million tonnes carbon dioxide equivalents. During the period, net removals varied between approximately 34 and 46 million tonnes of carbon dioxide equivalents. Net removals increased slightly between 2012 and 2013. However, there is no obvious trend in the total net removals in the sector as they are heavily influenced by harvest volumes and natural disturbances such as storms on forest land. There are also inter-annual variations in different subcategories, as with the cropland category.

FIGURE 1.16 Total greenhouse gas emissions and removals from Land Use, Land Use Change and Forestry (LULUCF, CRF 4), by sub-sectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



The largest emissions in this sector came from cropland and settlements. From 1990 to 2013, emissions in the category cropland varied between 7.6 and 1.4 million tonnes of carbon dioxide equivalents. Cropland management results in emissions of carbon dioxide when organogenic soils are cultivated. Emissions

from drained organic soils are the dominant sources in this land category. The inter-annual variation in cropland depends on variations in climate (precipitation, temperature etc.) and the cultivation of different crops in different years.

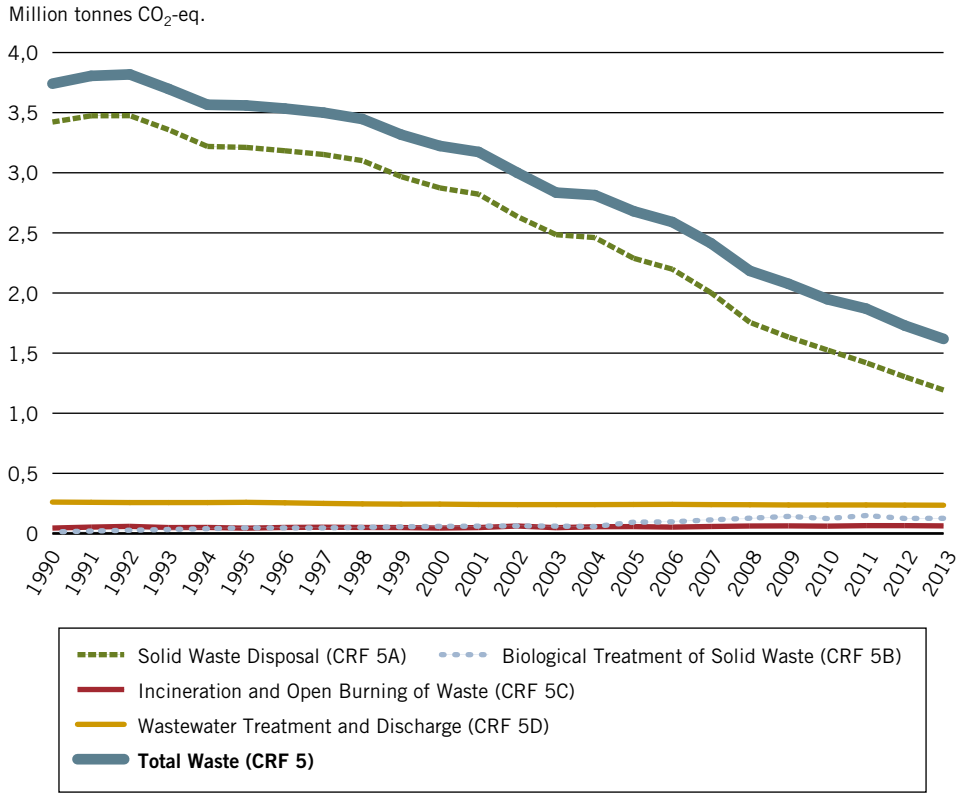
There are two dips in the trend, 2005 and 2007, because of two severe storms. The storm in 2005 brought down a large quantity of timber. According to the Swedish National Board of Forestry, felling (including wood felled by storms) was estimated at 122 Mm^3sk in 2005.

The total size and variation of net removals in the LULUCF sector are mainly affected by the carbon stock change in forest land, and change in the carbon pool of living biomass constitutes the major part of these net removals.

1.1.2.4 WASTE SECTOR (CRF 5)

In 2013, emissions from the waste sector were approximately 1.6 million tonnes carbon dioxide equivalents, or 3 per cent of total emissions (see Figure 1.17). Emissions from the waste sector have decreased by approximately 57 per cent since 1990. Between 2012 and 2013, emissions dropped by 6 per cent, mostly from landfills. The collection of methane gas from landfills, a ban on landfilling of organic material and the introduction of a landfill tax may have all had a significant impact on observed trends over several years.

FIGURE 1.17 Total emissions of greenhouse gases from the waste sector (CRF 5), by sub-sectors, 1990–2013 (million tonnes of carbon dioxide equivalents)



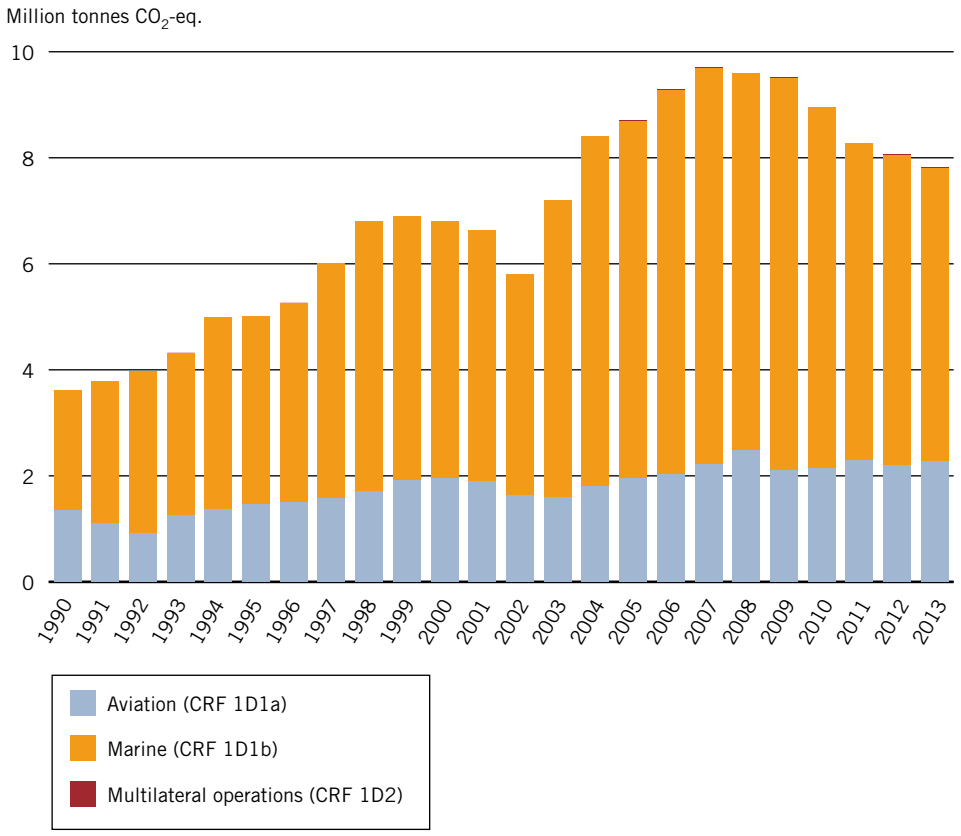
Emissions from the waste sector were dominated by methane from landfills. Methane gas makes up approximately 80 per cent, while nitrous oxide emissions from wastewater treatment as well as biological treatment of solid waste account for 16 per cent, and carbon dioxide emissions from incineration and open burning of waste is about 4 per cent. Bans on landfilling organic waste have been introduced and incineration of waste for energy recovery has increased. However, emissions from incineration using energy recovery are accounted for in the energy sector, not in the waste sector.

The subsector with the most significant emissions in the waste sector is *solid waste disposal*. The trend for solid waste disposal also shows the most significant emissions reductions within the sector. Emissions from solid waste disposal decreased 65 per cent from 1990 until 2013.

1.1.2.5 INTERNATIONAL TRANSPORT

Emissions from international transport, also known as international bunkers, include refuelling in Sweden by international shipping and aviation. These emissions are ***not*** included in the reporting of the total emissions from Sweden,

FIGURE 1.18 Greenhouse gas emissions from international shipping and aviation (CRF 1D, *not included* in Sweden's national total), 1990–2013 (million tonnes of carbon dioxide equivalents).



which is calculated in relation to the Kyoto Protocol commitments. They are noticeably larger than those from domestic shipping and aviation.

These emissions were considerably higher in 2013 than in 1990 as seen in Figure 1.18. In 2013, they amounted to around 7.8 million tonnes of carbon dioxide equivalents, which is a decrease by 3 per cent since 2012 but an increase with 145 % since 1990. Since 2008 the emissions have fallen sharply from marine bunkering. One explanation of this is the economic downturn as freight transport generally is following the economic development. The amount of fuel bunkered in Sweden is also dependent on the fuel price in Swedish ports compared to others, which also can be a part of the explanation of the fluctuations.

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

In accordance with the Kyoto Protocol and the associated Decision 24/CP19[20], as well as EU 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 (EU Monitoring Mechanism Regulation, MMR), Sweden has established a national system for the greenhouse gas inventory, see section 1.2.1. According to EU Regulation No 525/2013/EC a national system for policies and measures and projections, see section 1.3.1, shall be set up, operate in year 2015. The Swedish national system for policies and measures and projections aims to ensure that reporting of policies and measures and projections to the Secretariat of the Convention (UNFCCC), the Kyoto Protocol and the European Commission complies with specified requirements.

The Swedish national system for the GHG inventory came into force on 1 January 2006 and a national system for policies and measures and projections has been 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 policies, measures, and projections reporting. It has led to several changes in Swedish reporting such as enlarging the national system, adding other agencies, and also additing responsibilities for agencies already included. The ordinance requires that sufficient capacity be available for timely reporting.

20 UNFCCC 2002. FCCC/CP/2001/13/Add. 3

1.2.1 The national system for the GHG inventory

The Swedish National system for the GHG inventory was established in 2006 in accordance with 19/CMP.1, 20/CP.7 and decision 280/2004/EC. 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 greenhouse gas 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.

The national system for the GHG inventory will be further described in sections 1.2 and 1.3 of the National Inventory Report for 2016. The 2015 National Inventory Report still followed the now repealed Ordinance (2005:626) Concerning Climate Reporting. However, even if the new ordinance was not in force when the 2015 submission was carried out, the process generally followed the new ordinance. (See more about the differences in section 1.2.1.5.)

1.2.1.1 LEGAL ARRANGEMENTS

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 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. The previous Ordinance (2005:626) Concerning Climate Reporting was updated and expanded to fulfil the reporting requirements under the EU Monitoring Mechanism Regulation 525/2013/EC. It also includes other improvements needed on the national level. The new ordinance came into force in December 2014, superseding the previous one.

Supplemental to the Ordinance on Climate Reporting, formal agreements between the Swedish Environmental Protection Agency and the concerned agencies have been signed, listing in detail what is required regarding content and timetable from each agency.

Sweden also has legislation indirectly supporting 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 (offentlighets- och sekretesslag)[21] (SFS 2009:400).

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

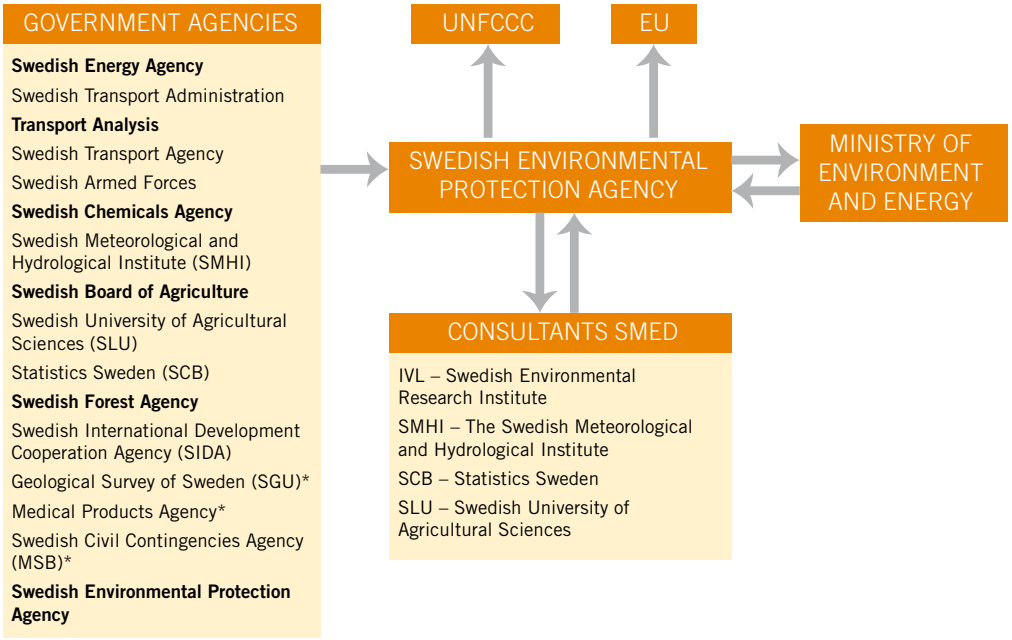
1.2.1.2 INSTITUTIONAL ARRANGEMENTS

Preparing the annual inventory and other reports is done in collaboration between the Ministry of the Environment and Energy, the Swedish Environmental Protection Agency and other government agencies and consultants. Depending on the role of the governmental agencies in the climate-reporting process, this responsibility may range from supplying data and producing emission factors/calorific values, to carrying out calculations for estimating emissions or conducting a national peer review. Figure 1.19 illustrates the institutional arrangements for the yearly inventory report, as well as for some other reporting, to the European Commission and the UNFCCC.

To enable reporting under 24/CP.19, using IPCC methodology guidelines from 2006, and in accordance with 525/2013/EC, the national system for the GHG inventory had to be expanded to include three governmental agencies; the Medical Products Agency, Swedish Civil Contingencies Agency, and Geological Survey of Sweden. All three new authorities cooperated on a voluntary basis through 2014.

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 Environmental Protection Agency 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 submit the material to the Government.

FIGURE 1.19 The Swedish national system for GHG inventory



** Indicates new agencies in the national system of the GHG inventory since 2015*

Under contract to the Swedish Environmental Protection Agency, consultants (SMED[22]) process data and documentation received from the various government agencies, as well as data they have produced themselves, and they calculate Swedish greenhouse gas emissions and removals.

1.2.1.3 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

1.2.1.4 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 Environmental Protection Agency and the consultants SMED, and new requirements arising from international decisions, for example.

Based on these criteria, the Swedish Environmental Protection Agency 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 sectorial organisations, and from

22 SMED = Svenska MiljöEmissionsData (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)

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.

Quality assurance is carried out in the form of a national peer review by government agencies, as provided in Ordinance 2005:626. The revised and updated ordinance (2014:1434) came into force after the 2015 submission was prepared. 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 Environmental Protection Agency. The government authorities conducting the national review marked in bold text in Figure 1.19. From the 2016 submission, quality assurance is conducted in two steps, with an annually quality control and verification of the trends, national statistic used, changes of methods (if changed). Every year there will also be an in-depth review of one sector. If we don't recieve recommendations during EU or UNFCCC review's or haven't changed methodology or if the first step review don't signal problems we'll have an in-depth review of each sector every fifth year. Sweden has also initiated expert meeting with Denmark, Finland and Norway where GHG inventory compilers discuss problems and needs for revised methods and such.

In addition, reporting is reviewed annually by the EU and UNFCCC.

FINALIZATION, PUBLICATION AND SUBMISSION

The preliminary results are published nationally in late November or early December each year. The Swedish Environmental Protection Agency supplies a draft report to the Ministry of the Environment in the beginning of January. The Environmental Protection Agency 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 Environmental Protection Agency, 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.

1.2.1.5 INFORMATION ON CHANGES IN THE NATIONAL SYSTEM FOR GHG INVENTORY

There have been changes in the Swedish national system since the previous Biennial Report.

New Ordinance Concerning Climate Reporting in Sweden (2014:1434)

These changes concern a new Ordinance on Climate Reporting in Sweden (2014:1434), which is a result of the new Monitoring Mechanism regulation 525/2013/EC. This led to an updated and expanded ordinance in Sweden. The national system had to be expanded by three governmental agencies; the Medical Products Agency, Swedish Civil Contingencies Agency and Geological Survey of Sweden. All three new authorities cooperated on a voluntary basis during 2014. Besides these new authorities, additional information is also requested from the previous agencies. One agency was removed due to the new ordinance in Sweden, the Swedish Maritime Administration.

Description of national system not consistent with National Inventory Report 2015

The description of the national system in the National Inventory Report of 2015 is not identical to the description in the second Biennial Report. In the National Inventory Report of 2015, the national system was still regulated by the previous Ordinance (2005:626). The new ordinance came into force late in 2014. However, even though the new Ordinance (2014:1434) was not in force when the 2015 submission was carried out, most of the process followed the new Ordinance. The new agencies reported the new information on a voluntary basis during 2014 and the previous agencies reported the new information in that year. The information will be further described in sections 1.2 and 1.3 of the National Inventory Report of 2016, where it also will be explained that the National Inventory of 2015 also followed the same arrangement.

1.2.2 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. The Swedish National system for policies and measures and projections was established in 2015. Its aim is to ensure that reporting of policies and measures and projections to the Secretariat of the Convention (UNFCCC), the Kyoto Protocol and the European Commission complies with specified requirements.

1.2.2.1 LEGAL ARRANGEMENTS

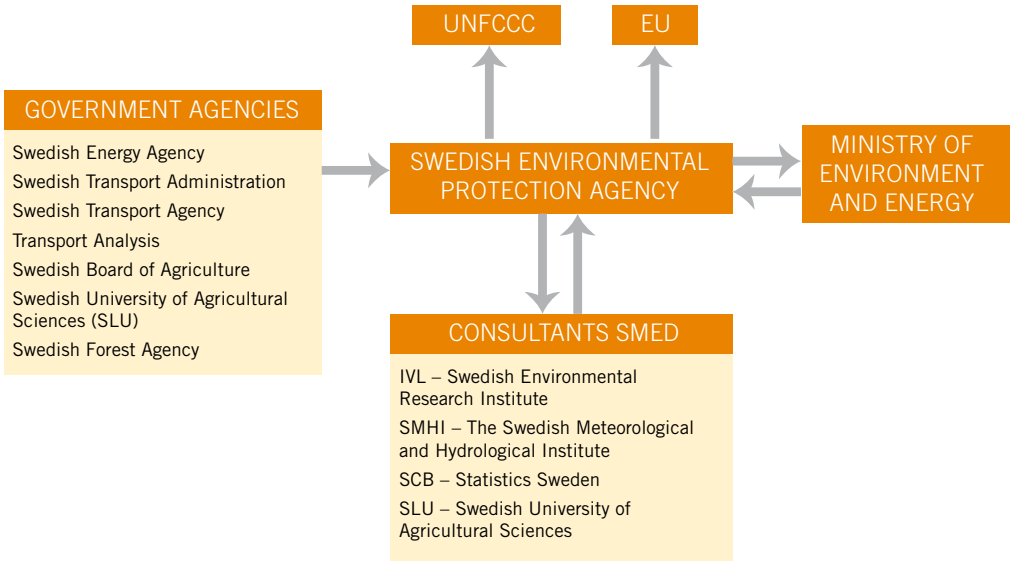
The legal basis for Sweden's national system for policies and measures and projections is the same as for the annual greenhouse gas inventory and is provided by the Ordinance on Climate Reporting[23] (SFS 2014:1434). See more information of the Ordinance above under 1.2.1.1. The ordinance includes all reporting according to the EU 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 (EU Monitoring Mechanism Regulation, MMR).

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

1.2.2.2 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 Environmental Protection Agency and other government agencies, see Figure 1.20.

FIGURE 1.20 Government agencies included in the Swedish national system for the reporting on policies and measures and projections



23 http://www.lagboken.se/Views/Pages/GetFile.ashx?portalId=56&cat=24593&docId=2232659&propId=5

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 Environmental Protection Agency* 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 agencies are responsible for peer review of different sectors.

The same contract to *consultants (SMED[24])* as for the GHG inventory is used in the institutional process of policies and measures and projections.

1.2.2.3 CONTACT DETAILS OF ORGANISATION RESPONSIBLE

The contact details are the same as for Sweden's national system for the GHG inventory (section 1.2.1.3).

1.2.2.4 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 with planning and setting 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 Environmental Protection Agency.

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

24 SMED = Svenska MiljöEmissionsData (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).

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 Environmental Protection Agency collects the additional data needed for reporting on policies and 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 Environmental Protection Agency.

All data are subjected to general quality control activities throughout the production of data. 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.

FINALIZATION AND SUBMISSION

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

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.

1.2.2.5 INFORMATION ON CHANGES IN THE NATIONAL SYSTEM

During 2015, Sweden has set up a new national system for reporting on policies and measures and projections, a system that will continuously improve in coming years.

1.3 References

National Inventory Report for Sweden 2015

Swedish Energy Agency, 2012b. *Energiläget 2012*

Swedish Energy Agency, 2013b. *Energiläget 2013*

Swedish Energy Agency, 2014. ES2014:06 *Summary of energy statistics for dwellings and non-residential premises 2013* (Energistatistik för småhus, flerbostadshus och lokaler 2013)

Swedish Energy Agency, 2014c. *Energiläget i siffor, 2014*

Swedenergy, 2014. *Elåret 2014* (Svensk Energi)

Swedish Energy Agency, 2014. EN11 SM 1401. Sveriges officiella statistiska meddelande *Electricity supply, district heating and supply of natural gas 2013* (El-, gas- och fjärrvärmeförsörjningen 2013)

Swedish Energy Agency, 2014d. ES2014:05. E*nergy statistics for one- and two-dwelling buildings in 2013* (Energistatistik för småhus 2013)

2 Quantified economy-wide emission to reduction target

This chapter explains the EU and it's Member States pledge under the Climate Change Convention and the Swedish national target, both for 2020.

2.1 The European Unions and its member states pledge under the Climate convention

The EU submitted a pledge in 2010 to reduce GHG emissions by 2020 by 20 per cent compared to 1990 levels (UNFCCC, 2014a). As this target under the convention has only been submitted by the EU-28 and not by each of its Member States, there are no specified convention targets for single Member States. For this reason, Sweden, as part of the EU-28, takes on a quantified economy-wide emission reduction target jointly with all 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.

The definition of the convention target for 2020 is documented in the revised note provided by the UNFCCC secretariat on the 'Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention'[25]. 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[26]. In a workshop that also formed part of this clarification process, the EU gave a presentation on its target in May 2012[27].

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

26 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"

27 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.

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 package introduced a clear approach to achieving the 20 per cent reduction of total GHG emissions from 1990 levels, which is equivalent to a 14 per cent reduction compared to 2005 levels. This 14 per cent reduction objective is divided between two sub-targets, equivalent to a split of the reduction effort between ETS and non-ETS sectors of two thirds vs one third[28].

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

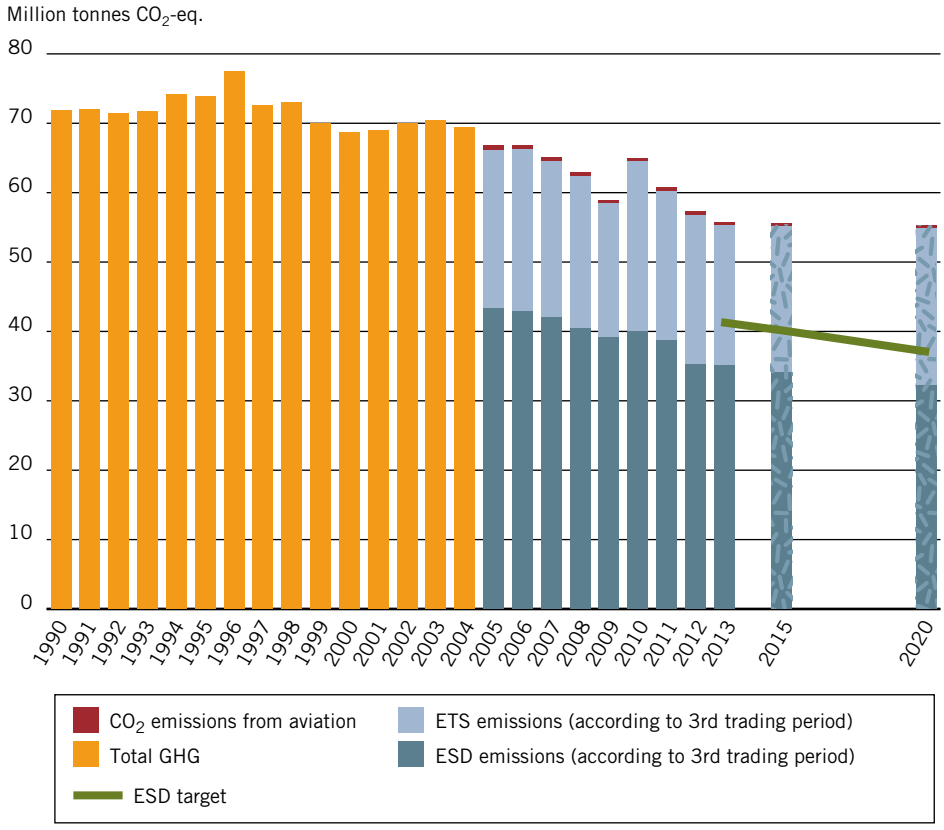
Parameters	Targets
Base Year	1990
Target Year	2020
Emission Reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF6
Global Warming Potential	AR4
Sectors Covered	All IPCC sources and sectors, as measured by the full annual inventory, partly international aviation.
Land Use, Land-Use Change, and Forests (LULUCF)	Excluded
Use of Flexible Mechanisms	Possible to certain extent under the Emissions Trading system (EU ETS) and the Effort Sharing Decision (ESD).
Others	Conditional offer to move to a 30% reduction by 2020 compared to 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.

28 Directive 2009/29/EC 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 g
as 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).

Under the revised EU ETS Directive[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 per cent 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 further information on the EU ETS see the second Biennial Report from EU, chapter 4.2.2.

FIGURE 2.1 Historic and projected GHG emissions, with separation between emissions included in the EU ETS and emissions covered by Effort Sharing Decision (ESD)



Note: GHG emissions Submission 2015, excluding sources and sinks of LULUCF sector. ETS emissions are corrected to take into account the extended scope of the EU ETS of the third trading period.

Sources: Swedish GHG inventory (Swedish EPA, 2015a), Swedish report on projections (Swedish EPA, 2015b)

29 Directive 2009/29/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.

Non-ETS emissions are addressed under the Effort Sharing Decision (ESD)[30]. 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 land use, land-use change and forestry (LULUCF). It thus includes a diverse range of small-scale emitters in a wide range of sectors: transport (cars, trucks), buildings (in particular heating), 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 per cent of total GHG 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 Effort Sharing Decision, national emission targets for 2020 are set, expressed as percentage changes from 2005 levels. These changes have been transferred into binding quantified annual reduction targets for the period from 2013 to 2020 (EC 2013)[31] [32], expressed in Annual Emission Allocations (AEAs). Sweden committed to reduce emissions in sectors covered under the ESD by 17 per cent compared to 2005 emissions. The quantified annual reduction targets are 41.7 million AEA in 2013, decreasing to 37.2 million in 2020 (adjusted to 2013–2020 ETS period).

In 2013 verified emission from stationary installations covered under the EU-ETS in Sweden totaled to 20.1 million tonnes of carbon dioxide equivalents. With total GHG emissions of 55.8 million tonnes of carbon dioxide equivalents (without LULUCF) the share of ETS emissions is 36 per cent.

The monitoring process is harmonized for all European Member States, especially laid down in the Monitoring Mechanism Regulation[33]. The use of flexible mechanisms is possible under the EU ETS and the ESD. For further information on the use of CER and ERU under ETS see EU-Biennial Report 2.

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 per cent for the use of project-based credits for each Member States. These are not used in

30 Decision No 406/2009/EC.

31 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).

32 Commission Implementing Decision 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 (2013/634/EU).

33 Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 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

any specific year, the unused part for that year can be transferred to other Member States or be banked for own use until 2020.

As Sweden (together with Austria, Belgium, Cyprus, Denmark, Finland, Ireland, Italy, Luxemburg, Portugal, Slovenia and Spain) fulfills additional criteria as laid down in ESD[34] 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 per cent 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 Swedish national emissions reduction target – in addition to the European target

To provide a clear structure to environmental efforts in Sweden, the Riksdag (the Swedish Parliament) has adopted several environmental quality objectives. One of these, the Reduced Climate Impact, forms the basis for action on climate change 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 per cent reduction in emissions by 2020, compared with 1990. This target applies to activities not included in the EU Emissions Trading System and the target does not include the LULUCF sector.

In addition, the Bill establishes as a priority for Sweden to have a vehicle fleet independent of fossil fuels by 2030, and sets out a vision of Sweden as a country with no net emissions of greenhouse gases to the atmosphere by 2050. For more information about the Bills and the national milestone targets see Sweden's Sixth National Communication on Climate Change.

2.3 Progress to quantified economy-wide emission reduction target

For quantification of progress towards the 2020 targets, the changes in greenhouse gas emissions is a key indicator. The Convention target for a reduction of emissions by 20 per cent 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 per cent for 2013.

34 Decision No 406/2009/EC

The development of greenhouse gas emissions is reported in CTF Table 4 for Sweden. Emissions in the sector of LULUCF are not included under the convention target, therefore they are not included in 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, for the achievement of Effort Sharing Decision (ESD) targets. More information on use in the ETS is contained in the second Biennial Report of the European Union.

The use of flexible mechanisms under the ESD cannot be quantified for the moment. The compliance assessment for the first year, 2013, under the ESD will only be done in 2016, and any potential use of units for the first year will only take place in 2016. Thus, the EU and its member states can only report for the second Biennial Report that no units have been used under the ESD so far. This is why no quantitative information can be provided for the use of flexible mechanisms in the second Biennial Report in CTF Table 4b.

For the moment, Sweden does not foresee any need to make use of flexibility provisions under the ESD. For further information see 5.6 Flexible mechanism.

3 Progress in achievement of quantified economy-wide emission reduction targets and relevant information

This chapter provides information on the progress of mitigation actions in Sweden. It includes a background on the policy landscape and an overview of the recent policy development in Sweden. Further, implemented and decided policy instruments are presented on a sectorial basis and regional and local actions on climate change are also described. In addition, 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.

3.1 Background and recent policy development

3.1.1 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. Other legislation, as those involving prohibitions, standards, and urban planning, also plays a part in curbing emissions, primarily in the waste sector. In recent years, EU-wide policy instruments, in particular the Emissions Trading System (EU ETS) and emission standards for new vehicles, 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.

3.1.2 Policy development

As described in chapter 2, the Swedish climate policy is based on the environmental quality objective 'Reduced Climate Impact' and is set out in the two Government Bills, entitled 'An Integrated Climate and Energy Policy'[35], as adopted by the Riksdag 2009. The bills set a milestone target of a 40 per cent reduction in greenhouse gas emissions by 2020 compared with 1990. They also set targets for energy efficiency and renewable energy (see Box 3.2 and 3.32) and a priority for Sweden to have a vehicle fleet independent of fossil fuels by 2030.

Moreover, these bills set out a vision for Sweden to become a country with zero net emissions of greenhouse gases to the atmosphere by 2050. In 2011, the Government commissioned the Swedish Environmental Protection Agency to undertake a background analysis for a Swedish 'roadmap', exploring how to achieve the vision for 2050. The analysis was presented at the end of 2012 and is now being further developed by the All Party Committee on Environmental Objectives appointed by the Government.

In line with current policy and previous decisions, efforts towards the target have been ambitious for a long period and recently Sweden intensified its efforts towards limiting greenhouse gas emissions even more. The most significant developments include a new support programme for local climate investment, and urban environmental agreements have been reinforced. In addition, the carbon dioxide tax on fossil fuels for heating in industry outside EU ETS, agricultural, forestry and aquacultural activities has been increased and a total exemption of tax on all volumes of HVO as well as increased funding for energy research and innovation for sustainable energy systems have been implemented.

Box 3.1 Sweden's milestone target for climate for 2020

Sweden has set out a vision to become a country with zero net emissions of greenhouse gases by 2050. A milestone target for the climate has been set to 40% reduction in emissions by 2020, compared with 1990. This target applies to activities not included in the EU Emissions Trading System and the target does not include the LULUCF sector.

35 (Govt. Bills 2008/09:162 and 163)

Box 3.2 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 burden sharing agreed, Sweden's renewable energy share in 2020 is set at 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 3.3 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.

3.2 Institutional arrangements and monitoring

Institutional arrangements and monitoring is described in chapter 1.

3.3 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 programmes to achieve the environmental quality objectives. After 2008 they were also 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 transfering knowledge between regional actors[36].

The counties of Dalarna, Skåne and Norrbotten were designated pilot counties for green development during 2010–2013 by the national government to further develop regional action on climate and energy. CABs in these three counties concluded that they have a unique role in coordinating various measures concerning climate and energy regionally, which can be used to further develop effective national policy instruments concerning spatial planning, and public procurement, for example[37].

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 taken. Municipalities are obliged to have an energy plan, which is often combined with a climate strategy to reduce greenhouse gas emissions. An evaluation of existing support for local authorities' climate strategy efforts[38] showed that 88 per cent of responding municipalities (163 in all) had adopted a climate strategy, or intended to do so shortly. Work on climate strategies resulted in concrete measures in some three-quarters of these municipalities. The assessment also showed that basic conditions and the options available differed among local authorities. According to a key-figure report[39], municipalities participating in a national government energy-efficiency support scheme showed greatly increased shares of renewable fuel use for public transport and slight reduction in energy use in municipality-owned premises and dwellings.

3.4 Policies and measures in Sweden's climate strategy

This section provides information on the most important policies and measures implemented in Sweden up to 16 December 2015 for reducing greenhouse gas emissions. Each sector is presented separately and the effect of the instruments is presented in a summary table (chapter 3.6). The main policies and measures are included in the projections on greenhouse gas emissions reviewed in section 3.

36 Swedish Energy Agency 2015b
37 Länsstyrelserna 2013
38 Swedish Environmental Protection Agency 2010
39 Swedish Association of Local Authorities and Regions 2012

TABLE 3.1 Existing policies and measures of significance for Sweden's climate strategy. EU instruments are marked in bold. Policy instruments with * are not included in the projections

Cross-sectoral	Energy supply	Residential	Industry	Product use	Transport	Waste	Agriculture	LULUCF
EU Emissions trading	**EU Emissions trading**	Energy and carbon dioxide taxes	**EU Emissions trading**	**F-gas regulation**	**CO_2 standards for new vehicles**	**Landfill directive**	**Rural Development Programme**	The Forestry Act
Energy and carbon dioxide taxes	Energy and carbon dioxide taxes	Building regulations	Energy and carbon dioxide taxes	National regulation	Energy and carbon dioxide taxes	Landfill tax	Advice /The rural network	Environmental Code
Local climate investment scheme*	Electricity certificates	Technology procurement	Energy advice and energy surveys in small and medium sized enerprises		Urban environment agreements*	Ordinance on landfilling of waste with bans on landfilling and on requirements on methane recovery	**EU Nitrates Directive**	Advice and training
Environmental Code	Special initiatives in support of wind and solar power	**Ecodesign Directive and energy labelling**			Tax relief on transport biofuels	Producer responsibility	Regulations to reduce nitrogen emissions	
Planning and Building Act	Tax relief for micro production of renewable energy	Energy declarations			Requirements of renewable fuels at filling stations	Municipal waste planning requirement	Investments support for biogas production	
Communication		Climate and energy advice			Research and demonstration		Energy and carbon dioxide taxes	
Research and development					CO_2-based annual vehicle tax			
					Super green car rebate			
					Car benefit taxation			
					Infrastructure planning			

3.4.1 Cross-sector policy instruments

3.4.1.1 EU EMISSIONS TRADING SCHEME, 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, reporting, and 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 at no charge to the covered installations, the rest are auctioned. There is no free allocation for emissions from electricity production.

EU ETS covers carbon dioxide emissions, and, in certain cases, emissions of perfluorocarbons and nitrous oxide, from power and district heating plants, oil refineries, installations that produce and process iron, steel, glass and glass fibre, lime, cement and ceramics, and installations that produce paper and pulp, in the aluminium and chemical industry and from aviation within EU.

At present, approximately 750 Swedish installations are included in the system. At the EU level in total, approximately 11 000 installations are covered.

Emissions from aviation where included in the system in 2012. Because of extensive protests from some countries outside EU, and pending adoption by ICAO (International Civil Aviation Organization) of a global market based instrument, the EU has decided on a temporary exemption for flights to and from the EU, which means only flights within EU are included in the system. Sweden is the Administering Member State for approximately 100 aircraft operators.

3.4.1.2 ENERGY AND CARBON DIOXIDE TAX

A *carbon dioxide tax* was introduced in 1991 and the maximum level has increased from SEK 0.25/kg carbon dioxide to SEK 1.12/kg in 2015. The carbon dioxide tax is mainly targeted towards use of fossil fuels outside the EU ETS. Government policy is to lower the reductions from the maximum CO_2 tax levels for activities outside the EU ETS.

Fuel used in combined district heating and power plants is covered by general carbon dioxide tax reductions, as is the manufacturing industry and agriculture, forestry and aquaculture. From 2011, the carbon dioxide tax has been removed for industry covered by the EU ETS and from 2013 for combined heat and power plants covered by the EU ETS. District heating plants within the EU ETS are granted a partly reduced carbon dioxide tax.

The government policy is to lower the reductions from maximum CO_2 tax levels for activities outside the EU ETS. The carbon dioxide tax reductions applied for heating fuels in industry outside the EU ETS as well as in agriculture, forestry and aquaculture has been reduced step-wise and the tax reductions will be completely ended by 2018. The special reimbursement of carbon dioxide tax on diesel for machinery in agricultural, forestry and aquacultural activities has been lowered to SEK 0.90 per litre in 2015 instead of the 2011 level (SEK 2.1 per litre), with a first step at SEK 1.70 per litre in 2013. However, a temporary increase to 1.70 per litre of the repayment will be applied from 2016.

A carbon dioxide tax, based on the fossil carbon content in the fuel, was introduced 1991. The tax level is proportionate to the corresponding calculated amount of carbon dioxide emissions (assuming complete combustion) and has increased from SEK 0.25/kg carbon dioxide to SEK 1.12/kg in 2015. The level of energy tax has changed over time and also varies between fuels. According to the 2009 climate policy decision, the energy tax was restructured. As of 2011, the tax level is set on the basis of energy content in the fossil fuel, at SEK 0.085/kWh on heating fuels for households, services and district heating. Fossil fuels used for heating in industry (within and outside the EU ETS), CHP, agriculture, forestry and aquaculture are subject to an energy tax of SEK 0.026 kWh. The energy tax on diesel as a vehicle fuel was also raised in two stages, in 2011 and 2013, by a total of SEK 0.40 per litre to partly close the gap to the energy tax level for petrol.

The energy tax on diesel will be increased 0.53 SEK/l and on petrol 0.48 SEK/litre in 2016.

Sweden applies tax reductions for biofuels. The energy tax exemption varies between biofuels and is between 8 and 100 percent compared to their fossil counterpart. In 2016, 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 tax reduction was restricted to not more than 5 percent by volume. Fuels used for the production of electricity are generally exempted from both energy and carbon dioxide taxes but the produced electricity is generally subject to energy tax.

3.4.1.3 LOCAL CLIMATE INVESTMENT PROGRAMME

Aiming to enhance and speed reduction of greenhouse gas emissions, a new programme for local investment was introduced in 2015. Grants for local and regional investment to mitigate climate change are provided. Investment can take place in all sectors except those included in the EU ETS, and applicants compete based on the climate mitigation effect of each investment. All types of organizations (not households) are eligible to apply to the scheme. The grants will total SEK 125 million (EUR 13 million) in 2015 and another SEK 600 million (EUR 61 million) annually is announced for the period 2016–2018.

3.4.1.4 THE ENVIRONMENTAL CODE AND PLANNING LEGISLATION

General legislation in the area of the environment has been collected in an *Environmental Code* since January 1999. Among other aspects, the Environmental code contains general rules for consideration to be observed in all activities and measures. 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 was no longer permitted.

Measures in the area of public planning chiefly have an impact on 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), but many measures, as for major infrastructure projects, are also covered by the Environmental Code. Since May 2011, the Planning and Building Act (SFS 2010:900) introduced new requirements to consider environmental and climate aspects in 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.

3.4.1.5 CLIMATE CHANGE COMMUNICATION

Several climate communication initiatives have been conducted in Sweden since 2002. The overall scope is to provide useful knowledge and tools to limit climate emissions and adapt to climate change. The efforts focus on disseminating facts about the climate change and to make these more accessible, especially regarding solutions, and sharing Swedish experience internationally.

Communication on possible measures in different sectors is disseminated through several channels. Both the Environmental Protection Agency and the Swedish Meteorological and Hydrological Institute (SMHI) have an ongoing responsibility for gathering information, mandated by the Government. Continuous information is also provided locally and regionally, through local climate and energy advisers, and regional energy offices.

The local climate and energy advisers (for which municipalities are receiving support from the Swedish Energy Agency (SFS 1997:1322)) aim to provide objective and locally adjusted information and advice about energy efficiency measures, energy use and climate related issues in buildings and households.

The Environmental Protection Agency carries out surveys of public awareness of and attitudes towards climate change on a regular basis. 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[40].

In agriculture and forestry, advice and training to landowners and managers plays a major role, for example in reducing climate gas emissions from manure management and use, and in improving energy efficiency (see section 3.4.7.2 The Rural Development Programme for further information). Regarding sustainable forest management practices, the government has stepped up providing advice in recent years, as detailed in section 3.4.8 Land use, land use change, and forestry. Further, 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. Also, the Swedish Forest Agency has a website that informs about the climate and, in particular, provides guidance on climate adaptation to forest owners.

3.4.1.6 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.

40 Swedish Environmental Protection Agency 2015

In 2012, the Swedish Riksdag decided to extend and progressively increase funding for energy research and innovation for sustainable energy systems (Govt. Bill 2012/13:21). The overarching aim is for the work undertaken to contribute to realizing existing energy and climate objectives, long-term energy and climate policy, and energy-related environmental policy goals. This funding was raised from SEK 0.9 billion per year to SEK 1.3 billion for the years 2013–2015.

Further, legislation was enacted (Government bill 2012/13:30) for research and innovation, focusing largely on reducing carbon dioxide emissions. Several research areas connected to reduced greenhouse gas emissions are prioritized. For example, appropriations were increased for research on forest commodities and biomass, sustainable society, energy research, and sustainable transport systems.

A link exists between innovation initiatives and economic instruments, in that the latter can facilitate market introduction of new technology, as with the green vehicle rebate, and the new investment scheme.

3.4.2 Energy

3.4.2.1 THE 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 per cent 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 regulation to the Directive, the following changes were implemented: i) Large companies shall make an energy mapping every fourth year; ii) Electricity suppliers shall 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.[41]

3.4.2.2 PRODUCTION OF ELECTRICITY AND DISTRICT HEATING

Production of district heating has risen approximately 50 per cent since 1990. At the same time, emissions from this source have remained relatively stable, as the expansion largely has been achieved by 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

41 Based on Government Bill 2013/14:174

of production, while additional production of electricity in recent years chiefly comes from biomass-fired combined heat and power plants (CHP) and wind power.

3.4.2.2.1 Electricity certificate system

A system of support for electricity based on renewable energy, an electricity certificate system, was introduced in 2003. The Swedish Parliament approved in October 2015 a new target which means that Sweden will finance an increase of the renewable electricity production within the electricity certificate system – totaling 30 TWh by 2020 compared to the 2002 level. As from 1 January 2012, Sweden and Norway have a common electricity certificate market. The two countries have set a joint target for greater renewable electricity production of 26.4 TWh from 2012 to 2020. In order to implement Sweden's increased ambition, the common target with Norway must be modified. Sweden and Norway reached an agreement in this increasing the common target from 26.4 TWh to 28.4 TWh. 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 target for 2020.

Conceptually, the system works as follows. Producers are allocated a certificate for every megawatt-hour (MWh) of renewable electricity produced. Electricity certificates are then sold to electricity users who are obliged by law to purchase electricity certificates corresponding to a certain share, or quota, of their consumption. This quota is gradually being increased yearly up to 2020.

In 2014, electricity users were required to purchase electricity certificates corresponding to 14.2 per cent of their electricity use. Since the common electricity certificate market commenced in 2012, plants with a total annual production of 9 TWh renewable electricity have been approved and taken into operation (November 2014). Of these, 7.5 TWh were built in Sweden. The portion of electricity production eligible for certificates has increased since the system started. The increase in recent years is dominated by greater wind power generatation[42].

3.4.2.2.2 Initiatives for wind power

The prospects for additional wind power generation have been improved by simplification of rules for permit appraisal. Further, the network for wind power disseminates knowledge and information about wind power to promote expansion.

Since 2004, certain land and water areas in Sweden have been designated as having national interest for wind farms. 310 areas of national interest for wind farms were designated, with 281 areas on land and 29 offshore and in inland

42 Swedish Energy Agency 2015a

lakes. The most recent update was carried out from 2010 to2013. The total area for this is approximately 8 000 km2, representing more than 1.5 percent of the country's land area, including Swedish waters.

3.4.2.2.3 Support for solar power

A subsidy for installations of photovoltaic cell technology was initiated in 2009. The budget for this support is set to SEK 1 395 million for the period 2016–2019.

All types of players can obtain financial support for installation of grid-connected photovoltaic, solar electricity and solar hybrid systems. The investment aid contributes to transformation in the energy sector and business development in solar energy technology.

3.4.2.2.4 Tax relief for micro production of renewable energy

A tax reduction for households and businesses was introduced in 2015 to stimulate investment in micro-production of renewable electricity. The income tax reduction is SEK 0.60/kWh fed into the grid in a connection point with a fuse size of up to 100 amperes. The tax reduction is capped at SEK 18 000 per year.

3.4.2.3 RESIDENTIAL AND COMMERCIAL/INSTITUTIONAL 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[43]. Oil prices and the technical availability of substitutes to fossil fuels 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. Other important ones are 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.

3.4.2.3.1 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

43 Profu 2013

electrically heated buildings effective 2009. Energy requirements for new buildings were revised and entered into force in 2012 with a stepwise implementation period including one transition year. The regulations apply in full from January 2013. This applies stricter requirements for specific energy use in buildings with heating systems other than electric heating (for which requirements were made stricter in 2009). Specific energy use (kWh/m2 and year) and average thermal transmittance (W/m2K) are now nearly 20 per cent stricter.

3.4.2.3.2 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 – 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 spreading and further development of more energy efficient technology. This is being used in such areas as heating and control, ventilation, and lighting. Purchaser groups exist for housing (BeBo), commercial and institutional premises (BeLok), and food distribution (BeLivs). There is also a network for public sector bodies that rent premises, HyLok. The five-year energy efficiency programme for 2010 to 2014 included increased support for technology procurement and market introduction in the industrial, residential, and service and transport sectors.

3.4.2.3.3 Ecodesign Directive (2009/125/EC) and Energy Labelling Directive 2010/30/EU and their implementing regulations
Mandatory energy labelling of domestic appliances has existed in the EU since 1995. Since 2005, Energy labelling has been further developed through the Ecodesign Directive (2009/125/EC) and the Energy Labelling Directive (2010/30/EU), which to set combined energy label requirements and energy efficiency requirements for products. Sweden has an active programme of market surveillance, involving both supervision of dealers and laboratory tests of products. The Ecodesign Act (SFS 2008:112) came into force in Sweden in 2008. Under the Act, energy consumption and other environmental factors have become even more important parts of product development when minimum requirements are laid down. In principle the Directive applies to all energy-using products (except transport) and covers all energy sources.

3.4.2.3.4 Energy declarations
Energy declarations are now required for buildings in Sweden based on Directive 2002/91/EC on the Energy Performance of Buildings. This includes an obligation for owners of single and multi-dwelling buildings, and commercial premises to declare the energy use of buildings and certain parameters for the indoor environment. This is intended to promote efficient energy use and good indoor environ-

ment in buildings by requiring property owners to learn more about which measures are cost-effective to implement for improving building energy performance.

3.4.3 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'.

3.4.3.1 CARBON DIOXIDE TAX FOR INDUSTRY OUTSIDE THE EU EMISSIONS TRADING SCHEME AND ENERGY TAX ON FOSSIL FUELS FOR HEATING IN INDUSTRY

Tax on fossil fuels used for heating and stationary engines in industry not covered by the EU ETS has been increased stepwise (see section 3.4.1.2 above). This tax was raised on 1 January 2011 from 21per cent to 30 per cent of the standard rate of carbon dioxide tax. In January 2015, the tax was increased to 60 per cent and in January 2016 to 80 per cent of the standard rate. The tax reduction is to be completely abolished in 2018.

Since 2011, the energy tax on fossil heating fuels has been levied based on energy content, significantly increasing the tax level on LPG, natural gas, coal, and coke. On fuels used in industrial manufacturing processes, inside and outside the trading system, 30 per cent of the standard energy tax is charged.

3.4.3.2 ENERGY ADVICE AND CONTRIBUTIONS TO ENERGY SURVEYS IN SMALL AND MEDIUM-SIZED ENTERPRISES

To stimulate greater energy efficiency in small and medium-sized enterprises, support for energy surveys of these SMEs and farms was introduced in 2010. The grants cover 50 percent of the survey costs, up to a maximum of SEK 50 000, and are available to businesses using more than 500 MWh of energy annually[44]. Also, resources have been added at the regional and local level for energy advice to smaller companies to help maximize the impact of policy instruments, such as the energy survey grant. A review for a new energy survey of support is currently under way.

44 Farms with at least 100 livestock units were eligible even if they used less energy

3.4.4 Product use

3.4.4.1 FLUORINATED GREENHOUSE GASES

Emissions of fluorinated greenhouse gases (f-gases) rose sharply after 1990, but have decreased since 2007 in Sweden. The largest increase was due to replacement of ozone-depleting refrigerants with hydrofluorocarbons (HFCs), which do not harm the ozone layer but are very potent greenhouse gases.

In industry, f-gases are emitted from manufacturing processes (mainly aluminium) and the use of refrigerants. Emissions of process-related f-gases have declined since 1990, partly as a result of the Environmental Code's requirement to use the best available technology.

3.4.4.1.1 F-gas Regulation

The use of certain f-gases has been regulated under EU Regulation No 842/2006, from 2006 to 2014. This primarily applied to use of f-gases in refrigeration, air conditioning, heat pump equipment, and fire protection systems. This was repealed in June 2014, with the passage of the new EU Regulation (No 517/2014) on fluorinated greenhouse gases, which entered into force on 1 January 2015. The new regulation, aims to cut emissions by two-thirds from current levels by 2030, and includes provisions for the use, reuse and destruction of f-gases. Most importantly, the new regulation includes a mechanism for quantified emission reductions of substances containing HFCs, with a gradual decreasing cap for the total emissions of HFCs. The supply of HFCs will be stopped in 2015, aiming at GHG emission reductions the years to follow (see table 3.2). To support the mechanism, the use of certain types of equipment containing HFCs will be banned.

TABLE 3.2 HFC Phase down in the EU

Year	Phase down (%)
2015	100 %
2016	93 %
2018–20	63 %
2021–23	45 %
2024–26	31 %
2027–29	24 %
2030	21 %

The EU is expected to adopt a BREF (Best Available Techniques reference document) for the non-ferrous metal industry in late 2015 or early 2016. Within four years of adoption, the specified performance requirements are to be met. These could significantly reduce emissions from the aluminium production. A review process is planned to start within eight years thereafter.

Since 2006, the use of HFC in air-conditioning units in cars is regulated in the EU Directive 2006/40/EC.

Swedish Regulation 2007:846 on fluorinated gases and ozone depleting substances 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, reconstruction and other interventions,
- requirements on leakage checks and certified competence also applies to mobile equipment containing f-gases,
- the results of the periodic inspection must be reported to the supervisory authority,
- the supervisory authority must be informed before the installation of equipment containing more than ten kilograms refrigerants,
- it is prohibited to sell f-gases as refrigerants to recipients other than those laid down in Regulation,
- Importers and those who transfer refrigerants are required to, free of charge, take back any refrigerants the delivered when these are disposed and to provide containers for this purpose.
- Equipment manufactured, imported or brought into Sweden shall be provided with accurate and easy-to-understand operating and maintenance instructions.

3.4.5 Transport

Emissions from domestic transport, where road transport dominates, increased after 1990, reaching a peak in 2006–2007, and declining since 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 where emission performance standards for new vehicles, vehicle taxes, and vehicle fuel taxes include the more significant. These have resulted in more energy efficient vehicles, and a larger the share of renewable energy.

3.4.5.1 EMISSION PERFORMANCE STANDARDS FOR NEW VEHICLES

Manufacturers selling vehicles in the EU are subject to EU Regulation (NO 443/2009, 333/2014, 510/2011, and 253/2014) setting emission performance standards for new passenger cars and vans as part of the Community's integrated approach to reduce 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.

3.4.5.2 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 greenhouse gas intensity reduction obligation.

3.4.5.3 CROSS-CUTTING POLICY INSTRUMENTS

3.4.5.3.1 Energy tax and carbon dioxide tax on vehicle fuel

Petrol and diesel are covered by both an energy tax and a carbon dioxide tax.

Carbon dioxide tax on fossil fuels was introduced in 1991 and has been raised in several steps since. The rise of carbon dioxide tax has, however, been partially offset by a simultaneous reduction in energy tax. The increased product costs for petrol and diesel have curbed the growth in transport, encouraged more energy-efficient vehicles and eased the introduction of vehicle biofuels. 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. As of January 2016 the energy tax on diesel is increased by another SEK 0.53 per litre and on petrol by SEK 0.48 per litre.

3.4.5.3.2 Urban environment agreements

A new scheme for investments in public transport at the regional and local level is being implemented in Sweden for the period 2015-2018. Municipalities are eligible to apply for grants to cover part of investment costs for public transports. The investment should be coupled with other actions aiming at increasing the long term sustainability of the urban areas and the transport system. Those actions include urban planning for fewer cars, increased accessibility with public transport, increased cycling and walking, lower speeds for vehicles, parking policies and pricing. The scheme is administered by the Swedish Transport Administration with a total budget of SEK 2 billion.

3.4.5.4 TARGETED INSTRUMENTS: THE RENEWABLE VEHICLE FUEL STRATEGY

3.4.5.4.1 Tax reduction for biofuels

Sweden applies tax reductions for biofuels. The energy tax exemption varies between biofules between 8 and 100 percent compared to their fossil counterpart. As of 2016, 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 tax reduction was restricted to not more than 5 percent by volume. Fuels used for the production of electricity are generally exempted from both energy and carbon dioxide taxes.

3.4.5.4.2 Requirements of renewable fuels at filling stations
The availability of renewable fuels has been affected by law where filling stations that sell more than a specified amount gasoline and diesel per year 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 from 1 January 2015, the requirements in the law became less stringent so that filling stations selling more than 1 500 m^3 gasoline or diesel must offer at least one kind of renewable fuel.

3.4.5.4.3 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, including:

- 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 with the objective to develop strategies for introduction of cost-effective alternative motor fuels. The project is also investigating potential effects on stationary installations using biofuels.

3.4.5.5 TARGETED INSTRUMENTS: COMPOSITION OF THE VEHICLE FLEET

3.4.5.5.1 Differentiated vehicle tax
Since 2006, Sweden has differentiated the annual vehicle tax with respect to the vehicle's CO_2 emissions per km. The CO_2-related vehicle tax is SEK 22 per g CO_2/km beyond 111g CO_2/km in mixed driving (2015). Cars that can be driven with alternative fuels such as ethanol fuel and gas fuel, except LPG, are taxed with a lower rate, SEK 11 per g CO_2/km beyond the first 111 g CO_2/km. Light trucks, light buses and campers have also been brought into the system of CO_2-differentiated vehicle tax from 2011. The vehicle tax on a diesel car with a specific CO_2/km is higher than the vehicle tax on a petrol car with the same specific CO_2/km. This is because diesel has a lower energy tax than petrol. The taxation of older cars and heavy trucks is mainly based on weight.

3.4.5.5.2 Super-green car rebate
Since 1 January 2012, buyers of passenger cars that meet the latest EU exhaust requirements 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. If the owner is an enterprise or another organization, the rebate is 35 per cent of the cost difference between the price of a super-green car and a non-super-green car of similar type. Maximum rebate is SEK 40 000. The main aim is to contribute to technology development and deployment as well as creating understanding within society to lower barriers for large scale introduction of electric and hybrid electric cars in future. After 1 January 2016, the rebate will be lowered to SEK 20 000 for buyers of hybrid cars. Buyers of pure electric cars still get the full SEK 40 000 rebate.

3.4.5.5.3 Tax exemption for environmental friendly vehicles

Sweden has 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 for EFV is related to the car's curb weight and allows heavy vehicles to emit more CO_2 compared to lighter vehicles. The new definition means that the highest approved emission level for an average weight gasoline or diesel car (average weight of 1 372 kilos) is 95 g CO_2/km.

Flex-fuel vehicles (so called FFVs, driven with 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 according to the environmental car definition.

The new definition also applies to motorhomes, vans and small buses, which were previously not included.

3.4.5.5.4 Lower benefit value on cars with advanced environmental technology

Company-registered cars represent about 50% of new car registrations in Sweden. Aproximately 50% of these company-registered cars are company cars, i.e. company-registered cars made available for private use by employees.

The benefits ofprivate 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.

In order to increase the incentive to substitute towards company cars with environment-friendly technologies, environmentally friendly cars receive a relatively favorable tax treatment by reducing its 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 natural gas powered cars (other than liquefied petroleum gas) is reduced to 60

per cent of the already reduced benefit value, up to a maximum reduction of SEK 16 000 annually until the end of 2016. This additional reduction for these cars is proposed to be prolonged for the years 2017 to 2019 but with a maximum reduction of the benefit value of SEK 10 000 per year.

3.4.5.6 CONSIDERATION OF CLIMATE IN LONG-TERM INFRASTRUCTURE PLANNING

In 2014, the Riksdag decided on a national infrastructure plan for 2014–2025, to be implemented by The Swedish Transport Administration with other actors, such as local and regional planning bodies. Long-term planning of infrastructure includes operation and maintenance, investment in new infrastructure, research, targeted environmental measures affecting existing infrastructure, and minor alterations such as public transport lanes. 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.

The Swedish Transport Administration has been commissioned by the Government to deliver analyses for a coming national plan for the transport system 2018–2029. The analysis includes one alternative in which the need for infrastructure measures are analyzed with the assumption that additional policy measures and other measures with the purpose to reduce greenhouse gases in a cost efficient way are introduced.

3.4.6 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.

3.4.6.1 LANDFILL DIRECTIVE (1999/31/EC)

The landfill directive requires landfilling of biodegradable waste be reduced by 2016 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.

3.4.6.2 LANDFILL TAX

In 2000 a tax was imposed on waste disposal to landfill (SFS 1999:673).

3.4.6.3 BAN ON LANDFILLING COMBUSTIBLE AND ORGANIC MATERIALS

Under the Swedish Ordinance (2001:512) on the landfill of waste, a ban on landfilling combustible materials was introduced in 2002 and a similar ban was

imposed on organic material in 2005. The ordinance also regulates 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.

3.4.6.4 EXTENDED PRODUCER RESPONSIBILITY

A set of ordinancesmandates extended producer responsibility for producers of eight product groups. This producer responsibility is intended to incentivize producers to develop more resource-efficient products that are easier to recycle and do not contain environmentally hazardous substances.

3.4.6.5 THE MUNICIPAL WASTE PLANNING REQUIREMENT

A municipal waste planning requirement was introduced in 1991. 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.

3.4.7 Agriculture

Greenhouse gas emissions from Swedish agriculture have decreased in recent years. As yet, there are relatively few economic policy instruments directly targeting greenhouse gas emissions from this sector. 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 fertilizer management, and from land use.

3.4.7.1 THE COMMON AGRICULTURAL POLICY

On 16 December 2013, the Council of EU Agriculture Ministers formally adopted the four Basic Regulations for a reformed CAP as well as Transition Rules for 2014. Based on certain requirements, farmers can get support for non-profitable services delivered to the wider public, such as landscapes, farmland biodiversity and climate change mitigation. The CAP second pillar for rural development requires member states to adopt environmental measures such as climate mitigation and adaptation.

3.4.7.2 THE RURAL DEVELOPMENT PROGRAMME

The Swedish Government decided on a new Rural Development Program in June 2014. The new programme for 2014–2020, includes support for investments, for young entrepreneurs, capacity building, cooperation and innovation, support to areas with natural constraints, animal welfare payments, ecological farming, and environmental and climate actions. Measures specifically contributing to climate 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; sustainable perennial grass ley with reduced soil tillage; and other separate projects relating to climate and energy. The programme budget totals SEK 36 billion, of which 59 per cent is financed by Sweden and the remaining 41 per cent by the EU.

3.4.7.3 SUPPORT FOR BIOGAS PRODUCTION

In January 2015, the Government introduced a new support scheme for biogas production through anaerobic digestion of manure. Increased digestion of manure offers several environmental benefits, reducing both emissions of greenhouse gases and eutrophication of fresh and marine waters as well as producing biogas for energy. The biogas generated can be used to generate electricity or heat, or as vehicle fuel. For 2015, the subsidy amounts to a maximum of 0.20 SEK/kWh of biogas produced.

3.4.7.4 THE RURAL NETWORK

The rural network complements the Swedish Rural Development Programme, the Ocean and Fishery Programme, and the Programme for local leadership development in the Social fund and Regional fund. The network collects actors at the local, regional and central level for exchanging information and experiences. The network is intended to reinforce implementation of these programmes.

3.4.7.5 MEASURES TO REDUCE NITROGEN LEAKAGE FROM AGRICULTURE

Activities to reduce nitrogen losses from agriculture, based on requirements in the EU Nitrates Directive (91/676/EEC) and regulations issued by the Swedish Board of Agriculture (SJVFS 2015:21), have led to reduced nitrogen leakage to the aquatic environment with indirect positive effects for the mitigation of greenhouse gas emissions.

3.4.7.6 CHANGES IN ENERGY AND CARBON DIOXIDE TAXATION FOR FUELS USED IN LAND-BASED INDUSTRIES

The carbon dioxide tax on fuels consumed for heating in industry and other activities outside the EU emissions trading scheme, including fuels consumed in agricultural, forestry and aquacultural activities has been raised in accordance with the Swedish Riksdag Climate Change Resolution in 2009.

The carbon dioxide tax reductions applied for heating fuels in agriculture, forestry and aquaculture has been reduced in steps and will be totally rescinded by 2018. The special reimbursement for carbon dioxide tax on diesel for machinery in agricultural, forestry and aquacultural activities has been lowered in a stepwise manner from SEK 2.10 per litre (2011) to SEK 0.90 per litre in 2015. However, a

partial, temporary increase to 1.70 per litre of the repayment will be applied from 2016.

In addition to general relief on the carbon dioxide tax, enterprises can currently claim a further reduction under what has been known as the 1.2 % rule. This tax relief has primarily taken effect for enterprises in the greenhouse horticulture sector. This tax relief ends in 2015.

3.4.8 Land use, land use change and forestry (LULUCF)

Sweden chooses to report on the LULUCF sector for transparency and consistency, even though this sector is not included in the EU and member states' pledge under the Climate convention for pre 2020.

3.4.8.1 FOREST POLICY AND THE FOREST ACT

Swedish forest Act (as of 1993) has two overarching, equal objectives: production and 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 giving 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 have been 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 regualtions concernings nature conservation and cultural heritage include leaving important biotopes and buffer zones and arable land, and leaving older trees, high stumps and dead wood.

3.4.8.2 ENVIRONMENTAL POLICY AND THE ENVIRONMENTAL CODE

Swedish environmental policy also affects existing provisions which influence carbon dioxide removals and emissions in various ways. Since 1998, Sweden has had 16 national environmental quality objectives, of which several involve LULUCF.

The Swedish Environmental Code is a coordinated, broad and stringent piece of environmental legislation aimed at promoting sustainable development that will

enable present and future generations to live in a good and healthy environement. The Code contains regulations on for example provisions 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 on sites specially protected under the RAMSAR Convention, such schemes are prohibited. .

3.4.8.3 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 have an impact on carbon stocks in forest biomass, and soil carbon are maintained or continue to increase. Protected forest ecosystems have a large capacity to sequester carbon, even long after a conservation measure has been 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.

3.4.8.4 ADVICE AND TRAINING

The Swedish government's advice and training has in recent years been stepped up. In the period of 2012–2015 10 million SEK annually has been allocated to strengthen governmental advice and training for sustainable forest management. The Swedish Forest Agency has mounted information campaigns on adapting forestry to a changing climate with support from the Rural Development Programme (RDP), 'Forestry in a changed climate' and 'Forest owners and climate'.

3.4.8.5 OTHER NOTABLE POLICY INSTRUMENTS

There are several policy instruments which have an indirect, but crucial, impact on the flux of greenhouse gases in forests. Carbon dioxide tax, energy tax, market-based support schemes such as the electricity certificates system and quota obligation on renewable transport fuels are all regulatory instruments that influence demand for forest raw materials for energy supply. These measures have been instrumental in increasing the profitability of biomass fuels and been a major factor behind the economy-wide emission reductions achieved.

3.4.9 Shipping and aviation, including international bunkers in Sweden

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. At its session in September 2013, the ICAO Assembly decided to develop a global

market-based measure, which is to be adopted in 2016 and implemented in 2020. Drafting of proposals on the design and operation of this measure is ongoing and will continue to their adoption in 2016. Sweden is actively engaged in this work.

Pending the decision from ICAO, the EU ETS regulation was amended in 2014 so that the scheme now only covers intra EU/EEA flights. After the ICAO Assembly in 2016, the EU Commission will revisit and possibly revise the ETS regulation depending on the outcome of the decision on the global market-based measure.

Under the joint leadership of the Swedish Transport Agency and the US Federal Aviation Administration, the CAEP has also adopted a carbon dioxide certification requirement for aircraft. A new standard in Annex 16 of the Chicago Convention is expected to be adopted by the CAEP in early 2016. This will also include limits on carbon dioxide emissions from new aircraft and possibly aircraft in production. When these standards will become effective has not been decided yet, but 2020–2028 is being discussed.

In June 2015, Sweden submitted an updated version of its 2012 'State Action Plan on CO_2 Emissions Reduction Activities' to ICAO. The action plan describes the measures and policy tools in place, or planned, in Sweden to reduce the CO_2 emissions from international aviation, including an estimate of expected emissions reductions. The action plan includes a common section for the EU/ECAC[45] area, and a national section dedicated to Swedish initiatives.

In the 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) – to standardize description of ships' energy efficiency – was made mandatory from 2013 for most (some 85%) newly built vessels. The EEDI attained by any ship can be compared to a reference level based on an average for existing vessels. Ship building contracts 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 2015, an EU regulation on monitoring, reporting and verification of carbon dioxide emissions from maritime transport was adopted. The regulation applies to all ships of over 5 000 gross tonnesexceedin in respect to their CO_2 emissions during their voyages to and from ports in the EU. In the IMO, a similar discussion regarding data collection from international shipping is being discussed as a first phase in order to analyse the need and design of a potential mechanism to reduce

45 European Civil Aviation Conference

CO_2 emissions. The negotiations were intensified in 2015 intending to finalize them in 2016.

Moreover, Sweden gives priority to IMO efforts to limit nitrogen oxide and sulphur emissions. Such measures also have benefits from a climate point of view.

3.5 Information on the assessment of economic and social consequences of response measures

Parties under the UN Framework Convention of Climate Change are to strive to implement policies and measures in such a way as to minimize 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.

Under Sweden's policy for global development (PGD), all policy areas are to 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 – are to 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 have beneficial effects on the capacity of developing countries to adapt to climate change and take action of their own to reduce their greenhouse gas emissions.

Finally, Sweden would emphasize that its broad ranging climate strategy, encompassing many different types of measures and covering most sectors (both inside and outside the country) and all the greenhouse gases regulated by the Kyoto Protocol, has a design which fundamentally seeks to minimize the risk of adverse effects.

3.6 Summary of policies and measures

Name of policy/ measure	Primary objective	Green-house gas(es) primarily affected	Type of instrument	Status of instrument	Implementing agency	Estimate of mitigation impacct in Mt CO_2 eq per year compared with 1990 instruments			
						2010	2015	2020	2030
CROSS-SECTORAL									
Local climate invest-ment programme*	Enhance and speed reduction of greenhouse gas emissions	All	Economic	Ongoing (2015–2018)	Swedish Environ-mental Protection Agency	N.E.	N.E.	N.E.	N.E.
Environmental Code	Ecologically sustainable development	All	Legislation	Ongoing (1999–	Swedish Environ-mental Protection Agency	N.E.	N.E.	N.E.	N.E.
Planning and Building Act	Promote sustaina-ble development of society	All	Legislation	Ongoing (2011–	Swedish National Board of Housing, Building and Planning	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 deve-lopment	Development of technology with very low climate impact	All	Economic	Ongoing (1990–	Swedish Energy Agency (mainly)	N.E.	N.E.	N.E.	N.E.

*Policy/measure marked with * are not included in the projections.*

Name of policy/ measure	Primary objective	Green-house gas(es) primarily affected	Type of instrument	Status of instrument	Implementing agency	Estimate of mitigation impacct in Mt CO_2 eq per year compared with 1990 instruments			
						2010	2015	2020	2030
PRODUCTION OF ELECTRICITY AND DISTRICT HEATING									
Energy tax	Fiscal, and to improve efficiency of energy use	Carbon dioxide	Economic	Ongoing (1957–	Swedish Tax Agency				
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 and Svenska Kraftnät (Swedish National Grid)	14[46]	16[46]	16[46]	15[46]
EU Emissions Trading System (EU ETS)	Reduce use of fossil fuels in trading sector	Carbon dioxide	Economic	Ongoing (2005–	Swedish Environ-mental Protection Agency and Swe-dish 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
Central government support for installa-tions of solar cells	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 re-newable energy	Carbon dioxide	Economic	Ongoing (2015–	Swedish Tax Agency	N.E	N.E	N.E	N.E
RESIDENTIAL AND COMMERCIAL/INSTITUTIONAL SECTOR									
Energy tax	Fiscal, and to improve efficiency of energy use	Carbon dioxide	Economic	Ongoing (1957–	Swedish Tax Agency				
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	1,3[46]	0,3[46]	0,5[46]	0,7[46]
Energy declarations	More efficient energy use	Carbon dioxide	Legislation and information	Ongoing (2009–	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				
Technology procurement	More efficient energy use and increased use of renwable energy	Carbon dioxide	Economic	Ongoing	Swedish Energy Agency	N.E	N.E	N.E	N.E

*Policy/measure marked with * are not included in the projections.*

Name of policy/ measure	Primary objective	Green-house gas(es) primarily affected	Type of instrument	Status of instrument	Implementing agency	Estimate of mitigation impacct in Mt CO_2 eq per year compared with 1990 instruments			
						2010	2015	2020	2030
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[46]	0[46]	0,2[46]	0,4[46]
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 and Svenska Kraftnät				
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				
Energy advice and contributions to energy surveys in 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
Environmental Code	Ecologically sustainable development	All	Legislation	Ongoing (1999–	Swedish Environmental Protection Agency	N.E	N.E	N.E	N.E
PRODUCT USE									
EU regulation on Fluorinated greenhouse gases	Reduce use of HFCs	HFCs	Legislation	Ongoing (new directive 2015)	Swedish Environmental Protection Agency	N.E.	N.E.	N.E.	N.E.
EU regulation on mobile air conditioning units in cars	Reduce use of HFCs	HFCs	Legislation	Ongoing (2006–	Swedish Environmental Protection Agency	N.E.	N.E.	N.E.	N.E.
Swedish regulation on fluorinated gases and ozone depleting substances	Reduce use of HFCs and ozone depleting substances	HFCs	Legislation	Ongoing	Swedish Environmental Protection Agency	N.E.	N.E.	N.E.	N.E.

*Policy/measure marked with * are not included in the projections.*

46 Profu 2013

Name of policy/ measure	Primary objective	Green-house gas(es) primarily affected	Type of instrument	Status of instrument	Implementing agency	Estimate of mitigation impacct in Mt CO_2 eq per year compared with 1990 instruments			
						2010	2015	2020	2030
TRANSPORT									
Energy tax, including stepwise increase of tax on diesel and petrol*	Fiscal, and to improve efficiency of energy use	Carbon dioxide	Economic	Ongoing (1957–	Swedish Tax Agency	N.E	N.E	N.E	N.E
Carbon dioxide tax, including tax reduc-tion for biofuel	Reduce use of fossil fuels	Carbon dioxide	Economic	Ongoing (1991–	Swedish Tax Agency	N.E	N.E	N.E	N.E
CO_2-emission standards for new vehicles	Reduce carbon dioxide emissions from light-duty vehicles	Carbon dioxide	Legislation	Ongoing (2015 and 2017)	Swedish Transport Agency	N.E	N.E	N.E	N.E
Urban environment agreements*	Reduce carbon dioxide emissions and incentivise building of public transport	Carbon dioxide	Economic	Ongoing (2015–2018)	Swedish Transport Agency	N.E	N.E	N.E	N.E
Support for research and demonstration	Develop techno-logy for sustainable growth and reduced fossil fuel depen-dence	Carbon dioxide	Economic	Ongoing	Vinnova and Swedish Energy Agency (mainly)	N.E	N.E	N.E	N.E
Targeted instru-ments to promote introduction of renewable transport fuels: Energy and carbon dioxide tax reduc-tion for biofuels, Requirements of renewable fuels at filling stations	Increase use of renewable transport fuels	Carbon dioxide	Economic	Ongoing	Swedish Tax Agency (mainly)	1,8[47]	2,6[47]	3[47]	N.E
Targeted instru-ments: Composition of the vehicle fleet : Differentiated vehicle tax, super-green car rebate, tax exemption for environmentally friendly vehicles, lower benefit value on cars with advan-ced environmental technology	Increase use of environmental friendly vehicles	Carbon dioxide	Economic	Ongoing	Swedish Tax Agency (mainly)	N.E	N.E	N.E	N.E

*Policy/measure marked with * are not included in the projections.*

47 Ministry of the Environment 2014

Name of policy/ measure	Primary objective	Green-house gas(es) primarily affected	Type of instrument	Status of instrument	Implementing agency	Estimate of mitigation impacct 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 separated 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	1,45[48]	1,75[48]	1,95[48]	N.E
AGRICULTURE									
Targeted agri-environment payments under the new Rural Development Programme	Reduced Climate Impact, a varied agricultural landscape and zero eutrophication	Nitrous oxide and methane	Economic	Ongoing (2014–2020)	Swedish Board of Agriculture	N.E.	N.E	N.E	N.E
Support for biogas produciton	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 Programme	Nitrous oxide and methane	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)	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 and 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

*Policy/measure marked with * are not included in the projections.*

48 Ministry of the Environment 2014

3.7 References

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 Enterprise, Energy and Communications.

Govt. Bill 2013/14:174: *Genomförande av energieffektiviseringsdirektivet*. Ministry of Enterprise, Energy and Communications.

Govt. Bill 2015/16:1: *Budgetpropositionen för 2016*. Ministry of Finance.

Länsstyrelserna Norrbotten, Dalarna, Skåne (2013). *Pilotlän för grön utveckling – Rekommendationer till regering och nationella myndigheter från Skåne, Dalarna och Norrbotten, Länsstyrelserna Norrbotten, Dalarna, Skåne* http://projektwebbar.lansstyrelsen.se/energi/SiteCollectionDocuments/Uppdrag%20och%20organisation/PM%20Pilotl%C3%A4nens%20rekommendationer%20och%20f%C3%B6rslag%20SLUTVERSION.pdf

Ministry of the Environment (2014). *Sweden's Sixth National Communication on Climate Change,* Sweden: Ds 2014:11.

Profu (2013). *Beräkningar med MARKAL-NORDIC inför Sveriges klimatrapportering (NC6)*. Mölndal: Profu i Göteborg AB.

Swedish Association of Local Authorities and Regions (2012). *Nyckeltal energi och klimat 2012*. ISBN 978-91-7164-895-2.

Swedish Energy Agency (2015a). *En svensk-norsk elcertifikatmarknad, Årsrapport för 2014*, Stockholm/Oslo. ET 2015:06 2015.

Swedish Energy Agency (2015b). *Utveckling och genomförande av regionala klimat- och energistrategier 2010–2014,* Report ER 2015:13.

Swedish Environmental Protection Agency (2010). *Gör arbetet med klimatstrategier någon skillnad? En utvärdering av lokalt klimatstrategiarbete*. Stockholm: Naturvårdsverket. ISBN 978-91-620-6358-0.

Projections

4

This section presents projections of greenhouse gas emissions for various sectors and as a total. The information in this chapter conforms to that submitted[49] under EU legislation[50]. All data presented and described is reported in the Common Tabular Format (CTF).

Projections of greenhouse gas emissions in Sweden were produced for 2015, 2020, 2025, 2030 and 2035. In text and tables, special attention is given to 2020 and 2030. The projections are based on policies and measures approved by the Swedish parliament up to 2014, which means it is a projection "with existing measures"[51]. When producing the projections, model-based calculations and, to some extent, expert evaluations are used. The projections are based on several assumptions, all of which contain uncertainty. The method for estimating these projections is primarily developed for medium or long-term projection, which means the projection does not consider variations on a short-term basis.

The same methodology to produce the projections was used in Sweden's second Biennial Report as in the first Biennial Report (and in Sweden's sixth National Communication) for all sectors except the agricultural sector, which is further described in Section 4.3.

49 Report for Sweden on assessment of Projected progress, March 2015

50 Regulation (EU) No 525/2013 of the European parliament and of the council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union levels relevant to climate change and repealing Decision No 280/2004/EC

51 All policies and measures, except those marked with an asterisk in table 3.1, are included in the projections

4.1 Key parameters and assumptions

Table 4.1 shows the key parameters and assumptions used in these projections.

TABLE 4.1 Key parameters and assumptions used in projections

	2011–2035	
GDP (annual % change)	2.0	
	2020	**2030**
Crude oil price (USD/barrel)	118	133
Price of coal (USD/tonne)	110	116
Price of natural gas (USD/Mbtu)	12.1	13.1
Emissions trading (€/tonne CO_2)	8	20
Electricity certificates (new renewable electricity)	26.4 TWh by 2020 and 2035	
Nuclear power (useful life)	60 years (except for the three oldest plants for which 50 years is assumed)	

4.2 Greenhouse gas emission projections

Total greenhouse gas emissions in Sweden, calculated as carbon dioxide equivalents, were 55.8 million tonnes in 2013 (excluding LULUCF). Total emissions decreased 16 million tonnes, or 22 per cent, between 1990 and 2013. The projection shows that total emissions of greenhouse gases are estimated to be 55.3 million tonnes of carbon dioxide equivalents in 2020, see Figure 4.1 and Table 4.2. The projected emissions for 2020 are 23 per cent below the 1990 level. After 2020, emissions will continue to decrease slowly, and by 2030, total emissions of greenhouse gases are expected to be about 28 per cent below the 1990 level.

For the 2013, 80 per cent of greenhouse gas emissions represent carbon dioxide emissions, while methane emissions account for just over 9 per cent, nitrous oxide almost 9 per cent, and fluorinated greenhouse gases for nearly 2 per cent.

Emissions of all gases decrease during the projection period, but the share of carbon dioxide emissions is estimated to increase to about 82 per cent in 2020. Other greenhouse gases are estimated to reduce their contribution to total emissions. See table 4.3 for the trends in emissions of the greenhouse gases.

FIGURE 4.1 Historical (1990–2013) emissions of greenhouse gases and projected greenhouse gas emissions to 2035 (million tonnes of carbon dioxide equivalents)

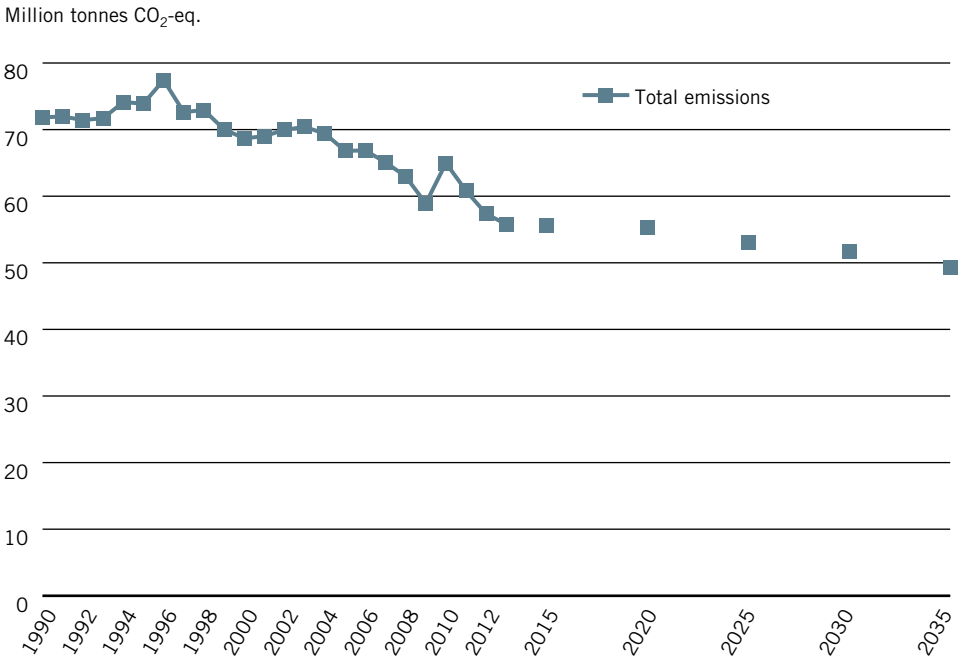


TABLE 4.2 Historical (1990–2013) and projected total emissions of greenhouse gases per gas (million tonnes carbon dioxide equivalents), change in per cent between 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	57.5	44.8	45.3	45.8	44.0	43.1	41.1	-20%	-25%
Methane	8.1	5.3	5.0	4.5	4.2	4.0	3.7	-44%	-51%
Nitrous oxide	5.7	4.7	4.5	4.4	4.3	4.3	4.2	-23%	-26%
Fluorinated greenhouse gases	0.5	1.0	0.9	0.6	0.5	0.4	0.3	17%	-28%
Total emissions	71.8	55.8	55.6	55.3	53.1	51.7	49.3	-23%	-28%

4.2.1 Greenhouse gas emission projections per sector

The trends in projected greenhouse gas emissions differ between sectors, see Figure 4.2 showing total emissions by sector. In the projections, the emissions from transport, product use, agriculture, and waste will decrease from 2013 to 2035. Emissions from industrial processes will increase during the projection period.

Emissions from energy (that is, primarily emissions from energy industries, industrial combustion, and combustion in households, agriculture, forestry and fisheries) will increase until 2020, to then slowly begin decreasing throughout the projected period. Each sector is described in the sections below.

FIGURE 4.2 Historical (1990–2013) and projected emissions of greenhouse gases by sector (million tonnes of carbon dioxide equivalents)

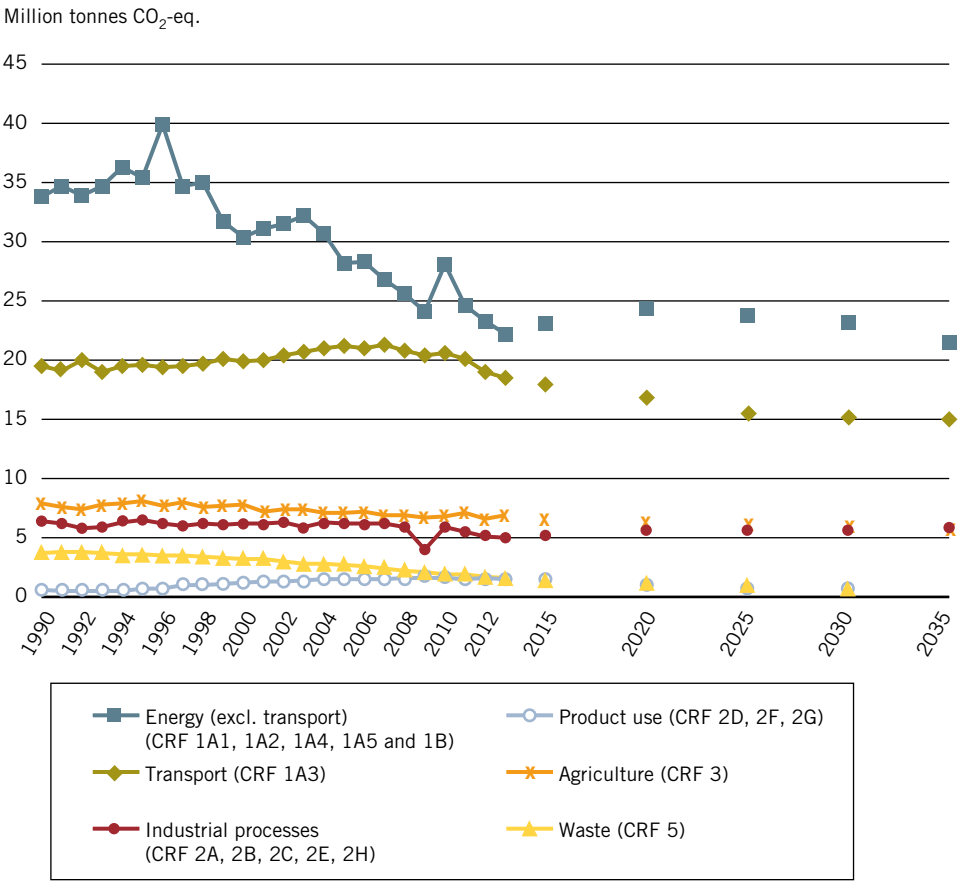


TABLE 4.3 Historical (1990–2013) emissions and projected emissions of greenhouse gases per sector (million tonnes of carbon dioxide equivalents), change in per cent between 1990–2020 and 1990–2030.

	CRF-code	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Energy (excl. transport)	1A1, 1A2 1A4, 1A5, 1B	33.8	22.2	23.1	24.4	23.8	23.2	21.5	-28%	-31%
Transport	1A3	19.5	18.5	18.0	16.8	15.6	15.2	14.9	-14%	-22%
Industrial processes	2A, 2B, 2C, 2E, 2H	6.4	5.0	5.2	5.6	5.7	5.7	5.8	-13%	-10%
Product use	2D, 2F, 2G	0.6	1.5	1.4	1.2	1.0	0.9	0.8	98%	55%
Agriculture	3	7.9	6.9	6.6	6.3	6.1	5.9	5.7	-20%	-25%
Waste	5	3.7	1.6	1.4	1.1	0.9	0.7	0.7	-71%	-80%
Total emissions		71.8	55.8	55.6	55.3	53.1	51.7	49.3	-23%	-28%

4.2.1.1 ENERGY (CRF 1)

Emissions from the energy sector include emissions from the production of electricity and district heating, refineries, manufacture of solid fuels, manufacturing industries, transports, other sectors (including commercial/institutional, residential, agriculture, forestry and fisheries), other (military transports), and fugitive emissions.

1.2.1.1.1 Energy excluding transport (CRF 1A1, 1A2, 1A4, 1A5 and 1B)

Emissions from the energy sector, excluding transport, as described in a separate section, are shown in Figure 4.3 and in Table 4.4 by gas and in total. The projection shows an increase in total emissions from 2013 to 2020, with a subsequent decrease in emissions during the projected period, to a level below 2013 emissions. The increase is mainly due to higher emissions from electricity and heat production and in industrial combustion.

Total emissions are 28 per cent lower in 2020 than in 1990, and 31 per cent lower in 2030 than in 1990. Carbon dioxide emissions are lower in 2020 and 2035 than in 1990, while emissions of methane and nitrous oxide are higher in 2020 and 2035 compared to 1990. The emissions are further analysed by subsector in the sections below.

FIGURE 4.3 Historical (1990–2013) and projected emissions from the energy sector by sub-sector, excluding transport, million tonnes carbon dioxide equivalents

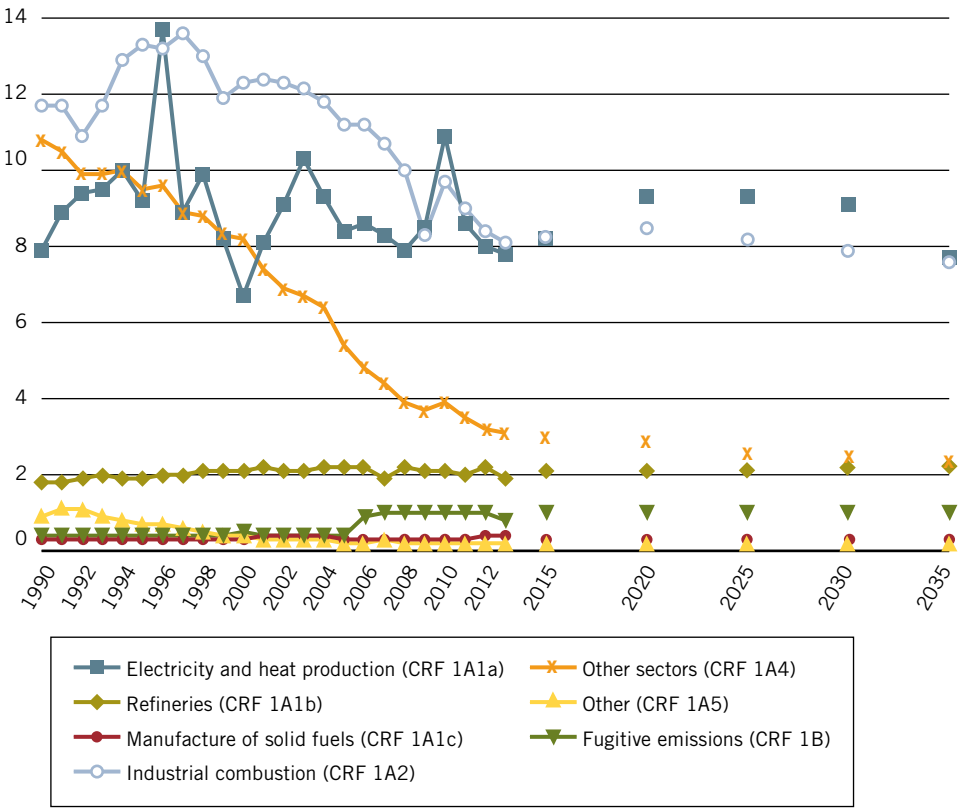


TABLE 4.4 Historical (1990–2013) and projected greenhouse gas emissions from energy (excluding transport and combustion in industry), (CRF 1A1, 1A2, 1A4, 1A5 and 1B), change in per cent between 1990–2020 and 1990–2030 (million tonnes of carbon dioxide equivalents) in total and by gas.

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	32.8	21.0	21.9	23.2	22.6	22.0	20.3	-29%	-33%
Methane	0.5	0.5	0.5	0.5	0.5	0.5	0.5	11%	10%
Nitrous oxide	0.5	0.7	0.7	0.7	0.7	0.7	0.7	26%	27%
Total emissions	33.8	22.2	23.1	24.4	23.8	23.2	21.5	-28%	-31%

Energy industry – Production of electricity and district heating (CRF 1A1a)
Greenhouse gas emissions from the production of electricity and district heating are projected to increase slightly from 2013 to 2020, after which they will stabilise, to decrease after 2025, see Table 4.5 and Figure 4.3. The emission level is projected to be 18 per cent higher in 2020 than in 1990, and 16 percent higher in 2030 than in 1990, and is projected to decrease to approximately the same level as in 1990 by 2015. Increased use of natural gas and, to some extent, an increased use of waste and peat contribute to the higher emissions during the projected period. The increase is offset by increased use of biomass, wind power and decreased use of oil and coal. The use of biomass and peat is particularly projected to increase in combined heat and power plants, a trend promoted by renewable electricity certificates as well as the EU Trading Scheme (EU ETS). Between 2013 and 2020, electricity production is projected to increase more than electricity consumption, leading to a projected net export of electricity by 2030.

TABLE 4.5 Historical (1990–2013) and projected greenhouse gas emissions from the production of electricity and district heating (CRF 1A1a), change in per cent between 1990–2020 and 1990–2030 (million tonnes of carbon dioxide equivalents).

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	7.7	7.3	7.7	8.8	8.8	8.7	7.2	14%	12%
Methane	0.03	0.1	0.1	0.09	0.09	0.09	0.07	245%	257%
Nitrous oxide	0.1	0.4	0.4	0.4	0.4	0.4	0.4	176%	184%
Total emissions	7.9	7.8	8.2	9.3	9.3	9.1	7.7	18%	16%

Energy industry – Refineries (CRF 1A1b)
Emissions from refineries are projected to increase throughout the projection period, by 20 per cent to 2020 and by 24 per cent to 2030 as compared to 1990 levels, see table 4.6. The increase is due partly to increased production and partly to increased emissions in production due to a shift to products that fulfil stricter requirements (as with lower content of sulphur). Refinery emissions are also reported in the fugitive emissions sector (CRF 1B).

TABLE 4.6 Historical (1990–2013) and projected greenhouse gas emissions from refineries CRF 1A1b, change in per cent between 1990–2020 and 1990–2030 (million tonnes of carbon dioxide equivalents).

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	1.8	1.9	2.1	2.1	2.2	2.2	2.2	20%	24%
Methane	0.001	0.001	0.001	0.001	0.001	0.001	0.001	30%	34%
Nitrous oxide	0.006	0.003	0.003	0.003	0.003	0.003	0.003	-40%	-40%
Total emissions	1.8	1.9	2.1	2.1	2.2	2.2	2.2	20%	24%

Energy industry – Manufacture of solid fuels (CRF1A1c)
Greenhouse gas emissions from the manufacture of solid fuels were 0.4 million tonnes of carbon dioxide equivalents and are projected to remain at roughly the same level as recent years and up to 2035.

4.2.1.1.2 Combustion in manufacturing industries and construction (CRF 1A2)
Total emissions from combustion in industry and construction are expected to increase from 2013 to 2020, when they are projected to be 27 per cent lower than in 1990 and then decrease to reach in 2030 a level 33 per cent lower than in 1990.

Several energy-intensive industries are responsible for the larger share of emissions in this sector. Together, iron and steel, pulp and paper, and chemicals account for nearly half of the sector's emissions, Figure 4.4. Energy use is expected to increase slightly until 2020 as a result of increased production. However, emissions are not expected to increase to the same degree since greater use of biofuel and electricity is expected to exceed any increase in use of fossil fuels. The decreasing emissions after 2020 are mainly explained by reductions in the pulp and paper industry due to a shift to biofuels from using fossil fuels. Emissions from the food processing industry are also expected to decrease while emissions from the chemicals industry will remain stable. Emissions from the iron and steel industry are expected to increase slightly during the projection period.

FIGURE 4.4 Historical (1990–2013) and projected greenhouse gas emissions from combustion in manufacturing industries (CRF 1A2) (million tonnes of carbon dioxide equivalents)

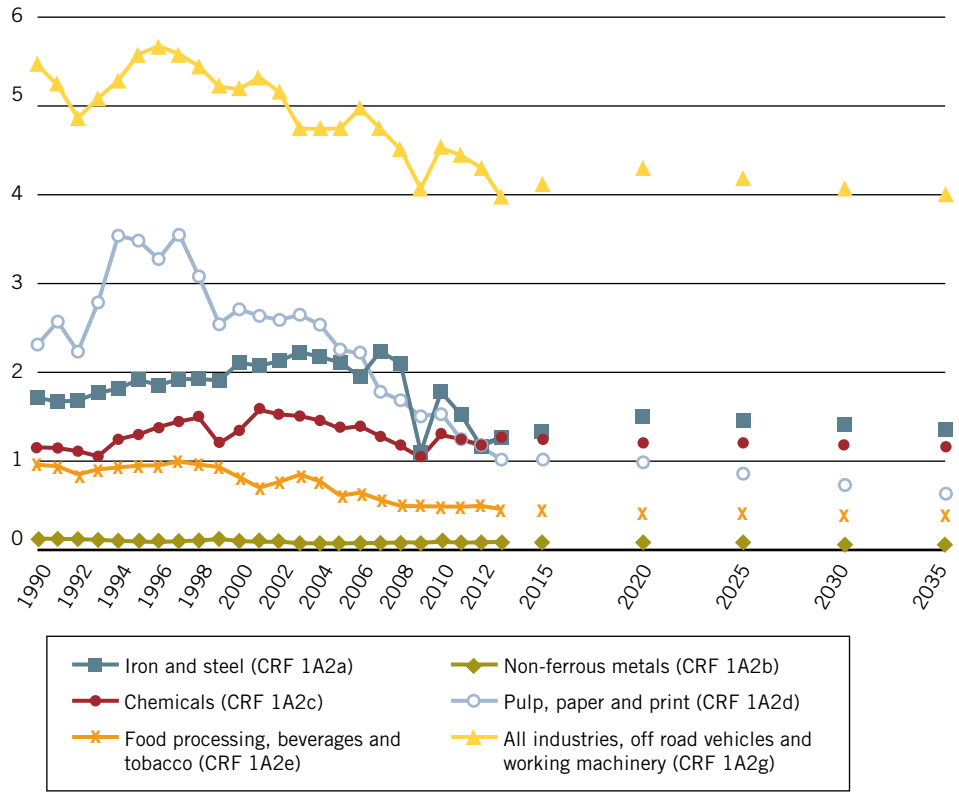


TABLE 4.7 Historical (1990–2013) and projected greenhouse gas emissions from combustion in manufacturing industries (CRF 1A2) change in per cent between 1990–2020 and 1990–2030 (million tonnes of carbon dioxide equivalents

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	11.5	7.8	8.0	8.3	8.0	7.6	7.4	–28%	–33%
Methane	0.06	0.06	0.05	0.05	0.05	0.05	0.04	–11%	–10%
Nitrous oxide	0.2	0.2	0.2	0.2	0.2	0.2	0.2	–19%	–23%
Total emissions	11.7	8.1	8.2	8.5	8.2	7.9	7.6	–27%	–33%

4.2.1.1.3 Transport (CRF 1A3)

Emissions from the transport sector were lower in 2013 compared with 1990. After a long period of increasing emissions, the trend is slightly downward since 2005. This decrease is projected to continue during the projected period, albeit at

a slower rate, see Tables 4.8 (emissions are shown by gas) and 4.9 (emissions are shown by transport mode). The majority of the emissions in this sector come from road transport, as described below. The other transport modalities are domestic aviation, national navigation, other working machinery, and off-road vehicles.

International transport

Greenhouse gas emissions from international shipping and aviation, also known as international bunkers, include refuelling in Sweden by international shipping and aviation. These emissions are ***not*** included in reporting national total emissions from Sweden, but are noted as a memo item. These emissions are considerably larger than those from domestic shipping and aviation. See section 4.2.1.2 for details.

TABLE 4.8 Historical (1990–2013) and projected emissions from domestic transport CRF 1A3 by gas (million tonnes of carbon dioxide equivalents), change in per cent between 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	19.1	18.3	17.8	16.6	15.4	15.0	14.7	-13%	–21%
Methane	0.2	0.1	0.05	0.04	0.04	0.04	0.04	–81%	–82%
Nitrous oxide	0.2	0.1	0.1	0.2	0.2	0.2	0.2	–12%	3%
Total emissions	19.5	18.5	18.0	16.8	15.6	15.2	14.9	–14%	–22%

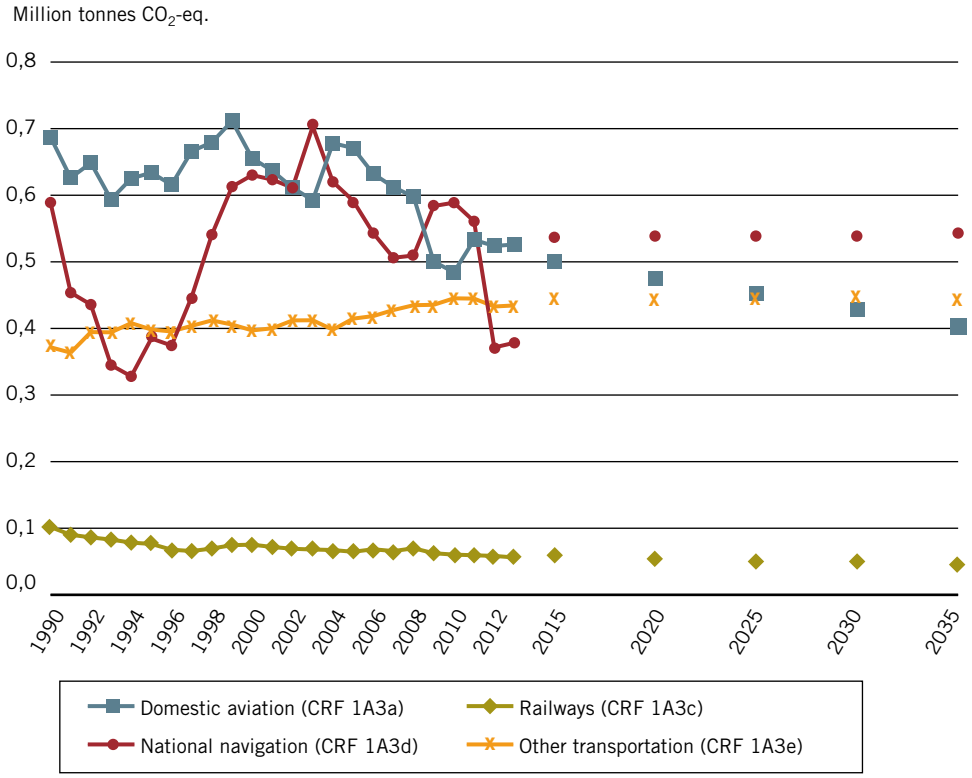
TABLE 4.9 Historical (1990–2013) and projected greenhouse gas emissions from different modes of transport CRF 1A3 (million tonnes of carbon dioxide equivalents), change in per cent between 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Road	17.7	17.1	16.5	15.3	14.2	13.7	13.5	-14%	-22%
Civil aviation	0.7	0.5	0.5	0.5	0.5	0.4	0.4	–31%	–38%
Navigation	0.6	0.4	0.5	0.5	0.5	0.5	0.5	–9%	–8%
Railways	0.1	0.06	0.06	0.05	0.05	0.05	0.05	–47%	–53%

Domestic aviation, railways, national navigation and other transportation (CRF 1A3a, 1A3c, 1A3d, 1A3e)

Emissions from domestic aviation, railways, national navigation and other transportation are shown in Figure 4.5.

FIGURE 4.5 Historical (1990–2013) and projected emissions from domestic aviation, railways, national navigation and other transportation in million tonnes carbon dioxide equivalents



Emissions from domestic aviation have decreased during the latest years, due mostly to greater efficiency. Domestic aviation has remained fairly constant during the latest 10-year period (except 2009 and 2010 when travel decreased due to external factors). In the reference scenario, the travel is assumed to remain constant at current levels throughout the scenario period, while energy efficiency is increasing, resulting in decreasing emissions. Emissions from domestic aviation are projected to decrease to 31 per cent lower than in 1990 by 2020, and to 38 per cent lower by 2030.

Emissions from domestic navigation have varied between 0.3 and 0.7 million tonnes of carbon dioxide equivalents. These emissions are projected to stay at around 0.5 million tonnes throughout the projected period.

Emissions from railway travel have decreased from 0.1 million tonnes of carbon dioxide equivalents in 1990 to 0.06 million tonnes in 2013. Railway traffic is expected to increase during the entire projection period. However, as railways are

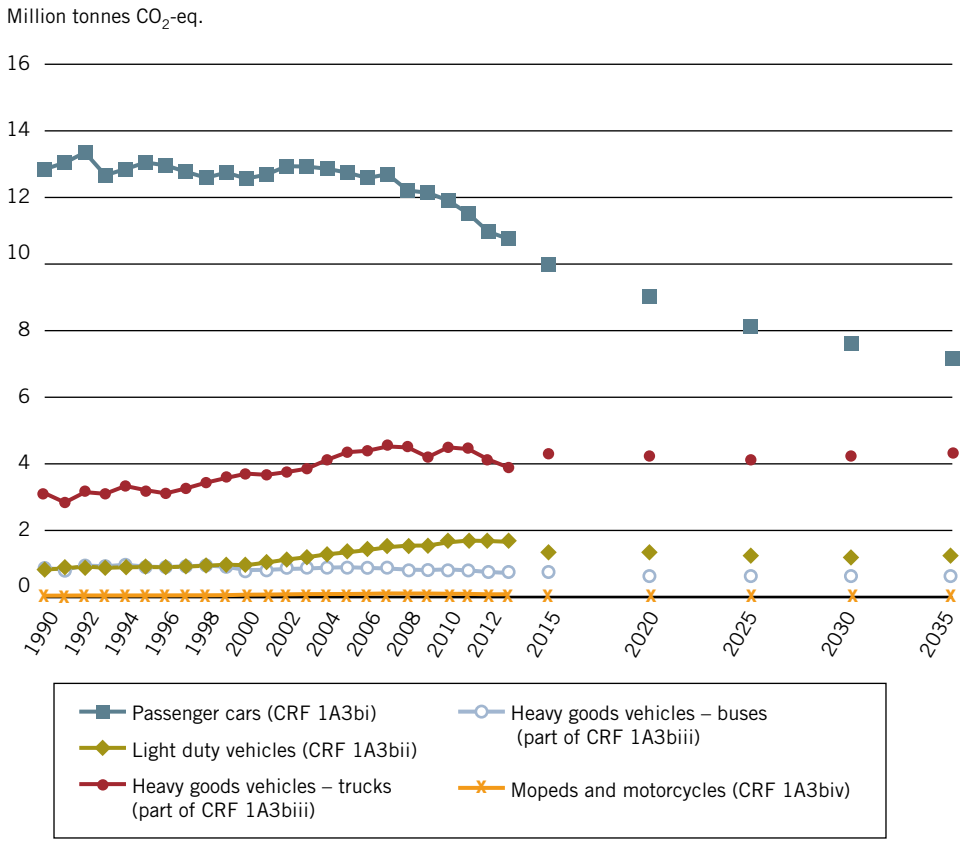
mostly electrified (90 percent), emissions are not expected to increase to the same extent. Diesel use in railway traffic is assumed to decrease during the scenario period and emissions will decrease to 0.05 million tonnes of carbon dioxide equivalents in 2030.

Emissions from other transportation (CRF 1A3e) were 0.4 million tonnes in 2013 and are projected to remain at the same level to 2030.

Road transport (CRF 1A3b)

The majority of emissions in the transport sector come from cars and heavy-duty vehicles, as shown in Figure 4.6.

FIGURE 4.6 Historical (1990–2013) and projected emissions from road traffic by vehicle category, million tonnes of carbon dioxide equivalents



Emissions from passenger cars are projected to decrease 14 percent from 1990 to 2020 and 22 per cent to 2030. The reason for this decrease is continuing improvements in energy efficiency due to EU regulations that limit emissions from new cars and light-duty vehicles. In the projection, the emission limitations are 95 and 147 grams of carbon dioxide, respectively, for passenger cars and light-duty vehicles by 2021. After 2021, energy efficiency gains will continue, but at a slower

rate (approximately 1% per year). Greater use of biofuels will contribute to decreasing emissions. In particular, the low-blend in diesel, which is subject to tax exemption, is responsible for these efficiency gains in combination with greater use of biogas.

4.2.1.1.4 Other sectors – Combustion in households, residential, agriculture, forestry and fisheries (CRF1A4)

Emissions from households and premises and from combustion in the agricultural, forestry and fishing sector decreased between 1990 and 2013, and are projected to decrease further to 73 per cent and 77 per cent below 1990 by 2020 and 2035, respectively. Historically, the decrease is mainly due to 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. Specially targeted subsidies such as investment grants to convert from oil to other heating sources along with contributing factors such as energy and carbon dioxide taxes and a rise in fossil fuel prices have provided strong incentives for this shift. The shift to electric and district heating leads to decreased emissions in this sector. On the other hand, production of heat and electricity will increase. However, since the increased production of electricity and heat is mainly based on biomass and waste, and district heating is more efficient for heating, the increase in emissions is therefore limited.

In addition, the total energy consumption for heating (temperature-corrected) is expected to decrease in the sector during the projection period. The expected decrease is due primarly to a shift to heat pumps and that the buildings become more energy efficient. Installation of heat pumps reduces the amount of commercial energy supplied for heating. New buildings will fulfil the new building regulations and will therefore be more energy efficient than older ones, by improved insulation and more energy efficient windows. The decrease in energy consumption can however be offset by greater use of household electricity and by adding new buildings.

Emissions from combustion in the agricultural, forestry and fishing sectors are expected to decrease during the projection period. Emissions from energy consumption in the agricultural sector are expected to decrease to some extent during the projection period, resulting from reduction in the use of diesel fuel for working machines and reduction of oil consumption for buildings. Emissions from working machines in the forestry sector and from fishing are assumed to remain at about the level of 2013 throughout the projection period.

TABLE 4.10 Historical (1990–2013) and projected emissions of greenhouse gases from combustion in households, premises, agricultural, forestry and fishing sectors (million tonnes of carbon dioxide equivalents)

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	10.3	2.7	2.6	2.5	2.2	2.1	2.0	-76%	-80%
Methane	0.3	0.3	0.3	0.3	0.3	0.3	0.3	7%	5%
Nitrous oxide	0.2	0.1	0.1	0.1	0.1	0.1	0.1	-31%	-30%
Total emissions	10.8	3.1	3.0	2.9	2.6	2.5	2.4	-73%	-77%

4.2.1.1.5 Other (CRF 1A5)

Emissions from the other sector comprises emissions from military activities. These emissions decreased between 1990 and 2013, see Table 4.11. Over the projection horizon, emissions are expected to remain at roughly the same level as in the last few years, around 0.2 million tonnes of carbon dioxide equivalents.

TABLE 4.11 Historical (1990–2013) and projected greenhouse gas emissions from military use (million tonnes of carbon dioxide equivalents), change in per cent 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	0.8	0.1	0.2	0.2	0.2	0.2	0.2	–78%	–78%
Methane	0.001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	–94%	–94%
Nitrous oxide	0.02	0.002	0.002	0.002	0.002	0.002	0.002	–84%	–84%
Total emissions	0.9	0.2	0.2	0.2	0.2	0.2	0.2	–78%	–78%

4.2.1.1.6 Fugitive emissions (CRF 1B)

Fugitive emissions come from processing, storage and use of fuels, flaring of gas, transmission and distribution of gas, and similar. The majority of emissions in this sector originate from refineries. Fugitive emissions are projected to remain at roughly the same level over the projection period, at around 1.0 million tonnes of carbon dioxide equivalents, see Table 4.12.

TABLE 4.12 Historical (1990–2013) and projected fugitive emissions of greenhouse gases (million tonnes of carbon dioxide equivalents), change in per cent 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	0.3	0.7	0.9	0.9	0.9	0.9	0.9	200%	200%
Methane	0.09	0.07	0.07	0.07	0.07	0.07	0.07	-26%	-26%
Nitrous oxide	0.0004	0.0005	0.0009	0.0009	0.0009	0.0009	0.0009	119%	119%
Total emissions	0.4	0.8	1.0	1.0	1.0	1.0	1.0	146%	146%

4.2.1.1.7 Industrial processes and product use (CRF 2)

This sector is comprised of greenhouse gas emissions from industrial processes, including emissions from materials in the processes and from product use, which means the use of solvents and other products.

Industrial processes subsectors (CRF 2A, 2B, 2C, 2E, 2H)

These emissions include greenhouse gas emissions from materials used in industrial processes. In 1990, emissions totalled 6.4 million tonnes, and in 2013 they were 5.0 million tonnes of carbon dioxide equivalents, respectively. Emissions in this sector have varied somewhat since 1990, mainly due to variation in production volumes and economic fluctuations. During the projection period, emissions of carbon dioxide, methane and nitrous oxide are expected to increase slightly (see Table 4.13), total emissions will increase slightly during the projection period but will remain lower than in 1990.

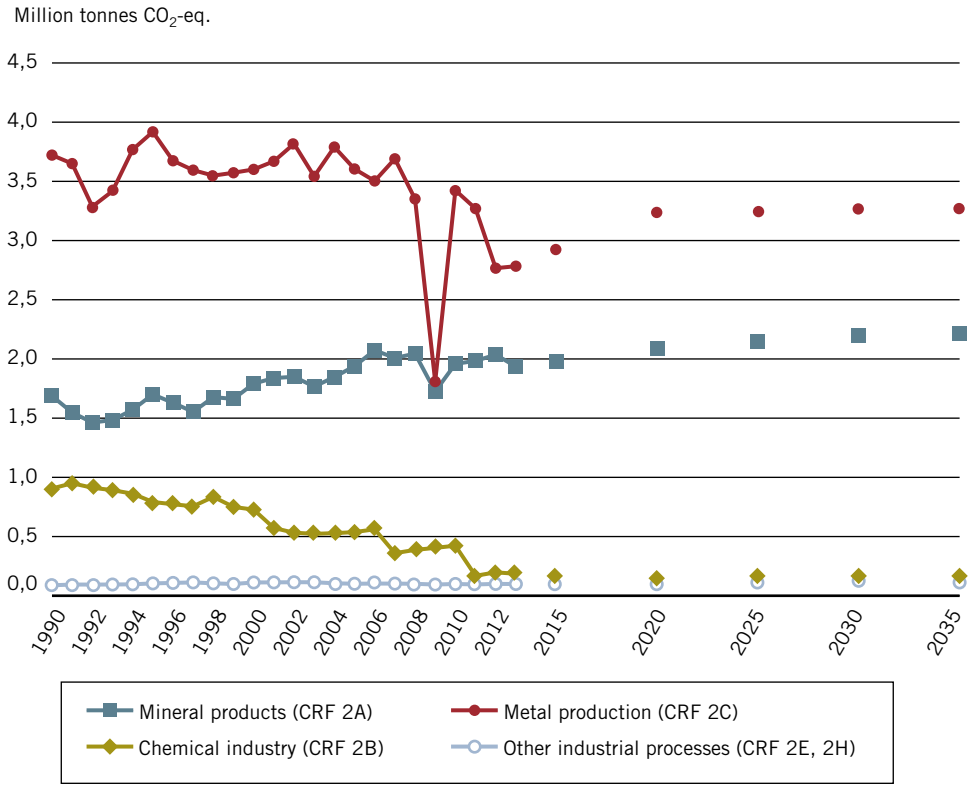
TABLE 4.13 Historical (1990–2013) projected emissions from industrial processes, (CRF 2A, 2B, 2C, 2E, 2H) (million tonnes of carbon dioxide equivalents), change in per cent 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	5.1	4.8	4.9	5.4	5.4	5.5	5.5	6%	9%
Methane	0.03	0.009	0.01	0.01	0.01	0.01	0.01	-62%	-58%
Nitrous oxide	0.9	0.1	0.1	0.1	0.1	0.1	0.1	-84%	-83%
Fluorinated greenhouse gases	0.5	0.06	0.08	0.08	0.08	0.08	0.09	-83%	-82%
Total emissions	6.4	5.0	5.2	5.6	5.7	5.7	5.8	-13%	-10%

Emissions of carbon dioxide were 2 per cent lower in 2013 compared to 1990 and are expected to increase by 9 per cent to 2030 compared to the 1990 level. The increase is due mainly to increased production in the mineral industry.

Emissions from the metal industry are expected to increase slightly from 2013 to 2035, but still show a decrease compared to 1990 levels. Iron and steel production is the major contributor to the emissions of the metal industry, responsible for 80 per cent of its total greenhouse gas emissions in 2013. Production of iron and steel is expected to increase slightly, which leads to an increase in total greenhouse gas emissions compared with 2013. However, emissions are expected to be 2 per cent lower in 2020 and 2030 compared to 1990 levels. The emissions from fuel combustion in industry are reported in the energy sector.

FIGURE 4.7 Historical (1990–2013) and projected emissions from industrial processes, (CRF 2A, 2B, 2C, 2E, 2H) (million tonnes of carbon dioxide equivalents)



Product use subsectors (CRF 2D, 2F, 2G)

Emissions of greenhouse gases from the use of solvents and other products including the use of fluorinated greenhouse gases, were around 1.5 million tonnes of carbon dioxide equivalents in 2013. Emissions of carbon dioxide from use of solvents and other products are estimated to decrease, while the use and

emission of nitrous oxide are expected to increase slightly to 2030, see Table 4.14. In total, emissions from product use will decrease during the projection period. The decrease in fluorinated greenhouse gases is primarily due to bans that will progressively come into effect in the EU for several areas of use of fluorinated greenhouse gases.

FIGURE 4.8 Historical (1990–2013) and projected emissions from product use, (CRF 2D, 2F, 2G) (million tonnes of carbon dioxide equivalents)

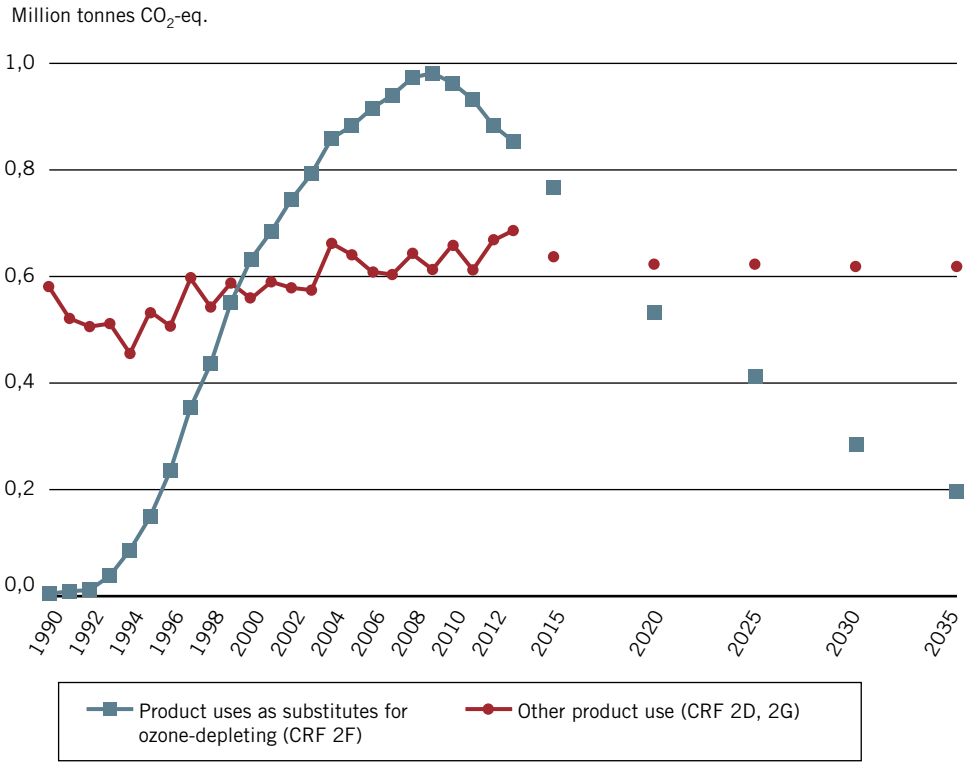


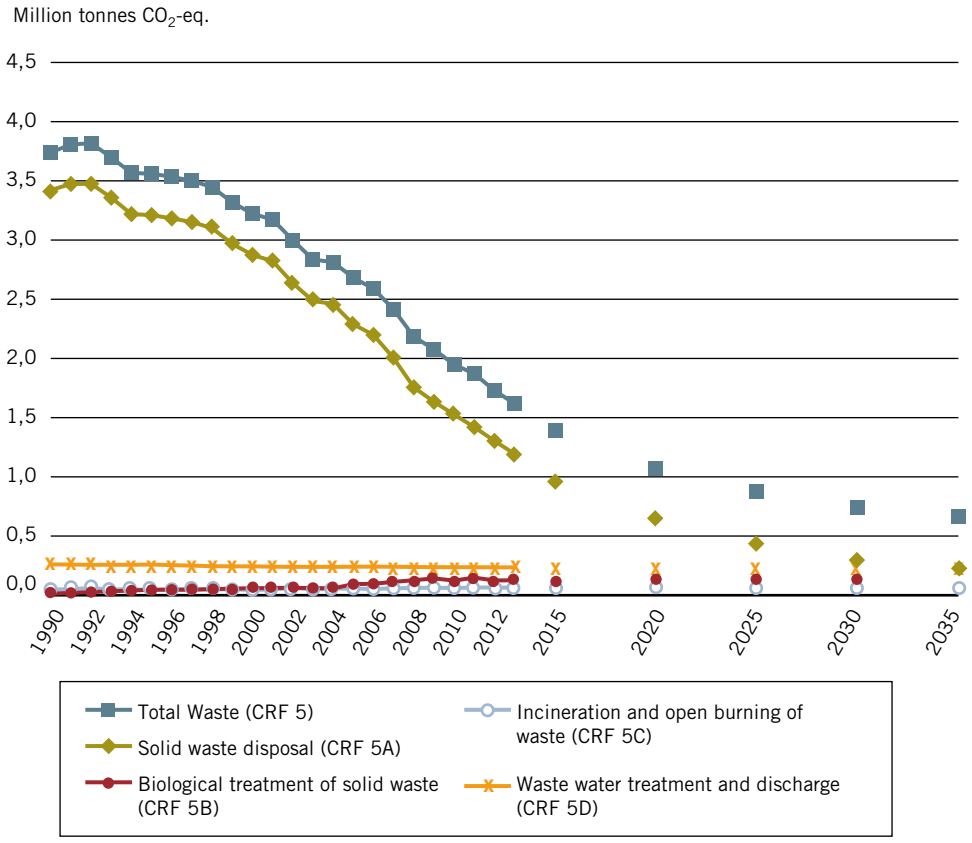
TABLE 4.14 Historical (1990–2013) and projected greenhouse gas emissions from solvents and other product use (CRF 2D, 2F, 2G), by gas (million tonnes of carbon dioxide equivalents), change in percent 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	0.4	0.6	0.5	0.5	0.5	0.5	0.5	16%	15%
Nitrous oxide	0.09	0.09	0.1	0.1	0.1	0.1	0.1	39%	39%
Fluorinated greenhouse gases	0.09	0.9	0.8	0.6	0.4	0.3	0.2	560%	265%
Total emissions	0.5	1.5	1.4	1.2	1.0	0.9	0.8	98%	55%

4.2.1.1.8 Waste (CRF 5)

Total emissions from the waste sector in 2013 were 1.6 million tonnes of carbon dioxide equivalents, and a reduction of 57 per cent compared with 1990. The majority of emissions in this sector have historically originated from landfills, see Figure 4.9. During the projected period, total emissions will continue to decrease, but at a slower rate.

FIGURE 4.9 Historical (1990–2013) and projected emissions from the waste sector, (CRF 5) (million tonnes of carbon dioxide equivalents)



Methane emissions from landfills are expected to decrease by 88 per cent, to 2030 compared with 1990. The historical and projected emissions by gas are shown in Table 4.15. The main cause for the decrease is the ban on depositing combustible materials in landfills, which was introduced in 2002, and the ban on depositing organic materials in landfills, which was introduced in 2005. Furthermore, a tax on depositing waste in landfills was introduced in 2000.

Emissions of carbon dioxide from waste incineration and nitrous oxide from waste-water processing are low and are expected to remain stable throughout the 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.

TABLE 4.15 Historical (1990–2013) and projected greenhouse gas emissions from the waste sector (CRF 5) (million tonnes of carbon dioxide equivalents), change in per cent 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Carbon dioxide	0.04	0.06	0.06	0.06	0.06	0.06	0.06	31%	31%
Methane	3.5	1.3	1.1	0.8	0.5	0.4	0.3	-78%	-88%
Nitrous oxide	0.2	0.3	0.3	0.3	0.3	0.3	0.3	13%	14%
Total emissions	3.7	1.6	1.4	1.1	0.9	0.7	0.7	-71%	-80%

4.2.1.1.9 Agriculture (CRF 3)

In 2013, emissions of greenhouse gases from agriculture totalled 6.9 million tonnes of carbon dioxide equivalents. Compared to 1990, emissions have decreased by more than 12 per cent. The decrease is largely due to increased efficiency in production and reduced numbers of cattle. This in turn led to lower methane emissions from digestion process in ruminant animals and reduced emissions of methane and nitrous oxide from manure management. Emission of nitrous oxide from agricultural land also declined as a result of reduced cereal acreage, reduced use of fertilizers, reduced nitrogen leaching and transition to slurry management. See table 4.16 and Figure 4.10 for the historical and projected emissions from the agricultural sector.

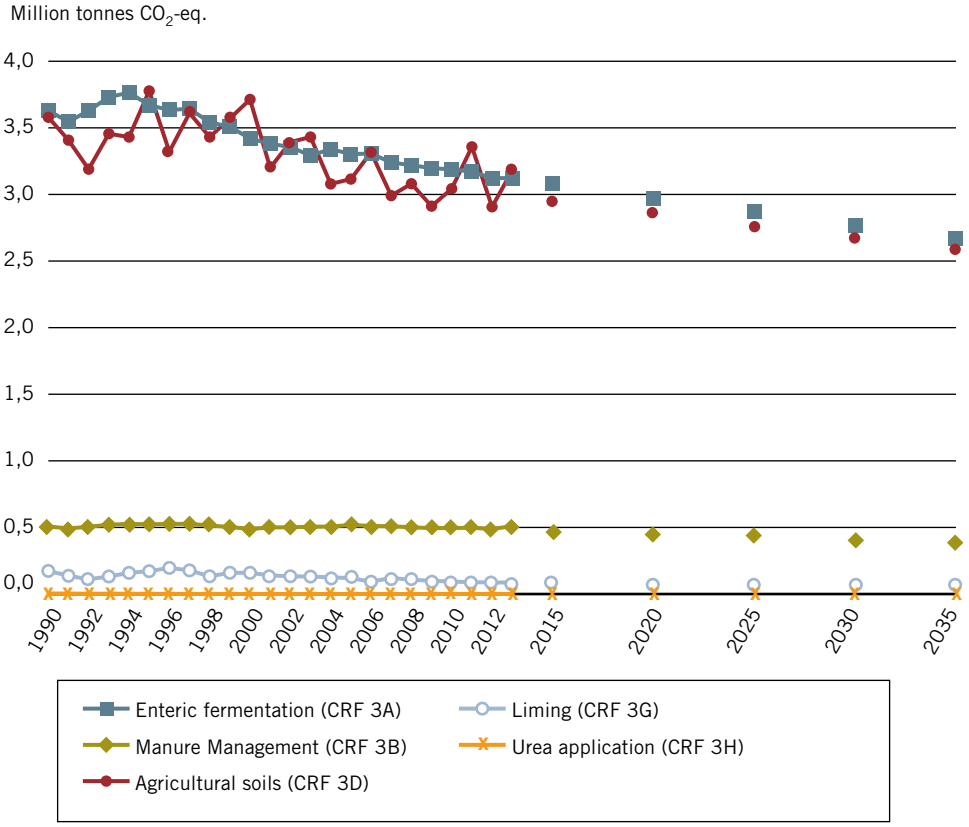
TABLE 4.16 Historical (1990–2013) and projected emissions from the agricultural sector (CRF 3), by gas (million tonnes of carbon dioxide equivalents), change in per cent 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Methane	3.9	3.4	3.3	3.2	3.1	3.0	2.9	-17%	-23%
Nitrous oxide	3.8	3.4	3.2	3.1	3.0	2.9	2.8	-20%	-25%
Carbon dioxide	0.2	0.09	0.08	0.07	0.07	0.06	0.06	-60%	-66%
Total emissions	7.9	6.9	6.6	6.3	6.1	5.9	5.7	-20%	-25%

Emissions are projected to decline to 6.3 million tonnes of carbon dioxide equivalents in 2020 and further to 5.9 million tonnes of carbon dioxide equivalents in 2030. This is based on the assumption that emissions from this sector are declining at the same rate as before. Emissions are estimated to decrease as a result of continuing decline in cattle population. The reduced numbers of dairy cows for

2020 and 2030 are primarily a result of increased productivity, changes in product prices, and continuous adaptation to EU agricultural policy regulation.

FIGURE 4.10 Historical (1990–2013) and projected emissions from the agricultural sector, (CRF 3) (million tonnes of carbon dioxide equivalents)



4.2.1.2 INTERNATIONAL TRANSPORT

Emissions from international aviation and shipping, also known as international bunkers, were considerably higher in 2013 than in 1990, and emissions are projected to continue to increase from today's levels. In the projection, emissions from international transport will increase during the projection period, mainly due to increased emissions from international aviation, private as well as business. Since 2008, emissions have fallen sharply from marine bunkering. Emissions from international navigation will decrease over a few years from current levels, and then start to increase slightly from 2020 onwards, see Figure 4.11.

The projection for marine bunkering is based on the assumption that transport volumes will increase, while transportation will become more efficient. In total, this leads to a slight increase in emissions from international navigation. Another effect that influences the refuelling for international navigation is the fact that Swedish refineries produce low-sulphur oil which meets strict environmental

requirements[52]. The effects of the sulphur requirements are uncertain. The amount of international bunkers counted in Sweden depends largely on where the international ships and airplanes choose to refuel.

FIGURE 4.11 Historical (1990–2013) and projected emissions from the international transport, (million tonnes of carbon dioxide equivalents)

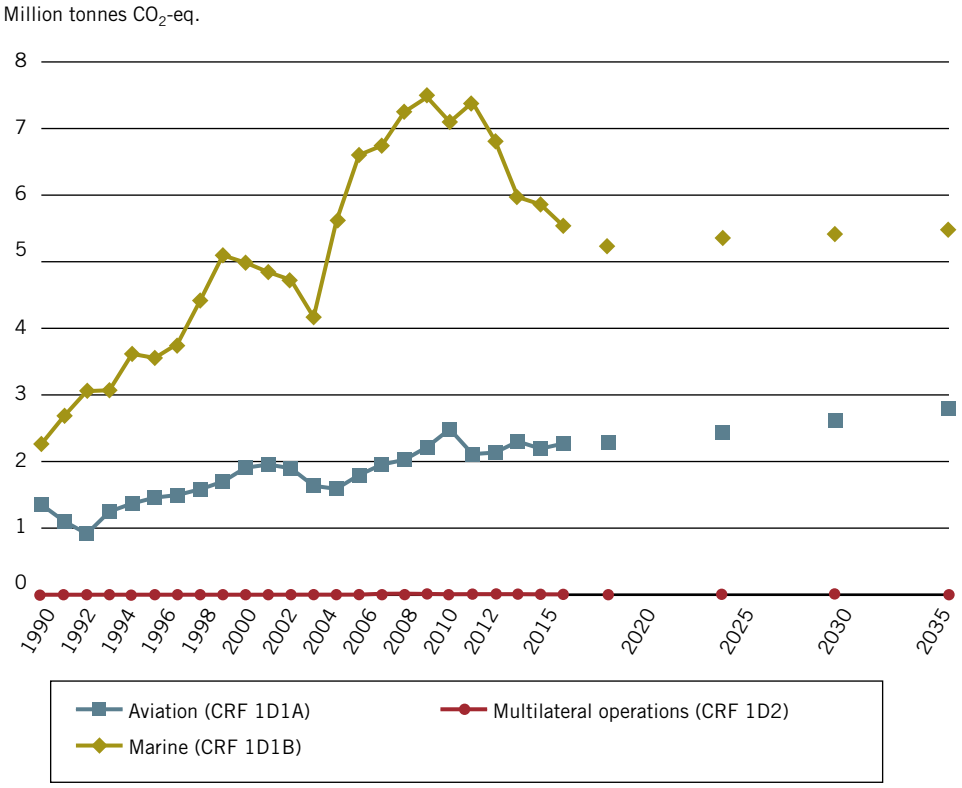


TABLE 4.17 Historical (1990–2013) and projected emissions from international transport (million tonnes of carbon dioxide equivalents), change in per cent 1990–2020 and 1990–2030

	1990	2013	2015	2020	2025	2030	2035	1990–2020	1990–2030
Navigation	2.3	5.5	5.2	5.3	5.4	5.5	5.5	135%	141%
Aviation	1.4	2.3	2.3	2.4	2.6	2.8	3.0	80%	107%
Multioperational	0.00005	0.005	0.01	0.01	0.01	0.01	0.01	197%	217%
Total emissions	3.6	7.8	7.5	7.8	8.0	8.3	8.5	115%	129%

52 Requirements due in the SECA (Baltic Sea, North Sea and English Channel) area

Greenhouse gas emissions from international aviation are expected to increase by 80 per cent to 2020, and by 107 per cent to 2030 compared to 1990, see Table 4.17. The increase is explained by the fact that private consumption is expected to increase during the projection period, which leads to increased travelling.

4.3 Changes in projection methodologies

The projections presented in Sweden's Sixth National Communication on Climate Change (NC6) and in Sweden's First Biennial report were based on the inventory submission of 2013. The projection set out here, in the Second Biennial Report, is based on the inventory submission of 2015. Submission 2015 is the first inventory based on IPCC 2006 guidelines which means that it refers the AR4. As the inventory data is not comparable between these years, the projection results are also not comparable as sectors and GWP have changed. Moreover, when it comes to projection methodology, it is partly based on different assumptions and assessments. The key assumptions for BR1/NC6 and BR2 are presented in Table 4.18.

TABLE 4.18 Key assumptions used in projections in the First Biennial Report (BR1)/Sixth National Communication (NC6) and second Biennial Report (BR2)

	BR1/NC6		BR2	
	2010–2020	**2020–2030**	**2011–2035**	
GDP (annual % change)	2.4	1.9	2.0	
	2020	**2030**	**2020**	**2030**
Crude oil price (USD/barrel)	112	128	118	133
Price of coal (USD/tonne)	104	110	110	116
Price of natural gas (USD/Mbtu)	10	12	12.1	13.1
Emissions trading (€/tonne CO_2)	16.5	36	8	20
Electricity certificates (new renewable electricity)	25 TWh by 2020		26.4 TWh by 2020 and 2035	
Nuclear power (useful life)	60 years		60 years (except for the three oldest plants for which 50 years is assumed)	

The same methodology in producing the projections was used in BR2, compared to NC6/BR1, for all sectors except the agricultural sector. A trend analysis has

been performed to obtain the projection for the activity data, for the projection instead of using results from an economic equilibrium model (SASM).

4.4 References

Report for Sweden on assessment of Projected progress, March 2015

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

5.1 Governing policies and principles

5.1.1 Sweden's policy for global development

Swedish policy for global development was adopted by the Riksdag (Swedish Parliament) in 2003. This was preceded by the work of a parliamentary committee, which had a broad mandate in designing such a policy. The committee concluded that Sweden's contribution to global development and poverty reduction could not be limited to development cooperation alone. The overarching objective of the policy – to contribute to equitable and sustainable global development – therefore applies to all policy areas. Two perspectives permeate all aspects of the policy: a rights perspective, based on international human rights conventions, and the perspective of the poor. In 2015, the new Swedish Government announced plans to revise the policy for global development in accordance with the new 2030 Agenda for Sustainable Development, including Sustainable Development Goal number 13: *"Take urgent action to combat climate change and its impacts"*.

5.1.2 Sweden's aid policy framework

A Government Communication in 2013 (2013/14:131) was issued that brought together the overarching direction and priorities for Swedish aid highlighted "a better environment, limited climate impact and greater resilience to environmental impact, climate change and natural disasters." as one of the six overarching objectives of the framework. Still, the environment and climate change were stated as a thematic priority to be mainstreamed in all development cooperation.

The Government formed after elections in 2014, started a process to revise this policy framework, indicating that climate change issues should have even higher priority, it being the challenge of our time. The new policy framework is being developed in a consultative process involving representatives of various stakeholders, and is expected to be ready in 2016.

5.1.3 Paris Declaration, Accra Agenda and Busan Partnership

The principles contained in the Paris Declaration of 2005, the Accra Agenda of 2008, and the Busan Partnership of 2011 are of key significance to Swedish development cooperation, and are relevant and applicable to all climate finance. National ownership is key to secure long-term sustainability of climate change-related initiatives. External actors should therefore align their efforts with existing national systems and processes in developing countries. These should also be harmonised with other actors to ensure national ownership, transparency, and mutual accountability.

5.1.4 New and additional financial resources

Article 4, paragraph 3 of the UN Framework Convention on Climate Change states that *"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 per cent of gross national income (GNI). In 2013 and 2014, Sweden's official development assistance (ODA) was equal to approximately 1 per cent of GNI.

Sweden is committed to upholding its ODA at 1 per cent and provide climate finance at increasing levels. In 2014, the Swedish government decided to further mainstream climate change in international development assistance, to enhance contributions to low-carbon development, and to make ODA more climate resilient. In its 2015 budget, the government also set aside SEK 250 million as climate financing beyond the 1 per cent of GNI. This was disbursed as part of the Swedish contribution to the Green Climate Fund.

Figures for total Swedish ODA are shown in Table 5.1, while the figures for total climate finance are found in CTF Table 7 and in Annex 1. All exchange rates used in this report are based on the annual average dollar exchange rates for OECD Develop-ment Assistance Committee (DAC) members. For Sweden, this means USD 1 = SEK 6.5132 (2013) and USD 1 = SEK 6.8599 (2014).

TABLE 5.1 Total Swedish official development assistance (ODA) in SEK, 2013 and 2014.

2013	2014
SEK 37 952 million	SEK 43 689 million

5.2 Multilateral financial support

During 2013–2014, Sweden contributed to the financial mechanism of the UN Framework Convention on Climate Change (UNFCCC), through the Global Environmental Facility and the start-up costs of the Green Climate Fund (GCF).

In the sixth replenishment of GEF, for which negotiations were completed in 2014, Sweden increased its contributions most of all donor countries (+47.5 per cent in USD) and is now the eighth largest donor in absolute terms, and the largest per capita. During GEF 6 (2015–2024, overlapping partly with previous and future replenishment cycles), Sweden will contribute SEK 1 335 million, and will contribute actively to the work of the Board. Approximately 30 per cent of total GEF funding is allocated to climate projects, while many projects in other work areas also create synergies that help ecosystems and communities to mitigate and adapt to climate change.

Sweden has also played a very active role in creating and operationalising the Green Climate Fund (GCF), both through the Board and in connection with initial resource mobilisation to the Fund. The Swedish agreement with GCF signed for SEK 4 billion (about USD 580 million) for the program period from 2015 to 2018, makes Sweden the largest per capita donor in this as well.

In addition, Sweden contributes climate finance through a variety of multilateral financing channels, such as the UNFCCC Trust Fund, the Least Developed Countries Fund (LDCF), the Adaptation Fund (AF), the Climate Investment Funds (CIF) and the Nordic Development Fund (NDF) (see CTF Table 7a and Annex 2 for the full list).

In addition to specific climate financing, the Swedish Government is also a major donor of core funding to several multilateral financial institutions, specialised United Nations bodies, and other relevant organisations and initiatives that work on climate change action in their operations in various ways, though this may not be their primary objective. Sweden considers core funding key for flexibility, rapid response, long-term planning, and in line with the principles of aid effectiveness. We have therefore chosen to visualise some of this support in CTF Table 7a , as well as in Annex 2.

5.3 Bilateral financial support

Roughly half the Swedish development cooperation is channelled to developing countries and countries with economies in transition, as bilateral official development assistance (ODA) through Sida. As for climate change, Sida supports specific climate change contributions and integration of climate change aspects in other sectors, technology transfer, capacity building, and research cooperation. In doing

so, the agency collaborates with government institutions in developing countries, non-governmental organisations, the private sector, research institutions, and Swedish authorities and municipalities, among others. ODA channelled through Sida (including 'multi-bi' support) is disbursed at the national, regional and global levels.

Sweden's bilateral development cooperation with a specific country is always conducted within the framework of a Swedish Government country development cooperation strategy. Those strategies are developed considering the developing country's own strategic priorities and poverty reduction strategies first. Local ownership is key to ensure the sustainability of support.

Table 5.2 summarizes Swedish climate related development assistance channelled through Sida for the period 2013-14. Only support to non-Annex I countries has been included as prescribed in the guidelines. It should, however, be noted that Sweden also supports climate change initiatives in Economies In Transition (EITs). Tracking uses 'Rio markers' on climate change mitigation and adaptation. These markers were developed and defined within the OECD DAC and are commonly used by donor countries to track public climate finance. At Sida, the responsible officer marks each contribution on a scale of 0-2, where 2 represents 'primary objective', 1 is 'significant objective' and 0 is 'not targeted'.

In compiling the figures presented in table 5.2 (and in CTF Table 7b), Sweden has included 100 per cent of the funding for contributions with mitigation and/or adaptation as a 'primary objective', but only 40 per cent of the funding for contributions with mitigation and/or adaptation is a 'significant objective'. This is in line with the additional reporting guidelines provided by the EU Commission in order to harmonise EU member states reporting. It is important to note that the methodology has changed from the first Biennial Report, where Sweden reported 50 per cent for funding of contributions with mitigation and/or adaptation having a 'significant objective'.

TABLE 5.2 Summary of Swedish climate related *bilateral* aid, committed and provided, in SEK million, 2013–2014

	Mitigation	Adaptation	Cross-cutting	Total
Committed 2013 (SEK million)	303	524	1 044	1 871
Provided 2013 (SEK million)	287	509	967	1763
Committed 2014 (SEK million)	420	732	1 092	2 244
Provided 2014 (SEK million)	233	692	1 021	1 946

The figures in CTF Table 7b represent net support *'provided'*, which is disbursed according to OECD terminology. Sweden has also chosen to present disbursements for bilateral contributions, as this is the information most commonly requested by developing countries in negotiations. The CTF instructions also prescribe the following order of priority: Provided, Committed, and Pledged.

The differences between bilateral funds *'committed'* and *'provided'* are, however, not significant, as shown in table 5.2. It should be noted that the differences are, in most cases, explained by challenges and changes at the implementation level on the recipient side –where, for example unrest in an area prevented or delayed implementation of a project or programme, or when a project or programme performed more cost-effectively than budgeted.

CTF Table 7b shows this financial support broken down further by country/region/global for the period 2013-14. More details regarding projects in a specific country can be found in the web-based information service for Swedish development cooperation, openaid.se. Only countries or regions where co-operation took place in a given year are included in CTF table 7b, and the list of countries and regions therefore varies from year to year. For greater transparency, negative figures are also included, which represent repayment of unspent funds, which can be for the reasons stated above. Sectors are reported according to OECD DAC Creditor Reporting System (CRS) classification. Important sectors for mitigation include energy and multi-sector (as with environmental policy and administrative management), but the most common support is in the Government and Civil Society sectors. Most adaptation contributions are within such sectors as Environmental Protection, and Government and Civil Society intended for improving natural resource management and building capacity. However, there are also emergency response initiatives, and some are classified as Multisector/Cross-cutting. Many contributions, create synergies and may benefit both mitigation and adaptation. For example, this is common for agricultural initiatives. The countries that received the largest volumes of climate change-financing from Sida in 2013 and 2014 were Mozambique, Kenya, Tanzania, Zambia and Mali. Sweden has been engaged in development cooperation with these countries for many years, often in key sectors, such as energy, natural resource management and water/sanitation.

5.3.1 Support through non-governmental organisations

Cooperation with civil society in the area of climate change is important, as these actors often have unique opportunities to work directly with those most vulnerable and exposed to impacts of climate change. Civil society organisations also have an important role to play when it comes to raising awareness and advocacy regarding climate change, and to increase resilience to climate change. Financial support from Sida is channelled through several Swedish organisations, such as the Swedish Society for Nature Conservation, PLAN Sweden, Forum Syd, the

World Wide Fund for Nature, and We Effect. Civil society support is also allocated directly to key organisations in developing countries, including the Pan African Climate Justice Alliance and the Asia Pacific Forum on Women, Law and Development.

Sida provides support to ENERGIA, an international network addressing gender and sustainable energy that targets 22 countries in Africa and Asia. The programme aims to mainstream gender in policy development, decision making, and practice. Fulfilling its commitment to the UN Sustainable Energy for All (SE4All) initiative, ENERGIA focuses on contributing to Women's Economic Empowerment (WEE) through scaling up proven business models and providing energy services to value chains dominated and operated by women.

Sida also supports global non-governmental organisations and think-tanks that are important actors at global, regional, and national/local levels. Organisations such as the World Resources Institute, Stockholm Environment Institute, and the International Institute for Environment and Development all receive core support from Sida and play an active role in normative efforts pertaining to climate change through global policy research.

Sida supports the International Institute for Environment and Development (IIED). The mission for IIED is to help build a fairer, more sustainable world using evidence, action, and influence in partnership with others. One of the goals for the institute is to find fair and equitable solutions to climate change. IIED combines research and action to generate evidence and know-how informed by a practical perspective acquired through hands-on research with grassroots partners. The institute has contributed to include more equitable resilience to climate change.

5.3.2 Support through Swedish authorities to institutions in developing countries

Sweden channels funding through several Swedish authorities and universities to enable programmes and projects in developing countries, focusing on their area of expertise. Key authorities involved in capacity building related to climate change, and similar, include the Swedish Environmental Protection Agency, the Swedish Energy Agency, and the Swedish Meteorological and Hydrological Institute.

Sida's International Training Programmes are open to candidates from low and middle income countries. These aim to support and strengthen participants' plans for change on the organizational and sectoral levels, and should not be regarded as individual competence training. Commissioned by Sida, the training programmes are organised by Swedish public authorities, universities, private companies and NGOs. Examples of ongoing ITP programmes with strong links to climate change include the ongoing Strategic Environmental Assessment Programme and the Integrated Sustainable Coastal Development Programme. Strategic Environmental Assessment may serve as a tool for analysis of environmental impacts and the integration of environmental considerations including climate change in strategic planning and decision-making. The programme is organised by NIRAS in collaboration with the Centre for Environment and Sustainability at the University of Gothenburg and Chalmers University of Technology, in close collaboration with the Western Indian Ocean Marine Science Association, WIOMSA. The programme focuses on increasing capacity among participants to plan and manage development challenges in coastal areas involving negative impact from climate change, sustainable management of natural resources, and ecosystem services.

5.3.3 Collaboration with the private sector

The dominant global capital flows are private, and linking these to mitigation and adaptation efforts in order to manage climate change is of utmost importance. Sida collaborates with the private sector through several different mechanisms, including the Public Private Development Partnerships, and Challenge Funds. The Innovation Against Poverty (IAP) challenge fund is an example. It is designed as a risk-sharing mechanism addressing the absence of investors ready to bear the financial risks of early-entrepreneurs by stimulating investment in new market-based solutions to the problems of poverty. Many of the entrepreneurs and business models focus on climate-smart solutions.

In 2013 Sida was also involved in creating the Swedish Leadership for Sustainable Development – a network of more than 20 leading companies and expert organisations with a Swedish connection. By systematically integrating sustainable development into business models and core business practices, members of the network are committed to contributing to achieving global development goals. Projects emerging from the network include initiatives to increase resilience to climate change impacts, and to reduce use of fossil fuels and other greenhouse gas producing activities.

5.3.4 Mobilisation of private climate finance

The Swedish Ordinance for Financing of Development Loans and Guarantees for Development Cooperation (2009:320), enacted in 2009, regulates governmental action in this area. Under this regulation the Swedish government has followed a strategy with a special focus on environmental loans for the period 2009–2014. This has provided opportunities to expand and leverage available resources for development by linking grant aid with market financing. The ordinance stipulates that the level of subsidy for development loans shall be maximum 80 per cent, defined as Sida's grant in relation to the total amount financed (including Sida's grant plus borrowing from markets).

Guarantees allow for mobilizing capital, including partner countries' domestic capital. The guarantee facility is essentially designed to overcome a market failure, and allows markets to better understand the true level of risk associated with particular investments. Sida can help lenders deal with these risks by insuring eligible projects against losses related to any market risks. If the borrower fails to repay their bank loans, Sida will cover part of the loss. Sida's guarantees are based on a set of simple core principles and conditions: additionality, risk-sharing, risk reflecting premiums charged, and ensuring it is non-distortionary.

This leveraging is calculated for each project, following OECD/DAC's methodology. There is usually a time lag between when Sida decides on a contribution, to when the project is implemented and finalized. In table 5.3 below, Sida has chosen to list projects which have been decided for which funds have been estimated for mobilization, rather than the actual funds eventually mobilized in a specific transaction. Sida's commitments are always in SEK.

TABLE 5.3 Examples of mobilised private climate finance

Country / region	Sida's contribution	Estimated mobilized capital	Other public co-financers involved
Global (Household Products)	Guarantee SEK 178 million	SEK 495 million	USAID (25% risk sharing)
Moldova (Guarantee for Sustainable Investments)	Guarantee SEK 7.25 million	SEK 14.5 million	USAID (25% risk sharing)
Pakistan (Wind Power)	Guarantee SEK 395 million	SEK 790 million	AsDB (25% risk sharing) Islamic Development Bank lender
Zambia (Agriculture)	Guarantee SEK 22.25 million	SEK 44.5 million	USAID (25% risk sharing)
Bosnia Herzegovina (SME Development)	Guarantee SEK 20.6 million	SEK 41.2 million	USAID (25% risk sharing)

Figures in section 5.3.4 Mobilisation of private climate finance, are ***not*** included in the CTF Tables.

5.3.4.1 SWEDFUND

Through Swedfund, Sweden's Development Finance Institution, Sweden invests in growth companies in developing countries. Swedfund aims to contribute to the goal of Sweden's Policy for Global Development (PGD) for equitable and sustainable global development. The objectives of Swedfund's operations comply with the goal of Sweden's international aid -- to contribute to creating conditions for improving that standard of living for people living in poverty and oppression. The investments shall be sustainable financially, environmentally, socially, and climate-smart. Swedfund seeks to establish sustainable and profitable companies in these markets in order to contribute to poverty reduction. An important part of these activities is to ensure and maintain excellence regarding environmental and social aspects. Since 2009, Swedfund has administered Swedpartnership (previously StartSyd and StartÖst). Swedpartnership offers small and medium-sized businesses (SMEs) financial support for investments in knowledge transfer and equipment when establishing new businesses in developing countries in Africa, Asia, Latin America and Eastern Europe.

In 2014, Swedfund increased its financial commitment to the Interact Climate Change Facility (ICCF) by investing a further EUR 5 million in climate change projects in growth markets. ICCF is financed by Swedfund and several other Development Finance Institutions. Swedfund initially invested in ICCF in 2010, and as of year-end 2014, Swedfund had committed EUR 14.4 million. This is designed to promote the use of environmental techniques as an important part of sustainable development. ICCF finances projects in renewable energy and energy efficiency in existing power generation plants. By demonstrating the economic viability of projects, ICCF also aims to act as a catalyst and attract additional financing for the development of sustainable energy in emerging markets.

Figures in in section 5.3.4.1 Swedfund, are ***not*** included in the CTF Tables.

5.4 Technology development and diffusion

The examples listed in CTF table 8 of technology development support illustrate that several interventions are cross-cutting in nature, targeting both adaptations and mitigation needs, and implementation is often multi-sectorial. There are no specific markers or codes for technology transfer, making it difficult to single out components integrated in these contributions. CTF table 8 is thus only a list of *examples,* not complete.

In September 2011, the Swedish Government launched a national environmental technology strategy. Its aim is to facilitate developing new, sustainable Swedish solutions to meet the challenges of climate change and environmental degradation while promoting new business and employment. Short-and long-term initiatives – targeting everything from research and innovation to exports – aim to make Sweden a green-tech pioneer. The Government invested SEK 400 million in environmental technology over the period 2011–14.

The strategy outlines measures to promote the Swedish environmental technology sector. These include steps to intensify research and innovation, initiatives aimed at facilitating financing and business development at an early commercial stage, support and assistance for market analyses and start-ups in export markets for small and medium-sized businesses (SMEs), and measures to improve coordination among government agencies and other actors of relevance to development in the environment sector.

Several government agencies have been tasked to implement the strategy by facilitating and improving conditions for the Swedish environmental technology sector to grow. These include the Swedish Energy Agency, the Swedish Agency for Economic and Regional Growth and the Swedish Trade and Invest Council (semi-governmental). The Swedish Trade and Invest Council is working to facilitate exports by Swedish companies, in areas such as waste management, recycling, bioenergy, solar power, wind power and energy efficiency.

Sweden considers the private sector to have an important role to play in technology development and diffusion. However, to create the necessary conditions for involvement in developing countries, support is often required to reduce associated risks, for which purpose loans and guarantees or risk credit can be used (read more in section 5.3).

From a development point of view, the issue of technology is more than the physical transfer of hardware or software, it includes developing capacity in developing countries to receive, use, and develop technology. Development cooperation has an important role to play in this context, and Sweden undertakes technology and research cooperation with significant elements of capacity development with a number of partner countries.

5.5 Capacity building

Capacity development is a critical factor in enabling developing countries to tackle climate change. Sweden considers capacity building to be cross-cutting, since capacity is required for developing countries to be able to receive financial and technology-related support for adaptation and mitigation, implement initiatives and to ensure that they are sustainable. There are no specific markers or codes for capacity building, which makes it difficult to single out these components integrated in the contributions. CTF table 9 is thus only a list of *examples from ODA-financed support,* and not complete.

National capacity on climate change and its effects are crucial, as is institutional capacity to develop and implement relevant climate change policies and strategies. The focus of capacity development needs to be based on countries' own needs and priorities, and is most likely to be relevant and sustainable when owned and operated locally, in partnership with external actors as a joint learning process. It is therefore important to strengthen and build on national systems for capacity development instead of creating new ones.

Support for capacity building is given both through ODA-financed support and through Other Official Flows (OOF).

5.5.1 Capacity building support, ODA-financed

Elements of capacity development are integrated into most programmes and projects that Sida supports. Sweden considers it important to take a broader view of capacity development in the form of training and research, but also to raise institutional capacity through various forms of support to national and local institutions. In addition, Sweden regards contributing to building capacity among developing countries' climate change negotiators as crucial, in order to create a level playing field and facilitate mutual understanding. This is done through several contributions, including Sida's support to African Climate Policy Centre, which provides policy support to the African Group of Negotiators. Media also has an important role to play in creating awareness and sharing knowledge about climate change. An informed and analytical media can contribute with reporting on climate related science, risks, and solutions. Examples of capacity building actions are listed in CTF Table 9.

Sida's research cooperation aims to strengthen the research capacity of partner countries and to promote development-oriented research. This includes support to establish enabling research environments within the countries, develop local research training, and to strengthen efforts to prioritise research topics based on local needs. Promoting development-oriented research means supporting, both financially and scientifically, opportunities for partner countries to identify new knowledge in areas of significant for their development.

Considering the cross-cutting nature of climate change causes and impacts, research capacity building in both natural sciences, technology, and social sciences is needed.

Sweden often promotes capacity building by supporting local partners in developing countries, but also uses a model of combining studies locally and abroad for key groups such as civil servants, researchers, and students. This approach has proved successful in enabling course participants to remain in their home countries after completing their education, and preventing capacity being lost through 'brain drain'.

5.5.2 Capacity building support, Other Official Flows (OOF)

Besides ODA-financed climate support for capacity building managed by Sida, climate financing flows also come from other channels in Sweden, financed through other expenditure areas than the Swedish ODA. Such other official flows (OOF) are channelled directly through Swedish authorities or universities to finance running programmes and project activities in developing countries and which also focus on capacity building.

Previous cooperation with China and India, for instance, was carried out within ODA-support from Sida under Partner Driven Cooperation, but was phased out in 2013. Since 2014, there is no ODA-financed bilateral cooperation with these countries.

Key authorities involved in capacity building which are financed by other official flows than ODA relating to climate change are the Swedish Environmental Protection Agency and the Swedish Energy Agency. Figures in section 5.5.2 are ***not*** included in the CTF Tables.

The Environmental Protection Agency (EPA) is one of many stakeholders with responsibility for the environment and is the public agency in Sweden that has an overview of conditions in the environment and progress in environmental policy. The Agency works on behalf of the Swedish Government. The Swedish EPA have bilateral cooperation with non-Annex 1 countries both through ODA-financing and financing managed outside ODA as OOF.

Climate relevant financial support in the form of capacity building is managed by the Swedish Environmental Protection Agency both as ODA (see section 5.3.2) and as OOF. An example of the latter is capacity building derived from a national grant managed by the *Swedish Environmental Protection Agency* focusing on cooperating with strategic countries. These countries include non-Annex 1 countries (Brazil, Chile, India, Indonesia, China, Uruguay and Vietnam). Four Swedish authorities are involved in this cooperation: the Swedish EPA, the Swedish Meteorological and Hydrological Institute, the Swedish Chemicals Agency, and the Swedish Agency for Marine and Water Management. The Swedish EPA administers the funding.

Examples from 2014 of climate relevant activities in this cooperation with OOF funding include organizing a workshop on SLCP (short-lived climate pollutants) with China, preparing a workshop on SLCP in India (February 2015), and a local air-pollution project in Brazil about soot and particulates.

The Swedish Energy Agency is a government agency for national energy policy issues. The agency promotes development of Sweden's energy system towards becoming ecologically and economically sustainable. The Energy Agency participates in international energy collaborations, both multilateral (IRENA, IEA, Clean Energy Ministerial) and bilateral collaborations.

Regarding non-Annex 1 countries, the *Swedish Energy Agency* is focusing on activities in China, India and Indonesia. The objectives of these activities include increasing collaboration within energy research and innovation, supporting countries in energy policy issues, and promoting Swedish energy technology.

Figures for OOF capacity building by the Swedish Energy Agency and the Swedish Environmental Protection Agency are not included in the reported CTF tables. A few examples of projects are listed below.

India

Sweden has various projects in India through the Swedish Energy Agency and the Swedish Environmental Protection Agency. One example is the India-Sweden Innovations' Accelerator program (ISIA) which the Swedish Energy Agency runs with the aim to build sustainable business relations between innovators, entrepreneurs and institutions in India and Sweden. The program is implemented through

a process based platform, including advisory services, networking interactions and through virtual communications. Focusing on renewable energy and energy efficiency, the overall purpose is to contribute to more efficient production and energy use in a way that can support much needed development in the area, ideally including minimum negative impact on the climate.

Another programme, which is being developed and deployed jointly between the Swedish Energy Agency, the Government of Sweden and the Ministry of New and Renewable Energy, Government of India, is the Micro grid programme – systems solutions for deployment of renewable energy. The aim is to create solutions for sustainable and local production, distribution and use of electricity and the programme supports and encourages the actors and research that strives to develop new solutions that are both robust and cutting edge, of relevance for the energy mix of 2020 and beyond.

Indonesia
The Swedish Energy Agency and the Indonesian National Energy Council (NEC) started, in 2013, an initiative for renewable energy development and policy. The initiative is called INSISTs (Indonesian-Swedish Initiative for Sustainable Energy Solutions) and works as a base for knowledge and network sharing, showcasing, development and test-proofing sustainable energy solutions. Focus areas today are Bioenergy, Micro Hydro, Hybrid wind and solar. Part of the Swedish Energy Agency's Indonesian engagement is also a Business Accelerator Program.

Brazil, China and India
The Swedish Environmental Protection Agency manages long term environmental and climate cooperation with strategic countries as part of an overall programme. Examples of projects are a local air-pollution project in Brazil about soot and particles and organizing workshops on short-lived climate pollutants (SLCP) with China and India. Four Swedish authorities are involved in the cooperation; the Swedish Environmental Protection Agency, the Swedish Meteorological and Hydrological Institute, the Swedish Chemicals Agency and the Swedish Agency for Marine and Water Management.

5.6 Flexible mechanisms

The Swedish Programme for International Climate Change Mitigation contributes to emission reductions and promotes technology transfer and sustainable development through investment in climate projects in low and middle income countries. Current portfolio of bilateral projects and funds are expected to generate about 30 million tonnes remission reductions of carbon dioxide equivalent, of which 8.4

million tonnes are already achieved. The cost is estimated to correspond to SEK 60–70 per ton (USD 10/ton). In 2014, Sweden has taken decisions on support for 12 new projects such as in Rwanda and Cape Verde, and for participation in a new innovative pilot facility to reduce emissions of mainly methane, Pilot Auction Facility of the World Bank. At year-end 2014, Sweden participated in 96 projects under the UN Clean Development Mechanism (CDM) and two projects under the mechanism of Joint Implementation (JI) and contributed in nine multilateral funds.

In 2014, the projects in the portfolio achieved further emission reductions and about two million emission reduction units from bilateral projects and funds have been delivered. Of these, approximately 1.6 million units originate from bilateral projects and about 400,000 from the projects in multilateral funds. At the end of 2014, a total of approximately 8.4 million emission reduction units had been delivered. The corresponding figure for 2013 was 6.3 million emission reduction units.

There is at present no need for Sweden to use the verified emission reductions achieved from the program for international climate efforts as a part of Sweden's international mitigation commitment under the convention or the Kyoto protocol and they will therefore not be used for this purpose. The purpose is to support climate change mitigation actions in developing countries, to contribute to further development of cost effective international flexible mechanisms (particularly CDM) and to support sustainable development in the host countries. If needed, the achieved emission reductions can be considered as a part of the national climate target for 2020. At present the financial support corresponding to the achieved emission reductions is not reported as climate finance.

ANNEXES

ANNEX 1.
Underlying data for CTF Table 7

PROVISION OF PUBLIC FINANCIAL SUPPORT: SUMMARY INFORMATION IN 2013

Allocation channels	National currency – mSEK					US dollar – mUSD				
	Core/ general	Climate-specific				Core/ general	Climate-specific			
		Mitigation	Adaptation	Cross-cutting	Other		Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:)										
Multilateral climate change funds		45	215	7			7	33	1	
Other multilateral climate change funds		130		64			20		10	
Multilateral financial institutions, including regional development banks										
Specialized United Nations bodies										
Total contributions through bi-lateral, regional and other channels		287	509	967			44	78	148	
Total climate specific by funding type (total for mitigation, adaptation, crosscutting, other)		462	724	1 037			71	111	159	
Total climate specific finance		**2 223**					**341**			

OECD DAC exchange rate for 2013: 1 USD=6.5132 SEK=0.7532 EUR
Definitions and explanations of methodology is given in the narrative part of the report

PROVISION OF PUBLIC FINANCIAL SUPPORT: SUMMARY INFORMATION IN 2014

Allocation channels	National currency – mSEK					US dollar – mUSD				
	Core/ general	Climate-specific				Core/ general	Climate-specific			
		Mitigation	Adaptation	Cross-cutting	Other		Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:)										
Multilateral climate change funds		39	15	12			6	2	2	
Other multilateral climate change funds		6		63			1		9	
Multilateral financial institutions, including regional development banks										
Specialized United Nations bodies										
Total contributions through bi-lateral, regional and other channels		233	692	1021			34	101	149	
Total climate specific by funding type (total for mitigation, adaptation, crosscutting, other)		278	707	1 095			41	103	160	
Total climate specific finance		**2 080**					**304**			

OECD DAC exchange rate for 2014: 1 USD=6.8599 SEK=0.7537 EUR
Definitions and explanations of methodology is given in the narrative part of the report

ANNEX 2.
Underlying data for CTF Table 7a

PROVISION OF PUBLIC FINANCIAL SUPPORT: CONTRIBUTION THROUGH MULTILATERAL CHANNELS IN 2013

Donor funding	Total amount				Status	Funding source	Financial instrument	Type of support	Sector
	Core/general		Climate-specific						
	mSEK	mUSD	mSEK	mUSD					
Multilateral climate change funds									
1. Global Environment Facility[1)]			45	7	Provided	ODA	Grant	Mitigation	Cross-cutting
2. Least Developed Countries Fund			115	18	Provided	ODA	Grant	Adaptation	Cross-cutting
3. Special Climate Change Fund									
4. Adaptation Fund			100	15	Provided	ODA	Grant	Adaptation	Cross-cutting
5. Green Climate Fund			5	1	Provided	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities			2	0.2	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate finance									
7a) Scaling Up Renewable Energy in Low Income Countries (SREP)			115	18	Provided	ODA	Grant	Mitigation	Energy
7b) Climate and Clean Air Coallition (CCAC)			15	2	Provided	ODA	Grant	Mitigation	Cross-cutting
7c) Nordic Development Fund			57	9	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7d) UNFCCC – Trust Fund for Participation			3	0.4	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7e) Other climate finance from Ministry of Environment			4	1	Provided	ODA	Grant	Cross-cutting	Cross-cutting
Multilateral financial institutions, including regional development banks									
1a) World Bank – IDA	2 187	336	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
1b) World Bank – IBRD	88	14	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. African Development Bank	867	133	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3. Asian Development Bank	163	25	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
5. Inter-American Development Bank	8	1	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
5. Other									
Specialized United Nations bodies									
1. United Nations Development Programme	561	86	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	32	5	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3. Other									
Total contributions through multilateral channels			460	71					

[1)] *Total contribution to GEF 2013 = 149 mSEK*

OECD DAC exchange rate for 2013: 1 USD=6.5132 SEK=0.7532 EUR
Definitions and explanations of methodology is given in the narrative part of the report

PROVISION OF PUBLIC FINANCIAL SUPPORT: CONTRIBUTION THROUGH MULTILATERAL CHANNELS IN 2014

Donor funding	Total amount				Status	Funding source	Financial instrument	Type of support	Sector
	Core/general		Climate-specific						
	mSEK	mUSD	mSEK	mUSD					
Multilateral climate change funds									
1. Global Environment Facility [1)]			39	6	Provided	ODA	Grant	Mitigation	Cross-cutting
2. Least Developed Countries Fund			15	2	Provided	ODA	Grant	Adaptation	Cross-cutting
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund			10	1	Provided	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities			2	0.2	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate finance									
7a) Climate and Clean Air Coallition (CCAC)			3	0.5	Provided	ODA	Grant	Mitigation	Cross-cutting
7b) Nordic Development Fund			60	9	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7c) UNFCCC – Trust Fund for Participation			2	0.2	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7d) New Climate Economy			1	0.1	Provided	ODA	Grant	Mitigation	Cross-cutting
7e) IISD/GSI Fossil Fuel Subsidy Reform			2	0.3	Provided	ODA	Grant	Mitigation	Cross-cutting
7f) Other climate finance from Ministry of Environment			2	0.2	Provided	ODA	Grant	Cross-cutting	Cross-cutting
Multilateral financial institutions, including regional development banks									
1. World Bank	2 210	322	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. African Development Bank	610	89	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3. Asian Development Bank	125	18	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
4. Inter-American Development Bank	12	2	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
5. Other									
Specialized United Nations bodies									
1. United Nations Development Programme	510	74	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	32	5	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3. IFAD	154	22	TBC	TBC	Provided	ODA	Grant	Cross-cutting	Agriculture
4. Other									
Total contributions through multilateral channels			135	20					

[1)] *Total contribution to GEF 2014 = 129 mSEK*

OECD DAC exchange rate for 2014: 1 USD=6.8599 SEK=0.7537 EUR
Definitions and explanations of methodology is given in the narrative part of the report