ADVANCE VERSION

United Nations FCCC/IDR.5/SWE

Framework Convention on Climate Change

Distr.: General
19 April 2011

English only

Report of the in-depth review of the fifth national communication of Sweden

Parties included in Annex I to the Convention are requested, in accordance with decision 10/CP.13, to submit a fifth national communication to the secretariat by 1 January 2010. In accordance with decision 8/CMP.3, Parties included in Annex I to the Convention that are also Parties to the Kyoto Protocol shall include in their fifth national communications supplementary information under Article 7, paragraph 2, of the Kyoto Protocol. In accordance with decision 15/CMP.1, these Parties shall start reporting the information under Article 7, paragraph 1, of the Kyoto Protocol with the inventory submission due under the Convention for the first year of the commitment period. This includes supplementary information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. This report presents the results of the in-depth review of the fifth national communication of Sweden conducted by an expert review team in accordance with the relevant provisions of the Convention and Article 8 of the Kyoto Protocol.

Contents

I. Introduction and summary

A. Introduction

1. For Sweden, the Convention entered into force on 23 June 1993 and the Kyoto Protocol on 16 February 2005. Within the burden-sharing agreement of the European Union (EU) for meeting commitments under the Kyoto Protocol, Sweden committed itself to limiting the growth in its greenhouse gas (GHG) emissions to 4 per cent above the base year[1] level during the first commitment period from 2008 to 2012.

2. This report covers the in-country in-depth review (IDR) of the fifth national communication (NC5) of Sweden, coordinated by the UNFCCC secretariat, in accordance with the guidelines for review under Article 8 of the Kyoto Protocol (decision 22/CMP.1). The review took place from 8 to 13 November 2010 in Stockholm, Sweden, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: Ms. Eglantina Bruci (Albania), Mr. Lukas Gutzwiller (Switzerland), Mr. Jongikhaya Witi (South Africa) and Mr. Remko Ybema (Netherlands). Mr. Gutzwiller and Mr. Witi were the lead reviewers. The review was coordinated by Ms. Xuehong Wang and Mr. Roman Payo (UNFCCC secretariat).

3. During the IDR, the expert review team (ERT) examined each section of the NC5. The ERT also evaluated the supplementary information provided by Sweden as a part of the NC5 in accordance with Article 7, paragraph 2, of the Kyoto Protocol. In addition, the ERT reviewed the supplementary information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, which was provided by Sweden in its 2010 annual submission under Article 7, paragraph 1, of the Kyoto Protocol.

4. In accordance with decision 22/CMP.1, a draft version of this report was communicated to the Government of Sweden, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

B. Summary

5. The ERT noted that Sweden's NC5 mostly complies with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications" (hereinafter referred to as the UNFCCC reporting guidelines). As required by decision 15/CMP.1, supplementary information required under Article 7, paragraph 2, of the Kyoto Protocol[2] is provided in the NC5. Sweden considered all the recommendations provided in the report on the in-depth review of the fourth national communication of Sweden.[3] The ERT commended Sweden for its improved reporting.

[1] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and 1995 for perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6). The base year emissions include emissions from sectors/source categories listed in Annex A to the Kyoto Protocol.

[2] Decision 15/CMP.1, annex, chapter II.

[3] FCCC/IDR.4/SWE.

6. The supplementary information on the minimization of adverse impacts referred to in paragraph 3 above is mostly complete and mostly transparent and was provided on time. During the review, Sweden provided further relevant information.

1. Completeness

7. The ERT noted that the NC5 covers all sections and almost all mandatory elements required by the UNFCCC reporting guidelines. Even though Sweden has provided information that indicates that new and additional financial resources have been allocated to climate change-related activities, the ERT noted that it did not transparently define what it considers "new and additional" financial resources. The ERT recommends that Sweden enhance its reporting of new and additional financial resources in its next national communication. The NC5 covers all supplementary information required under Article 7, paragraph 2, of the Kyoto Protocol.

2. Transparency

8. The ERT acknowledged that Sweden's NC5, including supplementary information provided under Article 7, paragraph 2, of the Kyoto Protocol, is comprehensive and transparent. The NC5 provides clear information on all aspects of implementation of the Convention and its Kyoto Protocol. The NC5 is structured following the outline contained in the annex to the UNFCCC reporting guidelines and supplementary information submitted under Article 7, paragraph 2, of the Kyoto Protocol is easily identifiable.

9. In the course of the review, the ERT formulated a number of recommendations that could help Sweden to further increase the transparency of its reporting with regard to: national circumstances (see para. 13 below), policies and measures (PaMs) (see paras. 28, 29, 33, 34, 49 and 66 below); projections and the total effect of PaMs (see paras. 70, 71, 75, 83 and 87 below); vulnerability, climate change impacts and adaptation measures (see para. 94 below); financial resources and technology transfer (see paras. 95, 100 and 101 below); education, training and public awareness (see para. 108 below); and information on the minimization of adverse impacts (see para. 68 below).

3. Timeliness

10. The NC5 was submitted on 4 February 2010, after the deadline of 1 January 2010 mandated by decision 10/CP.13. The ERT noted that the submission was made within six weeks from that date (15 February 2010).

II. Technical assessment of the reviewed elements

A. National circumstances relevant to greenhouse gas emissions and removals, including legislative arrangements and administrative procedures

11. In its NC5, Sweden has provided a concise description of the national circumstances and has elaborated on the framework legislations and key policy documents on climate change. The NC5 also refers to the description of a national system provided in the national inventory report (NIR) of the 2009 annual submission. Further technical assessment of the

institutional and legislative arrangements for the coordination and implementation of PaMs is provided in chapter II.B.1 of this report.

1. National circumstances

12. In its NC5, Sweden has provided a description of its national circumstances and information on how these national circumstances affect GHG emissions and removals in Sweden and how changes in the national circumstances affect GHG emissions and removals over time. Information was provided on the government structure, population, geography, climate, economy and relevant economic sectors. The ERT noted that the main drivers of emission trends in Sweden include population, the structure of primary energy supply, transport systems, industrial structure and economic development. In addition, GHG emission levels in Sweden are affected by annual precipitation, which has an impact on the availability of hydropower.

13. The ERT noted that, while the national circumstances were well described in the NC5, the analysis of how these national circumstances and changes therein affect GHG emissions and removals could be further enhanced. In particular, reporting on the population profile could be improved by providing the underlying assumptions for the projections of population and gross domestic product (GDP) growth. The ERT therefore encourages Sweden to provide such information in its next national communication, with a focus on the dynamics of its working population and its impact on GHG emission levels. Table 1 illustrates the national circumstances of the country by providing some indicators relevant to GHG emissions and removals.

14. Sweden is a parliamentary and representative democracy, consisting of central, regional and local authorities. Overall responsibility for climate change policymaking lies with the Ministry of the Environment, and a number of national institutions are involved in the implementation of this policy. Implementation of the Kyoto Protocol is underpinned by periodic climate and energy resolutions (e.g. 2002, 2004 and 2009 climate policy resolutions) and some PaMs are deferred to the local level. Further legislative arrangements and administrative procedures, including those for the national system and the national registry, are presented in chapters II.A.2, II.A.3 and II.B of this report.

15. Sweden has provided a summary of information on GHG emission trends for the period 1990–2007. This information is consistent with the 2009 national GHG inventory submission. Summary tables, including trend tables for emissions in carbon dioxide equivalent (CO_2 eq) (given in the common reporting format (CRF)), are also provided in an annex to the NC5. During the review, the ERT assessed the recently submitted 2010 annual submission and reflected the findings in this report.

16. Total GHG emissions excluding emissions and removals from land use, land-use change and forestry (LULUCF) decreased by 11.7 per cent between 1990 and 2008, whereas total GHG emissions including net emissions and removals from LULUCF increased by 19.1 per cent. The decrease in GHG emissions was mainly attributed to the change in methane (CH_4) emissions, which decreased by 24.4 per cent over this period. Emissions of nitrous oxide (N_2O) also decreased by 15.9 per cent, followed by emissions of CO_2, which decreased by 10.9 per cent. A major part of these decreases was experienced after 1995 (trends for 1995–2008: CH_4 –24.0 per cent, N_2O –14.6 per cent and CO_2 –13.8 per cent; total GHGs –14.6 per cent). Emissions of fluorinated gases (F-gases) accounted only for about 1.2 per cent of total GHG emissions in 1995 and 1.4 per cent in 2008.

Table 1

Indicators relevant to greenhouse gas emissions and removals for Sweden

	1990	*1995*	*2000*	*2005*	*2008*	*Change 1990–2000 (%)*	*Change 2000–2008 (%)*	*Change 1990–2008 (%)*
Population (million)	8.6	8.8	8.9	9.1	9.3	3.6	4.4	8.2
GDP (2000 USD billion using PPP)	202.1	209.0	246.3	279.4	298.1	21.9	21.0	47.5
TPES (Mtoe)	47.2	50.3	47.5	51.5	49.6	0.7	4.4	5.1
GDP per capita (2000 USD thousand using PPP)	23.6	23.7	27.8	30.9	32.2	17.6	15.9	36.3
TPES per capita (toe)	5.5	5.7	5.4	5.7	5.4	–2.8	0.0	-2.8
GHG emissions without LULUCF (Tg CO_2 eq)	72.4	74.3	68.9	67.7	64.0	–4.9	–7.1	–11.7
GHG emissions with LULUCF (Tg CO_2 eq)	41.4	50.6	32.7	47.4	49.3	–20.9	50.6	19.1
CO_2 emissions per capita (Mg)	6.6	6.6	6.1	5.9	5.4	–8.1	–10.4	–17.7
CO_2 emissions per GDP unit (kg per 2000 USD using PPP)	0.3	0.3	0.2	0.2	0.2	–21.9	–12.8	–31.9
GHG emissions per capita (Mg CO_2 eq)	8.5	8.4	7.8	7.5	6.9	–8.3	–11.0	–18.4
GHG emissions per GDP unit (kg CO_2 eq per 2000 USD using PPP)	0.4	0.4	0.3	0.2	0.2	–22.0	–23.2	–40.1

Sources: (1) GHG emissions data: Sweden's 2010 greenhouse gas inventory submission; (2) Population, GDP and TPES data: International Energy Agency.

Note: The ratios per capita and per GDP unit are calculated relative to GHG emissions without LULUCF; the ratios are calculated using the exact (not rounded) values and may therefore differ from a ratio calculated with the rounded numbers provided in the table.

Abbreviations: GDP = gross domestic product, GHG = greenhouse gas, LULUCF = land use, land-use change and forestry, PPP = purchasing power parity, TPES = total primary energy supply.

17. By sector, trends of total GHG emissions were mostly underpinned by the decrease in emissions in the residential and commercial, agriculture and waste sectors, while emissions from energy industries remained broadly stable, and emissions from transport and industrial processes increased. The decrease in CO_2 emissions from the residential and commercial sector was driven by the replacement of oil with biomass in district heating and a switch to heat pumps and pellet-fired boilers. CH_4 emissions from waste have decreased as a result of the ban on the landfilling of household organic waste and the increase in the collection and use of CH_4 gas from landfills for energy. The reduced number of cattle and the decrease in the use of both mineral fertilizers and manure have contributed to reduced emissions in the agriculture sector. An analysis of the drivers of GHG emission trends in each sector is provided in chapter II.B below. Table 2 provides an overview of GHG emissions by sector from 1990 to 2008.

Table 2

Greenhouse gas emissions by sector in Sweden, 1990–2008

	GHG emissions (Tg CO_2 eq)						*Change (%)*		*Shares[a] by sector (%)*	
Sector	*1990*	*1995*	*2000*	*2005*	*2007*	*2008*	*1990–2008*	*2007–2008*	*1990*	*2008*
1. Energy	53.2	55.0	50.3	49.6	48.5	46.7	–12.3	–3.8	73.4	73.0
A1. Energy industries	9.9	11.2	8.8	10.7	10.1	10.0	0.9	–0.5	13.7	15.6
A2. Manufacturing industries and construction	12.3	13.9	12.9	11.8	11.6	10.7	–5.3	–8.1	17.0	16.7
A3. Transport	19.0	19.4	19.7	21.4	21.2	20.7	8.8	–2.5	26.3	32.4
A4.–A5. Other	11.6	10.2	8.6	5.4	4.8	4.5	–61.7	–6.4	16.1	7.0
B. Fugitive emissions	0.3	0.3	0.4	0.3	0.8	0.8	149.7	–1.7	0.5	1.3
2. Industrial processes	6.3	6.6	6.7	6.9	6.9	6.8	8.4	–1.3	8.6	10.6
3. Solvent and other product use	0.3	0.3	0.3	0.3	0.3	0.3	–14.6	0.0	0.5	0.4
4. Agriculture	9.5	9.5	8.9	8.7	8.5	8.5	–11.0	–0.9	13.1	13.2
5. LULUCF	–31.0	–23.7	–36.1	–20.3	–14.8	–14.7	–52.7	–0.9	–42.9	–22.9
6. Waste	3.1	2.9	2.6	2.2	1.9	1.7	–44.3	–9.8	4.3	2.7
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GHG total with LULUCF	**41.4**	**50.6**	**32.7**	**47.4**	**51.3**	**49.3**	**19.1**	**–4.0**	**NA**	**NA**
GHG total without LULUCF	**72.4**	**74.3**	**68.9**	**67.7**	**66.2**	**64.0**	**–11.7**	**–3.3**	**100.0**	**100.0**

Note: The changes in emissions and the shares by sector are calculated using the exact (not rounded) values and may therefore differ from values calculated with the rounded numbers provided in the table.

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry, NA = not applicable.

[a] The shares of sectors are calculated relative to GHG emissions without LULUCF; for the LULUCF sector, the negative values indicate the share of GHG emissions that was calculated without including GHG removals through LULUCF.

18. The ERT noted that despite the economic growth of nearly 50 per cent since 1990, emissions of GHGs have been noticeably reduced in absolute terms and on a per capita basis. Specifically, between 1990 and 2008 GHG emissions (excluding LULUCF) on a per capita basis have been reduced from 8.5 t CO_2 eq to 6.9 t CO_2 eq, and per unit GDP from 0.4 kg CO_2 eq to 0.2 kg CO_2 eq. This suggests a decoupling of emissions from economic growth. The ERT also noted that the recent global economic crisis has led to reduced industrial output from many sectors as well as decreased demand in transportation, which in turn has resulted in a drop in GHG emissions.

2. National system

19. In accordance with decision 15/CMP.1, Sweden provided in its NC5 a description of how its national system is performing the general and specific functions defined in the guidelines for national systems under Article 5, paragraph 1 (decision 19/CMP.1). Sweden also provided a reference to the 2009 annual submission, which contains a more detailed description of the national system. The description includes all the elements as required in decision 15/CMP.1.

20. Sweden provided a description of national legislative arrangements and administrative procedures that seek to ensure that the implementation of activities under Article 3, paragraph 3, and elected activities under Article 3, paragraph 4, of the Kyoto Protocol also contribute to the conservation of biodiversity and the sustainable use of natural resources. Sweden's current forest policy puts great emphasis on the conservation of forests as a natural resource and on biodiversity conservation.

21. During the review, Sweden provided additional information on the national system, elaborating on the capacity of the national system, institutional and legislative arrangements and administrative procedures for GHG inventory planning, preparation and management, and quality control/quality assurance (QA/QC).

22. The ERT took note of the recommendations of the report of the individual review of the 2009 annual submission of Sweden[4] (2009 ARR). The ERT recommends that Sweden report any changes in the national system in its next annual submission in accordance with section I.F of the annex to decision 15/CMP.1. The ERT concluded that the national system continues to perform its required functions as set out in decision 19/CMP.1.

3. National registry

23. In its NC5, Sweden has provided information on the national registry, including a description of how its national registry performs the functions defined in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and how it complies with the requirements of the technical standards for data exchange between registry systems. Sweden has also provided a reference to the 2009 annual submission, which contains a more detailed description of the national registry.

24. During the review, Sweden provided additional information on the measures put in place to safeguard, maintain and recover registry data, the security measures employed in the registry to prevent unauthorized manipulations, the measures put in place to protect the registry against security compromises, the test procedures related to the performance of the current version of the national registry and on the recording of the changes and discrepancies of the national registry. In response to questions raised by the ERT, Sweden provided documents demonstrating how it records the changes related to the national registry and how it maintains these records. The ERT noted that updates of databases and applications, implemented security measures, and changes to the national registry software are documented on a regular basis by nominated responsible staff.

25. The ERT took note of the conclusion of the standard independent assessment report (SIAR) that the reported information on the national registry is complete and has been submitted in accordance with the annex to decision 15/CMP.1. The ERT also took note of the recommendations of the 2009 ARR that Sweden make the information referred to in paragraphs 45–47 of the annex to decision 13/CMP.1 publicly available, and that the Party correctly report several transactions that were recorded in Sweden's database as "rejected"

[4] Report of the individual review of the annual submission of Sweden submitted in 2009 (FCCC/ARR/2009/SWE).

where they should have been recorded as "terminated". During the review, Sweden informed the ERT that it has addressed these recommendations and has made some efforts to improve the reporting of publicly available information and to correctly report the status of transactions in future annual submissions.

26. The ERT concluded that Sweden's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with decisions 16/CP.10 and 12/CMP.1.

B. Policies and measures, including those in accordance with Article 2 of the Kyoto Protocol

27. As required by the UNFCCC reporting guidelines, Sweden has provided in its NC5 comprehensive information on its package of PaMs implemented, adopted and planned in order to fulfil its commitments under the Convention and its Kyoto Protocol. Each sector has its own textual description of the principal PaMs, supplemented by summary tables on PaMs by sector. Sweden has also provided information on how it believes its PaMs are modifying longer-term trends in anthropogenic GHG emissions and removals, consistent with the objective of the Convention. The NC5 contains, with a few exceptions, a similar set of PaMs to those in the fourth national communication of Sweden (NC4).

28. The ERT noted that recommendations from the previous review were taken into consideration to improve the reporting in the NC5, including the description of national legislative arrangements and administrative procedures relating to the implementation of activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, and information on the efforts Sweden is making to implement PaMs in such a way as to minimize adverse impacts. The ERT encourages Sweden to report in more detail on the quantitative estimates of the impacts of individual PaMs in its future national communications.

29. Sweden provided comprehensive information on PaMs at the national level, and some information at the subnational level. The ERT encourages Sweden to include further information on PaMs at the subnational level. The ERT noted that the success of the Swedish climate policy is largely based on the fuel switch from fossil fuels to biomass-based energy and the continuation of the use of nuclear power. While most of the biofuels used for district heating can be covered by domestic biomass, the largest and increasing share of biofuels in the transport sector has to be imported.

30. The most prominent cross-sectoral PaM to address climate change is the carbon tax introduced in the early 1990s, which has been tripled to more than EUR 100/t CO_2 by 2010. The ERT noted that in the past decade, Sweden has increasingly focused its energy and climate policy on economic and market-based instruments, such as the energy and carbon tax and emissions trading, while gradually shifting away from cross-sectoral investment grants such as the Local Investment Programme (LIP). In addition, the Government of Sweden attaches great importance to climate-related research, especially to technological and scientific research and development. In the autumn of 2008, the Swedish Parliament took a decision on a new research and innovation initiative which meant an increase in the annual fund allocation to research on climate modelling with EUR 4.0 million and on energy research with EUR 30 million. In addition, universities, colleges and public research providers received reinforcements which, indirectly, will add even more funding to climate and energy research.

31. The ERT commends Sweden for its commitment to its energy and climate policy, which is reiterated in the government bill entitled "An Integrated Climate and Energy

Policy" (hereinafter referred to as "the 2009 climate and energy bill"), approved in spring 2009.[5] It sets ambitious targets for Sweden's energy and climate policy by 2020 (see para. 39 below). The previous long-term target for 2050 (i.e. that emissions should be less than 4.5 t CO_2 eq/year/capita) has been replaced under this new bill by the vision that, in 2050, Sweden will not have any net emissions of GHGs in the atmosphere.

32. Sweden's commitments under the Kyoto Protocol and the EU burden-sharing agreement are that GHG emissions, as an annual average for the period 2008–2012, will be no more than 104 per cent of the base year emissions. Sweden is on track to meeting and, possibly, overachieving this target through domestic actions alone, that is, without the use of the flexible mechanisms under the Kyoto Protocol. GHG emissions in Sweden, excluding emissions and removals from LULUCF, decreased by 11.7 per cent over the period 1990–2008 and are expected to continue to decline.

33. The NC5 provides estimates of the effects of PaMs by sector and by gas. For energy-related emissions in particular, the impact is assessed based on the prevalent economic instruments, which are the energy and carbon taxes. This impact is aggregated at the sectoral level: i.e. local investment programmes, such as LIP and the Climate Local Investment Programme (Klimp), which are considered cross-sectoral; heat (from district heating) and electricity production; transport; the residential and services sector; and energy combustion in the industrial sector. The impact of PaMs in the waste sector is assessed based on the reduction in CH_4 emissions due to the landfill ban. The ERT encourages Sweden to continue its assessments of PaMs and to expand its efforts by assessing and reporting the effect of PaMs such as legislation and in other sectors in its next national communication.

34. An approximate indication of the cost-effectiveness of the entire climate strategy is presented in the NC5 as a marginal abatement cost curve. The marginal cost varies between approximately –1,500 Swedish kronor (SEK)[6]/t CO_2 for new waste-fired combined heat and power (CHP) plants and +SEK 1,000/t CO_2 for the switch from direct electric heating to heat pumps in commercial premises. According to this estimate, the CO_2 reduction potential with negative costs amounts to around 6 Mt CO_2 or roughly one tenth of Sweden's 2008 GHG emissions. This result, however, is sensitive to the future cost of waste and biomass energy on the one hand, and, on the other hand, to the future cost of the fossil-fuel heating system, to which the biomass-based technology is compared. The ERT therefore encourages Sweden to assess the abatement costs based on different scenarios for future biomass prices and marginal electricity in its next national communication.

35. Compared to the NC4, only one policy instrument has been discontinued – the Local Climate Investment Grants under Klimp – which has been replaced by the Delegation for Sustainable Cities initiative due to cost-efficiency considerations. Table 3 provides a summary of the reported information on the PaMs of Sweden.

Table 3

Summary of information on policies and measures

Major policies and measures	*Examples/comments*
Policy framework and cross-sectoral measures	
Local Investment Programme (LIP)	Promotes ecological sustainability at the local level
Climate Investment Programme	Provides subsidies for projects that reduce the

[5] A sustainable energy and climate policy for the environment, competitiveness and long-term stability. 6 February 2009. Available at <http://www.sweden.gov.se/sb/d/2031/a/120088>.

[6] SEK 1 is equivalent to USD 0.155 and EUR 0.113 in 2010.

Major policies and measures	*Examples/comments*
(Klimp)	impact of climate change
Environmental Code	Promotes ecologically sustainable development
Climate information campaign	Aims to increase knowledge of the issue of climate change
Research and development	The development of technology with a very low climate impact
Policies and measures by sector	
Energy	
Energy and carbon tax	Aims to improve the efficiency of energy use and reduce the use of fossil fuels
European Union (EU) emissions trading scheme	Aims to reduce fossil fuel consumption
Green electricity certificates and quota system	Incentive-based system for the increased production of renewable electricity; target: an additional 25 TWh until 2020 compared to the 2002 level
Building regulations – standards for energy efficiency	The tightening of minimum requirements for energy use in buildings
Mandatory energy labelling	Promotes a more energy-efficient use of appliances
Transport	
Vehicle fuel taxes	Internalizes the external effects of road transport, including GHGs (1.9 Mt CO_2 in 2010 and 2.4 Mt CO_2 in 2020)
Temporary tax exemption for biofuels	Promotes biofuels in the transport sector (1.8 Mt CO_2 in 2010 and 3 Mt CO_2 in 2020)
Industrial processes	
Fluorinated gases (F-gases) regulation	Aims to reduce the use of F-gases as coolants
Agriculture	
Targeted environmental grants under the rural development programme	Promotes the move away from direct aid to targeted grants in line with the agricultural policy of the EU
Forestry	
Provisions on forest stewardship, etc. in the Forestry Act	For the attainment of environmental objectives and production targets for forests
Voluntary set-asides, partly through voluntary forest certification systems (FSC and PEFC)	Promotes environmentally sound forestry
Waste	
Rules on municipal waste planning; rules on producer responsibility for certain goods; a tax on the landfilling of waste; and the prohibition on the landfilling of organic waste	Aims to reduce CH_4 emissions from landfills, and increase the recycling of waste (1.4 Mt CO_2 eq in 2010 and 1.9 Mt CO_2 eq in 2020)

Note: The greenhouse gas reduction estimates, given for some measures (in parentheses), are reductions in CO_2 or CO_2 eq for the years 2010 and 2020.

1. Policy framework and cross-sectoral measures

36. Sweden has a unitary government with active local authorities. Responsibility for the development of climate policy remains with the central government. The main government bodies active in energy and climate policy are the Ministry of the Environment, the Swedish Energy Agency as well as the Ministry of Finance, which is in charge of levying the energy and carbon tax. The projections for energy demand and supply are coordinated by the Energy Agency, which works closely with the other ministries and research institutes, and the National Institute of Economic Research, which plays a key role in assessing the impact of economic and fiscal instruments such as the energy and carbon tax as well as the macroeconomic cost of these measures.

37. At the national level, the Swedish Environmental Protection Agency (EPA) is responsible for the environmental quality objectives and for Sweden's regular climate reporting to the UNFCCC and the EU. The EPA is tasked with ensuring that new statistics are produced annually on the national emissions trend and that projections and reports of initiatives taken in the context of the Swedish climate strategy are produced every two years.

38. Since 1998, the county administrative boards have been tasked with adapting the national environmental quality objectives to the regional level. All the county administrative boards have set regional climate targets since 2008. They have also been tasked, since 2005, with developing regional action programmes to attain the environmental quality objectives. All the county administrative boards developed regional energy and climate strategies in 2008. In addition, a large number of municipalities have adopted local climate targets. A Delegation for Sustainable Cities was appointed for the period 2009–2010 to work for the sustainable development of cities, urban communities and housing areas. The Delegation will promote integrated cross-sectoral planning and cooperation in urban devolopment projects between business, municipalities and other actors as well as public participation. It will assist the export of environmental technology and promote international cooperation on the development of sustainable cities.

39. The 2009 climate and energy bill sets out four ambitious targets for Sweden's energy and climate policy by 2020. These include: a 40 per cent reduction in GHG emissions compared to the 1990 level in the sectors not covered under the EU emissions trading scheme (EU ETS); a target of at least 50 per cent of renewable energy in total primary energy supply; a 20 per cent more efficient energy use based on GDP (energy intensity); and a target of at least 10 per cent of renewable energy use in the transport sector. The long-term vision embodied in this bill specifies that in 2050 Sweden will not have any net emissions of GHGs in the atmosphere. To achieve this long-term target, the Government of Sweden has adopted a programme to further tighten policy instruments, including by setting the objective of making the transport sector independent of fossil energy by 2030.

40. The energy and carbon taxes have been of key significance in reducing GHG emissions in Sweden since the early 1990s. This tax system is based on a combination of a carbon tax, an energy tax on fuel, a nuclear power tax and a consumption tax on electricity. The energy and carbon taxes have contributed to sharp reductions in GHG emissions in the residential and services sector and in the district heating sector, and have also moderated the emissions trend in the transport sector. The taxes have been supplemented by other instruments, such as technology procurement, a climate information campaign, differentiated vehicle taxes and the EU ETS. For the electricity and district heating sector, which accounted for more than 70 per cent of emissions from the energy supply in 2007, it is estimated that emissions would have been around 15 Mt higher in 2007 and were projected to be around 16 Mt higher in 2010 if the energy and carbon taxes applied in 1990 had remained unchanged in the sector instead of a number of other economic and market-

based instruments being further developed and tightened. In particular, the wider use of coal for heat and power generation would have been profitable if the policy instruments had not been tightened.

41. The EU ETS is an important element of Swedish climate efforts for the period up to 2020. Emissions covered by the EU ETS in Sweden accounted for around 33 per cent of total emissions over the period 2005–2007. According to the National Allocation Plan, annual emission allowances are set to be 22.3 Tg CO_2 during the first commitment period, with an additional 0.2 Tg CO_2 for new entrants. The annual emissions cap during the Kyoto Protocol first commitment period (also the second trading period) was reduced overall by around 10 per cent compared with the cap that applied during the first trading period from 2005 to 2007. The allocation for Sweden until 2020 has not yet been decided.

2. Policies and measures in the energy sector

42. Between 1990 and 2008, GHG emissions from the energy sector decreased by 12.3 per cent (6,527 Gg CO_2 eq), mainly driven by the increased use of biofuels in sectors other than industry. The trend in GHG emissions from fuel combustion showed notable increases in the transport sector (+8.8 per cent or 1,666 Gg CO_2 eq). In the residential and services sector, emissions have decreased significantly by 60 per cent since 1990 as a result of the switch from oil to biomass in district heating, and in recent years to heat pumps and pellet-fired boilers.

43. ***Energy supply.*** Electricity production in Sweden is dominated by nuclear and hydropower that account for at least 90 per cent of electricity production, while the increase in electricity production in recent years has principally come from wind power as well as biomass CHP plants. Sweden has a quota system with green electricity certificates, which favours the use of biofuels and peat in CHP plants, wind power and hydropower, etc. The potential for wind energy is considerable, especially in the north of the country but also offshore. One of the main barriers to the deployment of wind energy in the north appears to be the cost of connecting the remote sites to the national electricity grid. The Swedish quota system also favours the use of peat for renewable electricity production. The ERT notes that this might have a negative impact on the climate since peat is not considered a renewable energy at the international level.

44. Sweden has 10 nuclear power plants – six boiling-water reactors (BWRs) and four pressurized-water reactors (PWRs) – in operation at three sites. The future of nuclear energy in Sweden has remained a political issue since 1980, when Swedish voters opted by referendum for a delayed phase-out of nuclear energy and the parliament set 2010 as the date for the completion of the phase-out. The parliament also stated that closing down nuclear units should not reduce employment or the welfare of society, neither should it increase the use of oil and gas, and renewable energy sources should be available. In June 2010, the parliament opened up the possibility to construct new nuclear power reactors replacing existing reactors. The ERT noted that the future of nuclear power in Sweden is of critical importance to any plans to achieve the national climate change targets.

45. Aggregate emissions from electricity and district heating production taken together were 0.5 Gg CO_2 eq above the 1990 level in 2008. District heating energy production taken separately has increased by over 30 per cent since 1990, while emissions have decreased. This can be explained by the successful policy that led to a shift in district heating from fossil fuels to the use of biomass and waste fuels from the late 1980s onwards.

46. ***Renewable energy sources.*** Sweden's primary energy use amounts to approximately 600 TWh. Hydropower contributes about 80 TWh to primary energy use, while biofuels contribute about 100 TWh (up from 60 TWh in 1990). Energy supply to district heating is composed of biofuels (60 per cent), fossil energy (less than 20 per cent) and heat pumps as

well as waste heat (about 10 per cent each). Biofuels make up approximately 5 per cent of fuels for road transportation and are increasing significantly in pursuance of the EU target of a 10 per cent share of biofuels by 2020.

47. In 2003, Sweden introduced a green electricity certificate system. This is a market-based support system (quotas) for the expansion of electricity production from renewable energy sources and peat. The currently applicable target is to increase renewable electricity production by 25 TWh by 2020 from the 2002 level. The ERT noted with appreciation these very ambitious targets for renewable energy. The ERT also noted that the proportion of electricity production eligible for the green electricity certificate has increased since the certificate system started. The increase principally consists of the increased production of electricity from biofuels in existing CHPs, as well as from an expansion of capacity in biofuel plants. In recent years, the significant potential of wind power, particularly in the north of the country, has been tapped under the certificate system. However, the ERT noted that the use of peat for electricity production could be controversial (see para. 43 above). The ERT also commends the sizeable increase in biomass use, in particular in district heating.

48. ***Energy efficiency.*** The Swedish programme for energy efficiency in energy-intensive industry (PFE[7]) addresses the energy efficiency of electricity consumption in industry. The programme gives companies in manufacturing industry the opportunity of being granted tax exemption on their electricity consumption if they take action to improve their energy efficiency. Participation in the programme is voluntary, and is open to energy-intensive manufacturing companies which implement cost-effective measures. Although this programme might lead to minor market distortions internationally, the ERT commends Sweden for this innovative instrument which supplements the energy and carbon tax in achieving energy-efficiency improvements.

49. The ERT also commends Sweden for its steps to address energy efficiency in buildings; one of the Party's 16 environmental objectives is to reduce the energy use per heated surface area by 20 per cent by 2020. However, it remained somewhat unclear to the ERT by which precise PaM this target is going to be met. At some point in the future, PaMs in other sectoral policies have to be taken into account, such as removing investment barriers for landlords who can transfer the costs of the carbon tax directly to their tenants. In such cases, the carbon tax may be ineffective and other instruments to stimulate building refurbishment work would have to be developed. The existing exemption of the labour costs of building refurbishment work from social charges addresses one of these barriers regarding privately owned buildings.

50. ***Residential and commercial sector.*** A major success story of the Swedish climate policy is the replacement of a large share of fossil fuels with renewables in district heating since the 1970s, with a 60 per cent share of biofuels by 2007. As a result of this measure, GHG emissions from residential and commercial buildings were reduced from approximately 9 Gg/year in 1990 to approximately 2 Gg/year in 2008. The key policy instrument to promote the use of renewable energy in the residential and commercial sector is the energy and carbon tax (see para. 30 above).

51. The building regulations for new buildings underwent a major change in 2006 and the tightening of the requirements for electrically heated buildings came into effect on 1 February 2009. It is foreseen that the energy requirements for new buildings will be tightened in further stages starting in 2011. A review of the implementing rules is in progress to ensure that energy requirements will also have to be met in the modification of existing buildings. The ERT noted that opportunities also exist to improve the energy

[7] Programmet för energieffektivisering.

efficiency in building refurbishment and renovation. Minimal performance standards for household appliances are in line with the EU ecodesign directive.

52. ***Transport sector.*** Road transportation is the dominant mode of transport in meeting the steadily increasing demand for domestic transportation. In spite of the increasing demand for road transportation, GHG emissions from this sector have been stabilized in recent years due to: the increasing share of biofuels, which amounted to approximately 5 per cent in 2008; the purchasing of more efficient vehicles, promoted mainly by increased fuel prices (which have almost tripled in nominal terms since 1990); and a rebate system for energy-efficient cars. The estimated carbon reductions in 2010 due to the fuel tax and the increased use of biofuels amount to 1.8 Mt and 1.4 Mt, respectively.

53. The Government of Sweden has set the objective of making the transport sector independent of fossil energy by 2030 (see para. 39 above) and has therefore adopted a programme to further tighten policy instruments. This programme includes: increased levels of energy and carbon taxation, which provide incentives for a more climate-efficient transport sector; a strategy to encourage the increased use of vehicle biofuels; a carbon-differentiated vehicle tax; and ever-more stringent EU requirements regarding the CO_2 emissions of new cars as well as requirements regarding long-term community and infrastructure planning, which will enable the implementation of a more climate-efficient transport system. The ERT noted that long-term infrastructure funding is crucial for a reliable public transport system.

54. Emissions from bunker fuels used for international shipping and aviation amounted to around 9.5 Mt CO_2 eq in 2008 and have increased by 160 per cent compared to the 1990 level, which is significantly higher than the EU average. Aviation bunker fuels will be covered by the EU ETS from 2012 onwards. Fuel consumption in the international maritime transport sector has experienced the greatest increase. Sweden has been pressing for measures to limit international aviation emissions and for the International Civil Aviation Organization (ICAO) to assume a principal role. In addition, Sweden is assisting the International Maritime Organization (IMO) in the development of a design index for newly built ships, which could serve as a basis for economic instruments.

55. ***Industrial sector.*** In 2008, emissions from fuel combustion in industry amounted to around 10.7 Mt CO_2 eq, which is approximately 13 per cent lower than the 1990 level. In recent years, the pulp and paper industry has experienced the greatest decrease in emissions. The main instruments that have influenced these emissions are, at the EU level, the EU ETS and, at the national level, the energy and carbon taxes, the green electricity certificate system, the PFE and the rules of the Environmental Code. Emissions from the industrial sector are dominated by emissions from industries included in the EU ETS. Manufacturing industries are subject to a much lower carbon tax than the residential sector, but the Swedish Parliament has approved a proposal to increase the carbon dioxide tax for manufacturing industries outside the EU ETS to 30 per cent from 2011 and then to 60 per cent in 2015 compared to the general tax level.

56. Emissions from Swedish installations under the EU ETS equated to around 33 per cent of total GHG emissions in Sweden over the period 2005–2007. About 80 per cent of these emissions came from industrial installations and 20 per cent from electricity and district heating installations. The Swedish breakdown differs substantially from the breakdown for the EU ETS as a whole, where emissions from energy supply installations (about 60 per cent) are greater than emissions from industrial installations (about 40 per cent). The national carbon tax for industry covered by the EU ETS has been withdrawn from 2011 and replaced by the EU minimum tax on energy for industry.

3. Policies and measures in other sectors

57. Between 1990 and 2008, GHG emissions from the industrial processes (including solvent and other product use), agriculture and waste sectors decreased by 9.9 per cent (1.9 Gg CO_2 eq), mainly driven by reductions in emissions from agriculture and waste management. The trend in GHG emissions from industrial processes (including solvent and other product use) showed an increase of 7.6 per cent (or 0.5 Gg CO_2 eq), which was more than compensated for by the decreases in emissions from the agriculture (–1 Gg CO_2 eq) and waste sectors (–1.2 Gg CO_2 eq).

58. ***Industrial processes.*** In 2008, emissions from industrial processes and from F-gases amounted to 6.8 Gg CO_2 eq, which is 8.4 per cent higher than the 1990 level. Combined process emissions vary from year to year depending on economic conditions, the transformation of the industrial structure and the use of F-gases. Emissions from the industrial processes sector will be almost entirely covered by the EU ETS following the expansion proposed from 2013. Emissions of F-gases are regulated through European Commission (EC) regulations and directives.

59. ***Agriculture.*** In 2008, emissions of CH_4 and N_2O from agriculture represented around 13 per cent of total Swedish GHG emissions. These emissions have decreased by around 11 per cent since 1990, principally because the number of dairy cows has declined, as has the use of mineral fertilizer and manure. Emissions of CH_4 and N_2O account for a significant share (around 20 per cent) of the Swedish GHG emissions not covered by the EU ETS.

60. There are relatively few policy instruments to date that are directly aimed at limiting GHG emissions in the agriculture sector in Sweden. Interest in reducing the sectoral climate impact has, however, increased, and the government has taken a number of initiatives in recent years to limit the use of fossil fuels in the sector and to increase knowledge and encourage measures that lead to reduced GHG emissions from manure management and land use.

61. ***LULUCF.*** The LULUCF sector was a net sink of CO_2 over the period 1990–2008. The net sink ranged between 21 and 36 Mt CO_2/year over this period and has decreased in recent years. The decreasing sink is due to the increased forest felling as a result of increased demand from the industry, such as paper and pulp. The government bill, entitled "A Forest Policy in Line with the Times", stresses the role of forests in climate action and the need for increased forest growth. The Government of Sweden is therefore putting extra effort into the provision of forest growth-oriented advice.

62. Sweden's most important PaMs in the forestry sector are the provisions on forest stewardship in the Forestry Act and on land drainage in the Environmental Code. In addition, Sweden has provisions on nature reserves and habitat protection in the Environmental Code as well as nature conservation agreements.

63. Beyond the mandatory accounting of emissions and removals of GHGs under Article 3, paragraph 3, of the Kyoto Protocol, Sweden has elected to account for forest land management under Article 3, paragraph 4, of the Kyoto Protocol. Sweden follows the criteria that apply to the definition of forest land according to the Food and Agriculture Organization of the United Nations (FAO) and the IPCC good practice guidance for LULUCF. A methodology and database for calculating the changes in carbon stocks have also been developed.

64. ***Waste management.*** CH_4 emissions from landfills are estimated to have decreased by around 1,300 Gg CO_2 eq between 1990 and 2008. This is equivalent to a decrease of over 41 per cent. CH_4 emissions have steadily declined since the early 1990s, first as a

result of the expansion of the collection and use of landfill gas for energy and, secondly, as a result of the ban introduced in 2005 on the landfilling of organic waste.

65. The significant decrease in GHG emissions from the waste sector is mainly attributed to the municipal waste planning requirements introduced in 1991, a tax on waste sent to landfill introduced in 2000, and a ban on the landfilling of separated combustible and organic material introduced in 2002 and 2005, respectively. Further, the introduction of producer responsibility for sorting different groups of articles, such as packaging, waste paper, stationery and tyres, has contributed to a rise in recycling. It is anticipated that emissions from landfills will continue to decline sharply over the next decade.

66. Overall, in the context of PaMs, the ERT encourages Sweden to report more extensively on new PaMs and their potential impact based on ex ante assessments. The ERT also encourages Sweden to provide more information on how PaMs are being designed and implemented to meet the long-term policy objective of zero net emissions and a low carbon society by 2050.

4. Minimization of adverse effects in accordance with Article 2, paragraph 3, of the Kyoto Protocol

67. In its NC5, Sweden reported information on how it strives to implement PaMs under Article 2 of the Kyoto Protocol in such a way as to minimize adverse effects, including the adverse effects of climate change and effects on international trade and social, environmental and economic impacts, on other Parties, especially developing country Parties. Further information on how Sweden strives to implement its commitments under Article 3, paragraph 1, in such a way as to minimize adverse social, environmental and economic impacts on the developing country Parties, as reported in the 2010 annual submission, is presented in chapter II.I of this report.

68. The NC5 underlines the fact that Sweden's focus on the increased use of bioenergy, both through increased domestic production and through increased imports, in particular from developing countries, has meant that this area has been prioritized in Sweden's scientific research. The implementation of sustainability criteria devised for vehicle biofuels under the EU renewable energy directive through a certification scheme[8] as well as the continuing research regarding biofuels are just two examples. The ERT encourages Sweden to continue to closely monitor the origin and production conditions of its imported biofuels and biomass feedstock.

C. Projections and the total effect of policies and measures, and supplementarity relating to the Kyoto Protocol mechanisms

69. In its NC5, Sweden has provided comprehensive information on its projections for all GHG emissions. New projections of emissions and removals of GHGs were produced for the NC5, which are the same as those reported to the EU in 2009. The projections are based on the policy instruments that were implemented and adopted up to June 2008. The projections do not include the impact of the EU climate and energy package, the national policies and targets adopted in 2009, and the impact of the recent global economic crisis. These policies and issues will be taken into account in the most up-to-date projections that Sweden is currently preparing to be submitted to the EU by March 2011. These projections were presented and discussed during the review.

[8] For further details, see SEKAB, available at <www.sekab.com>.

1. Projections overview, methodology and key assumptions

70. The GHG emission projections provided by Sweden in the NC5 include a 'with measures' scenario (the main scenario) and two 'with additional measures' scenarios until 2020, presented relative to actual inventory data for 2007. The projections also include a 'without measures' scenario relative to the 1990 level. Projections are presented on a sectoral basis, using the same sectoral categories used in the PaMs section, and on a gas-by-gas basis for all GHGs: CO_2, CH_4, N_2O and F-gases (PFCs, HFCs and SF_6 taken together). The ERT recommends that Sweden provide, in its next national communication, disaggregated projections for the F-gases. Projections are also provided in an aggregated format for each sector as well as for a national total, using global warming potential (GWP) values. Emission projections related to fuel sold to ships and aircraft engaged in international transport were reported separately and not included in the totals.

71. The ERT noted that Sweden has reported almost all mandatory information on emission projections required by the UNFCCC reporting guidelines, but information on some key underlying assumptions and factors was not provided, including industrial output and numbers of households. The ERT encourages Sweden to report this information in future national communications. Further, the ERT noted that completeness could be enhanced by providing projections of the indirect GHGs (carbon monoxide (CO), nitrogen oxide (NO_X), non-methane volatile organic compounds (NMVOCs), as well as sulphur dioxide (SO_2)) and therefore encourages Sweden to provide this information in its next national communication.

72. Sweden submitted four scenarios in its NC5, with 1990 as the starting year: one 'without measures' scenario, one 'with measures' scenario, which includes all policies that have been implemented up to June 2008, and two 'with additional measures' scenarios. One of the 'with additional measures' scenarios includes additional measures at the EU level, and the other includes the additional measures covered by Sweden's 2009 climate and energy bill. The principal additional measures at the EU level include the requirement for limits on the emissions of new cars, the inclusion of aviation in the EU ETS and the increase in the level of permitted low admixture of ethanol in petrol. The additional measures from the 2009 climate strategy include increased levels of energy and carbon taxes. In addition, two sensitivity analyses have been calculated for the energy and transport sectors and one analysis has been undertaken for the agriculture and industrial processes sectors (on F-gases).

73. The methodology used to prepare the projections is well described in the NC5. There is continuity in the use of models between the NC4 and the NC5. For transport projections, a new car choice model has been used for the NC5. Several institutions are involved in producing the projections in Sweden, including institutions dealing with economic, energy, forestry and agriculture modelling and projections. These institutions are the same as those involved in the NC4 projections.

74. Different approaches and models are used to calculate the projections for different sectors. Projections for economic development are an important starting point for the calculation of energy-related emissions. They are produced using a general equilibrium model, EMEC, run by the National Institute of Economic Research. Projections for electricity and district heating are based on the MARKAL-Nordic model developed by PROFU, an energy system analysis consultant firm. Projections of energy use in the residential and services sector are calculated by combining the model results from a bottom-up model called DoS (developed by SWECO, an energy system analysis consultant firm). Projections in the LULUCF sector are produced using the Hugin calculation system, which simulates the future development of forests on the basis of assumptions regarding the way in which they are managed and exploited over a one-hundred-year period. Projections for agriculture are based on the SASM model, and projections for the waste sector are

based on a method that is consistent with the method used for the GHG inventory, which takes into account the impact of existing policies, such as the landfilling of organic waste and the landfill tax, on activity data and emission factors.

75. The ERT noted that transparency in the GHG projections could be enhanced through the provision of further detail on some of the models used to project energy demand and the associated emissions, including on energy demand subsectors within the energy sector, such as industry, the residential and commercial sector, and the transport sector.

76. The level of emissions in Sweden depends on the economic activity across all sectors, energy prices, energy policies, and developments in agriculture and waste management. Key assumptions have been provided with a considerable level of detail in annex 5 to the NC5 and were further elaborated on during the review. GDP is assumed to increase by 2.6 per cent/year between 2005 and 2010 and 2.1 per cent/year between 2010 and 2020. The average price of crude oil is projected to be USD 90/barrel for the period 2010–2020. Nuclear power production is projected to increase slightly to 72.4 TWh/year in 2020. In the transport sector, the price of ethanol (E85) is assumed to be lower than the price of gasoline over most of the projection period. Biofuel is projected to be available on the international market but no precise prices were provided.

77. A carbon allowance price of EUR 30/t CO_2 has been used. This is considerably higher than the current CO_2 price in the EU ETS. As Sweden has a large uptake of CO_2 in its forests, the assumptions used in the forestry sector were also important. For forestry logging, the assumption is based on the maximum level possible – of 95 million m^3 standing volume/year – without a reduction in the timber stock in the future.

78. Detailed projections by gas and by sector are presented for the 'with measures' scenario. For the two 'with additional measures' scenarios, the results of the projections were reported only for total GHG emissions. The sensitivity of the results for different input parameters is reported in the NC5. The main parameters investigated are fossil fuel prices, economic development, productivity in the agriculture sector and the leakage factor for F-gases. The sensitivity analysis results in emission projections for 2020 ranging between +1.2 Mt and –3.0 Mt CO_2 eq compared to the 'with measures' scenario.

2. Results of projections

79. The key results of Sweden's GHG emission projections reported in the NC5 are provided in table 4 below, and the emission trends are illustrated in the figure below. Total GHG emissions excluding LULUCF are projected to be 65.0 Mt CO_2 eq in 2010 under the 'with measures' scenario. Sweden is expected to meet its target under the Kyoto Protocol (75.0 Mt CO_2 eq) with a wide margin of 10 Mt CO_2 eq annually, or 10 per cent below the 1990 levels. This margin will become wider if credits from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol are taken into account. Overall, activities under Article 3, paragraphs 3 and 4 are expected to result in removals of 2.13 Mt CO_2 eq annually that could be issued as removal units. If that is the case, the margin could be increased to 12.13 Mt CO_2 eq annually, or 12.9 per cent below the 1990 levels. Sweden's GHG emissions in 2020 are expected to be 63.1 Mt CO_2 eq under the 'with measures' scenario, which is 3 per cent below the level in 2010. For the 'with additional measures' scenario, emissions in both 2010 and 2020 are lower than those in the 'with measures' scenario by around 1 Mt CO_2 eq and 2.7 Mt CO_2 eq, respectively.

80. In the 'with measures' scenario, CO_2 emissions are projected to increase by 0.5 per cent between 2010 and 2020. The aggregate of CH_4, N_2O and F-gas emissions is projected to drop by 18 per cent by 2020. In 2010, emissions of CO_2 accounted for 80 per cent of total Swedish GHG emissions and this share is projected to increase as the non-CO_2 GHG

emissions decrease, while CO_2 emissions remain constant. The CO_2 uptake from LULUCF is projected to remain at approximately 20 Mt CO_2 eq between 2010 and 2020.

81. With regard to the most recent projections, these are prepared in the context of the EU climate and energy package, where Sweden's target is to reduce its GHG emissions from the non-EU ETS sector by 17 per cent by 2020, or to 37.7 Mt CO_2 eq, compared to the 2005 level of 45.5 Mt CO_2 eq. For the 'with measures' scenario, the non-EU ETS emissions are projected to be 40.9 Mt CO_2 eq in 2020. This suggests that Sweden is not expected to meet its target under the 'with measures' scenario. In the 'with additional measures' scenario, which includes additional measures at both the EU and national levels, Sweden's emissions in 2020 are projected to be 38.2 Mt CO_2 eq, which brings the amount of total GHG emissions from the non-EU ETS sector close to the national target.

82. In addition to the 17 per cent target for the non-EU ETS sector set at the EU level, Sweden has assumed a national target for these sectors which is 40 per cent below the 1990 level by 2020. Sweden plans to achieve its national target for the non-EU ETS sector using additional PaMs as well as climate investment in other countries (e.g. carbon credits obtained from the Kyoto Protocol flexible mechanisms). Additional measures envisaged by Sweden include a significant increase in the use of biomass for energy in industry, electricity and heat production, transport and – to a lesser extent – in the residential and commercial sector. The government estimates that a third of the effort will be implemented as climate investments in other countries.

Table 4

Summary of greenhouse gas emission projections for Sweden

	Greenhouse gas emissions (Tg CO_2 eq per year)	*Changes in relation to base year level (%)*	*Changes in relation to 1990 level (%)*
Inventory data 1990[a]	72.4	0.3	NA
Inventory data 2007[a]	64.0	–11.4	–11.6
Kyoto Protocol base year[b]	72.2	NA	–0.3
Kyoto Protocol target[b]	75.0	4.0	3.6
'Without measures' projections for 2010[c]	Up to 96	33.0	32.6
'With measures' projections for 2010[c]	65.0	–10.0	–10.2
'With additional measures' projections for 2010[c]	64.0	–11.4	–11.6
'Without measures' projections for 2020[c]	Up to 98	38.5	38.1
'With measures' projections for 2020[c]	63.1	–12.6	–12.8
'With additional measures' projections for 2020[c]	60.4	–16.3	–16.6

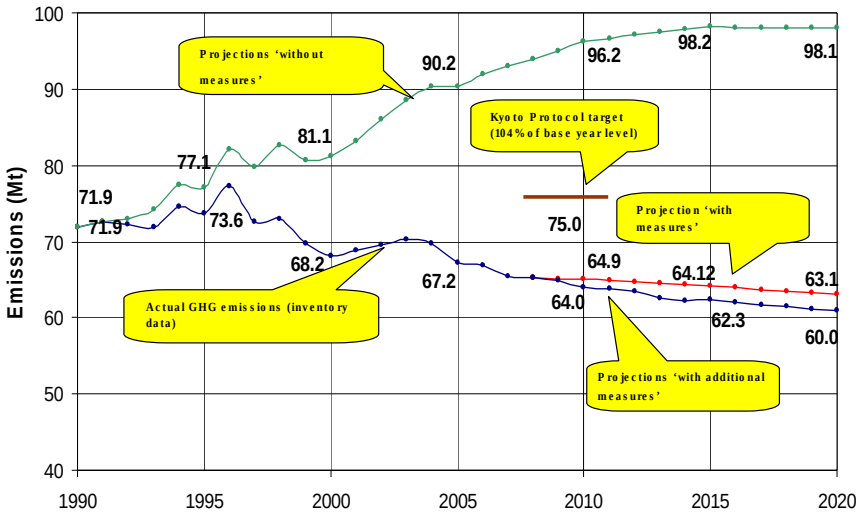
Abbreviations: NA = not applicable.

Sources: [a] Sweden's 2010 greenhouse gas (GHG) inventory submission; the emissions are without land use, land-use change and forestry (LULUCF).

[b] Based on the initial review report contained in document FCCC/IRR/2007/SWE.

[c] Sweden's fifth national communication.

Greenhouse gas emission projections



Sources: (1) Data for the years 1990–2008: Sweden's 2010 greenhouse gas inventory submission; the emissions are without land use, land-use change and forestry (LULUCF). (2) Data for the years 2009–2020: Sweden's fifth national communication; the emissions are without LULUCF.

83. Sweden's ambition in the long term is to have zero net GHG emissions by 2050. The ERT encourages Sweden to develop projections until 2050 with the aim of exploring the options which could facilitate the transition of Sweden to a low-carbon society. Such options could relate to new technologies, policies and changes in lifestyle, and the Party is encouraged to map the consequences of the implementation of these options for 2020 and 2030.

3. Total effect of policies and measures

84. In the NC5, Sweden presents the estimated and expected total effect of implemented and adopted PaMs introduced since 1990, and the effect of additional measures implemented since June 2008 at both the EU level and the national level (policies included in the 2009 climate and energy bill). The results for the 'without measures' scenario compared to the 'with measures' scenario indicate that the level of emissions in 2010 and 2020 would be up to 31 and 35 Mt CO_2 eq higher without the introduced measures. This reflects the total effect of implemented and adopted PaMs. The results show that further sizeable reductions in CO_2 emissions (2.7 Mt eq in 2020) can be achieved with additional measures.

85. In 2010, PaMs implemented in the energy sector (electricity and district heating) are estimated to deliver by far the most significant emission reductions (16 Mt CO_2 eq). This estimate is based on the assumption that coal-fired power plants would have been built in the absence of the energy and carbon taxes that have provided a strong incentive for fuel switching in electricity and district heating. The effects of PaMs from energy use in households and the services sector are estimated to deliver the second largest emission reductions (8 Mt CO_2 eq), followed by the effect of PaMs implemented in the transport (3.7 Mt CO_2 eq), waste (1.4 Mt CO_2 eq) and industry (0.2 Mt CO_2 eq) sectors. Table 5 provides an overview of the total effect of PaMs and effects by sector as reported by Sweden.

86. Emissions are projected to decrease in most sectors, especially in the residential and services sector, followed by a decrease in emissions from the waste and agriculture sectors. Emissions in the residential and commercial sector are projected to drop substantially and in 2020 are projected to be 70 per cent lower than the 1990 level. This decrease is principally due to the continued switching from heating oil to heat pumps, biofuels and district heating. Small increases in CO_2 emissions are projected for electricity and heat production, refineries and transport. Electricity production is projected to increase significantly, but this will have only a small effect on CO_2 emissions, as the growing demand for electricity is expected to be met primarily from renewable energy sources. Similarly, CO_2 emissions from road transport are projected to increase only slightly, even though their share in total GHG emissions is expected to continue to grow. In its mitigation strategy, Sweden relies heavily on biomass energy use, which is projected to increase in industry, electricity and heat production, transport and – to a lesser extent – in the residential and commercial sector. The most effective PaMs and drivers behind the GHG emission reductions are described in chapters II.B.1 and II.B.2 below.

Table 5

Projected effects of planned, implemented and adopted policies and measures in 2010 and 2020

Sector	*Effect of implemented and adopted measures (Tg CO_2 eq)*	*Relative value (% of 1990 emissions)*	*Effect of planned measures (Tg CO_2 eq)*	*Relative value (% of 1990 emissions)*	*Effect of implemented and adopted measures[b] (Tg CO_2 eq)*	*Relative value (% of [1990 emissions)*	*Effect of planned measures (Tg CO_2 eq)*	*Relative value (% of 1990 emissions)*
	2010				*2020*			
Cross-sectoral	Up to 1.8	Up to 2.5	NA	NA	Up to 2	Up to 2.8	NA	NA
energy (electricity and heat production)	16	22.3	NA	NA	16	22.3	NA	NA
Energy use in the residential and services sector	Up to 8	Up to 11.1	NA	NA	Up to 9	Up to 12.5	NA	NA
Transport – CO_2	3.7	5.1	1.05	6	5.4	7.5	1.46	8
Industrial processes	0.2	0.3	0.4	4	0.7	1.0	0.4	4
Agriculture	NA	NA	NA	NA	NA	NA	NA	NA
Land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA
Waste management	1.4	1.9	NA	NA	1.9	2.6	NA	NA

Source: Sweden's fifth national communication.

Note: The total effect of implemented and adopted policies and measures is defined as the difference between the 'without measures' and 'with measures' scenarios; the total effect of planned policies and measures is defined as the difference between the 'without measures' and 'with additional measures' scenarios.

Abbreviations: NA = not available.

87. The ERT commends Sweden for its work on projections and for the way in which the information is reported in the NC5. The ERT encourages Sweden to continue to strengthen its approach to producing projections and to explore further possible impacts, both domestically and abroad, of its bioenergy strategy. Sweden is also encouraged to assess the strengths and weaknesses of the models and approaches used for the projections. Further, more information could be provided in the next national communication on the demand side of the energy system and the identification of the potential for demand-side measures.

4. Supplementarity relating to mechanisms pursuant to Articles 6, 12 and 17

88. In its NC5, Sweden has provided information on how its use of the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol is supplemental to domestic action. Sweden has allocated SEK 1,200 million for the period up to 2011 and has launched 26 projects (24 clean development mechanism (CDM) and two joint implementation (JI) projects) in six countries. However, these projects are not necessarily required in order for Sweden to comply with its target under the Kyoto Protocol for the period 2008–2012 given that, according to the projections, Sweden is expected to meet this target with domestic measures alone.

89. In the 2009 climate and energy bill, Sweden envisages achieving a part of its national target for the non-EU ETS sector of a 40 per cent emissions reduction in 2020 compared to 1990 levels by climate investments in other EU member States and/or Kyoto Protocol flexible mechanisms.

D. Vulnerability assessment, climate change impacts and adaptation measures

90. In its NC5, Sweden has provided the required information on the expected impacts of climate change in the country and on adaptation options. The ERT noted that Sweden has broadly complied with the UNFCCC reporting guidelines on vulnerability, climate change impacts and adaptation measures. However, the required information on the expected impacts of climate change and on adaptation options was provided in very general terms in the NC5. During the review, Sweden provided additional information with substantially more detail with regard to climate change threats as well as the support and policy instruments to enhance adaptation and reduce vulnerability. Table 6 summarizes the information on vulnerability and adaptation to climate change presented in the NC5.

Table 6

Summary of information on vulnerability and adaptation to climate change

Vulnerable area	*Examples/comments/adaptation measures reported*
Agriculture and food security	*Vulnerability:* Agriculture will benefit from a warmer climate, the extension of growing periods, the possibility of harvesting more crops and cultivating new crops, but some problems could arise from the increased risk of pest, plant diseases, insects and weeds; a longer vegetation period and plant production during the summer will increase the potential for reindeer herding. *Adaptation:* Ensure that the knowledge of the consequences of climate change and options for action has been communicated to farmers; encourage the close cooperation of different institutions to facilitate work on climate adaptation for municipalities and county administrative boards; develop a web portal on adaptation to climate change in order to

Vulnerable area	*Examples/comments/adaptation measures reported*
	disseminate information.
Biodiversity and natural ecosystems	*Vulnerability:* The climatic and vegetation zones will move northwards due to the warmer climate, which will have an impact on the reproduction of plants and animals, their distribution and population size; the warmer climate will lead to the occurrence of pest; the biodiversity in the Baltic Sea will be significantly affected by the temperature and sea level rise and the decreased salinity. *Adaptation*: Enhance the knowledge of the risks linked to climate change on biodiversity and natural ecosystems.
Coastal zones	*Vulnerability:* Coastal areas, in particular western and south-western parts of the country, are threatened by flooding. *Adaptation:* A study on the impact of the rise in sea levels on the coastal environment to support the physical planning along the coast by county administrative boards in southern Sweden.
Fisheries	*Vulnerability:* Increased risk for Baltic herring, cod and salmon due to the temperature rise in the Baltic Sea, combined with a decrease in salinity; cold-water species will be replaced by warm-water ones in freshwater. *Adaptation*: Enhance the knowledge of the risks linked to climate change on fisheries.
Forests	*Vulnerability:* The longer growing season may lead to: (i) increased production; and (ii) a greater risk of frost damage; an increased risk of storm felling of forests and damage to the power supply due to stronger winds, particularly in southern Sweden; an increased risk from pest, plant diseases, insects and weeds. *Adaptation:* Enhance the knowledge of the consequences of climate change and options for action and ensure that it is communicated to forest owners; develop a web portal on adaptation to climate change in order to disseminate information.
Human health	*Vulnerability:* Extremely high temperatures during the summer may particularly affect vulnerable groups; an extended growing season may cause an increased production and spread of pollen as well as increased pollen allergies; a milder winter climate will reduce the number of cold-related health problems; higher temperatures during the summer may increase the risk of infectious spread with food water; floods may pollute drinking water, adversely affecting human health. *Adaptation:* Enhance the knowledge of the risks linked to climate change on human health.
Communication	*Vulnerability:* Floods, landslides and landslips due to the expected increase in precipitation, extreme rainfall and flow rates will affect the road and railway networks; the reduced depth of ground frost due to the increased temperature may affect the road network; shipping and aviation will probably not be greatly affected; port activity, particularly in the southernmost parts of the country, might be affected. *Adaptation:* Amend the legislation, the Planning and Building Act (2008); consideration of the risk of accidents, flooding and erosion in

Vulnerable area	*Examples/comments/adaptation measures reported*
	development plans; guidance prepared and methods developed for the adaptation of planning and construction; increased maintenance where road construction is based on ground frost; road protection from heat and water load; a tree-securing project for the railway network is under way.
Settlements	*Vulnerability:* Settlements located close to lakes, watercourses and the coast, in particular in western and south-western parts of the country, are threatened by flooding; an increased risk of damp and mould on buildings owing to the potentially warmer and damper climate; historic buildings close to the coast will be particularly vulnerable. *Adaptation:* Reach an agreement between the county administrative boards to change the water-discharging strategy to prevent the risk of flooding around Lake Vänern and the risk of landslides along the River Göta Älv.
Drinking water supply and wastewater management	*Vulnerability:* An increase in water resources, except in the south-eastern regions, owing to the increase in precipitation; the increased frequency of flooding will negatively impact the drinking water supply; a risk of sewage pipes being overloaded; pollution from contaminated soil and old landfills could be dispersed and carried to lakes and watercourses; a risk of the spread of waterborne infection and viruses; brown-coloured water and increased eutrophication as a result of increased leaching of nutrients and humus owing to the temperature increase; an increased risk of saltwater penetration into wells close to the coast in southern Sweden due to the sea level rise. *Adaptation*: No specific measures are mentioned.
Supply and use of energy	*Vulnerability:* The expected climate change will affect both energy supply and demand; the need for heating in the residential and services sector will decrease in winter; the peak load on electricity production and electricity networks will thus decrease; hydropower production will benefit from the increase in precipitation; increased wind power production; increased bioenergy production owing to the longer growing season; a risk for hydropower dams because of the increased precipitation. *Adaptation*: No specific measures are mentioned.

91. The ERT noted that Sweden has substantially broadened and deepened the understanding of climate risks through increased research, capacity-building and awareness-raising activities. Sweden is expected to be very vulnerable to climate change in view of the fact that its infrastructure (roads, railways, buildings, water and wastewater systems) is highly sensitive to flooding and landslides. Sweden has presented in its NC5 the expected impacts of climate change on infrastructure (communications, settlements, drinking-water supply and wastewater management, supply and use of energy), land-based industries (forestry, agriculture, fisheries, reindeer herding) and tourism, the natural environment and biodiversity, and human health. Extensive research with regard to climate change scenarios and an impact assessment have been undertaken since the Party's NC4.

92. Sweden has also reported on the adaptation measures which have been implemented so far and those planned for implementation in the future. The ERT notes that Sweden has intensified its work on climate adaptation since the NC4. In the area of legislation, the Planning and Building Act was amended in 2008. Different institutions have cooperated since 2005 in facilitating work on climate adaptation for municipalities and county administrative boards.

93. Responsibility for practical climate adaptation, such as physical and contingency planning, and emergency services, is assumed by the municipalities. Some municipalities in

Sweden recently affected by extreme climatic events are working on measures in the areas of physical planning and construction, investment in pumping systems to protect against flooding, and in water and wastewater systems, among others, in order to reduce their exposure to the prevailing climatic conditions and to respond to future climate change.

94. The strategy of Swedish environmental development cooperation aims to contribute to the long-term integration of climate change adaptation and mitigation in developing countries and countries with economies in transition. Sweden's contribution to adaptation is focused on the areas of water, agriculture and forestry, food security, disaster risk management, health, research and education. For example, support has been provided for the following projects: (i) adaptation in the agriculture sector for AIDS victims in Zimbabwe; (ii) an integrated water resource management strategy for the Zambezi River; and (iii) capacity-building under the CDM in the United Republic of Tanzania, Kenya, Uganda, and other developing countries. The ERT encourages Sweden to provide more substantive information on support and policy instruments to reduce vulnerability and to adapt, as well as to improve the structure of the chapter on vulnerability, climate change impacts and adaptation measures in its next national communication.

E. Financial resources and transfer of technology, including information under Articles 10 and 11 of the Kyoto Protocol

1. Provision of financial resources, including "new and additional" resources and resources under Article 11 of the Kyoto Protocol

95. In its NC5, Sweden has provided most of the information required under the Convention and the Kyoto Protocol. Substantially increased financing was provided for climate change through official development assistance (ODA) over the period 2004–2008. During this period, the total development assistance budget has increased to 1 per cent of gross national income (GNI), beyond the 0.7 per cent international ODA target, which indicates that "new and additional" financial resources have been provided pursuant to Article 4, paragraphs 3, 4 and 5 of the Convention as required by the UNFCCC reporting guidelines and under Article 11 of the Kyoto Protocol, as required by the Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol. Sweden has integrated climate concerns into development assistance to strengthen resilience to climate change while achieving other development objectives with the same financial input. During the review, Sweden noted that, while there is no internationally agreed definition of what constitutes "new and additional" financial resources, its increased allocation of ODA, which goes beyond the 0.7 per cent threshold, and additional climate funding provided during the period 2004–2008 could be considered as "new and additional" financial resources. The ERT recommends that Sweden be more transparent in its description of what it considers as "new and additional" financial resources in its next national communication.

96. Sweden has also provided detailed information on the assistance it has made available for each year during the period 2004–2008 to developing country Parties that are particularly vulnerable to the adverse effects of climate change to help them meet the costs of adaptation to those adverse effects. Furthermore, Sweden has provided information on financial resources related to the implementation of the Convention provided through bilateral, regional and other multilateral channels. The Swedish International Development Cooperation Agency (SIDA) plays an important role in channelling the bilateral aid to developing countries and countries with economies in transition. In particular, Sweden has provided, in its NC5, information on its financial contributions to the Global Environment

Facility (GEF) during the period 2004–2008. Sweden's contribution to the GEF amounts to SEK 947 million for the GEF Trust Fund, while its pledge for the fourth replenishment of the GEF Trust Fund (GEF 4) amounts to SEK 838 million to be paid over a 10-year period up to 2016.

97. In addition, Sweden has provided information on its financial contributions to the core budget of the UNFCCC, and to the CDM Executive Board. The Swedish contribution to the Adaptation Fund totalled SEK 100 million and was a one-off contribution in 2010. Table 7 summarizes information on financial resources.

Table 7

Summary of information on financial resources and technology transfer for 2004–2008

	Years of disbursement (SEK million)				
Channel of financial resources	*2004*	*2005*	*2006*	*2007*	*2008*
Official development assistance (ODA)		23 746	28 090	30 139	32 038
Climate-related aid in bilateral ODA[a]	998.4	2 100	2 116	1 777	2 182
Contributions to the GEF	132	138	175 (incl 10 SCCF)	273 (incl 15 SCCF, 7 LDCF)	276 (incl 15 SCCF)
Pledge for the 4th GEF replenishment			838 (76.2 SDR) + 356 (32.4 SDR voluntary contribution)		
JI and CDM under the Kyoto Protocol	The budget given to the Energy Agency will provide a total of 12–16 Mt of Kyoto units from project-based mechanisms.				
Other (bilateral/multilateral) (USD million)	NA		NA	NA	NA

Note: [a] bilateral and regional financial support related to the implementation of the Convention and its Kyoto Protocol.

Abbreviations: CDM = clean development mechanism, GEF = Global Environment Facility, JI = joint implementation, LDCF = Least Developed Countries Fund, NA = not applicable, SCCF = Special Climate Change Fund, SDR = special drawing rights.

98. The ERT noted that the greatest share of bilateral and regional contributions for the period 2004–2008, around SEK 5 billion, is allocated to adaptation measures, focused on interventions in the water and agriculture sectors, disaster risk management, health, education and research. Around SEK 3.3 billion is used for mitigation, consisting predominantly of contributions to energy and waste management. Compared to the NC4, the cooperation has shifted from a traditional approach to a results-based approach. The largest share of climate change related support has been provided to the United Republic of Tanzania, Mozambique, Viet Nam and other developing countries.

99. In addition to the financial contributions in the period 2004–2008, Sweden has committed substantial funds for climate change adaptation and mitigation through the 'fast-start funding' under the Copenhagen Accord during the period 2010–2012. This funding covers the areas of disaster preparedness, clean technology, capacity-building and forestry activities. Adaptation is the main focus of the bilateral part of the Climate Change Initiative

that amounts to half of the Swedish 'fast-start' fund contribution, at approximately SEK 4 billion. A total of approximately EUR 800 million will be channelled via bilateral, regional as well as multilateral organizations to address climate concerns in developing countries.

2. Activities related to transfer of technology, including information under Article 10 of the Kyoto Protocol

100. In its NC5, Sweden has provided information on measures related to the promotion, facilitation and financing of the transfer of, or access to, environmentally sound technologies. It has also provided information on its support for technology transfer in relation to the implementation of a broad range of activities, including the transfer of 'soft' and 'hard' technologies. Furthermore, Sweden has reported in textual format on steps taken by the government to promote, facilitate and finance the transfer of technology, and to support the development and enhancement of endogenous capacities and technologies of developing countries. However, the ERT noted that a clear distinction was not made in the NC5 between activities undertaken by the public sector and those undertaken by the private sector. According to the NC5, the private sector assists in climate change related cooperative actions and activities with regard to financial support, such as technology development, research and various forms of capacity development in developing countries. However, the magnitude of private sector activities compared to public sector activities has not been clearly stated, and the success and failure stories in relation to technology transfer have not been provided in the NC5. The ERT encourages Sweden to provide this information in its future national communications.

101. The ERT noted that Sweden supports both "enabling environment" through institutional capacity-building, the development of standards and education programmes as well as research support, and 'hard' and 'soft' technology transfer through targeted activities such as the initiative Demo-Environment and a number of projects. Sweden supports technology transfer mainly through bilateral and multilateral initiatives in areas such as environmental technology and waste management, recycling, bioenergy, solar energy, wind power and energy efficiency. Some specific examples of technology transfer activities reported in the NC5 include: support for holistic and sustainable urban development (SymbioCity) in China, South Africa and India; a project on Energy Services Companies in Zambia; a project entitled Demo-Miljö on environmental technology initiatives aimed at sustainable urban development and renewable energies in a number of countries; a waste management project in India; and a project to set up monitoring systems in Mozambique and Viet Nam. The ERT encourages Sweden to further improve the quality of its reporting by specifically providing success and failure stories in relation to technology transfer in its next national communication.

F. Research and systematic observation

102. Sweden has provided information on its actions relating to research and systematic observation, and has addressed both domestic and international activities, including the World Climate Research Programme (WCRP), the Global Climate Observing System (GCOS), and the Intergovernmental Panel on Climate Change (IPCC). Information was provided on the National Geodata Strategy which is based on EU directives and linked to access to national and international environmental and climate data. The NC5 also reflects action taken to support related capacity-building in developing countries through SIDA. Furthermore, Sweden has provided a summary of information on GCOS activities in accordance with the UNFCCC reporting guidelines.

103. The ERT noted numerous ongoing research activities at the national, Nordic, European and global levels, including research on climate models, the impacts of climate change, and socioeconomic analyses. Several national universities, the Swedish Meteorological and Hydrological Institute (SMHI) and the Rossby Centre are contributing to various research projects, such as the EU projects ENSEMBLES, DAMOCLES, ERA-Net CIRCLE, SAWA, and BALTEX. Sweden is also active in the WCRP regarding the downscaling of phase five of the Coupled Model Intercomparison Project (CMIP5) of the global scenarios, and participates in the European Earth Modelling Consortium to develop a Global Earth System Model. An interdisciplinary research programme is being undertaken on how Sweden can steer energy and transport systems towards low-carbon and sustainable pathways by 2050.

104. In the NC5, Sweden has provided information on its collaboration with developing countries on agricultural research through the Consultative Group on International Agricultural Research (CGIAR). Research cooperation relates to energy, the environment and the climate in Mozambique, and to the reduction of the risk of flooding by adapting the courses of rivers in Honduras. New measuring stations have been installed in Asia, and studies on the impacts of climate change on agriculture as well as on access to water and health have been carried out within the framework of the research programme Atmospheric Brown Clouds (ABC) Asia.

105. Sweden participates fully in the GCOS Surface Network (GSN), providing long-term observations and measurements, including Essential Climate Variables (ECV), to the World Meteorological Organization's World Weather Watch, GSN, the GCOS Upper-Air Network (GUAN), the Global Terrestrial Observing System (GTOS), and the Global Runoff Data Centre (GRDC). Sweden also contributes to the development of a new infrastructure for global observation systems and services based on remote analysis within the framework of the European programme Global Monitoring for Environment and Security (GMES). In addition to the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) programme, Sweden also contributes to the development of satellite products for climate monitoring at various scales and assists, through the Jason-2 project, in the monitoring of the dynamics of the oceans and of sea levels. Under the cooperation programme of the European Space Agency (ESA), the Swedish Space Agency assists in the development of new generations of meteorological satellites and other remote-sensing satellites for studies of the Earth and its climate system. SMHI hosts the European EuroGCOS secretariat and, at the European level, is working to increase access to data and improve measurement activity, particularly in coastal zones.

G. Education, training and public awareness

106. In the NC5, Sweden has provided extensive information on its actions relating to education, training and public awareness. Communication on climate change and climate-related measures is one of the Party's key activity areas in relation to climate change impacts and mitigation. Knowledge transfer and information are considered to be an important policy instrument in the overall context of climate change policy. At the national level, the Swedish EPA coordinates work towards strengthening and broadening environmental responsibility in society and, in particular, supports the environmental efforts of other actors by developing and disseminating knowledge, formulating requirements and levels of aspiration regarding environmental responsibility in society, and following up and evaluating the effects of those efforts. To stimulate knowledge-building at the local level (e.g. municipalities), public education and information initiatives relating to climate change have become a mandatory requirement for obtaining government investment grants for local authority climate measures.

107. Sweden has a very comprehensive package of awareness-raising activities. During the review, detailed information on past and recent developments of these activities was provided, including information on the current level of awareness and willingness to act among Swedish citizens. Sweden has used a variety of means to communicate knowledge on the impacts of climate change, and has recently shifted its focus to sectoral initiatives in order to communicate concrete options for action at the sectoral level. The ERT noted that training in the building sector could be improved and encourages Sweden to include information on such training in its next national communication.

108. Non-governmental organizations (NGOs) have an active role to play in framing climate change policies in Sweden. NGOs and other information centres also contribute to knowledge-building and dialogue regarding the problems of and solutions to climate change. The ERT encourages Sweden to continue its high level of activities on education, training and public awareness. The Party could also consider knowledge-sharing regarding activities and elements related to a low-carbon society in order to prepare the broader public about possible changes that might be needed in the longer term.

H. Evaluation of supplementary information under Article 7, paragraph 2, of the Kyoto Protocol

109. Sweden has provided all supplementary information under Article 7, paragraph 2, of the Kyoto Protocol in its NC5. The supplementary information is placed in different sections of the NC5. Table 8 provides an overview of supplementary information under Article 7, paragraph 2, of the Kyoto Protocol as well as references to the NC5 chapters in which this information is provided.

110. The technical assessment of the information reported under Article 7, paragraph 2 is contained in the relevant sections of this report.

Table 8

Overview of supplementary information under Article 7, paragraph 2, of the Kyoto Protocol

Supplementary information	*Reference*
National registry	Annex 4
National system	Annex 3
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	Chapter 5.7
Policies and measures in accordance with Article 2	Chapter 4.2
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	Chapter 4.1
Information under Article 10	Chapters 4.2–4.3, 6.1, 6.4, 7.5, 8.2.6, 8.3 and 9.5.5
Financial resources	Chapters 7.2–7.4

I. Minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol

111. Sweden reported the information requested in section I.H. of the annex to decision 15/CMP.1 on the "Minimization of adverse impacts in accordance with Article 3, paragraph

14" as part of its 2009 annual submission and elaborated thereon in its 2010 annual submission. During the in-country review, Sweden provided the ERT with the additional information on how it strives to implement its commitments under Article 3, paragraph 1, of the Kyoto Protocol in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention. The ERT considers the reported information to be transparent and complete. The ERT encourages Sweden to continue exploring and reporting on the adverse impacts of the response measures.

112. In connection with the implementation of PaMs, Sweden has carried out an impact assessment, including an environmental impact assessment as a basis for decision-making. The analysis also includes an assessment of the risks of adverse effects on other countries, to the extent possible. Proposals for changes to policy instruments are formulated in consultation with the stakeholders involved in order to provide them with an opportunity to comment on the proposals. Suggestions regarding new rules or guidelines that may affect trade with other countries are transmitted within the EU and in accordance with the rules of the World Trade Organization (WTO). The design of proposals for changes to policy instruments follows a process that takes into account any possible negative side effects on other countries that may arise from these instruments; one example in this connection is the special sustainability criteria devised for vehicle biofuels under the EU renewable energy directive.

113. Sweden is committed to actions that may have positive effects on the prospects of developing countries to adapt to climate change and implement measures to reduce their GHG emissions. A description is given in chapter 7 of the NC5 of such actions in the areas of technology transfer, knowledge-sharing and support for adaptation measures. In addition, Sweden has contributed multilateral aid in the form of additional financial support to the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund (LDCF).

114. The 2010 NIR and the additional information provided during the review presented several of Sweden's initiatives which aim to minimize the adverse effects of climate change. The ERT notes that Sweden has, to a large extent, reformed the energy markets and phased out market imperfections. The market price of electricity is deregulated and governed by the balance between demand and supply in a cross-border electricity market. In Sweden, fossil fuels used outside the EU ETS are subject to a carbon tax to reflect the external cost. Within the EU ETS, it is mainly the price of allowances that reflects the external effect of CO_2 emissions and the market failure. Sweden does not extract oil, natural gas or coal, and therefore has no subsidies on these fuels.

III. Conclusions and recommendations

115. The ERT concludes that the NC5 provides a good overview of the national climate policy of Sweden. The information provided in the NC5 includes almost all mandatory information required by the UNFCCC reporting guidelines and all elements of the supplementary information required under Article 7 of the Kyoto Protocol, with the exception of information on what "new and additional" financial resources it has provided. During the review, Sweden provided additional information on this matter. The ERT noted that despite economic growth of nearly 50 per cent since 1990, GHG emissions have been noticeably reduced in absolute terms and on a per capita and per unit of GDP basis; namely, GHG emissions (excluding LULUCF) per capita have been reduced from 8.5 t CO_2 eq in 1990 to 6.9 t CO_2 eq in 2008, and per unit GDP from 0.4 kg CO_2 eq in 1990 to 0.2 kg CO_2 eq in 2008. This suggests a decoupling of emissions from economic growth.

116. Sweden's emissions for 2008 were estimated to be 11.7 per cent below the 1990 level excluding LULUCF and 19.1 per cent above the base year level including LULUCF. Emission decreases were driven by a replacement of oil with biomass in district heating and a switch to heat pumps and pellet-fired boilers in the residential and services sector, a reduction in the number of cattle and a decrease in the use of both mineral fertilizers and manure in agriculture as well as an increase in the collection and use of landfill gas for energy and the imposition of a ban on the landfilling of organic waste. The onset of the economic crisis at the end of the 2000s affected industrial output, transportation activities and related emissions.

117. In the NC5, Sweden presents GHG projections for the period 1990–2020. Four scenarios are included and related sensitivity analyses are provided: the baseline ('without measures') scenario; the 'with measures' scenario; and two 'with additional measures' scenarios. The projected reduction in GHG emissions under the 'with measures' scenario in relation to the base year is 10 per cent. Thus, the projections indicate that Sweden will meet its emission-reduction commitments under the Kyoto Protocol and the EU burden-sharing agreement for the first commitment period of the Kyoto Protocol, which is 104 per cent of the base year level emissions. Under the 'with measures' scenario, GHG emissions are expected to further decrease by 12.6 per cent in 2020 compared to the Kyoto base year level. Sweden is expected to reach its EU-level 2020 target for the non-EU ETS sector, which is having emissions 17 per cent below the 2005 level in 2020. To achieve its national target for the non-EU ETS sector, which is having emissions 40 per cent below the 1990 level by 2020, further PaMs are needed as well as climate investment in other countries.

118. The NC5 contains information on how its use of the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol is supplemental to domestic action. Sweden is not planning to make use of the Kyoto Protocol mechanisms to meet its target for the first commitment period of the Kyoto Protocol.

119. Sweden is on track to meet its commitments for the first commitment period of the Kyoto Protocol with existing measures alone. The most important PaMs to meet these commitments are the energy and carbon taxes as well as the EU ETS. The effect of these key measures has been complemented by the effect of a number of other measures, such as the green electricity certificate system that promotes the use of renewables, the improvement of energy efficiency in energy-intensive industry and in the building sector, and legislation such as the ban on the landfilling of household organic waste. The 2009 climate and energy bill sets ambitious climate and energy targets by 2020. Further, it specifies the long-term vision that, in 2050, Sweden will have zero net emissions in the atmosphere. To achieve this long-term target, the Government of Sweden has adopted a programme to further tighten its policy instruments. New PaMs may also have to be put in place to achieve this ambitious long-term goal.

120. The greatest share of Sweden's bilateral and regional contributions for the period 2004–2008 is allocated to adaptation measures, focused on interventions in the water and agriculture sectors, disaster risk management, health, education and research. Sweden, through the 'fast-start funding' under the Copenhagen Accord, has committed substantial additional funds for climate change adaptation and mitigation, including disaster preparedness, clean technology, capacity-building and forestry activities during the period 2010–2012. Technology transfer activities include 'soft' and 'hard' components and occur mainly through bilateral and multilateral initiatives, as well as through the private sector. However, the magnitude of private sector activities compared to public sector activities was not clearly stated, and the information on success and failure stories of technology transfer was not provided in the NC5.

121. Sweden considers vulnerability and options for adaptation to climate change in all relevant sectors and areas, with particular attention to infrastructure, land-based industries

and tourism, the natural environment and biodiversity, and human health. Its strategy for adapting to climate change focuses on devolving power and responsibility of practical climate adaptation to local governments. Some municipalities in Sweden recently affected by extreme climatic events are implementing measures to reduce their exposure to the prevailing climatic conditions and to respond to future climate change.

122. Sweden uses a broad range of communication means to promote education, training and public awareness with regard to climate change. It also has a very comprehensive package of awareness-raising activities. The Party has recently shifted its focus to sectoral initiatives in order to communicate concrete options for action in specific sectors. An impressive array of research activities is under way in Sweden at the national, Nordic, European and global levels, including research on climate models, the impacts of climate change, and socioeconomic analyses. Sweden also actively participates in international research and systematic observation activities, such as GCOS.

123. The ERT concluded that Sweden's national system continues to perform its required functions as set out in decision 19/CMP.1; that the national registry continues to perform the functions set out in decision 13/CMP.1 and decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions. The ERT noted that updates of databases and applications, implemented security measures and changes to the national registry software are documented on a regular basis by nominated responsible staff.

124. Supplementary information under Article 7, paragraph 1, of the Kyoto Protocol on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol provided by Sweden in its 2009 and 2010 annual submissions is complete and transparent. Sweden contributes to a number of measures that may have positive effects on the prospects of developing countries to adapt to climate change. Moreover, Sweden has, to a large extent, reformed the energy markets and phased out any market imperfections.

125. In the course of the IDR, the ERT formulated one key recommendation relating to the completeness and transparency of Sweden's reporting under the Convention and its Kyoto Protocol. Specifically, the ERT recommends that Sweden improve the completeness of its reporting by providing, in the next national communication, a definition of "new and additional" financial resources.

126. The ERT encourages Sweden to undertake a number of improvements regarding transparency and completeness of reporting; the most important of these are that Sweden:

(a) Provide more information on how PaMs are being designed and implemented to meet the long-term policy objective of zero net emissions and a low-carbon society by 2050;

(b) Report more extensively on new PaMs and their potential impact based on ex ante assessments;

(c) Present a broader portfolio of PaMs to include measures aimed at energy saving in buildings;

(d) Evaluate, through sensitivity analyses, the implications of its climate strategy on future emission trends and the cost of different options for bioenergy;

(e) Assess the strengths and weaknesses of the projection model approaches and if and how they can be improved;

(f) Provide more information on the success and failure stories of technology transfer.

IV. Questions of implementation

127. During the review, the ERT assessed the NC5, including supplementary information provided under Article 7, paragraph 2, of the Kyoto Protocol and reviewed information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, with regard to timeliness, completeness and transparency. No question of implementation was raised by the ERT during the review.

Annex

Documents and information used during the review

A. Reference documents

"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications". FCCC/CP/1999/7. Available at <http://unfccc.int/resource/docs/cop5/07.pdf>.

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2009 GHG inventory submission of Sweden. Available at <http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/4771.php>.

2010 GHG inventory submission of Sweden. Available at <http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5270.php>.

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Reino Abrahamsson (Swedish Environmental Protection Agency), including additional material on updated PaMs, GHG projections, the national registry and recent climate policy developments in Sweden, in particular on the certification of biofuels. The following documents[1] were also provided by Sweden:

Frances Sprei. 2010. *Energy Efficiency versus Gains in Consumer Amenities; examples from passenger cars and the Swedish building sector.* Göteborg, Chalmers University of technology. <http://www.dissertations.se/dissertation/b25c426cde/>.

[1] Reproduced as received from the Party.