Statistics Finland

Ympäristöministeriö
Miljöministeriet
Ministry of the Environment

Finland's First Biennial Report
under the UNFCCC

30 December 2013

Contents

1 Introduction

Finland's first biennial report (BR1) under the UNFCCC has been elaborated in accordance with the UNFCCC biennial reporting guidelines for developed country Parties contained in Decision 2/CP.17 (Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention, Document: FCCC/CP/2011/9/Add.1) as adopted by the Conference of the Parties at its seventeenth session.

Information provided on greenhouse gas emissions and trends is consistent with the information in Finland's greenhouse gas inventory submission in 2013. The emission and removal estimates presented are those in the resubmission made in September 2013 in response to the annual inventory review under the UNFCCC and Kyoto Protocol.

The EU and its Member States are committed to a joint quantified economy-wide emission reduction target of 20 per cent by 2020, compared to 1990 levels. Therefore, Finland and other Member States of the EU, have not submitted individual economy-wide emission reduction targets to the UNFCCC secretariat. The details of the EU joint target under the UNFCCC are clarified in the document *Additional information relating to the quantified economy-wide emission reduction targets contained in document FCCC/SB/2011/INF.1/Rev.1* (FCCC/AWGLCA/2012/MISC.1).

This biennial report provides information on progress made in relation to Finland's contribution to the joint EU quantified economy-wide emission reduction target, including information on the target, Finland's historical emissions and projected emissions. As the period for the joint target covers the years 2013 to 2020, some of the information requested for in the reporting requirements for the biennial report will be available only from 2015 onwards. Finland has in these cases used the notation key NA (not available) or NE (not estimated), as appropriate in the CTF tables. The information provided in the tables assessing progress in the achievement of the emissions reduction target cover years only up to 2012, and are therefore not relevant to the target for the period 2013 to 2020. The information provided describes progress in meeting Finland's target under first commitment period under the Kyoto Protocol, which is part of emission reduction pathway towards 2020. Finland's target for the first commitment period was to limit the greenhouse gas emissions to the level in the base year.

Furthermore, the report includes information on Finland's provision of financial, technological and capacity-building support to Parties not included in Annex I to the Convention.

The information to be reported electronically in the Common Tabular Format in accordance with Decision 19/CP.18 adopted by the Conference of the Parties on its eighteenth session and contained in the document: FCCC/CP/2012/8/Add.3 is submitted separately to the UNFCCC using the CTF software.

2 Information on greenhouse gas emissions and trends

This section of Finland's biennial report under the UNFCCC contains summary information on the national greenhouse gas emissions and emission trends in accordance with the UNFCCC Annex I reporting guidelines[1]. The information is consistent with Finland's most recent annual inventory submission to the UNFCCC and Chapter 3 of Finland's Sixth National Communication.

Also summary information on the national inventory arrangements in accordance with the UNFCCC Annex I inventory reporting guidelines is included, as well as changes to these arrangements since Finland's Fifth National Communication.

2.1 Total greenhouse gas emissions and trends

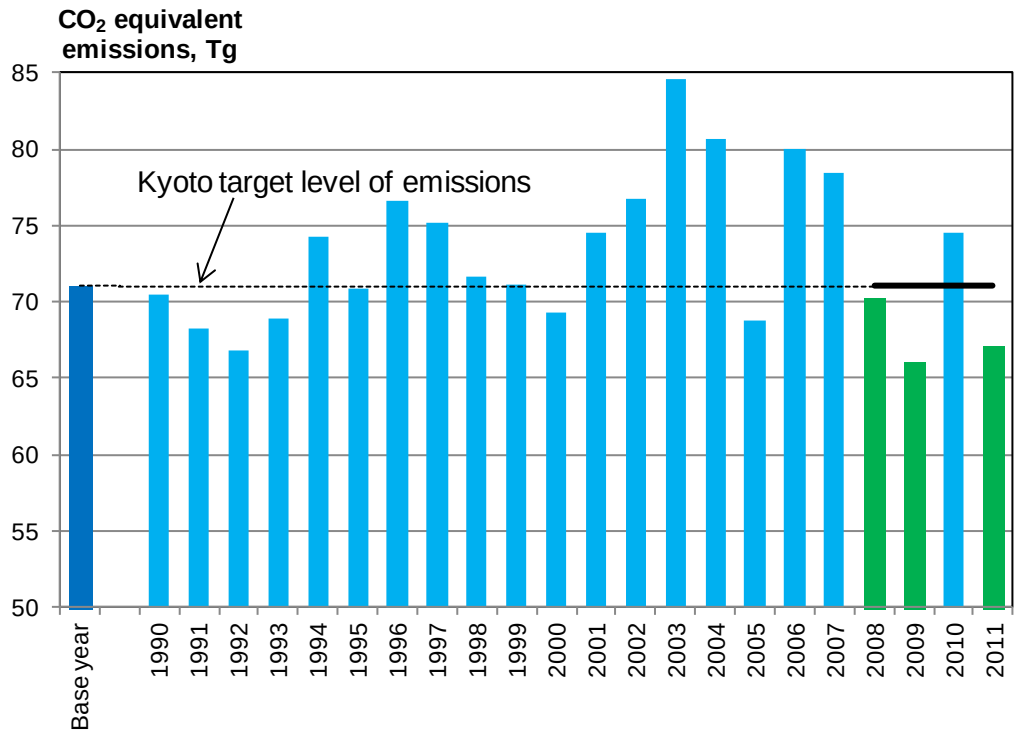
Description and interpretation of emission trends for aggregated greenhouse gas emissions

In 2011, Finland's greenhouse gas emissions totalled 67.0 Tg CO_2 eq. (million tonnes of CO_2 equivalent). The total emissions in 2010 were approximately 6 per cent (4.0 Tg) below the level of the base year (1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6) – the level to which Finland should limit its emissions during the Kyoto Protocol's first commitment period between 2008 and 2012. Compared to 2010, the emissions decreased with 10 per cent.

Figure 2.1 shows a time series of CO_2 equivalent emissions in Finland during 1990–2011 and the emission limitation target for the first commitment period of the Kyoto Protocol. The total greenhouse gas emissions as CO_2 equivalent are presented in CTF table 1.

[1] 'Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories'. In: Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11. (FCCC/SBSTA/2006/9).

Figure 2.1 CO_2 equivalent emissions and the emission target of the Kyoto Protocol (Tg CO_2 eq.)



Description and interpretation of emission trends by gas

The most important greenhouse gas in Finland is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions has varied from 80 per cent to 86 per cent. In absolute terms, CO_2 emissions have decreased 0.4 Tg (i.e. 1 per cent) since 1990. Around 94 per cent of all CO_2 emissions originate from the energy sector in 2011. The amount of energy-related CO_2 emissions has fluctuated much according to the economic trend, the energy supply structure (including electricity imports and exports) and climate conditions.

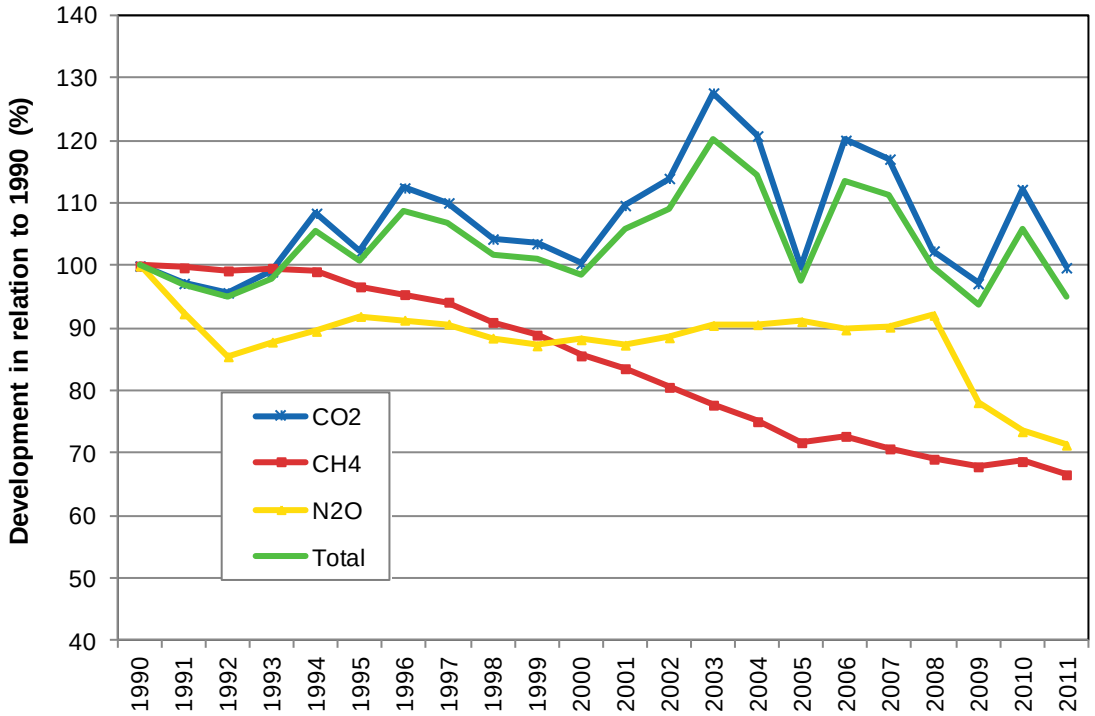
Methane emissions (CH_4) have decreased by 33 per cent from the 1990 level. This is mainly due to the improvements in waste treatment and a contraction in animal husbandry in the agricultural sector.

Correspondingly, emissions of nitrous oxide (N_2O) have also decreased by 29 per cent; the biggest decline occurred 2009 when the implementation a N_2O abatement technology in nitric acid production reduced emissions significantly. Another reason for the decrease of the emission is the reduced nitrogen fertilisation of agricultural fields.

The emissions of F-gases have increased over eleven fold during 1990–2011. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications.

The development of emissions of the three main greenhouse gases (CO_2, CH_4 and N_2O) relative to the 1990 level is presented in Figure 2.2.

Figure 2.2 Relative development of CO_2, CH_4 and N_2O without the LULUCF sector in time series relative to the 1990 level (%)

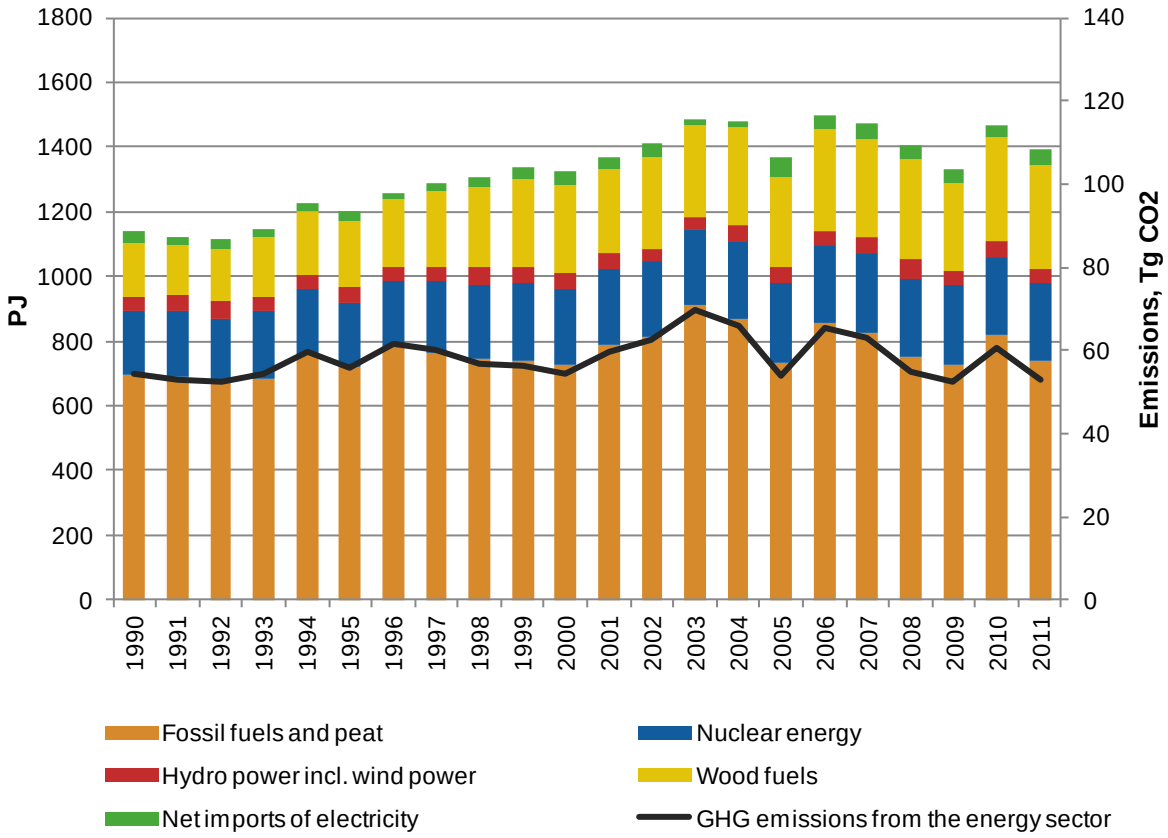


Description and interpretation of emission trends by category

The development of the greenhouse gas emissions by sector is presented in CTF Table 1. The energy sector is the most significant source of greenhouse gas emissions in Finland. This reflects the high energy intensity of the Finnish industry, extensive consumption during the long heating period, as well as energy consumption for transport in a large and sparsely inhabited country (Figure 2.3). In the middle of time series total energy consumption increased even if emissions decreased, reasons for that were in increased use of wood fuels, nuclear energy and net imports of electricity. In 2011, the energy sector's emissions were about 2 per cent below the 1990 level. The total energy consumption decreased in 2011 approximately 5 per cent compared with the previous year, totalling 33.2 Mtoe. The final energy consumption has decreased slightly in all consumption sectors in 2011. The biggest decrease was in heating of buildings due to around 20 per cent lower number of heating degree days compared to previous year. Another reason for decreasing emissions is the increased share of net imports of electricity, which lowers the condensing power production.

Energy industries (mainly electricity and district heating production) caused approximately 46 per cent of the total emissions in the energy sector in 2011. Emissions from the energy industries were 27 per cent higher in 2011 than in 1990.

Figure 2.3 Development of total energy consumption by energy source (PJ) and the energy sector's greenhouse gas emissions (Tg CO_2 eq.) in Finland



The most important drivers in the trend of the energy sector's greenhouse emissions have been the changes in the level of annually imported electricity and fossil fuel based condensing power in annual energy production (Figure 2.4). Total consumption of energy in Finland amounted to 1,388 petajoules (PJ) in 2011, which was 5 per cent less in 2010. The industrial output increased slightly as well as total energy consumption in industry. The rise in consumption was particularly caused by increased production in energy-intensive industries, e.g. the forest industry, chemical industry and manufacture of basic metals. The forest industry is the biggest user of electricity in manufacturing and the most significant user of renewable energy. The use of fossil fuels excluding peat went down by 11 per cent from the year before. Of fossil fuels, the consumption of coal (including hard coal, coke, and blast furnace and coke oven gas) decreased by 22 per cent. The use of coal went down significantly in condensing power production. The use of peat decreased by 10 per cent and the use of natural gas 13 per cent from the year before.

The share of renewable energy of total energy consumption was at 28 per cent. The use of fossil fuels went down by 11 per cent from the year before. Of fossil fuels, the consumption of coal (including hard coal, coke, and blast furnace and coke oven gas) decreased by 22 per cent. The use of coal went down significantly in condensing power production. The hydro power situation in the Nordic countries improved, but in Finland the production of hydro power decreased by 4 per cent. The production of wind power increased by 64 per cent, but it still accounted for only 0.7 per cent of all electricity produced.

Total electricity consumption diminished by four per cent and amounted to 84.2 TWh. Of the total electricity consumption, 84 per cent was covered by domestic production and 16 per cent by net imports of electricity from Russia, the Nordic countries and Estonia. Net imports of electricity increased by 32 per cent due to the improved water situation in the Nordic countries.

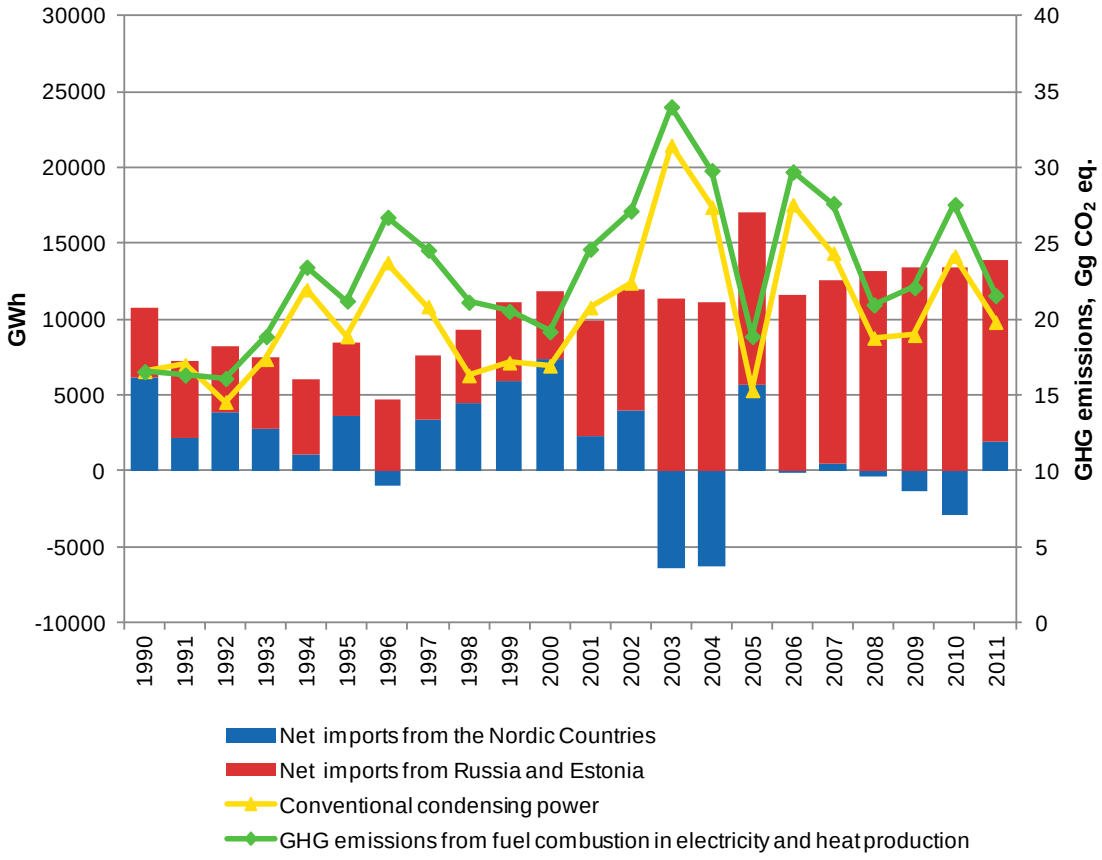
Production of electricity decreased by nine per cent from the previous year. The use of fossil fuels in the production of electricity and heat decreased by 21 per cent and the use of peat by 12 per cent. By contrast, the use of renewable fuels increased by three per cent and exceeded the use of fossil fuels.

Altogether 33 per cent of electricity produced in Finland was produced with renewable energy sources. Around one-half of this was produced with hydro power and almost all of the remainder with wood. Thirty-two per cent of the production of electricity was covered with nuclear power, 27 per cent with fossil fuels and seven per cent with peat. The amounts of electricity produced with fossil fuels and peat decreased from the previous year. The biggest decrease was seen in electricity produced with coal.

Production of district heat amounted to 34.0 TWh in 2011. Production decreased by 13 per cent from the previous year. The consumption of district heat diminished from the previous year as the autumn was exceptionally mild according to the Finnish Meteorological Institute. More than half of the district heat was produced with fossil fuels, although the amount of district heat produced with fossil fuels decreased by almost 20 per cent from the previous year. The individual fuel that was used most in the production of district heat was natural gas.

Production of industrial heat amounted to 56.2 TWh in 2011. Production decreased by four per cent from the previous year. As in the previous years, lower than normal amounts of industrial heat were used. Over 60 per cent of the heat used by industry was produced with renewable fuels. The individual fuel that was used most was black liquor from the forest industry.

Figure 2.4 Greenhouse gas emissions from fuel combustion in electricity and heat production, net imports of electricity from the Nordic Countries and Estonia and Russia and production of conventional condensing power



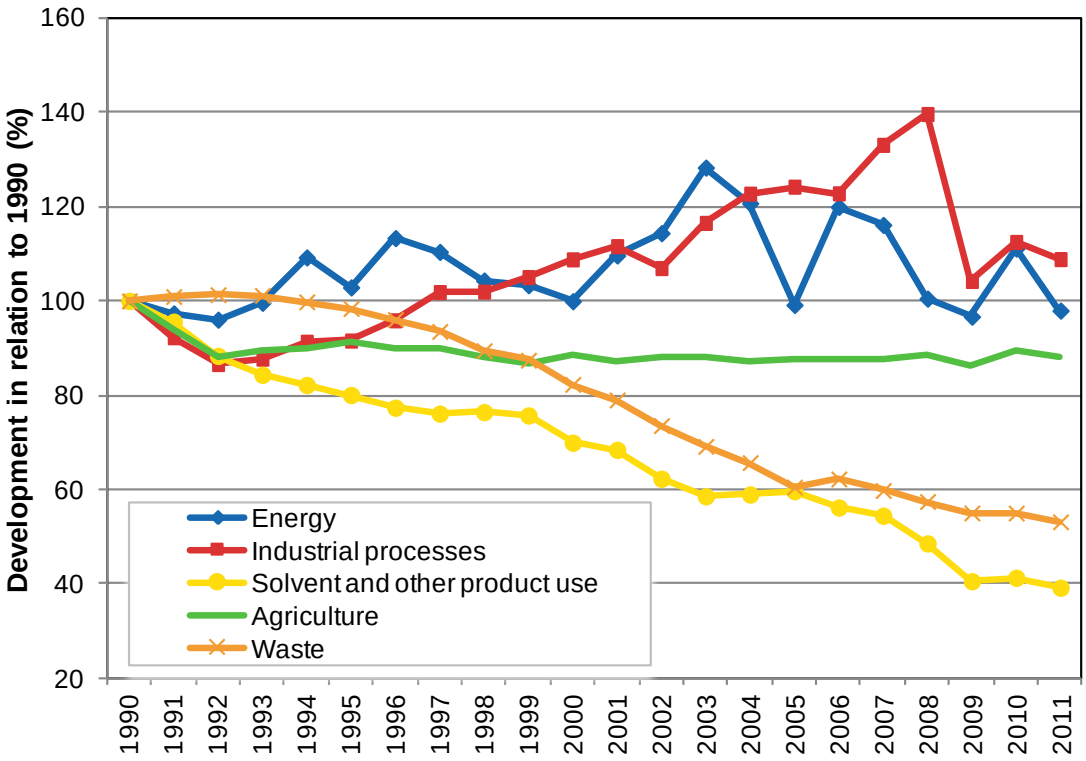
Manufacturing industries and construction produce much energy themselves. Their share of the energy-related emissions was around 18 per cent in 2011. Emissions from manufacturing industries and construction have declined by 28 per cent since 1990. The main reasons behind this trend are increased use of biofuels in the forest industry and outsourcing of power plants from industry to the energy sector.

Emissions in the transport sector have grown by around 4 per cent compared with the 1990 level. The magnitude of the growth is smaller in Finland than in many other Annex I countries, mainly due to the effect that the economic recession in the early 1990's had on transport. The share of transportation of energy-related emissions was one fourth in 2011. The worldwide economic downturn that began 2008 decreased the kilometrage of all transport modes. The upward trend in emissions in 2010 compared to the year 2009 is due to the recovery from the economic downturn in road traffic. The increase in emissions comes especially from heavy-duty transport.

Emissions from the residential sector have decreased by 52 per cent and from commercial sectors by 52 per cent compared with the 1990 levels. The decrease is mainly due to substitution of direct oil heating with district heating and electricity.

Figure 2.5 provides an overview of the development of the CO_2 equivalent emissions in the years 1990-2011 by IPCC source sector.

Figure 2.5 Relative development of greenhouse gas emissions by main source category relative to the 1990 level (1990=100%)



Emissions of industrial processes have increased by 9 per cent (0.5 Tg CO_2 eq.) from 1990 to 2011. At the beginning of the time series, some production plants were closed down and that caused a fast decrease in emissions. After this, the production outputs and emissions increased and reached the level of the year 1990 in 1996. Since these years the overall trend in the emissions has been increasing, however emissions decreased rapidly in 2009 due to the global recession as the demand for industrial products diminished. Emissions however started to grow along with production after the recession and in 2010 CO_2 emissions were almost at the same level than in 2008. CO_2 emissions have increased 31 per cent from 1990 to 2011. Reasons are increased production of steel, hydrogen and use of limestone and

dolomite. Methane emissions have increased by 75 per cent, but he total emissions were only 0.009 Tg CO_2 eq. in 2011. Nitrous oxide emissions have fluctuated during the period 1990 to 2011; the first fast decrease due to the closing of a nitric acid production plant and after that a slow increase of emissions, the second fast decrease started in 2009 originated from implementation new N_2O abatement technology in nitric acid production and decreased demand of fertilisers. Since 1990, nitrous oxide emissions have decreased 1.5 Tg CO_2 eq. (92 per cent). The F-gas emissions are over eleven fold compared with the 1990 as well as the 1995 emissions. 1995 is the base year for these emissions under the Kyoto Protocol. Emissions of F-gases have increased 0.9 Tg CO_2 eq. A key driver behind the increasing trend in emissions of F-gases has been the substitution of ozone depleting substances (ODS) by F-gases in many applications.

Agricultural emissions have decreased by 12 per cent (0.8 Tg CO_2 eq.) over the period 1990-2011. The main driver behind the decreasing trend has been the overall change in the economy of agriculture, which has resulted in a decrease in the number of animals and an average increase in farm size. Cattle produce the major part of the emissions from enteric fermentation in Finland, thus the 33 per cent decrease in the number of cattle since has influenced both emissions from enteric fermentation and nitrous oxide emissions from manure management. Methane emissions from manure management have, on the contrary, increased somewhat, despite the decrease in the number of animals. This is mostly due to an increase in the number of cattle and swine kept in slurry-based manure management systems, which have methane emissions tenfold compared with solid storage or pasture. Nitrous oxide emissions from manure management are smaller in slurry than in solid storage systems, which have also had an impact on the decreasing trend in N_2O emissions.

The most important sources of N_2O emissions in the agricultural sector are agricultural soils. Nitrous oxide emissions from agricultural soils have decreased by over 10 per cent compared with the 1990 level. The main reasons for the decreasing trend are the reduction in animal numbers, which affects the amount of nitrogen excreted annually to soils and the fall in the amount of synthetic fertilisers used annually. The emissions from cultivated organic soils have increased as a result of the increased area of these soils.

Emissions from the waste sector have declined quite constantly since 1990. The decrease of 1.9 Tg CO_2 eq. has mainly been due to the implementation of the new Waste Act in Finland in 1994. At the beginning of the 1990's, around 80 per cent of the generated municipal waste was taken to solid waste disposal sites (landfills). After the implementation of the new Waste Act, minimisation of waste generation, recycling and reuse of waste material and alternative treatment methods to landfills have been endorsed. Similar developments have occurred in the treatment of industrial waste and municipal and industrial sludges. While the emissions from solid waste disposal on land have decreased, the emissions from composting have increased during the last years. In addition, the increase of waste incineration has decreased the emissions from landfills from 2008 onwards. Implementation of landfill gas recovery has significant impact on emissions. The waste tax and adoption of the National Waste Plan have also had an impact on the decreasing trend in emissions of the waste sector. In the early 1990's the economic recession reduced the amount of waste.

The LULUCF as a whole sector is a net sink in Finland. The sink has varied from approximately 20 per cent to 60 per cent of the annual emissions from other sectors during 1990-2011. Most of the removals in the LULUCF sector come from tree biomass growth. The annual volume increment has increased almost steadily for which reason the CO_2 uptake has also grown. The total drain is very much affected by commercial roundwood fellings and the global market situation. Due to the falling domestic roundwood markets the commercial roundwood removals in 2010 were 41 million m^3 being 20 per cent smaller than in previous year. The global economic downturn had a considerable negative effect on demand for forest-based industry products in 2009. In 2010, production of forest industry recovered. The wood products industry's production rebounded closer to its normal level when demand increased both domestically and in the export markets. In addition, pulp and paper demand recovered. Thus roundwood fellings in Finland increased in 2010 almost to the normal level. In 2010 commercial fellings totalled 52 million m^3, which is almost one fourth more than in previous year. Felling increased also due to the big storms in late July and early August 2010, which felled trees approximately by 8 million m^3. Most of the storm-felled trees were used as raw material in recovered forest industry. Increased fellings caused most of the decrease in biomass C stock sinks compared the previous year. In 2011, the growth of the Finnish national economy was at a modest rate. Forest industry production was at the level of one-fifth lower than during the high production year 2007. The total drain was 70.9 million m^3 of which the

commercial roundwood removals were 52.4 million m^3 that is about at the same level as in previous year. The drain also includes the 3.5 million m^3 of wood damaged or felled by the storms in December 2011.

2.2 Greenhouse gas inventory system, under Article 5, paragraph 1, of the Kyoto Protocol

Institutional arrangements

Statistics Finland is the national entity with the overall responsibility for compiling and finalising inventory reports and submitting them to the UNFCCC Secretariat and the European Commission. Statistics Finland approves the inventory submissions to the European Community, the UNFCCC and the Kyoto Protocol independently.

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As a national entity, Statistics Finland also bears the responsibility for the general administration and quality management of the inventory and for communicating with the UNFCCC, for coordinating participation in the inventory review and for publishing and archiving the inventory results. In addition, Statistics Finland calculates the estimates for the energy and industrial processes (except for F-gases: HFCs, PFCs and SF_6) sectors.

The legal basis of Finland's national system under the Kyoto Protocol is defined by the resolution of the Finnish Government of 30 January 2003 on the organisation of climate policy activities of Government authorities. The legal framework of the national system is further defined by the agreement between the Ministry of the Environment and Statistics Finland on operating the national system for estimating greenhouse gas emissions under the Kyoto Protocol and on the reporting requirements under the climate convention; it is also defined by the regulations concerning Statistics Finland (the Statistics Finland Act (48/1992) and the Statistics Act (280/2004)).

As a Member State of the European Union, Finland participates in compiling the European Community's greenhouse gas inventory and also has obligations to report to the European Commission (see Box 2.1).

Various specialist organisations acting as parties to the inventory system are responsible for the inventory data of the different sectors (Figure 2.6).

The roles and responsibilities of the organisations participating in the preparation of the inventory are defined in agreements between Statistics Finland and the Finnish Environment Institute (SYKE), MTT Agrifood Research Finland, the Finnish Forest Research Institute (Metla) and VTT Technical Research Centre of Finland. The resources for inventory preparation for the first three of these organisations are channelled via the relevant ministries' performance guidance arrangements (Ministry of the Environment, Ministry of Agriculture and Forestry). The contribution by VTT Technical Research Centre of Finland is based on annual contracts with Statistics Finland. The continuance of this contribution is ensured via a long-term framework agreement. In addition, all ministries participating in the preparation of the climate policy ensure that their data is available for use in the emission inventories.

SYKE prepares the estimates for the F-gas and NMVOC emissions (excluding combustion sources) and for the waste sector. MTT estimates the agricultural emissions, including the CO_2 emissions reported by the LULUCF sector, while Metla has the overall responsibility for estimates in the LULUCF sector. VTT Technical Research Centre of Finland provides transportation emissions data.

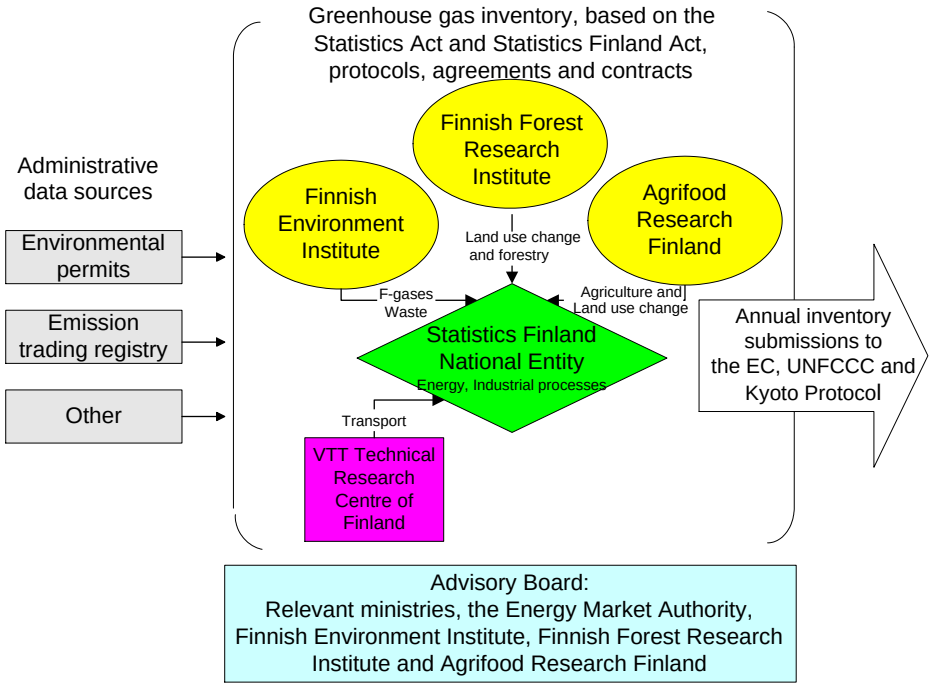
Box 2.1 European Community monitoring mechanism for greenhouse gas emissions and for implementing the Kyoto Protocol

EC monitoring mechanism for greenhouse gas emissions and for implementing the Kyoto Protocol (Decision 280/2004/EC of the European Parliament and of the Council of 11 February 2004) contains provisions for monitoring greenhouse gas emissions and for implementing the Kyoto Protocol. The reporting requirements for the Member States are elaborated in European Commission Decision 2005/166/EC, which lays down the rules for its implementation.

The monitoring mechanism is an instrument for accurate and regular assessment of the progress being made throughout the EU towards the European Community's commitments under the UNFCCC and the Kyoto Protocol. It includes provisions concerning monitoring and reporting on the anthropogenic greenhouse gas emissions, as well as the policies and measures being implemented, adopted and planned, and on the projections based on such policies and measures. According to Decision 280/2004/EC, Member States are required to submit their national inventories annually to the European Commission – DG Climate Action (DG Clima). DG Clima bears the main responsibility for preparing the EC inventory, which is compiled on the basis of the national inventories of the Member States. As the EC inventory is an aggregated total of the national emissions, its quality depends on the quality as well as the quality assurance and quality control procedures of the Member States' inventories.

In order to implement the reporting provisions set by the Climate and Energy Package of the European Union and take into account recent developments in the UNFCCC negotiations, the Commission proposed in 2011 a new Monitoring Mechanism Regulation (MMR) to replace Decision 280/2004/EC and its implementing provisions, 2005/166/EC. In April 2013, an agreement was reached between the Council and the European Parliament on the content of the regulation. The MMR Regulation (EU) 525/2013 further strengthens the reporting of the Member States' information on greenhouse gases, their projections and their policies and measures. Detailed reporting provisions are to be agreed upon through implementing and delegated acts in 2014.

Figure 2.6 National system for the greenhouse gas inventory in Finland



The agreements between Statistics Finland and the participating organisations confirm the division of responsibilities defined in the so-called reporting protocols. The protocols specify the procedures and tasks for the annual inventory process coordinated by Statistics Finland. The reporting sectors for which Statistics Finland is responsible are also defined in the protocols. They are annexed to the description of the national greenhouse gas inventory system in Finland, which is available on the Internet.

All of the participating organisations are represented in the inventory working group set up to support the process of producing annual inventories and to fulfil the reporting requirements. The working group advances collaboration and communication between the inventory unit and the experts in charge of the different reporting sectors and it ensures that the inventory's quality assurance/quality control (QA/QC) process is implemented.

Statistics Finland has also set up an advisory board consisting of representatives from the participating organisations, the responsible ministries and the Energy Market Authority. The advisory board functions as a higher level forum for collaborating and communicating with the parties involved in the national greenhouse gas inventory system and it decides on changes in the division of responsibilities. In addition, the advisory board coordinates longer term research programmes related to developing the inventory and reporting as well as to international cooperation, which includes participating in inventory reviews.

Both the inventory working group and the advisory board are appointed for a period of three years at a time.

In accordance with the Government resolution referred to above, the ministries produce the data needed for international reporting on the content, enforcement and effects of the climate and energy policy. Statistics Finland assists in the technical preparation of the policy reporting and in the technical compilation of the National Communications under the UNFCCC and the Kyoto Protocol. Separate agreements have been made on the division of responsibilities and cooperation between Statistics Finland and the relevant ministries.

The Energy Market Authority is the national emissions trading authority in Finland. Statistics Finland and the Energy Market Authority signed an agreement in 2006 on collaboration between the national inventory system and the national registry, which includes the division of reporting responsibilities.

Inventory process

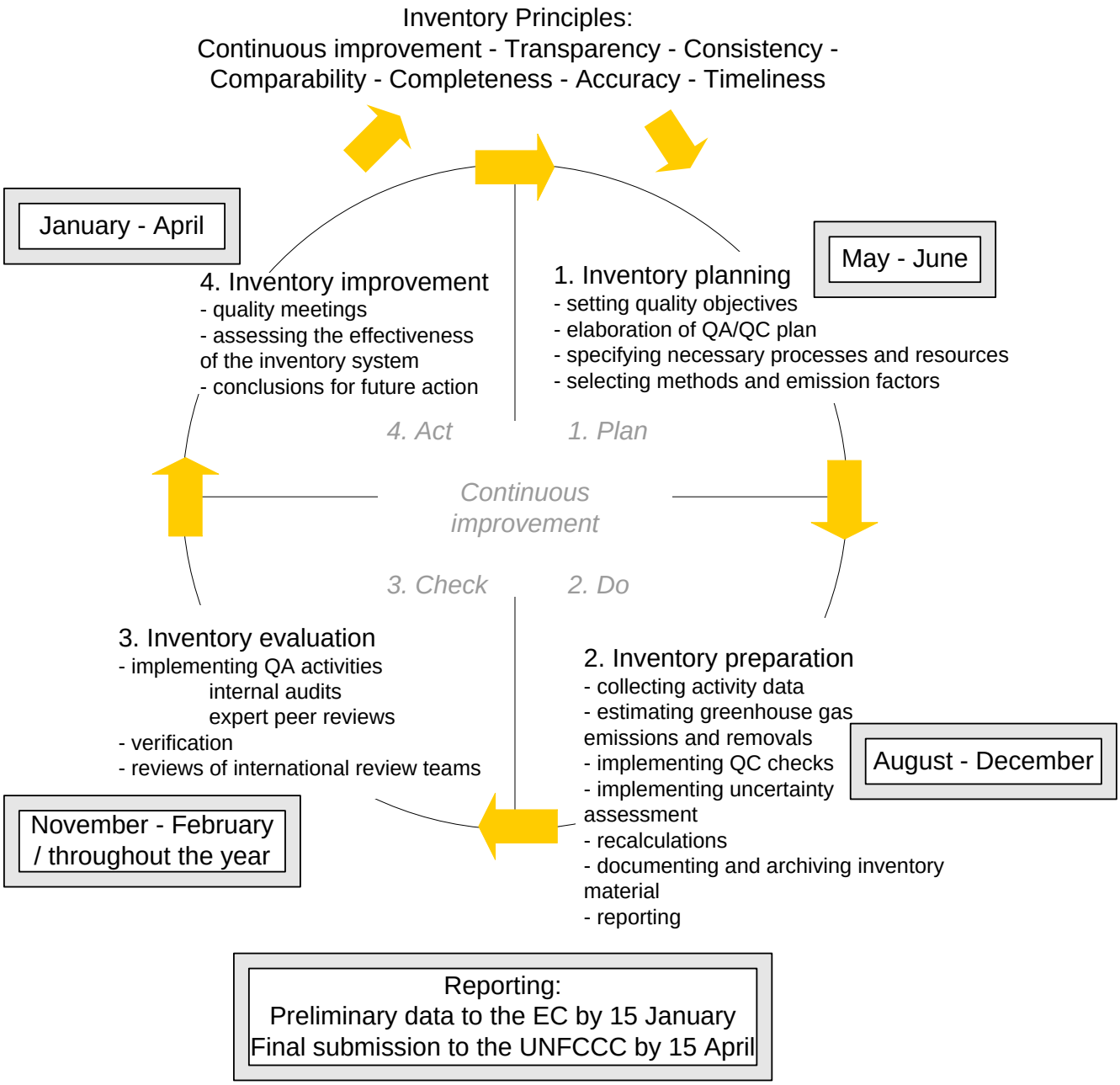
The UNFCCC, the Kyoto Protocol and the European Community monitoring mechanism for greenhouse gas emissions require Finland to submit annually a National Inventory Report (NIR) and Common Reporting Format (CRF) tables. The annual submission contains emission estimates for the year prior to the previous year.

The participating organisations produce their emission estimates in accordance with the pre-agreed responsibilities. Statistics Finland compiles national reports based on this data and submits these reports to the UNFCCC Secretariat and the European Commission.

The preparation of the annual inventory follows a predefined reporting schedule. Under the EC monitoring mechanism, the annual inventory must be submitted to the Commission by 15 January. The Member States may then complement and update their submissions until 15 March. The official greenhouse gas inventory is then submitted to the UNFCCC Secretariat by 15 April.

The annual inventory process set out in Figure 2.7 illustrates at a general level how the inventory is produced within the national system. The quality of the output is ensured by inventory experts during compilation and reporting, which consists of four main stages: planning, preparation, evaluation and improvement. The quality control and quality assurance elements are integrated into the inventory production system, which means that each stage of the inventory process includes relevant procedures for quality management.

Figure 2.7 Annual inventory process



The methodologies, collection of activity data and choice of emission factors are consistent with the guidance in the Revised 1996 IPCC Guidelines and the IPCC Good Practice Guidance reports.

Advanced and country-specific approaches (Tier 2 and Tier 3 methods) are used wherever possible, as these are designed to produce more accurate emission estimates than the basic (Tier 1) methods. Detailed activity data is used for most categories, and the emission factors and other parameters are based on national research and other data. For large point sources within the energy and industrial processes sectors, the estimates are based on plant and process-specific data. The Compliance Monitoring Data System VAHTI, used by the Centres for Economic Development, Transport and the Environment for processing and monitoring environmental permits, is the central data source for plant and

process-specific data. Detailed descriptions of the methodologies used can be found in the sector-specific chapters of the National Inventory Report.

Statistics Finland annually conducts a Tier 2 key category analysis prior to submitting inventory information to the EC. The Tier 2 methodology makes use of category-specific uncertainty analyses. The analysis covers all of the sources and sinks of the inventory.

The key category analysis functions as a screening exercise. The end result is a short list (20+) of important categories that are subjected to further, more detailed analysis. The goal of the detailed analysis is to pinpoint the factors that cause most of the uncertainty within each category. The detailed analysis also provides the sector experts with recommendations on how to improve the inventory. The results of the key category analysis are included annually in the national inventory report and the common reporting tables. This information is archived following Statistics Finland's archival practices.

Recalculations are made for the purpose of implementing methodological improvements in the inventory, including changes in activity data collection and emission factors, or for including new source or sink categories within the inventory or for correcting identified errors, omissions, overlaps or inconsistencies within the time series.

Greenhouse gas inventory recalculations are based on an annual evaluation of the preparation and improvement needs for the inventory, including input from the QA/QC activities. The driving forces when applying the recalculations are the need to implement the guidance given in the IPCC Good Practice Guidance reports and the recommendations in the UNFCCC inventory reviews.

Statistics Finland coordinates the development of the inventory. Each organisation participating in the inventory preparation process bears the primary responsibility for developing its own sector. The advisory board discusses and promotes the horizontal development projects and resources needed for development work.

Inventory development needs and projects that require additional resources are identified at bilateral quality meetings between the inventory unit and the participating organisations. Statistics Finland keeps a record of the development needs and planned or proposed improvement measures and uses this information to compile an annual inventory improvement plan. Methodological changes are discussed and evaluated by the advisory board before being implemented. Any changes that are made are documented in the CRF Tables and in the National Inventory Report in accordance with the IPCC Good Practice Guidance reports and the UNFCCC reporting guidelines. Changes in methodologies are implemented for the whole time series.

Finland has undertaken several research programmes and projects to improve the quality of the country-specific emission factors and other parameters as well as the methods used in the greenhouse gas inventory. The results have been disseminated through, for example, articles in scientific journals and presentations at various national workshops and seminars. Some of the research results have also been used by the IPCC, for instance in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, the IPCC Emission Factor Database and the ‘2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands’.

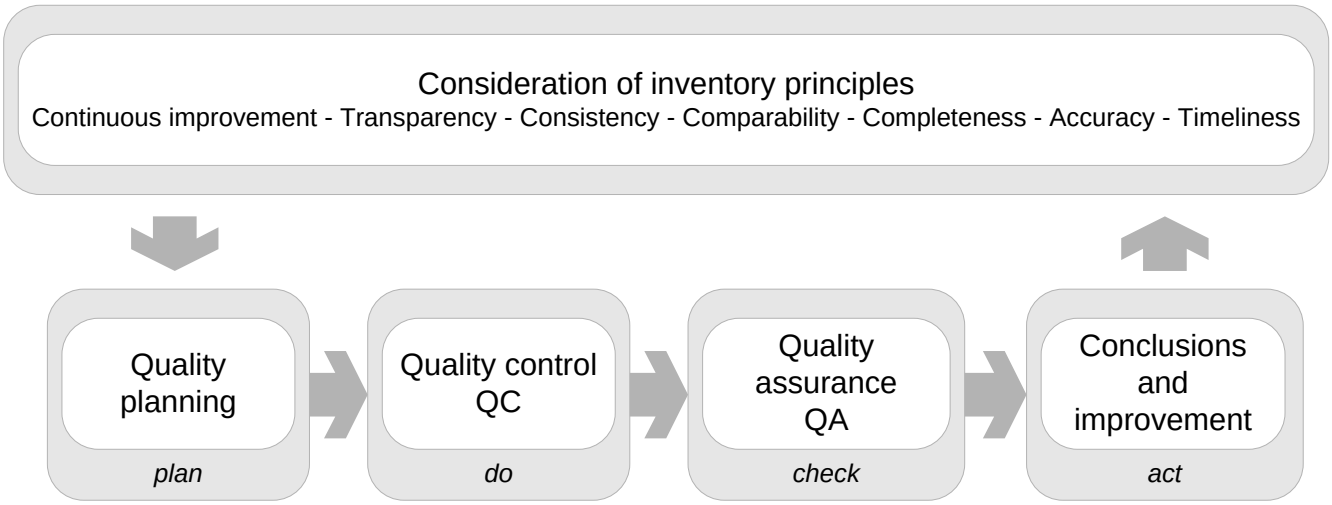
Quality management

Statistics Finland has the responsibility for co-ordinating the quality management measures and for steering and facilitating the quality assurance and quality control (QA/QC) process of the greenhouse gas inventory at the national level. The expert organisations contributing to the production of emission or removal estimates are responsible for the quality of their own inventory calculations and for implementing and documenting the QA/QC procedures.

The objective of Finland’s GHG inventory system is to produce high-quality GHG inventories. Within the context of greenhouse gas inventories, high quality means that the structure of the national system (i.e. all institutional, legal and procedural arrangements) for estimating greenhouse gas emissions and removals and the content of the inventory submissions (i.e. outputs, products) comply with the requirements and principles.

The quality requirements set for the annual inventories — transparency, consistency, comparability, completeness, accuracy, timeliness and continuous improvement — are fulfilled by implementing the QA/QC process consistently (Figure 2.8).

Figure 2.8 QA/QC process concerning preparation of the national greenhouse gas inventory



The setting of quality objectives is based on the inventory principles. Quality objectives are specified statements about the intended quality level when preparing the inventory with regard to the inventory principles. The objectives aim to be appropriate and realistic while taking into account the available resources and other conditions in the operating environment. Where possible, quality objectives should be measurable. The quality objectives regarding all calculation sectors for Finland's greenhouse gas inventory are presented in Table 2.1.

The quality objectives and the planned general quality control and quality assurance procedures regarding all sectors are set in the QA/QC plan. It is a checklist that specifies the actions, schedules and responsibilities necessary for attaining the quality objectives and instilling confidence in the Finnish national system's capability to deliver high-quality inventories.

The QC procedures used in Finland's greenhouse gas inventory comply with the IPCC Good Practice Guidance and IPCC Good Practice Guidance for LULUCF. General inventory QC checks (IPCC GPG 2000, Table 8.1; and IPCC GPG LULUCF 2003, Table 5.5.1) include performing routine checks on the integrity, correctness and completeness of the data, identifying errors and deficiencies and documenting and archiving the inventory data and quality control actions. Category-specific QC checks, including technical reviews of the source categories, activity data, emission factors and methods, are applied on a case-by-case basis by focusing on key categories and on categories where significant methodological and data revisions have taken place.

In addition, the quality control of Member States' submissions, which is conducted under the European Community monitoring mechanism for greenhouse gas emissions (e.g. completeness checks, consistency checks and comparisons across Member States), produces valuable information about errors and deficiencies, and the information is taken into account before Finland submits its final annual inventory to the UNFCCC.

The QA reviews are performed after the implementation of QC procedures concerning the finalised inventory. The QA system comprises reviews and audits that assess the quality of the inventory and the inventory preparation and reporting process, determine the conformity of the procedures taken and identify areas where improvements could be made. Specific QA actions differ in their viewpoints and timing. The actions include basic reviews of the draft report, quality meetings, internal audits, peer reviews, UNFCCC and EU inventory reviews, and data verifications.

Table 2.1 Quality objectives for Finland's greenhouse gas inventory

Inventory principle	Quality objectives
1. Continuous improvement	1.1. Treatment of review feedback is systematic 1.2. Improvements promised in the National Inventory Report are carried out 1.3. Improvement of the inventory is systematic 1.4. Inventory quality control procedures meet the requirements 1.5. Inventory quality assurance is appropriate and sufficient
2. Transparency	2.1. Archiving of the inventory is systematic and complete 2.2. Internal documentation of calculations supports emission and removal estimates 2.3. CRF tables and the National Inventory Report include transparent and appropriate descriptions of emission and removal estimates and of their preparation
3. Consistency	3.1. The time series are consistent 3.2. Data have been used in a consistent manner in the inventory
4. Comparability	4.1. The methodologies and formats used in the inventory meet comparability requirements
5. Completeness	5.1. The inventory covers all the emission sources, sinks, gases and geographic areas
6. Accuracy	6.1. Estimates are systematically neither higher nor lower than the true emissions or removals 6.2. Calculation is correct 6.3. Inventory uncertainties are estimated
7. Timeliness	7.1. High-quality inventory reports reach their receivers (EU / UNFCCC) within the set time

The ultimate aim of the QA/QC process is to ensure the quality of the inventory and to contribute to the improvement of the inventory. At the improvement stage of the QA/QC process, conclusions are made based on the realised QA/QC measures taken and their results. The main findings and conclusions concerning the inventory's quality and improvement needs are considered by the advisory board and communicated to the Parties to Finland's greenhouse gas inventory system so that they can make decisions concerning the next inventory round.

Changes in Finland's GHG inventory arrangements since NC5

Since 23 December 2009, the submission date for Finland's Fifth National Communication, very few changes have been made to the greenhouse gas inventory arrangements and the national system under Article 5, paragraph 1, of the Kyoto Protocol.

Finavia was responsible for the estimation of greenhouse gas emissions from aviation until 2010 when Statistics Finland took over this responsibility. The calculation process and methodologies are described in Finland's national inventory report. Finavia continues to support these calculations with activity data (flight data) and expertise.

Finland's aim has been to utilise data on aviation emissions provided by Eurocontrol. Eurocontrol has started developing a portal from which its member states, including Finland, could retrieve the information needed to estimate the emissions for inventory purposes. Finland has participated in the development of the portal. The work has however not

advanced as planned and the portal has not been finalised but Eurocontrol has provided activity and emission data annually since the development work begun. Finland has utilised this data to complement data from national sources as well as for QA/QC.

In 2010, also the agreement between Statistics Finland and the Energy Market Authority was updated. The updated agreement defines in more detail the collaboration as well as contents and timelines for data/other information exchange between the organisations in the reporting of the data to UNFCCC secretariat. The agreement has given Statistics Finland also access to more detailed data collected by the Energy Market authority than the previous agreement.

The effects of the implementing and delegated acts of the Monitoring Mechanism Regulation (EU) 525/2013 on the greenhouse gas inventory will be taken into account when the legislation is finalised.

3 Quantified economy-wide emission reduction target

Finland's emission reduction target for the years 2013-2020 is part of the joint target of the European Union. The EU quantified economy-wide emission reduction target is implemented through the EU Climate and Energy Package. Key assumptions and conditions related to the EU's target (for example sectors, base year, coverage of gases) are included in the document FCCC/AWGLCA/2012/MISC.1, the EU 6th National Communications and first Biennial Report under the UNFCCC, and CTF Tables 2(a−f).

Under the Climate and Energy Package, the EU is committed to reducing its greenhouse gas emissions by 20 per cent by 2020 from the 1990 level. The majority of the reduction will be reached as part of the EU emissions trading scheme (EU ETS): in 2020, emissions from sectors covered by the EU ETS will be 21 per cent lower than in 2005.

The Effort Sharing Decision established binding annual greenhouse gas emission targets for Member States for the period 2013–2020. These targets concern emissions from sectors not included in the EU ETS such as transport, housing, agriculture and waste. The emissions will be cut by approximately 10 per cent from the 2005 level by 2020 within the EU as a whole. Finland's reduction obligation for the sectors not covered by the EU ETS is 16 per cent. It is up to each Member State to decide how these targets will be achieved, but domestic measures are needed to fulfil the targets. Certified emission reduction units from the clean development mechanism and emission reduction units from joint implementation projects, as well as units transferred from other Member States, can be used to fulfil the targets. A Member State that fails to meet its annual target will be penalised with an additional 8 per cent emission reduction obligation for the following year.

The Climate and Energy Package also requires Finland to increase its use of renewable energy sources to 38 per cent of final energy consumption by 2020 and the share of biofuels in gasoline and diesel to 10 per cent by 2020.

More information on the EU's Climate and Energy Package can be found:

http://ec.europa.eu/clima/policies/package/index_en.htm

Finland is also implementing the first commitment period of the Kyoto Protocol to the UNFCCC (2008-2012), which is part of emission reduction pathway towards 2020. In accordance with the Kyoto Protocol, the EU was committed to reducing its emissions by 8 per cent in 2008–2012 compared to the base year emissions. This commitment was shared among the EU Member States through the Council Decision of 25 April 2002 concerning the joint fulfilment of commitments pursuant to Article 4 of the Kyoto Protocol. Under this burden sharing agreement, Finland's commitment was defined as limiting its national average annual emissions to their 1990 level during the first commitment period of the Protocol, 2008–2012.The second commitment period of the Kyoto Protocol for the years 2013-2020 has been agreed in Doha 2012. The EU is preparing to ratify the Doha amendments. The information provided in this report does not prejudge the terms of joint fulfilment by the EU and its Member States in the second commitment period under Article 3 of the Kyoto Protocol, including notification of the obligations and respective base years of the EU and its Member States.

4 Progress in achievement of quantified economy-wide emission reduction targets

4.1 Background for the information provided

Finland's emission reduction target for the years 2013-2020 is part of the joint target of the European Union. In this chapter, progress in achievement of quantified economy-wide emission reduction targets is described through actions implemented so far for the first commitment period of the Kyoto Protocol and under the EU's Climate and Energy Package. The measures are also described in Finland's sixth National Communication to the UNFCCC. Information on progress in achievement of targets, where available and relevant, has been included in CTF Tables 4−4(b).

4.2 Mitigation actions and their effects

Sectoral policies and measures

Energy

Policies and measures in the WM projection

The general objective of Finland's energy policy is to ensure energy security at competitive prices and with the lowest possible environmental impacts. Finland uses a diversity of energy sources, one third of which (including energy for transport) are domestic. The major trend is a steady increase both absolutely and in relative terms in the use of renewable energy.

The 'with measures' (WM) projection includes all energy policy measures in use at the end of 2012. Direct governmental intervention to guide the choice of energy sources is rare in Finland. However, economic instruments, i.e. taxation and subsidies, have been used to improve energy efficiency and to promote the development of domestic energy sources, such as biomass, hydro, wind and peat.

Within the energy sector, the greenhouse gas emissions are in practice reduced in two ways: 1) the primary energy consumption is reduced by cutting the end use or by increasing the conversion efficiency in power plants; 2) fuels and energy use are shifted to alternatives with less emission.

The main policies and measures in the energy sector include the EU ETS, an increase in renewable energy and energy conservation measures.

The EU ETS is an EU-wide domestic measure, while renewable energy sources are supported by various national measures: investment grants, taxation, support for research, and the most recently introduced measure, feed-in tariffs.

Energy conservation measures concern all sectors of the economy. Energy efficiency agreements, a voluntary scheme for industry and municipalities, have proven to be an efficient measure along with taxes and subsidies. For both new and existing buildings, building codes and regulations play an important role.

The policies and measures included in the WM projection for the energy sector are described in more detail in the following section. A list summarising the policies and measures can be found in CTF Table 3. Energy taxation and tax-related subsidies are described in the respective section below.

EU Emissions Trading Scheme

The EU ETS has been operating since 2005 and is the most important economic steering method for reducing emissions at both the domestic and EU level. The EU ETS is included in the WM projection. It is considered here as a domestic measure, even though entities with emission ceilings participating in the scheme acquire emission units (AAUs, CERs and ERUs) through trading. The EU ETS covered only CO_2 emissions until the year 2013, when N_2O

and PFC emissions from certain industries were also included. In addition to emissions from energy production and use, the EU ETS also includes emissions from industrial processes. Industrial processes currently count for one tenth of EU ETS emissions in Finland (Table 4.1).

The share of EU ETS emissions with respect to the total greenhouse gas emissions in Finland has been 52–55 per cent between the years 2008 and 2011 (Table 4.1). The share is clearly higher than the EU-27 average, which is around 40 per cent.

The emissions in the EU ETS sector have decreased since 2010. The main reason for this has to do with a reduced use of fossil fuels and increased imports of electricity. The EU ETS sector emissions are also expected to decrease in the future. This is partly the result of the EU ETS making emission-free production of electricity and heat more competitive and partly the result of its promotion of renewables and energy efficiency.

A steady decrease is foreseen in the emissions from district heating and combined heat and power (CHP) production. The use of domestic condensing power will decrease when Olkiluoto 3, the nuclear power plant unit that is currently under construction, begins operation. Positive decisions-in-principle have been made concerning two additional nuclear power units. The start up of these nuclear power units will reduce the emissions in the ETS sector from the 2020s onwards. The emissions from industry are not expected to change dramatically.

Table 4.1 Greenhouse gas emissions in the emission trading (ETS) sector (including the plants participating in the emissions trading each year) and non-emission trading sector in 1990, 2005 and 2008-2012 in Finland, million tonnes CO2 eq. (the figure for 1990 is an estimate)

	1990	**2005**	**2008**	**2009**	**2010**	**2011**	**2012***
ETS	31.4	33.1	36.2	34.4	41.3	35.1	29.5
of which energy		29.5	31.8	30.8	37.3	31	26
industrial processes		3.6	4.3	3.4	4.0	4.0	3.5
Non-ETS	39	35.6	34	31.7	33.2	31.9	31.9
Total	**70.4**	**68.7**	**70.2**	**66.1**	**74.5**	**67.0**	**61.4**

* preliminary data

Energy efficiency

The Finnish economy is relatively energy intensive, which has led to fairly high per capita greenhouse gas emissions. However, because energy use is efficient by international comparison, the high energy and emission intensities can be explained by structural factors. While the industrial structure has changed significantly towards less energy intensive industries, Finland still has a considerable number of energy intensive industries. Other factors explaining the quite high energy use per capita are the cold climate and long transport distances.

In the spring of 2008, the Ministry of Employment and the Economy set up a broad-based committee to prepare new energy conservation and energy efficiency measures in accordance with the climate and energy strategy. The committee report, completed in June 2009, includes 125 measures for the period between 2009 and 2020. On the basis of the committee's proposals, the Government Decision on Energy Efficiency Measures (4 February 2010) established the policy lines and measures for pursuing energy efficiency. An ex post evaluation framework has been established to monitor the progress achieved as a result of the Government Decision.

Energy efficiency agreements and energy audits (see below) and subsidies for developing and implementing energy efficient technology and innovative modes of operation are important for reaching the energy efficiency targets. The

Government Decision also includes measures that aim to cause a behavioural change and, in the longer term, to effect a fundamental change in society through education, research and development.

Voluntary energy efficiency agreements

Since the 1990s, Finland has employed a voluntary energy efficiency agreement scheme for companies and municipalities. Voluntary measures, such as energy efficiency agreements, energy audits and sector or measure-specific programmes, have already resulted in significant energy savings. The agreement scheme covers almost 85 per cent of all industrial energy end-use and more than 50 per cent of the building stock of the service sector.

The second generation of energy efficiency agreements for industries, municipalities and the oil sector are mainly the responsibility of the Ministry of Employment and the Economy and have been signed for the period 2008–2016. They follow the energy conservation agreements that were in force in the period 1997–2007.

Additional energy efficiency agreements are currently in force for goods transport, logistics and public transport (see Transport section below). The housing sector has an energy conservation agreement scheme (since 2010), which is overseen by the Ministry of the Environment, and there is another one for commercial properties (since 2011) under the responsibility of the Ministry of Employment and the Economy. In 2010, an energy efficiency agreement was also launched in the agriculture sector under the Ministry of Agriculture and Forestry.

Total new savings from measures under the energy efficiency agreements (2008−2016) within the industry, energy, municipal, property and building sectors were approximately 5.5 TWh per year at the end of 2011 (Figure 4.1). More than one third of the energy saved was electricity. The savings were equal to 1.4 per cent of Finland's total energy consumption (386 TWh in 2011). For example, in 2010 in the food and drink industry approximately one third of the savings arose from measures related to heat recovery, while roughly one third of the savings were related to the heating of buildings. Within the plastic industry, one third of savings stemmed from more efficient process cooling. Within the energy intensive industry, savings in the actual process equipment and processes accounted for more than half of the savings, while measures addressing, e.g. steam and condensate, were also significant.

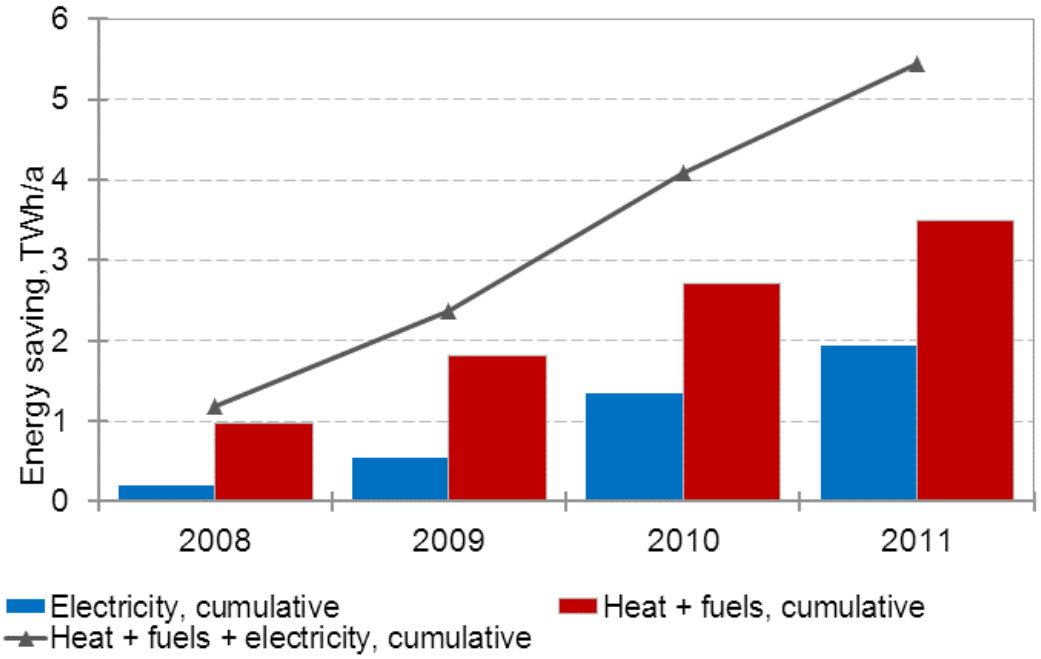
CO_2 reductions under the energy efficiency agreements were approximately 4.1 million tonnes CO_2 per year at the end of 2010 (based on a marginal emissions rate of 600 kg CO_2/MWh for electricity). It is estimated that by the end of 2015, the emissions reduction will be 5.9 million CO_2 tonnes per year, and 5.2 million tonnes per year by 2020 when taking into account the termination of current agreements at the end of 2016 (see CTF Table 3). Additional emissions reductions have been achieved as a result of the energy efficiency agreement (2008–2016) for the oil sector. These amounted to 0.34 million tonnes in 2010 and are estimated to reach 0.39 million tonnes in 2015 and 0.43 million tonnes in 2020.

The energy efficiency agreements are especially important for implementing the Energy Services Directive[2], which entered into force in May 2006, and its successor, the Energy Efficiency Directive[3], which entered into force in December 2012.

[2] (2006/327/EC)

[3] (2012/27/EC)

Figure 4.1 Total energy saving resulting from energy efficiency agreement scheme, 2008–2011



Energy audits

The Energy Audit Programme is one of the oldest national energy efficiency grant schemes in place in Finland. The full-scale programme was launched in January 1994.

The purpose of energy auditing is to analyse the energy use of the facility being audited, to work out the potential for energy savings and to present a profitability calculation of saving proposals. In addition to working out possible ways to use different forms of renewable energy and the energy saving potentials, the energy audit reports on the impact of the proposed measures on CO_2 emissions.

The Energy Audit Programme is a voluntary programme promoted by a 40 to 50 per cent subsidy by the Ministry of Employment and the Economy. The ministry provides subsidies for conducting energy audits on commercial and public buildings and in the industrial and energy sectors. It also supports municipalities to carry out audits concerning the promotion of renewable energy use within the municipality's territory (Renewable Energy Municipal Audit). Apart from energy audits subsidised by the Ministry of Employment and the Economy, there are energy audits intended for blocks of flats and terraced housing. Subsidies for private sector buildings are granted by municipalities, whereas subsidies for municipal housing stock are granted by the Housing Finance and Development Centre of Finland (ARA). The Ministry of the Environment determines the total annual amount of these subsidies.

By the end of 2010, the estimated savings in energy achieved by conducting audits in the service, municipal and industry sectors were approximately 1.0 TWh per year. About 90 per cent of the savings originated in the industry sector. The corresponding CO_2 reduction was 0.98 million tonnes CO_2 per year (based on a marginal emissions rate of 600 kg CO_2/MWh for electricity). The emissions reduction is estimated to be 0.65 million CO_2 tonnes per year by the end of 2015 and 0.56 million tonnes per year by the end of 2020. While 90 per cent of the energy audits are implemented in connection with the energy efficiency agreements, overlap in energy savings and emission reductions has been removed in the estimates and the results are additive.

Renewables

Finland aims to increase the proportion of renewable energy in final energy consumption to 38 per cent by 2020 (32.2 per cent in 2010). This target is to be achieved by reducing energy consumption and increasing the use of renewables. Wood-based fuels, liquid biofuels, wind power and heat pumps will contribute most to the target.

The Act on Production Subsidy for Electricity Produced from Renewable Energy Sources[4] and the Government Decree on Production Subsidy for Electricity Produced from Renewable Energy Sources[5] entered into force on 1 January 2011, with the exception of subsidy levels. The provisions on subsidy levels entered into force on 25 March 2011 under a Government Decree[6].

The production subsidy scheme initially consisted of two different subsidy categories: a feed-in tariff and a fixed production subsidy. A fixed subsidy was paid only for the year 2011, after which this subsidy category was discontinued.

A feed-in tariff is available for new and existing forest chip power plants, new wind power plants, new biogas power plants (gas produced by digestion) and new wood-fuelled power plants, which also produce heat.

For forest chip power plants, the feed-in tariff varies between 0 and 18 EUR/MWh according to the price of emission allowances. For other renewables, the basic subsidy is the difference between 83.5 EUR/MWh and the market price.

The feed-in tariff is expected to further the construction of wind power in line with the National Energy and Climate Strategy (2013). The objective is to in-crease the production of wind power to 6 TWh by the year 2020, whereas the current production level is approximately 0.5 TWh. The effect on emissions has been estimated based on the assumption that wind power reduces the need to produce electricity mainly in condensing power plants using fossil fuels and peat (for more information on the IMPAKTI calculation tool used to estimate the emission reduction impacts of renewables, see Methodology Section under V. Projections). Using a marginal emission coefficient of 600 t CO_2/GWh, the promotion of wind power will reduce the emissions in the year 2020 by 3.6 million tonnes CO_2 (CTF Table 3). The reduction will occur totally in the ETS sector. The estimate includes the impact of all policies and measures promoting wind power (including the impact of the feed-in tariff).

Increasing the use of forest chips in multi-fuel boilers is the most central and cost-efficient way of increasing the use of renewable energy in the generation of power and heat. Adopted in the summer of 2010, the Finnish National Renewable Energy Action Plan sets the 2020 target for the use of forest chips in the generation of heat and power at 25 TWh. The use of forest chips will replace the use of other fuels (mainly peat) in heat and power production and heating oil on farms. The estimated emission reduction achieved due to the use of forest chips was 5.2 million tons CO_2 for the year 2010, whereas it should be 9.9 million tonnes in 2020. Slightly more than 10 per cent of the emission reduction is in the non-ETS sector. The estimates do not include the impact of the increased use of wood energy on the carbon sink of forests. Current scenarios for the increase of wood energy suggest a reduction that is equal to about one third of the total sink of Finnish forests (from 60 to 40 Mt CO_2eq/year).

The impact of the feed-in tariff for biogas has not been numerically estimated for 2020. The promotion of biogas will replace power and heat production using other fuels. CH_4 and N_2O emissions from material used for biogas production will also be avoided, such as CH_4 emissions from landfilling of biogenic waste or CH_4 and N_2O emissions from manure management.

In addition, the Finnish National Energy and Climate Strategy (2013) also includes other measures to increase the use of renewable energy, especially biomass. These include improving the logistics for harvesting and transporting forest chips and furthering the emergence of local heat entrepreneurs. Wind power will be advanced by reducing barriers for wind power investment and by enabling demonstration projects for off-shore wind power. The historic use of and WM projection for renewable

[4] (1396/2010)

[5] (1397/2010)

[6] (1397/2010)

energy in Finland is shown in Figure 4.2 and Table 4.2.

Figure 4.2 Historic development and WM projection for renewable energy

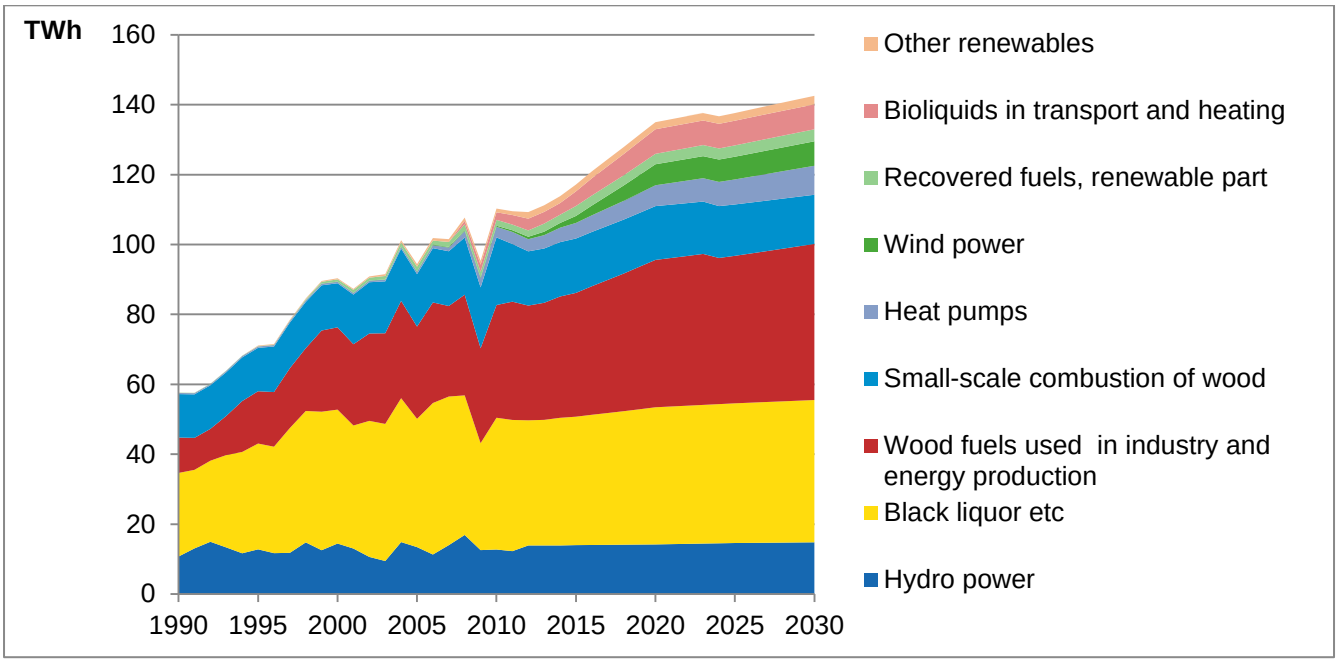


Table 4.2 Renewable energy in the WM projection, TWh

	20	20	20	20	20	20	20
Renewable fuels related to industrial production							
Black liquor	39	30	37	37	39	40	41
Industrial wood	20	15	18	18	18	18	18
Total	**60**	**46**	**56**	**56**	**57**	**58**	**59**
Renewables targeted by policies							
Hydro power	16	12	12	12	14	15	15
Wind power	0.	0.	0.	0.	6.	6.	7.
Forest chips	8.	12	13	15	25	24	27
Small-scale	16	17	19	16	15	15	14
Heat pumps	1.	2.	3.	3.	6.	7.	8.
Bioliquids in	1.	2.	2.	2.	7.	7.	7.
Biogas	0.	0.	0.	0.	0.	0.	0.
Recovered fuels	1.	1.	1.	1.	3.	3.	3.
Other	0.	0.	0.	0.	1.	1.	1.
Total	**48**	**50**	**54**	**53**	**78**	**80**	**84**

Renewable energy policies and measures for the transport sector are described in the Transportation Section below.

Energy use in residential and other buildings

CO_2 emissions from the use of energy in buildings are mainly covered by the EU ETS. District heating is the source of about half of all space heating in Finland. The majority of district heating production falls within the sphere of the EU ETS. The total space heating energy used in residential, commercial and public buildings was 70 TWh in 2011 (23 per cent of the total end use of energy). Slightly less than 30 TWh of the space heating belongs to the non-ETS sector. Non-ETS CO_2 emissions from the energy used to heat buildings are less than 5 million tonnes annually. These emissions mainly cover the use of light fuel oil (and to a very small extent, natural gas) in buildings, as well as the fuels used in small district heating plants. The non-CO_2 emissions from energy use in buildings are much smaller, approximately 0.2 million tonnes CO_2 eq. annually. Most of these emissions are CH_4 emissions from wood combustion.

Policies and measures for buildings and housing aim at improving energy efficiency, reducing ETS and non-ETS-emissions and increasing the use of renewable energy sources. Policy measures include standard setting, economic instruments, the dissemination of information and education and research. The measures target both new and existing buildings, including the use and maintenance of the building stock. In addition to policy measures in the building sector, energy use is affected by policy instruments for renewable energy via changes in the prices of heat and electricity.

The Directive on the Energy Performance of Buildings (EPBD)[7] aims to reduce CO_2 emissions by improving the energy efficiency of buildings. The directive was implemented in Finland by a new regulation that came into force at the beginning of 2008. New Finnish legislation on the energy efficiency of buildings includes the following:

- Act on Energy Certification of Buildings[8] and the Ministry of the Environment Decree on Energy Certification of Buildings[9]
- Act on Inspection of Air-conditioning Systems[10]
- Amendments to the Land Use and Building Act[11], which was expanded to cover energy efficiency requirements and details on how energy efficiency should be calculated[12]

The minimum requirements for thermal insulation and ventilation in new buildings have been set by the National Building Code since 1976. The energy efficiency requirements were tightened by 30 per cent compared to earlier requirements in December 2008 due to the implementation of the EPBD. The requirements were further tightened (by 20 per cent) in March 2011 due to the implementation of the Directive on the Energy Performance of Buildings (Recast)[13]. The new building regulation came into force in July 2012, and it is based on the overall energy consumption, which takes into account, among other things, air conditioning, cooling, lighting and heating, the washing water and heating energy. The new regulation favours the utilisation of district heating and renewable energy when defining the energy performance of a building as a whole.

The Government has supported energy efficiency improvements in renovation and investment in low-carbon heating systems through various subsidies. Low-carbon heating systems utilise renewable energy sources, especially ground heat and wood bioenergy (pellets, small-scale firewood). Due to the overall reductions in the Government's budget,

[7] (2002/91/EC)

[8] (487/2007)

[9] (765/2007)

[10] (489/2007)

[11] (1129/2008)

[12] (488/2007)

[13] (2010/31/EU)

these subsidies have now been ceased. There is also an interest subsidy system promoting loans for renovations that improve energy efficiency.

Based on the modification in the decree of the national building code for sewage and fresh water systems, water measurement instruments became compulsory in new apartment buildings at the beginning of 2011. The aim was to reduce the consumption of water and the need for heating it. The water measurement instruments provide information on the use of water in each apartment and make it so that the billing is done according to the actual water use, which provides a direct price signal for inhabitants. The requirement will be expanded into the existing building stock in 2013 in the case of pipe and plumbing system repairs subject to a building permit.

Information provision and the campaigns supported by the Government seek to influence the behaviour of building users and owners. At the moment, activities exist for giving internet-based informational guidance, e.g. in repair, energy efficiency and long-term planned real estate maintenance issues.

Systematic and well-timed real estate maintenance activities for buildings include repairs and replacement as well as the proper adjustment and settings for heating, ventilation and air conditioning equipment. The aim is to reach the full extent of the technical and economic lifecycle. The maintenance and repair plan is based on condition assessment surveys in which the conditions as well as any need for repairing a building or equipment are determined, mainly by sensory and empirical evaluations and non-destructive methods. Systematic and well-timed renovations can reduce costs while meeting the needs of users and sustainable development, e.g. energy and material efficiency.

Renovation and the retrofitting of buildings will increase rapidly in Finland in the next two decades. The reason is that, among other things, a large amount of the building stock will need improvements in their physical condition or in their energy efficiency. Such an increase in repair and renovation work will require considerable development and changes in the property and building sectors. In order to address the expected challenges, the Ministry of the Environment launched a programme in co-operation with the Finnish real estate and construction branch, various research institutions and the public administration. As a result of the programme, the Strategy for Repair and Renovation 2007–2017, an implementation plan (2009) and the Government Resolution on Renovation (2008) were compiled.

The implementation plan consists of thirteen measures for action that define the aims and concrete measures to be taken. The actions include, e.g. developing a maintenance culture, making improvements in energy efficiency, improving know-how and disseminating knowledge, developing the materials and resource efficiency, and developing renovation services. Research and communication play an important role in the implementation of the strategy. The responsibility for implementing the strategy is broadly spread among the actors in the property and building sectors.

Improving the built environment, including the transport systems, thus plays a key role in reducing greenhouse gas emissions and mitigating climate change. The Energy-Smart Built Environment 2017 (ERA17) action plan originally proposed 31 necessary actions for reducing emissions in the built environment, for improving energy efficiency and for promoting the use of renewable energy. The overall target of the programme is to create an ‘energy-smart built environment’ that is energy-efficient and low in emissions and that provides a high-quality living and working environment. The action plan combined simultaneous and former programmes and was drawn up as a joint effort by the Ministry of the Environment, the Finnish Innovation Fund (Sitra) and the Finnish Funding Agency for Technology (Tekes) and in collaboration with the business sector, research institutions and the public administration. The programme has focused on five actions for the years 2013–2014.

The emission impacts of building-related policy measures have been evaluated using EKOREM and POLIREM calculation models (see Methodology Section under V. Projections) and information on the emission coefficients for district heating and electricity. These models calculate the heat and energy consumption and the resulting greenhouse gas emissions of the building stock. The impacts of policy measures are evaluated by modifying the energy efficiency of the building elements (EKOREM) or specific consumptions of energy (POLIREM), or the distribution of heating systems. The energy savings are converted into emission reductions with an average emission coefficient in the case of district heating (236 t CO_2/GWh) and with a mean marginal emission coefficient in the case of electricity (600 t CO_2/GWh).

The emission reduction impacts of the policy measures are presented in CTF Table 3. The regulation for the energy performance of new buildings entails the largest emission reductions, namely 2.1 million tonnes CO_2 by 2020 and 3.7 million tonnes CO_2 by 2030. Most of the emission reduction will take place in the EU ETS sector through the reduced use of district heat and electricity.

The reduction of indoor temperature by 0.5°C has been used to illustrate the possible impact of long-term planned real estate maintenance. The estimated impact would be 0.7 million tonnes CO_2 annually by 2020 and 2030.

Subsidies for energy efficiency improvements will supposedly reduce the annual emissions by 0.3 million tonnes CO_2 in 2010, 2020 and 2030. The impact will be larger in the non-ETS sector because of the fact that subsidies were provided to replace the oil boilers with ground heat or wood bioenergy (pellets, small-scale firewood) in 2011–2012.

Real estate maintenance activities, like adjusting the heat and ventilation systems, are able to provide immediate energy savings and emission reductions. In addition, no investments in equipment or materials are needed. Therefore, the net emission and cost reductions will take place immediately. The possibilities to reduce emissions are, however, limited. The short-term impacts of minimum standards for energy performance in new and existing buildings are small. The impact will gradually increase over time when the building stock is renewed and renovated.

New regulations for both new and existing buildings state that the energy performance target can be obtained by improving the energy efficiency and/or changing the heating system. This substantially complicates the evaluation of energy saving and emission impacts.

Policies and measures in the WAM projection

A package of measures – the clean energy programme – was outlined in connection with preparing the energy and climate strategy. The aim of the programme is to balance Finland's current account by investing in the domestic production of clean energy in order to replace imports, thereby creating tens of thousands of new jobs in the energy cluster and reducing Finland's greenhouse gas emissions to a level that is on track to meet the EU's 2050 target for 2025.

In terms of its energy objectives, the clean energy package can be summarised as follows:

- An approximately 20 per cent reduction in the use of mineral oil will be pursued. Most of this cut will originate in road transport, while the rest will come from replacing oil heating. Increased investments will be made in development projects for domestic biofuels. The adoption of new motor technology will be supported, while an infrastructure and incentives will be created to purchase low-emission cars.
- Use of coal in power plants will be for the most part replaced by new, emission-free forms of energy production, such as nuclear power and wind power. The wind power target for the year 2025 is 9 TWh. In addition, the net import of electricity will largely be replaced. Most coal used for heat generation in cities will be replaced with biomass. Further use will be made of the opportunities provided by heat pumps, solar heat and the energy efficiency of buildings. Building-specific, small-scale generation of energy will be promoted.
- Approximately 10 per cent of natural gas will be replaced with biomass-based solutions, which will make it possible to replace imported gas while utilising the current gas pipelines and power plants.

The public administration has employed and will continue to employ various measures to promote the objectives of the clean energy package. These include emissions trading, taxes levied on heating fuels, taxes levied on transport fuels and taxes levied on the acquisition and use of vehicles, as well as various financial incentives granted by Finland or the EU and positive decisions-in-principle for two nuclear power units.

However, the package of measures would require additional public funding as well as the addition of further measures. It would require a continuation of the feed-in tariff for wind power when the current maximum of 2500 MW, which has been accepted as part of the support scheme, is full; securing the use of renewable sources of energy in heat and power cogeneration plants; possible incentives for the acquisition of low-emission vehicles; and incentives to make the transition from mineral oils used as heating fuels to other sources of energy, either through fiscal or other means, in case the desired progress is not otherwise achieved.

In the building sector, additional measures include a regulation to ensure the improvements of energy and resource efficiency in the renovation and alteration of buildings. Due to the implementation of the Directive on the Energy Performance of Buildings (Recast), the regulation for the energy efficiency of the existing building stock was put into effect on 27 February 2013. The impacts of the regulation on energy savings are evaluated using the REMA calculation model (see Methodology Section under V. Projections). The corresponding emission reductions, presented in CTF Table 3, have been calculated by using the additional information on the shares of different energy types and the emission coefficients for district heating and electricity.

It is estimated that the emission reductions due to improvements in energy performance in renovations and alterations in the WAM projection will be 0.5 million tonnes CO_2 in 2020 and 1.0 million tonnes CO_2 in 2030. Energy efficiency improvements are related to the normal lifecycle of buildings and are thus realised during long periods of time in connection with other renovations and alterations. Some efficiency improvements will already take place as part of the WM projection. Most of the emission impact is due to the reduced use of district heating and electricity produced in the ETS sector. It is estimated that the emission reductions in the non-ETS sector will be quite modest, namely 0.04 million tonnes CO_2 in 2020 and 0.05 million tonnes CO_2 in 2030. Part of the emission reductions will be obtained when oil fuelled boilers are replaced with ground heat and other heating systems that need electricity. This will increase emissions somewhat in energy production within the ETS sector.

One goal of the National Energy and Climate Strategy is to level off growth in final energy consumption by improving energy efficiency so that, in 2020, consumption will be a maximum of 310 TWh. With the policies and measures included in the WAM projection, the estimated final energy consumption in Finland should be 317 TWh in 2020. Further measures are consequently needed to reach the target, and it can be assumed that some of them will also reduce greenhouse gas emissions.

Summary of policies and measures

A summary of the policies and measures in the energy sector is presented in CTF Table 3.

Transport

Policies and measures in the WM projection

Policies and measures within the transport sector under the WM projection are outlined in CTF Table 3. The WM projection includes all measures that were in use in the transport sector to cut down the emissions at the beginning of the year 2013. The measures are designed to achieve the target of the Climate Policy Programme for the Transport Sector and Finland's Long-term Climate and Energy Strategy (–15 per cent in 2020) and the EU's Effort Sharing Decision (–16 per cent in 2020).

The WM projection contains the following measures: 1) promoting the use of biofuels within the transport sector, 2) renewing the vehicle fleet, 3) improving energy efficiency within the transport sector, and 4) directing the growth of passenger traffic volumes in urban areas to include more environmentally friendly transport modes. It is assumed that the growth in transport performances needs to stay at a moderate level (0.5–1.5 per cent per year) so that it will be possible to achieve the climate policy aims within the transport sector.

The greenhouse reduction impact of the policies and measures (both ex post and ex ante) has been estimated by the VTT Technical Research Centre of Finland and Motiva Oy based on, for example, the results of the LIPASTO calculation model, which is the model used to estimate emissions from the transport sector for the GHG inventory. The methods used for impact assessment are documented in Finland's second National Energy Efficiency Action Plan (NEEAP 2).

Promoting the use of biofuels

The amendment to the national act on promoting the use of biofuels within the transport sector[14] came into force on 1 January 2011. The biofuel distribution obligation will be six per cent for 2011–2014, followed by a phased increase to 20 per cent by 2020. At the beginning of 2011, 95 E10 petrol with a 10 per cent share of biofuel was introduced to the market; it replaced 95 E5 petrol. The energy content of second-generation biofuels (biofuels produced, for example, from waste material) is taken into account as double its actual energy content when calculating the share of biofuels for the purposes of the distribution obligation. Therefore, the actual share, by which biofuels would replace fossil fuels, is likely to be smaller than the target.

By 2020, it is assumed that biofuels will have replaced 12.5 per cent of fossil fuels in transport (5 per cent of first-generation biofuels and 7.5 per cent of second-generation biofuels). This means that emission reductions in the transport sector will be 2 million tonnes CO_2 in 2020. In 2011, the estimated emission reduction was 0.7 million tonnes CO_2.

Biofuels can be used in machinery and in various sectors in addition to transportation (construction, agriculture, forestry, mining, industry, service and households). In the WM projection, it is assumed that the share of biofuels used in machinery will be 10 per cent in 2020. Due to the use of biofuels, the emissions from machinery in 2020 are projected to remain approximately at the 2010 level despite the increased use of machinery.

Renewing the vehicle fleet

In the Climate Policy Programme for the Transport Sector, the aim is that in 2020 the specific emissions of new cars sold in Finland will be close to the EU objective (95 g CO_2/km; the level in 2011 was at around 144.5 g CO_2/km and 2012 at 139.7 g CO_2/km) and that the rate of vehicle fleet renewal will be approximately 7 per cent a year.

Regulation No 443/2009 of the European Parliament and of the Council setting emission performance standards for new passenger cars (a binding CO_2 standard for passenger cars), entered into force in June 2009. It set the average CO_2 emissions for new passenger cars at 130 g CO_2/km by 2015 and 95 g/km by 2020. A corresponding regulation for light commercial vehicles (Regulation No 510/2011 of the European Parliament and of the Council) entered into force in 2011. This regulation sets a target of 175 g CO_2/km by 2017 and 147 g/km by 2020 for the average emissions of new light commercial vehicles registered in the European Union.

Car taxation was reformed in Finland in 2007 and in 2011. The tax on passenger vehicles was differentiated according to vehicle-specific emissions (g CO_2/km). The lowest tax rate (5 per cent) applies to cars with zero carbon dioxide emissions, while the highest tax rate (50 per cent) applies to cars with carbon dioxide emissions exceeding 360 g/km. The Vehicle Tax Act was also reformed in 2007 and 2011. In these reforms, the basic part of the tax was differentiated according to the carbon dioxide emissions of each vehicle, similarly as in the car taxation reform. The basic part of the emission-based vehicle tax now varies between EUR 43 and 606 per year, depending on the car's specific carbon dioxide emissions. This taxation model is beneficial to all low-emission cars, irrespective of the technology used.

Finland has also been active in providing information to consumers about the CO_2 emissions of passenger cars. Examples of this include the energy label for cars, the Choosing a Car website and the online car comparison engine produced by the transport administration, which enables potential car buyers to compare different car models based on fuel consumption and CO_2 emissions.

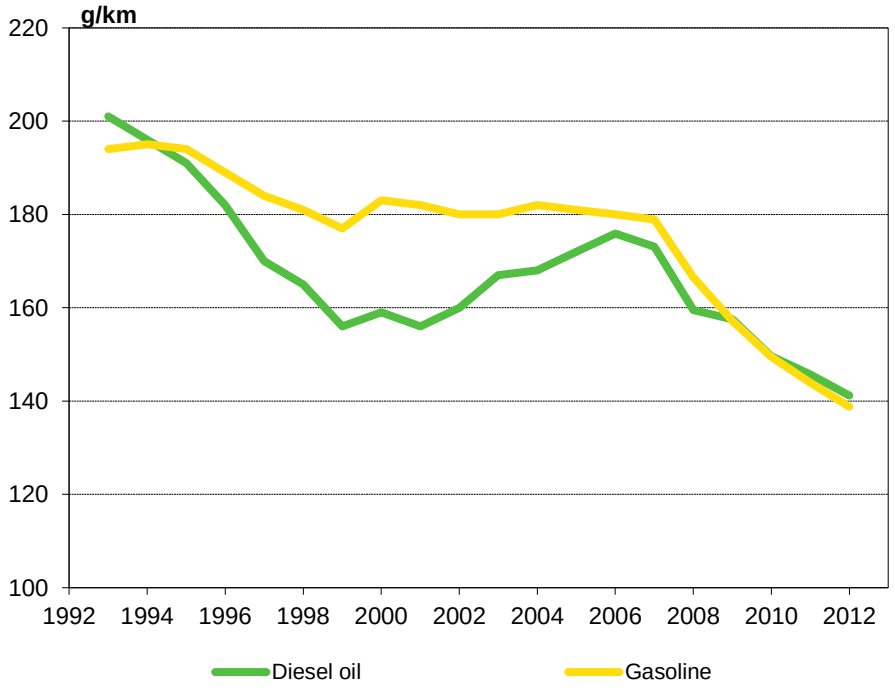
If the renewal rate of the vehicle fleet speeds up to reach the level set for the sector, it is estimated that the emission reduction effects of new vehicle technologies will be as much as 2.1 million tonnes in 2020.

During the period 2007–2011, the average CO_2 emissions of new cars de-creased by some 20 per cent. The average CO_2 emissions in December 2011 were 142.6 g/km for new petrol-driven passenger cars and 146.1 g/km for diesel-driven passenger cars (see Figure 4.3). A total of some 111,000 new cars were sold in 2012 (the goal was 150,000).

[14] (446/2007)

The emission reduction effects of new low-emission cars were estimated at approximately 0.16 million tonnes CO_2 in 2011.

Figure 4.3 CO_2 emissions (g/km) of new registered cars (gasoline and diesel), 1993–2012



Energy efficiency in the transport sector

According to the Climate Policy Programme for the Transport Sector, energy efficiency in transport will be improved. This can be achieved through such means as energy efficiency agreements and eco-driving.

There are two ongoing energy efficiency agreements in the transport sector: one on goods transport and logistics and one on public transport services. Both aim to reduce the energy consumption of enterprises that have joined the agreement by 9 per cent by the year 2016 (a target set out in the directive on energy end-use efficiency and energy services). The target in public transport services is to have at least 80 per cent (around 560) of enterprises join the effort. In goods transport, the target is 60 per cent, or 5,400 enterprises.

Training in eco-driving has been provided to bus and coach drivers since 1997. The Act on Professional Qualifications for Truck, Bus and Coach Drivers entered into force in August 2007. The Act emphasises predictive and economical ways of driving. Eco-driving education is included in basic driver training, too. The basics of eco-driving have been included in basic driver training since 1994 and in the revised two-stage training since 1997.

For bus and coach drivers, the annual CO_2 emission reduction is estimated at 0.01 million tonnes annually. It is estimated that the annual CO_2 emission reductions for trucks will be 0.07 and for private drivers 0.06 million tonnes by 2020.

Influencing modal splits and curbing the growth in vehicle kilometres

According to the Climate Policy Programme for the Transport Sector, the growth in passenger traffic volumes in urban areas will be directed to more environmentally friendly transport modes. The aim is that by 2020, a total of 100 million more public transport journeys and 300 million more walking and cycling journeys will be made, which constitutes an approximate 20 per cent increase over the current figures.

The reconciliation of land use, housing and transport is promoted through MAL letters of intent in the Finnish urban regions. These aim at creating more efficient urban structures and reducing people's need to use private cars. Transport and land-use planning is also being carried out in conjunction with regional transport system work and other land-use planning. Efforts are being made to implement transport infrastructure investments in such a way as to contribute to better cohesion of the urban structure.

Finland's Public Transport Act was reformed in 2009 to comply with the requirements of the EU's Public Service Obligations (PSO) regulation. The current bus transport system is to be reorganised after the service contracts for the transition period, concluded pursuant to the Public Transport Act, expire between 2014 and 2019. After a transition period, competent authorities must organise public transport in their area. When implementing the Public Transport Act, particular attention must be paid to introducing a national ticketing system and implementing a schedule and journey planner service. The goal is to create a uniform, user-friendly service package and to increase the number of people using public transport. In 2011, some EUR 10 million of State aid was granted to support public transport in large urban areas (Helsinki, Tampere, Turku and Oulu).

A national strategy and implementation plan for the promotion of walking and cycling, covering the period 2011–2020, was released in 2011. This strategy aims to increase the share of trips made by walking or cycling. The target is that by 2020, the share of walking and cycling trips will increase from the current 32 per cent to 35–38 per cent in the modal slit and that the proportion of short trips made by passenger cars will correspondingly decrease.

The popularity of public transport, walking and cycling is also being promoted through Mobility Management, which was made a national-level project in 2010. With Mobility Management, the aim is to reduce travelling by car by, for example, providing information and developing services that ease the usage and combine different travel modes. Mobility Management work at the regional level has been supported through R&D calls for projects and through a EUR 0.7 million appropriation included in the 2012 budget.

Policies and measures in the WAM projection

CTF Table 3 sets out the main policies and measures included in the WAM projection for the transport sector. The WAM projection contains the following measures: 1) energy efficiency in transport will be improved by offering new energy subsidies for the transport sector, 2) the growth in passenger traffic volumes in urban areas will be directed to more environmentally friendly transport modes by offering new financial support for public transport in urban areas, and 3) traffic volumes and the modal split will be influenced by additional/supplementary economic steering measures, such as fuel taxes, car taxes and/or road user charges if the climate policy objective for the transport sector cannot be achieved through other measures. Decisions regarding potential new financial steering models can be expected in 2013–2014 at the earliest.

It has been estimated that the potential emission reduction effects of the energy efficiency agreements will be as much as 0.3 Mt CO_2 by 2020. This figure partially overlaps with the impact assessment of eco-driving training for professional drivers.

It has been estimated that the emission reduction effects of public transport, walking and cycling will total some 0.3 Mt CO_2 by 2020. For public transport, the target is to reach a 0.15 Mt emission reduction, and the same target applies to walking and cycling.

In the Climate Policy Programme for the Transport Sector, it has been estimated that the emission reduction effects of additional economic steering measures will be as much as 1.4 Mt CO_2 by the year 2020.

Summary of policies and measures

A summary of the policies and measures in the transport sector is presented in CTF Table 3.

International bunkers

Policies and measures in the WM projection

Finland has participated actively in IMO's and ICAO's work to limit emissions from international traffic. In October 2013, ICAO's Assembly adopted a resolution on climate change and environmental protection according to which the ICAO Council will prepare an international emission limiting mechanism. The aim is to adopt the mechanism at the 2016 Assembly and for it to enter into force in 2020. In July 2011, the IMO approved binding energy efficiency targets for new ships. An Energy Efficiency Design Index (EEDI) will be calculated for each ship during the planning phase. The new regulations have been in force since the beginning of 2013. In addition, all ships, the gross tonnage of which is 400 tonnes or more, are required to compile a Ship Energy Efficiency Management Plan (SEEMP) following a guidance format prepared by IMO. National implementation of these measures is currently being prepared by the Ministry of Transport and Communications. The impacts of these measures on the emissions of ships in Finland have not yet been evaluated.

The legislation to include aviation in the EU ETS was adopted in November 2008, and it entered into force as Directive 2008/101/EC of the European Parliament and of the Council on 2 February 2009. According to this directive, all aircraft taking off and/or landing in the EU will be included in the trading system. Airlines have been able to derogate temporarily from their obligations under the EU ETS relating to their 2012 emissions based on a decision by the European Parliament and the Council.

The environmental outcome of an emissions trading system is pre-determined through the setting of an emissions cap. In the case of the EU ETS, a cap is established for aviation emissions in addition to the overall emissions cap. However, aircraft operators are also able to use allowances allocated to other sectors to cover their emissions. It is therefore possible (indeed highly likely given traffic growth forecasts) that the absolute level of CO_2 emissions from aviation will exceed the number of allowances allocated to aviation. However, any aviation emissions will necessarily be offset by CO_2 emission reductions elsewhere, either in other sectors within the EU that are subject to the EU ETS or through emission reduction projects in third countries. The 'net' aviation emissions will, however, be the same as the number of allowances allocated to aviation under the EU ETS.

In terms of contributing to the ICAO global goals, the states implementing the EU ETS together delivered, in 'net' terms, a 3 per cent reduction below the 2005 level of aviation CO_2 emissions in 2012, and will deliver a 5 per cent reduction below the 2005 level of aviation CO_2 emissions for the period 2013–2020.

Policies and measures in the WAM projection

In 2012, the Ministry of Transport and Communications set up a working group to consider the possible future energy sources for transportation. The task of the working group was to consider the extent to which and the time frame within which alternative energy sources could be used in different transport modes and to propose objectives and measures. One of the proposed objectives was to increase the use of LNG (liquefied natural gas) and other alternative energy sources in marine transport, which would result in considerable reductions of both air pollutants and CO_2 emissions. In aviation the objective was to increase the use of biofuels so that the share would be 40 per cent in 2050, which is in line with the common EU target.

Summary of policies and measures

A summary of the policies and measures for international bunkers is presented in CTF Table 3.

Industrial processes

The most significant CO_2 emissions from industrial processes are included in the EU ETS and are covered in Section 4.7.1. The remaining CO_2 sources in this sector are small and no specific policies in the WM projection target either these emissions or the CH_4 emissions from industrial processes. Therefore, the policies and measures described in this section are those mitigating nitrous oxide (N_2O) emissions and F-gases.

Policies and measures in the WM projection

During the years 2009–2012, there were three JI projects under track I within the Finnish territory. The projects cut N_2O emissions at the nitric acid plants of Yara Suomi Oy, two of which are located in Uusikaupunki and one in Siilinjärvi. The Ministry of the Environment has issued 971 926 emission reduction units (ERUs) for these projects. In addition, the projects contributed altogether approximately 1.85 million tonnes of CO_2 eq. towards achieving Finland's Kyoto targets because the actual emissions cut exceeded the verified amount and the requirements of the environmental permits. The estimated mitigation impact in 2010 presented in CTF Table 3 is based on the information in the JI project's verification reports. Since 2013, nitric acid production is included in EU ETS, and therefore, the mitigation impact has not been estimated for future years.

The amount of emissions from F-gases (HFC, PFC, SF_6) is small in Finland (about 1 per cent of total emissions). Emissions from the use of HFC have in-creased since the 1990s, while PFC emissions have declined since their peak level in the late 1990s and SF_6 emissions have decreased compared to 1990. The most important regulations affecting the amount of these gases are the F-gas regulation and the directive relating to HFC emissions from air-conditioning systems in motor vehicles. Also, technical developments have affected the development of emissions. There is no domestic production of F-gases in Finland.

The WM projection for F-gases includes the impacts of the EC regulation concerning F-gases (842/2006)[15] and the EC directive relating to emissions from air-conditioning systems in motor vehicles (2006/40/EC)[16]. Emissions from refrigeration and air-conditioning equipment are expected to decline due to these measures and technical changes that will lead to smaller charges and decreased leakage. Emissions from electricity distribution equipment and foam blowing have declined as a result of voluntary actions by the industries and are assumed to be similar to recent years' emission levels. Restrictions forced by the EC regulation will decrease emissions from aerosols and other sources, but it is expected that the emission levels will begin increasing again due to increased activity in the remaining source fields. Emissions from refrigeration and air-conditioning equipment account for close to 90 per cent of Finnish F-gas emissions, and therefore the projected overall emission trend is declining.

The mitigation effect of the policy measures has been estimated by assuming that the emissions prior to the introduction of the measures would have continued to grow in line with the volume of F-gases being used. This assumption is subject to several uncertainties, but it provides an indication of the mitigation impact. The mitigation measures were able to cut the almost exponential increase in emissions from refrigeration and air-conditioning equipment that started in the mid-1990s.

Policies and measures in the WAM projection

While harmonised EC legislation limits the possibilities to apply different national restrictions on the use of F-gases, it does not fully refute it. Some EU Member States, like Denmark, Sweden and Finland, have some stricter rules in their legislation. Member States are also allowed to promote the use of alternative substitutes for F-gases. As an additional measure, Finland will promote F-gas substitutes by using information dissemination and campaigns. Finland will also give its support to including a partial prohibition on F-gases in the EU F-gas regulation during its review process in 2013.

The WAM projection for F-gases is based on the assumption that the Commission's reassessment (2011) of the EC regulation on F-gases (842/2006) will lead to additional regulatory measures. Further restrictions on its use in refrigeration and air-conditioning equipment, foam blowing and aerosols are expected in all applications that are technically feasible and in line with safety and health concerns. The additional reductions relative to those of the WM projection are expected to be small. The EU Commission's draft proposal[17] for revising the existing F-gas regulation was pub-

[15] (842/2006)

[16] (2006/40/EC)

[17] (COM(2012) 643)

lished in November 2012. The objective of the proposal is to cut F-gas emissions by two thirds by 2030 compared to their current levels. The proposal will be dealt with in the EU legislative process in 2013. The new F-gas regulation will take effect in 2014 at the earliest. The elements of the draft proposal have not been taken into account in the WAM projection.

It is estimated that the emission reduction achieved by these additional measures will be 0.07 Mt CO_2 eq. in 2020 compared to the WM projection.

Summary of policies and measures

A summary of the policies and measures in the industrial processes sector is presented in CTF Table 3.

Agriculture

Policies and measures in the WM and WAM projections

Finnish agricultural policy is based on the view that the competitive disadvantage due to natural conditions (such as the short growing period, low temperatures, frosts and problematic drainage conditions) must be compensated for in order to have profitable domestic production and to make agriculture sustainable and multifunctional. The objectives of sustainable and multifunctional agriculture include taking into account greenhouse gas emissions, the possible need for adaptation measures and other environmental and socio-economic aspects. These objectives can be reached through the Common Agricultural Policy (CAP) of the EU as well as through national measures. According to conclusions made by the European Council, agricultural production should continue in all areas of the Community.

The most effective climate policy measures can conflict with agricultural policy objectives and measures, such as securing the availability of food and animal welfare and reducing strain on water systems. If Finnish consumption patterns remain unchanged, a reduction in domestic agricultural production would probably not reduce global greenhouse gas emissions because domestic production would be replaced by production elsewhere.

Annual CH_4 and N_2O emissions from agriculture have fallen by 12 per cent over the period 1990–2011 due mainly to a decrease in the number of livestock and in nitrogen fertilisation. Changes in agricultural policy and farming subsidies have had a significant influence on agricultural activities, and hence, on the emissions from this sector.

There are measures in the CAP to reduce greenhouse gas emissions. Agri-environmental payment is an essential tool for promoting sustainable development in agriculture. Approximately 90 per cent of Finnish farmers have participated in the payment programme. Agri-environmental payment is part of the Rural Development Programme for Mainland Finland 2007–2013, which is based on a Council regulation[18]. The objectives of the programme are to decrease nutrient load on the environment, especially on surface and ground waters, and to preserve plant and animal biodiversity and the rural landscape. The measures also aim to maintain or improve the productive capacity of agricultural land and reduce greenhouse gas emissions to meet these targets. The Rural Development Programme for Mainland Finland will be renewed for the time period 2014–2020. Similar actions as were taken in the period 2007–2013 will be planned for the new programme period.

CTF Table 3 presents a quantitative emission reduction estimate for one of the measures promoted by agri-environment payment: the long-term cultivation of grass on organic soils. The effect of other measures cannot be estimated before the programme for 2014–2020 has been accepted.

The WAM projection does not include any additional measures compared to the WM projection, and therefore, the two projections are identical for the agriculture sector.

[18] (1783/2003)

Land use, land-use change and forestry

Policies and measures in the WM and WAM projections

The land use, land-use change and forestry (LULUCF) sector affects the mitigation of climate change in three different ways:

- By protecting and increasing existing carbon storages and sinks
- By creating new carbon storages and sinks
- By replacing fossil-based energy, raw materials and products with biomass

The LULUCF sector as a whole acts as a net sink in Finland because the emissions under this sector are smaller than the removals. This net sink from the LULUCF sector can vary greatly from one year to the next: in the period 1990–2010 it was between 14.5 and 36.1 million tonnes CO_2 eq. In 2010, the net sink was 22.1 million tonnes CO_2 eq. The variation is mainly due to changes in forest harvesting levels.

According to the National Forest Inventory, the annual increment of growing stock has been increasing since the 1970s, reaching its current level of 104 million cubic metres, of which 97 million cubic metres is in commercially managed forests.

Finland's forest policy aims at sustainable forest management, and the policy measures include legislation, the National Forest Programme 2015, financial support and extensive public forestry organisations.

The studies by Metla indicate that Finnish forests will probably act as a net sink in the future, too. The objective for the forests' carbon sink (incl. trees and soil) set out in the National Forest Programme (NFP 2015) is to maintain the sink at a level of at least 10–20 million tonnes CO_2 eq. per year up to 2015. The harvesting of wood is targeted to increase by 10–15 million cubic metres a year in the NFP 2015. The objectives and measures in the Long-term Energy and Climate Strategy are consistent with the policy defined in the NFP 2015 regarding the increase in industrial roundwood and energy wood, and they will help achieve the target set by the directives on promoting the use of energy from renewable sources[19]. The current global economic downturn will influence the achievements of the NFP 2015.

The national measures set out in the NFP 2015, which are consistent with the Long-term Energy and Climate Strategy, include implementing the following measures in order to secure the climatic advantages provided by forests and to ensure the availability of renewable raw materials:

- Producing forecasts of the forest damage risks associated with climate change, developing the forest damage monitoring system, improving preparedness plans for forest and other damages, and coordinating efforts among the authorities;
- Factoring in the effects of the carbon sink and measures for improving harvesting conditions, and including the vitality of forests in revised forest management recommendations and guidelines as well as in the provision of advice and guidance;
- Implementing the Functioning of Forest Ecosystems and Use of Forest Resources in Changing Climate Research Programme (concluded 2012) and the Finnish Research Programme on Climate Change (FICCA) 2011–2014;
- Exploring models of operation for trading or leasing carbon sinks as well as for other means of increasing carbon sequestration in forests; and

[19] Directives 2001/77/EC and 2009/28/EC

- Promoting the carbon sink effects of forests and the carbon stored in wood products in negotiations on the UNFCCC.

With regard to agricultural soils, CO_2 emissions from croplands and grasslands are not expected to be subject to large changes in the WM projection by 2020. The CO_2 emission reductions due to increasing the area of multiannual crops on organic soils is presented in CTF Table 3. There are still significant uncertainties in these estimates, and new methods are being developed to increase their accuracy.

The WAM projection does not include any additional measures compared to the WM projection, and therefore, the two projections are identical for the LULUCF sector.

Implementation of Articles 3.3 and 3.4 of the Kyoto Protocol

Articles 3.3 and 3.4 of the Kyoto Protocol concern emissions and removals from land use, land-use change and forestry (LULUCF) activities. Article 3.3 activities (afforestation, reforestation and deforestation) are based on land-use changes, and reporting these activities is mandatory for the Annex I Parties. Under Article 3.4, the election of activities (forest management, cropland management, grazing land management and revegetation) is voluntary for Parties during the first commitment period. The Finnish Government decided to apply Kyoto Protocol Article 3.4 regarding forest management (FM) for the first commitment period. This enables Finland to compensate for net emissions resulting from Article 3.3 activities and to provide removal units (RMUs) worth up to 0.59 million tonnes CO_2 eq. per year. The accounting for the emissions and removals under Article 3, paragraphs 3 and 4 will be done at the end of the commitment period.

Based on a study by Metla, Article 3.3 activities are estimated to cause net emissions for the period 2008–2012. This is due to land-use changes as a result of converting forest land to other land uses as well as low carbon sequestration rates in areas afforested or reforested since 1990. During the period 2008–2011, the emissions were on average 3.6 million tonnes CO_2 eq. per year. Land-use change from forest land to other land uses is difficult to avoid in a country where forests cover 72 per cent of the land area. Most of the change is driven by settlements and infrastructure (e.g. roads and transmission lines). The estimations still include high degrees of uncertainty and will become more accurate as the calculation methods are further developed.

In line with Article 3.4, the FM net sink between 2008 and 2011 has been approximately 39.6 million tonnes CO2 eq. per year. Net removals from forest management vary significantly based on the overall economic situation. In 2009, the sink was 47 million tonnes, whereas in 2008 it was 36 million tonnes. The NFP 2015 estimates that the annual carbon sink of forests (incl. trees and soil) will remain at a level of at least 10–20 million tonnes CO_2 eq. by 2015 if logging increases by 10–15 million cubic metres a year, as is currently projected. The policy defined in the NFP regarding the increase in industrial roundwood and energy wood is consistent with the climate and energy strategy and it will help to achieve the target set by the directive on promoting the use of energy from renewable sources.

It is estimated that forest management will be a sink for the entire duration of the first commitment period, and therefore Finland expects to receive a total of 2.95 million tonnes worth of RMU units (0.59 million tonnes/year, i.e. the maximum cap).

The potential of cropland management and grazing land management activities has been assessed by MTT Agrifood Research. It estimates that CO_2 emissions from agricultural soils are increasing. However, uncertainties associated with estimations of soil CO_2 emissions and removals and non-CO_2 emissions are still significant, and therefore agricultural activities under Article 3.4 were not elected for the period 2008–2012.

Forest Management Reference Level

For the second commitment period of the Kyoto Protocol, forest management will become a compulsory activity and the accounting will be based on a reference level (RL) approach. Finland's RL is an average value of the projected removals and emissions for the period 2013–2020 and it is based on the long-term climate and energy strategy as well as the National Forest Programme (NFP 2015). The FMRL for 2013–2020 is –19.30 million tonnes CO_2 eq. and –20.4 million tonnes CO_2 eq., including harvested wood products (HWP).

Waste management

Policies and measures in the WM projection

Greenhouse gas emission projections from the waste sector include CH_4 from landfills, CH_4 and N_2O emissions from composting and CH_4 and N_2O emissions from wastewater treatment. Finnish waste legislation is largely based on the EU's Landfill Directive[20], the Waste Directive[21] and, most recently, the Waste Framework Directive[22]. The first Waste Tax Act[23] entered into force in 1996 for municipal landfills. The tax level per tonne of waste has increased from EUR 15.15/t in 1996 to EUR 23/t in 2003, EUR 30/t in 2005 and EUR 40/t in 2011. A new Waste Tax Act[24] entered into force at the beginning of 2011 and replaced the former Waste Tax Act. The purpose of the new Waste Tax Act is to collect tax from those waste fractions that could be technically and environmentally recovered but are currently being disposed in landfill sites. The tax list for waste is based on a Commission decision[25] regarding what to include on the waste list. The industrial landfills are under taxation as well. The waste tax was EUR 40 per tonne in 2011 and EUR 50 per tonne in 2013.

Enforcement of the new Waste Act[26] will increase recycling and recovery, thus replacing landfilling, and it will contribute to reducing greenhouse gas emissions as well.

Restrictions on the landfilling of biodegradable municipal waste have been introduced based on the biowaste strategy (2004) and through the Government decree on landfills (revised 2006, 2012).

The monitoring of the effectiveness of the policies and measures affecting waste are based on statistics and modelling that follow the IPCC methodology for estimating emissions. It is not possible to identify in detail the effects of individual policy measures in terms of emission reductions. The overall reduction that has been achieved has been estimated by using 1995 as a base year, when none of the climate-oriented waste policies were yet in place. When estimating the mitigation impact, the assumption has been made that 1995 would represent the average emission level without measures. This assumption is somewhat uncertain as the amount of waste would probably have changed and the accumulation of waste would have increased CH_4 emissions. The average emissions from the waste sector in 1990–1995 were close to the 1995 level of approximately 3.9 million tonnes CO_2 eq.

The same IPCC-based modelling methodology is also used for projections based on assumed developments in the amount of waste. The projections for the waste sector do not, however, include emissions from waste incineration, which belong to the energy sector emissions.

Greenhouse gas emissions from the waste sector will decrease in the WM projection (see also Waste Section under Projections). The main reason for this is the implementation of the Landfill Directive and national legislation and strategies that aim at reducing the amount of waste and minimising the amount of waste delivered to the landfills. The reform of the waste legislation, previously reported in the WAM projection, has now been included in the WM projection, leading to an additional reduction in emissions relative to those reported earlier.

Policies and measures in the WAM projection

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[20] (Directive 1999/31/EC)

[21] (Directive 2006/12/EC)

[22] (Directive 2008/98/EC)

[23] (495/1996)

[24] (1126/2010)

[25] (2000/532/EC)

[26] (646/2011)

The additional potential for emission reductions under the WAM projection is limited. A new national waste plan is under preparation and is expected to be ready by the end of 2016. Plans are progressing to ban legally the landfilling of biodegradable and other organic waste after 2016.

The limiting value for organics in waste would be 10 per cent total organic carbon (TOC) or loss on ignition (LOI). This is likely to increase the incineration of waste significantly.

The additional emission reductions in the waste sector are thus mainly based on a drastic reduction of biowaste in landfills. However, as existing measures have already reduced emissions significantly, the additional reduction relative to the WM projection is modest in terms of million tonnes CO_2 eq. and should only be 0.2 million tonnes CO_2 eq. in 2020.

Summary of policies and measures

A summary of the policies and measures in the waste sector is presented in CTF Table 3.

Land-use planning and spatial structure

The development of the urban structure has long-term effects on greenhouse gas emissions from transport and buildings. The most recent national Energy and Climate Strategy (2013) includes policy objectives and indicates measures that aim to minimise greenhouse gas emissions related to land use and the urban structure.

The National Energy and Climate Strategy of 2013 specifies the following policy objectives in relation to the spatial structure and related land-use planning:

- In urban regions and built-up areas, enhanced cohesion of the urban structure will be promoted as part of planning a high-quality living environment. Dependence on private cars will be reduced through land-use planning, by steering construction into zones that offer the opportunity to walk, cycle and use public transport. Resources allocated for transport will be targeted at small, cost-efficient development measures that promote public transport, walking and cycling.
- Municipalities will be encouraged to plan energy-efficient, high-quality communities and planning and assessment tools employed to this end will be developed.
- Enhancing the cohesion of the urban structure in major urban regions and reconciling regional land use and the transport system will be done more efficiently by means of the 'MAL' letters of intent (MAL=land-use, housing and transport) and, if necessary, legislative amendments. The binding nature of the MAL letter of intent procedure will be increased by taking better account of service structures and the operating conditions of businesses. Promotion of a low-carbon economy is also one of the priorities in the forthcoming Structural Fund period, 2014–2020.
- Municipalities and the state will jointly carry out pilot projects to promote sustainable means of travel (for example, high-quality cycle paths to highlight the cycling opportunities in city centres and to improve the image of cycling).

Nearly all regions in Finland and many individual municipalities have prepared their own climate strategies. It is, however, difficult to provide quantitative emission reduction potentials for the policies and measures concerning land-use planning and the urban structure. The urban form influences emissions mainly through its effects on transport and the heating of buildings. Estimates suggest that differences in greenhouse gas emissions between planning options will be approximately 10 per cent at a regional level, 60 per cent at the level of a single municipality and as much as 200 per cent at the level of a specific community. In particular, emissions from daily mobility may be many times higher in car-oriented zones compared to urban centre areas. Emissions from the heating of buildings depend greatly on energy solutions for the dwelling and possible district heating. The location of a dwelling is also connected to emissions via the consumption of goods and services as well as long leisure trips, mainly due to spatial differences in income levels. The overall reductions in emissions in different regions are thus dependent not only on the urban structure, but also on complex processes that include lifestyle changes as well as economic conditions and developments.

Energy taxation and related measures

Energy taxation

Energy taxes are a substantial revenue source for the Government. They generate around EUR 4 000 million annually, or nearly 10 per cent of the Government tax revenue. Over the past ten years, energy taxes have been increasing steadily in terms of the amount generated and as a share of the total tax revenue. Energy taxation is a key instrument of the Government's energy and climate policy.

Energy taxes are levied on electricity, coal, natural gas, peat, tall oil and liquid fuels. Major changes to the structure of energy taxation were introduced in January 2011. Energy taxation now takes account of the energy content, carbon dioxide emissions and sulphur content of fuels (see Table 4.3 for details). The overall tax rates are driven primarily by the energy content component and the CO_2 component. An additional surcharge, called the strategic stockpile fee, is also added to the total (to cover expenses incurred by the state when securing the supply of energy).

The energy content tax has been adjusted to reflect the volumetric energy content of the fuel. The energy tax component is levied on both fossil fuels and biofuels, based on the same taxation criteria. For liquid fuels, the energy content is based on the heating values (MJ/litre) used in the European Union Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

The CO_2 component is based on the CO_2 emissions of the fuel in question. The weight of levies on CO_2 has been raised from their 2011 levels. For fossil fuels, the CO_2 emission values (g/MJ) are based on the values used in the national fuel classification of Statistics Finland.

The energy content component is levied on both fossil fuels and biofuels based on their volumetric energy content. Higher rates apply to fuels used in the transport sector. Lower rates apply in the case of light and heavy fuel oils and electricity used for agricultural purposes. The CO_2 component is based on the CO_2 emissions of the fuel in question, and for this reason biofuels are subject to a CO_2 tax rate that is reduced from 50 to 100 per cent if they meet the European Union's sustainability criteria. Carbon dioxide taxes for the fossil fuels used in combined electricity and heat production are also lowered by 50 per cent. The strategic stockpile fees range from EUR 0.28 per kilo for heavy fuel oil to the EUR 0.68 per litre for most liquid fuels.

Furthermore, a reduced energy content tax is applied to fuel grades that are better in terms of local emissions than traditional fossil fuels. Local emissions are emissions causing health effects in nearby areas like NO_x and particle emissions. The reduction corresponds to the imputed value of the emission benefit in accordance with the principles set out in EU Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles.

Energy taxation rules include exemptions and reduced tax rates resulting in tax expenditure. LPG and fuel for commercial aviation and shipping are not taxed. Peat is taxed at a lower rate, but it is subject to progressive increases in 2013 and 2015. Natural gas is subject to a tax expenditure that is due to expire in 2015.

In transport, diesel fuel accounts for more than 50 per cent of CO_2 emissions and energy content. Diesel and biofuels are taxed at lower rates than gasoline, leading to a tax expenditure compared to the taxes levied on gasoline. In heating and process use, waste and biomass are not taxed and account for more than 40 per cent of the energy content and emissions from the heating and process use of fuels. All heating fuels are taxed at a lower rate than transport fuels.

Electricity used by industry is taxed at a much lower rate than electricity used for commercial and residential purposes. Energy taxes are not levied on energy used for the transformation of other fuels and for rail.

A further tax applied to diesel-driven vehicles is the annual propelling-force tax, which is on average EUR 420 per diesel vehicle. The annual propelling-force tax is levied to achieve the tax burden required by the environmental tax model.

Government expenditure on energy and climate policy

Government appropriations for the energy and climate policy are discussed and decided upon during the annual budget process. Table 4.4 highlights the main energy and climate appropriations included in the state budget for 2011–2013. The list of policy measures included in the table is not exhaustive. Funding for most energy and climate policy measures will continue beyond 2013.

Table 4.3 Energy taxes in Finland

	Energy taxes, strategic stockpile fees and oil pollution fees												
Date	**Fuels 1)**							**Electricity**					
								Consumption		**Production**			
	Motor-gasoline, unleaded 2)	Diesel fuel 3)	Light fuel oil 12)	Heavy fuel oil	11) Hard coal	Natural gas	Peat	Electricity, I 4)	Electricity, II 5)	Nuclear power	Hydro power	Imports	
	c/l			c/kg	€/t	c/nm³	€/MWh	c/kWh					
Excise taxes 10)													
1.1.1990	21.53	16.82	0.34	0.34	2.69	0.17	0.34	-	-	-	-	-	
1.1.1995	45.12	27.5	3.02	3.12	19.53	0.94	0.59	-	-	0.4	0.07	0.37	
1.7.2005	58.08	31.59	6.71	5.68	43.52	1.82	-	0.73	0.44	-	-	-	
1.1.2007	58.08	31.59	6.71	5.68	43.52	1.82	-	0.73	0.22	-	-	-	
1.1.2008	62.02	36.05	8.35	6.42	49.32	2.016	-	0.87	0.25	-	-	-	
1.1.2011	62.02	36.05	15.7	18.51	126.91	8.94	1.9	1.69	0.69	-	-	-	
1.1.2012	64.36	46.6	15.7	18.51	126.91	8.94	1.9	1.69	0.69	-	-	-	
1.1.2013	64.36	46.6	15.99	18.93	131.53	11.38	4.9	1.69	0.69	-	-	-	
Energy content tax 8)													
1.1.2011	50.36	-	7.7	8.79	54.54	3	-	-	-	-	-	-	
1.1.2012	50.36	30.7	7.7	8.79	54.54	3	-	-	-	-	-	-	
1.1.2013	50.36	30.7	6.65	7.59	47.1	4.45	-	-	-	-	-	-	
Carbon dioxide tax 9)													
1.1.2011	11.66	-	8	9.72	72.37	5.94	-	-	-	-	-	-	
1.1.2012	14	15.9	8	9.72	72.37	5.94	-	-	-	-	-	-	
1.1.2013	14	15.9	9.34	11.34	84.43	6.93	-	-	-	-	-	-	
Energy tax 7)													
1.1.2011	-	-	-	-	-	-	1.9	1.69	0.69	-	-	-	
1.1.2013	-	-	-	-	-	-	4.9	1.69	0.69				
Strategic stockpile fees													
1.7.1984	0.72	0.39	0.39	0.32	1.48	-	-	-	-	-	-	-	
1.1.1997	0.68	0.35	0.35	0.28	1.18	0.084	-	0.013	0.013	-	-	-	
Oil pollution fees 6)													
1.1.1990	0.28	0.031	0.031	0.037	-	-	-	-	-	-	-	-	
1.1.2005	0.038	0.042	0.042	0.05	-	-	-	-	-	-	-	-	
1.1.2010	0.113	0.126	0.126	0.15	-	-	-	-	-	-	-	-	

1) Fuels in electricity production tax-exempt since 1 January 1997
2) Reformulated, since 1 January 1993, also sulphur-free since 1 September 2004. Fossil fuel
3) Sulphur-free, sulphur content < 50 ppm since 1 July 1993, sulphur content < 10 ppm since 1 September 2004. Fossil fuel.
4) Tax class I: others
5) Tax class II: industry and professional greenhouses
6) Fee for imported oil and oil products: EUR 1.50/t
7) Energy tax included in excise taxes
8) Energy content tax included in excise taxes
9) Carbon dioxide tax included in excise taxes
10) Excise taxes contain energy content tax,, carbon dioxide tax, and energy tax
11) Excise taxes for hard coal is in the heat production. In CHP use excise tax is lower.
12) Fossil fuel. Sulphur free

Table 4.4 Energy and climate policies in the state budget in 2011-2013

		EUR million		
		2011	2012	2013
	APPROPRIATIONS	final accounts	estimated	budgeted
R&D	Energy technology research and development	210	184	176
	Climate research (ministries and the Academy of Finland)	16	21	7.9
SUBSIDIES	Electricity production subsidy (feed-in tariff/wind power plants, wood chip power plants, wood-fuel powered plants, biogas power plants)	0.1	33	125
	Fixed electricity production subsidy (wind power plants, wood chip power plants, biogas power plants, hydro power plants)	-	8.5	-
	Subsidy for land-use planning for wind power	1.5	1.5	1.5
	Repair and energy grants (residential buildings)	44	19	13
	Forest management and basic improvement subsidies (KEMERA)			
	Energy wood harvesting subsidy	14	11	12
	Energy wood chipping subsidy (discontinued at the end of 2012)	5.2	11	-
	Subsidies for the production of bioenergy (included in the 2012 budget for the last time, funds available until the end of 2014)	5	5.5	
	Certain climate measures under agri-environmental subsidies			
	Long-term grass cultivation on peat fields	0.3	0.3	0.3
	Use of liquid manure in fields	5.3	3	3
	Measures for winter-time plant coverage	33	30	30
	Renewable energy investment subsidies for micro enterprises under the Rural Development Programme	7.3	11	9
	Agricultural investment subsidies for heat plants using renewable energy	6.2	5.6	5.6
	Public transport subsidies	30	30	30
INFORMATION	Mobility management and other public transport development p	1	2.9	2.8
	Communications, guidance, studies	4.6	3.9	3.9
OTHER	Kyoto mechanisms	7	0.4	2
	Promotion of cycling and walking	20	20	20
	Climate funding for developing countries (ODA, incl. FSF)	62	68	64
	Appropriations TOTAL	**472**	**469**	**506**
	BUDGET AUTHORITY			
SUBSIDIES	Energy subsidy for investments (enterprises and corporations; in	114	38	145
	Budget authorities TOTAL	**114**	**38**	**145**
ADDITIONAL ITEMS	Tax subsidy for production of electricity (until 2011)			
	Estimated share of energy repairs in the increased tax credit scheme for domestic costs			
	Certain tax reliefs and exemptions from taxes related to R&D activities and increasing the use of renewable energy			
	Interest subsidy loans for energy repairs in housing companies (Housing Fund of Finland)			
	Interest subsidy loans for low-energy houses (Housing Fund of Finland)			
	Loans, guarantees and investments by Finnvera plc and Finnish Industry Investment Ltd			

Use of Kyoto mechanisms

Under the EU emissions trading scheme, companies may meet part of their emission reduction obligations by engaging in the Clean Development Mechanism (CDM) and the Joint Implementation (JI) mechanism. These are projects in developing countries and in other Annex I countries that will cost-efficiently reduce emissions and create tradable emission units in the form of certified emission reductions (CERs) and emission reduction units (ERUs). The Government may also use project mechanisms or acquire assigned amount units (AAU) through international emissions trading in accordance with the Kyoto Protocol in order to meet Finland's national emission commitments. In 2008–2012, Finland allowed its operators in the EU ETS to use CERs and ERUs up to a maximum relative threshold of 10 per cent. The operators used 12.3 Mt CERs and 4.1 Mt ERUs.

The budget for the acquisition of Kyoto mechanisms is approximately EUR 80 million. About EUR 21 million of this amount has been allocated for purchasing post-2012 credits. Approximately EUR 20 million were invested already during the CDM/JI pilot programme, which operated from 1999 until early 2006. The rest have been allocated in the years 2006–2012.

To date, Finland has invested approximately EUR 20.8 million in 12 bilateral projects for Kyoto Protocol first commitment period credits. In addition, Finland has committed more than EUR 3 million for Kyoto Protocol second commitment period credits from some of these bilateral projects. Beside these projects Finland has invested in multilateral carbon funds. Ten million US dollars have been invested in the World Bank's Prototype Carbon Fund (PCF), EUR 4.25 million in the Nordic Environmental Financing Corporation's (NEFCO) Testing Ground Facility (TGF), EUR 10 million in the European Bank for Reconstruction and Development's Multilateral Carbon Credit Fund (MCCF), USD 25 million in the Asian Development Bank's Asian Pacific Carbon Fund (APCF), EUR 3 million in the NEFCO Carbon Fund and USD 20 million in the Asian Development Bank's Future Carbon.

Several reports that examine the use of the mechanisms were compiled in January–February 2006; based on these reports, the inter-ministerial Mechanisms Use Steering Group prepared strategic policies for the use of the Kyoto mechanisms for the years 2006–2012. In addition, the Ministry for Foreign Affairs has drafted its own action plan for CDM acquisitions. The Ministry of the Environment has compiled an executive strategy for joint implementation projects and international emissions trading for the years 2006–2012. The use of the Kyoto mechanisms was reviewed at the end of 2007. The Ministerial Working Group on Climate and Energy Policy approved the new strategy in February 2008.

It has been estimated that the present investments and contracts could generate more than 5 million tonnes CO_2 eq. for the first Kyoto commitment period and more than 4 million tonnes CO_2 eq. for the second Kyoto commitment period. Considerable uncertainties are involved, because both the funds and bilateral projects contain some risks. The use of the Kyoto mechanisms is supplementary to domestic actions for cutting greenhouse gas emissions (see also V. Projections).

Effect of policies and measures on longer term trends

The Government's Foresight Report on Long-term Climate and Energy Policy (published in 2009) highlighted possible paths towards a low-carbon Finland. The national energy and climate roadmap will outline the key options for reaching an 80–95 per cent emission reduction by 2050 (see Box 4.2).

A large proportion of current Finnish climate and energy policies also contribute to reducing greenhouse gas emissions in the longer term, in particular when they are based on creating structural changes in the respective systems. For example, buildings have long lifetimes, and therefore the regulations for improving the energy efficiency of new and existing buildings will have long-lasting impacts.

Land-use planning yields also permanent emission reductions in buildings and transport, for example by allowing the use of low-emission heating modes or by improving the possibilities for walking, biking and using public transportation. However, the actual emission reductions will depend on a large array of factors, including general economic development.

Box 4.2 Finland's national energy and climate roadmap towards the year 2050

As outlined in the Government Programme, the national long-term goal of Finland is a carbon-neutral society, which can be achieved by following a roadmap towards 2050 and which involves an increase in energy-efficiency and the use of renewable energy. The Government's objective is to reduce greenhouse gas emissions by 80–95 per cent by 2050, which means that energy-related emissions in particular have to be dramatically cut in the upcoming decades. The roadmap will outline the key options for reaching the 2050 emission reduction targets. Furthermore, it will assess the challenges, opportunities and economic impacts of these options. Work on the national roadmap started in spring 2013 and involves extensive consultation with interest groups and citizens.

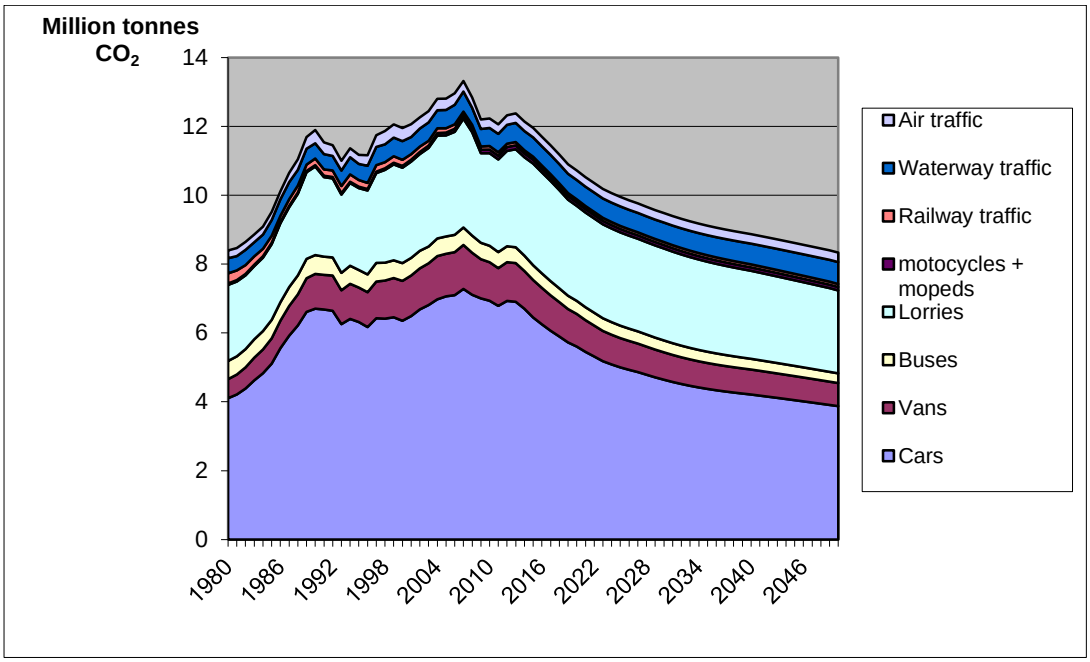
The impact of alternative energy sources on GHG emissions from the transport sector were considered during 2012–2013 in a working group set up by the Ministry of Transport and Communications. The group's vision is that passenger car traffic, rail transport and boating will be almost entirely independent of oil in 2050. Liquid and gaseous biofuels should cover at least 70 per cent of the fuels used in heavy-goods transport by 2050, and electricity should have an equally large share in bus and delivery transport in urban areas. In aviation, biokerosine would replace 40 per cent of the current fuels, whereas in shipping the use of sustainable alternative fuels would contribute to the reduction of greenhouse gas emissions by 40–50 per cent. Transport in airport and port terminals would be nearly emission-free as early as 2030.

Investments in the energy infrastructure have long lifetimes. Therefore, measures that promote investments in renewable energy and improve the competitiveness of renewable energy sources will reduce greenhouse gas emissions in the longer term. This applies also to measures that would in principal contribute to emission reductions only as long as the measure is ongoing, such as feed-in tariffs for renewable energy or biofuel blending obligations for transport fuels.

Prohibiting certain F-gases or halting the disposal of biodegradable waste on landfills can be expected to lead to permanent changes in current practices, and therefore to yield permanent emission reductions.

In the research project ILARI (2010–2012), the longer-term impacts of alternative policies and measures in GHG emissions within the transport sector were studied. The first phase of the project produced a baseline scenario for CO2 emissions related to transport in Finland up to the year 2050. The baseline scenario was based on statistics and forecasts on transport volumes and vehicle fleets provided by the Finnish Transport Agency and the Finnish Transport Safety Agency, energy efficiency forecasts for private vehicles provided by VTT Technical Research Centre of Finland and the national calculation system for measuring traffic exhaust emissions and energy consumption in Finland, LIPASTO. The baseline scenario, presented in Figure 4.4, shows that the GHG emissions from transport are expected to decrease considerably by 2050 without further measures. During the second phase of the project, the impacts of different policy packages on emissions in the transport sector were considered for 2030 and 2050. The project produced alternative future visions and scenarios, including policy packages, for meeting the projections. The results of the research show what policy packages will have the most important impacts in terms of GHG emission reductions, and which, in contrast, will have only marginal impacts in the longer term.

Figure 4.4 The baseline scenario for greenhouse gas emissions from the transport sector by 2050



Mitigation benefits other than greenhouse gas reduction

Environmental impact assessments (EIAs) have been made for all of Finland's national energy and climate strategies. The EIAs for the strategies include a general examination of the benefits and adverse impacts of the strategy, specifically using lifecycle assessments and evaluating the relationship between measures for climate mitigation and air pollution. The latest assessment concludes that measures for reducing the greenhouse gas emissions included in the strategy should have an overall positive impact on the environment. From an environmental point of view, the most important measures are those for improving energy efficiency and those that will result in an absolute reduction in energy demand. A reduction in energy demand will make it easier to fulfil the objectives regarding the share of renewable energy and reduce pressures on using natural resources and on biodiversity.

In general, measures that reduce greenhouse gas emissions will also reduce air pollution. Small-scale wood burning is an exception, however. A significant expansion of small-scale wood burning using simple technologies would have negative health impacts and also contribute to global warming through black carbon emissions.

The lifecycle analysis of the WM and WAM projections shows that the combined environmental impact of fuel production and consumption is likely to decrease relative to the year 2000. The combined environmental impact includes eight categories of effects on the environment: climate change, acidification, freshwater eutrophication, human health damage due to ozone formation, fresh water ecotoxicity, terrain ecotoxicity, human toxicity and fossil fuel depletion. This combined environmental impact will decrease mainly due to reduced fuel consumption in Finland and technological improvements.

Information on changes in domestic institutional arrangements

Finland has not made major changes in the domestic institutional, legal, administrative and procedural arrangements for domestic compliance, monitoring, reporting and archiving of information and evaluation of the progress towards Finland's emissions reductions obligations and targets since the submission of Finland's 5th National Communication.

The Finnish government assesses progress in international as well EU-wide and domestic targets on a continuous basis. The preparation, monitoring and update of the national energy and climate strategies is an important tool in this

respect. Since the year 2003, every Finnish government has appointed a ministerial working group on energy and climate policy with representatives from all government parties. These ministerial working groups have been responsible for preparing and updating the national strategies on energy and climate policy. The current strategy on energy and climate policy has been updated in 2013.

The national greenhouse gas inventory provides basic information used in assessing progress in the achievement of emission reduction targets. Statistics Finland is the national entity with the overall responsibility for compiling greenhouse gas inventory to the UNFCCC and the European Commission. It bears the responsibility for the general administration and quality management of the inventory and for communicating with the UNFCCC, for coordinating participation in the inventory review and for publishing and archiving the inventory results. The National system of Finland is described in Chapter II. The National System was established 1.12005 and very few changes have been made to it after that (see Chapter II).

Reporting on policies, measures, projections and mitigation actions is made in collaboration with different organisations. A committee chaired by the Statistics Finland consisting of representatives from different ministries have coordinated the preparation for the Sixth National Communication and First Biennial report. A working group chaired by the Ministry of the Employment and the Economy, consisting of experts from ministries and expert organisations, has prepared Policies and Measures report to the European Commission under the Monitoring Mechanism (280/2004/EC). The new Monitoring Mechanism Regulation (MMR), Regulation (EU) 525/2013, replacement of Decision 280/2004/EC), further strengthens the reporting of Finland's and other EU Member States' information on greenhouse gases, projections, policies and measures and their effects. Detailed reporting provisions are to be agreed upon through implementing and delegated acts in 2014. Finland has developed reporting of policies and measures and their effects in different research projects. Results of the projects have been utilised in the reporting.

A working group has been appointed to prepare a proposal for the national climate change act. The purpose of the climate change act would be to steer the reduction of emissions not covered by the EU ETS. A long-term emissions reduction target would be included in the act. The act would make emission reduction measures and their monitoring more systematic and predictable.

4.3 Estimates of emission reductions and removals and the use of unit from the market-based mechanisms and land use, land-use change and forestry

The information to be provided in this section and in the CTF tables 4, 4(a)I, 4(a)II and 4(b) is not available for the period 2013 - 2020 for which the EU joint target described in the EU´s submission in the document FCCC/AWGLCA/2012/MISC.1 applies. For example, information on relevant national emissions/removals for the first year of the target period, 2013, will be available only in 2015.

According to the above mentioned submission, the EU target does not include land use, land-use change and forestry (LULUCF). Hence no information is provided in CTF Table 4 4(a)I. However, in CTF table 4(a)II information on Articles 3.3 and 3.4 of the Kyoto protocol concerning LULUCF sector in the first commitment period of the Kyoto Protocol for the years 2008-2011, has been included to demonstrate progress in the achievement of the target under the first commitment period of the Kyoto Protocol.

There are currently no decisions on the use of market-based mechanisms under the Convention. The information on the use of units from mechanisms for meeting the target under the first commitment period will be available only at the end of the true-up period in 2015 or 2016, when the final accounting is done. Finland has also not made any decision on the use of unit from mechanisms for meeting its commitments under the EU joint target for the period 2013 – 2020. According to the Finnish Energy and Climate Strategy 2013, the non-ETS Sector may meet its emission reduction target without the use of units from mechanisms. Therefore, Finland has not filled CTF Table 4(b) with information on use of units from mechanisms in 2011 and 2012.

5 Projections

5.1 Overview of WM and WAM projections

The projections presented in this chapter correspond to the projections of the National Energy and Climate Strategy that were presented by the Government in March 2013. The projections were formulated in 2012 by a working group consisting of experts from ministries that are central to Finland's climate policy.

The 'With Measures' projection (WM) describes a development in which the measures already implemented and adopted that affect the different sectors are continued. Therefore, the projection represents a development path that is likely to take place in the light of the current situation and assumptions.

The 'With Additional Measures' projection (WAM) consists of a set of cost-efficient additional measures that will likely be implemented in accordance with various ministries' plans at the time of Energy and Climate Strategy update. In the meantime, an implementation decision has been approved for some of the WAM measures. The WAM measures typically reduce national greenhouse gas emissions and the domestic use of energy. However, the measure concerning additional biorefineries in the WAM projection increases domestic energy use and emissions in stationary combustion within the energy sector. The net effect of the biorefineries is nevertheless positive, which will result in less emissions in Finland because the fuel produced from domestic, renewable energy sources will replace imported fuel, which is mainly of fossil origin.

Most of the measures included in the WAM projection of the Fifth National Communication have already been implemented and are now part of the WM projection. In addition, the WM projection includes measures that were decided upon in 2010 by the Government regarding renewable energy and energy efficiency in order to meet the obligations for Finland in 2020 set by the EU Climate and Energy Package (see Chapter 3). The most significant measures affecting future energy consumption, and hence, decreasing greenhouse gas emissions compared to the Fifth National Communication have to do with tightening the National Building Code in 2008 and 2011 and measures aiming at renewing the existing car fleet with vehicles that emit considerably less CO_2.

The WAM projection includes the need to continue promoting renewable energy as well as measures to further reduce greenhouse gas emissions and energy consumption. These are described in Chapter 4.

In 2010, the gross final energy consumption was 322 TWh. The National Energy and Climate Strategy states that a target will be set to level off growth in the final energy consumption by improving energy efficiency so that the consumption level in 2020 will be, at a maximum, 310 TWh. The final energy consumption in the WAM projection is 317 TWh, which means that further measures are required in order to reach the new target of 310 TWh. These new measures are not included in the current projections because they had not yet been specified at the time when the projections and calculations were made.

Economic growth and the change in the structure of the economy play a key role in the estimation of energy consumption and emissions. In the long term, economic growth will mainly be determined by the size of the labour force and its productivity. The ageing population is the single most significant factor in terms of its effect on the development of the national economy. Another factor that will affect the availability of labour is the level of structural unemployment. The population forecast of Statistics Finland is used in the projections. It estimates that the population will increase from the current 5.4 million to 5.9 million by 2035. The average size of households will decrease slightly, while the number of households is expected to grow from 2.5 million to 2.9 million during the period.

The economic outlook provided by the Ministry of Finance forms the basis for the estimate regarding the development of the Finnish economy in the near future, whereas longer term development assumptions are based on a study published by the Government Institute for Economic Research.

During the 2010s, the economy will not reach the growth rate experienced before the global recession of 2009. In the projections, the annual growth of the national economy will be 1.6 per cent during the current decade and slightly higher, 1.9 per cent, in the 2020s. The Finnish economy is experiencing a structural change, where the outlook of en-

ergy intensive industries in particular differs from the past. In addition to the generally lower starting level, the branch-specific growth expectations have partly changed due to the recession compared to the projections made in the Fifth National Communication. The main differences include a more positive development expectation for the mining industry in particular and, on the other hand, lower production level expectations for the forest industry and basic metals than originally predicted in 2008.

The economic growth expectation after 2020 is overall about the same as in the Fifth National Communication, even though the starting level is clearly lower. It may not be possible to make up for the gap caused by the recession.

It is assumed that Finland's fifth nuclear power plant unit will be completed in 2015. In 2010, decisions-in-principle were approved for constructing two additional nuclear power plant units. The projections assume that the units will be operational during the 2020s. Finland is currently heavily dependent on electricity imports. One of the aims of the Government is to achieve a level of self-sufficiency in terms of the nation's electricity supply. In the projections, it is assumed that the electricity net imports will decrease from its current level so that from 2020 onwards, Finland will be self-sufficient on a yearly basis. In addition to the EstLink2 cable that is currently under construction, the projections include a new electricity interconnection with Sweden and a bi-directional interconnection with Russia. The development of the primary energy supply in the WM projection is shown in Figure 5.1.

Figure 5.1 Historical development (1990-2011) and WM projection (up to 2030) of the primary energy supply

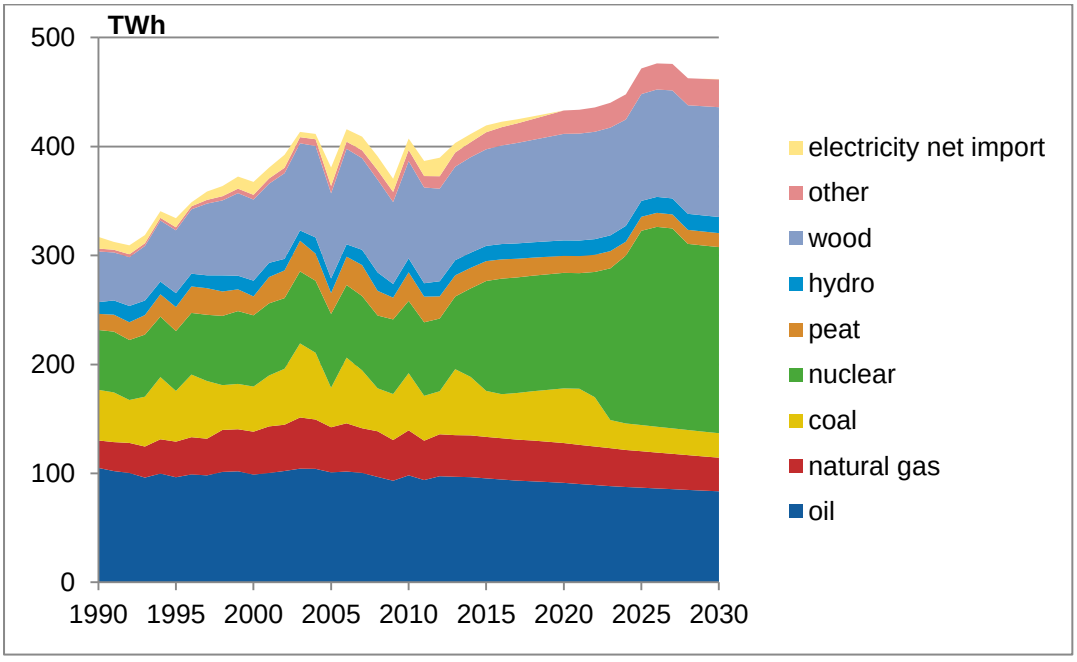


Table 5.1 shows a summary of the main assumptions of the WM projection for 2015–2020. Numerical values for key variables and assumptions are presented in CTF Table 5. The assumptions regarding international fuel prices on the world market are consistent with the latest estimates of the International Energy Agency (IEA).

Table 5.1 Assumptions of the WM projection

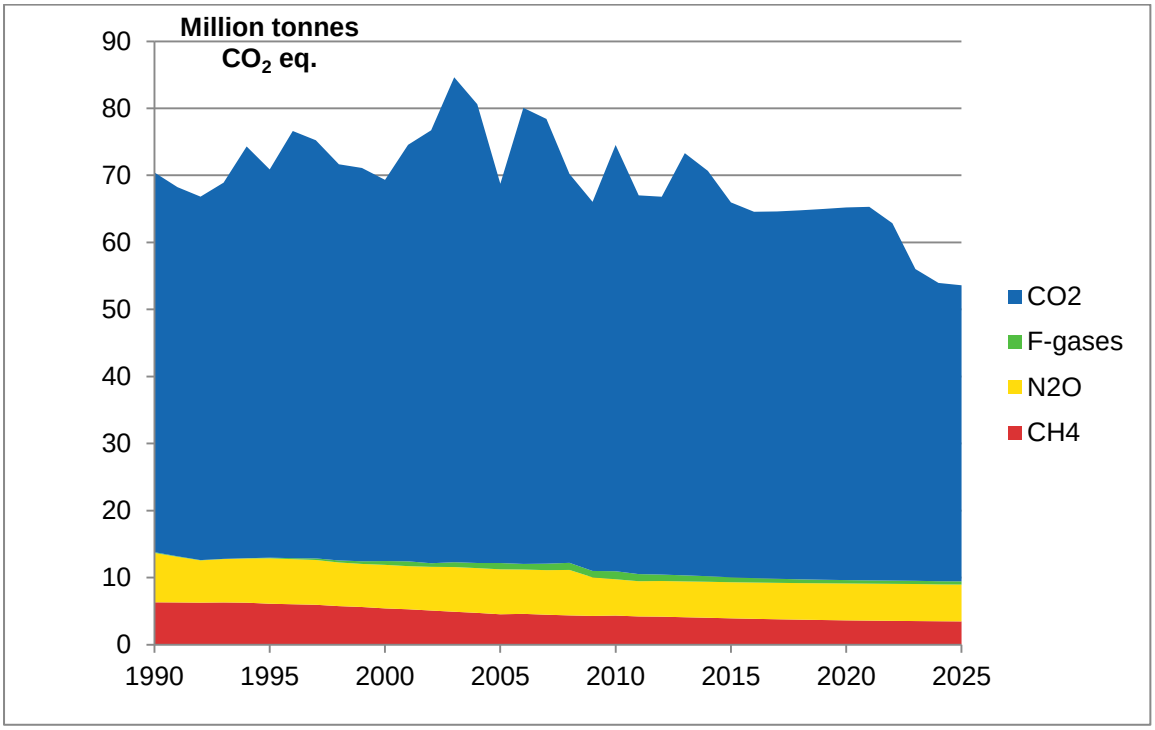
Parameter	Trend 2015–2020
GDP growth	Almost 2 per cent annually
Structure of the economy	Increasing share of services
Structure of industry	Less capital and energy intensive
Population growth	Increasing slowly
Population structure	Ageing
Technology development	Gradual introduction of improved and more efficient technology

5.2 'With Measures' projection

Total effects

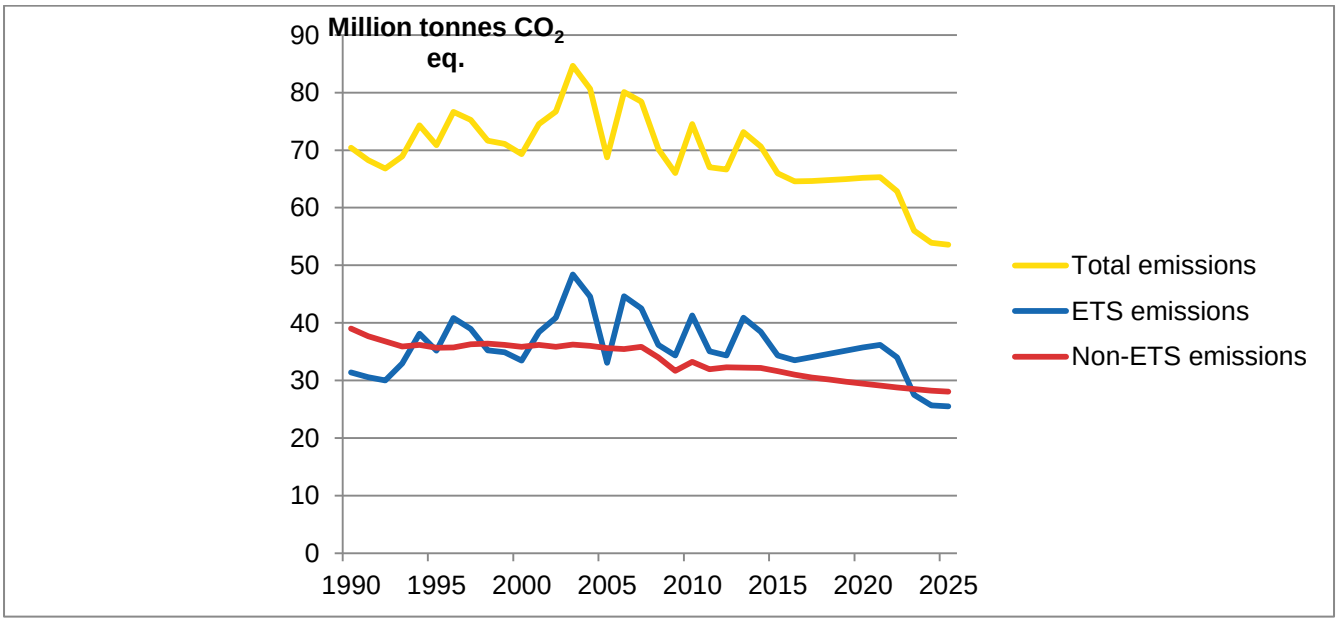
Total emissions in the WM projection for the years 1990–2025 are shown in Figure 5.2 Compared with the base year of 1990, the total greenhouse gas emissions are expected to be 7 per cent lower in 2020 and 24 per cent lower in 2025. Correspondingly, the CO_2 emissions are projected to be 2 per cent lower in 2020 and 22 per cent lower in 2025. CH_4 emissions are expected to continue to decline steadily, whereas N_2O emissions are projected to remain at current levels, which is one fourth lower than in 1990. The amount of emissions from F-gases is small and expected to decrease in the coming years. Numerical information on sector specific GHG emissions and emissions per gas in the WM projection is presented in CTF Table 6(a).

Figure 5.2 Greenhouse gas emissions by gas according to the latest greenhouse gas emission inventory (1990-2011) and the WM projection (up to 2025)



The split of greenhouse gas emissions between the EU ETS sector and the non-ETS sector is illustrated in Figure 5.3. It seems that emissions in the EU ETS sector have reached their peak in the mid-2000s and they are expected to decline. In 2011, emissions in the EU ETS sector were 52 per cent of the total GHG emissions, whereas they were 48 per cent in the non-ETS sector. The split is expected to remain roughly the same during the current decade. In the WM projection, new nuclear power units will reduce the EU ETS emissions by the mid 2020s.

Figure 5.3 Greenhouse gas emissions according to the latest greenhouse gas emission inventory (1990-2011) and the WM projection (up to 2025) in the EU ETS and non-ETS sectors



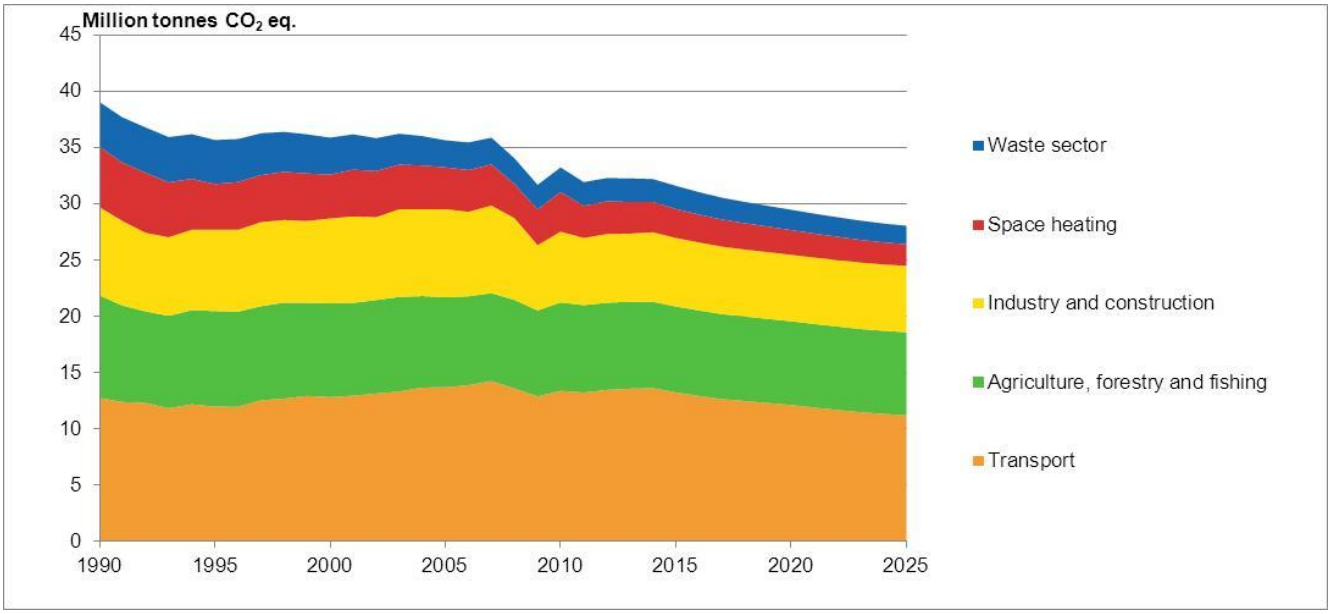
The development of total emissions with regard to the number of inhabitants, primary energy use and economic development is presented in Table 5.2.

Table 5.2 Greenhouse gas emission intensity based on the latest greenhouse gas inventory for 2010–2011 and the WM projection for 2015–2030

	2010	2011	2015	2020	2025	2030
Emissions per capita, tonnes CO_2 eq. /capita	13.9	12.4	11.8	11.4	9.2	8.6
Emissions per GDP, kg CO_2 eq./EUR	0.55	0.49	0.45	0.41	0.30	0.27
Emissions per primary energy, tonnes CO_2 eq./MWh	0.18	0.17	0.15	0.15	0.11	0.11

The emissions from the non-ETS sector have steadily decreased since 1990, and the decrease is expected to continue until 2025 (Figure 5.4). According to the WM projection, the emissions from the non-ETS sector in the year 2020 will be 17 per cent below the 2005 level, which is sufficient for reaching the target set by the EU Climate and Energy Package (16 per cent reduction in 2020 compared to 2005).

Figure 5.4 Emissions in the non-ETS sector by category (1990–2011) based on the latest greenhouse gas inventory and the WM projection (up to 2025)



Sectoral emissions

Energy

The energy sector is strongly affected by the measures to reduce the emissions, to enhance energy efficiency and to increase the share of renewable energy sources. Both the supply and demand sides will face important changes in the coming years. As many of the changes concern investments like power plants and the building stock, the impact will be robust and long lasting.

In the WM projection, the most significant changes in electricity production will be introduced by the start up of the nuclear power plant unit currently under construction in 2015, two more units in the 2020s and the increase in the use of renewable energy sources, mainly wind power and biomass in CHP plants. All of these changes will reduce emissions. In the WM projection, Finland will not remain a net importer of electricity after the year 2020, which will still serve to increase the emissions from condensing power plants using fossil fuels for the next few years.

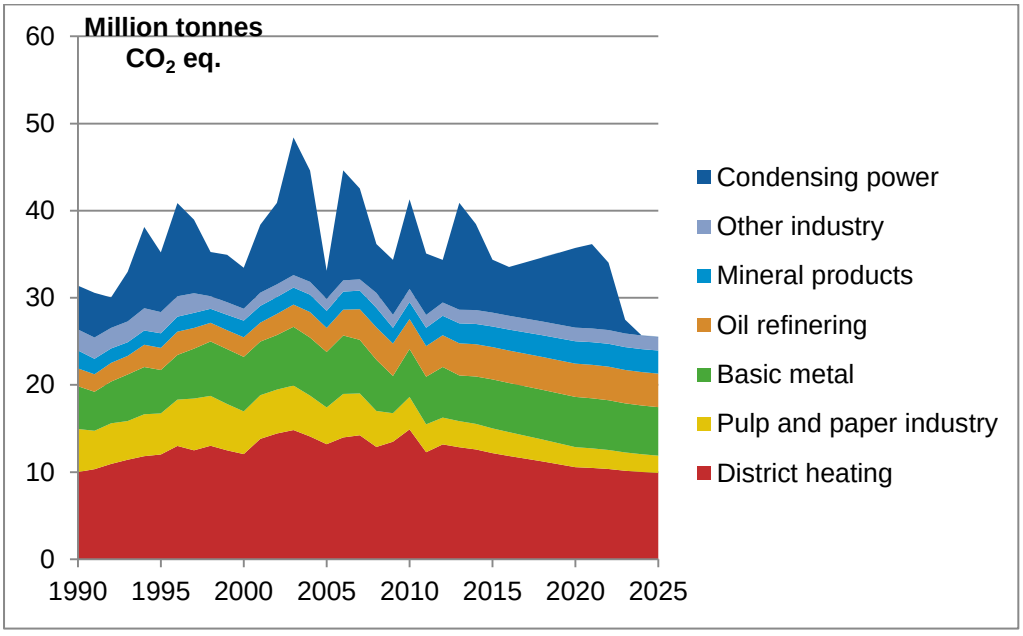
Factors affecting the future energy demand are first of all energy efficiency measures, but also structural changes within the industry. According to the WM projection, heating energy consumption in 2020 will be on par with 2012, but slightly lower in 2030 (by 0.5 per cent), even though the volume of buildings is expected to increase continuously. The emissions from space heating are decreasing even faster than the energy demand due to the increased use of renewable energy. The historical and projected emissions from the energy sector in the WM projection are presented in Table 5.3.

Table 5.3 Historical (1990-2011) and projected (up to 2030) greenhouse gas emissions from the energy sector (excluding transport) based on the latest inventory and the WM projection, respectively

	Historical						WM Projection			
	1990	1995	2000	2005	2010	2011	2015	2020	2025	2030
Total emissions, million tonnes CO_2 eq.	41.7	44.1	41.6	40.3	47.1	40.2	38.4	39.0	28.3	27.0
CO_2	40.7	43.0	40.6	39.2	45.9	39.1	37.3	37.8	27.2	25.8
CH_4	0.2	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3
N_2O	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8

The emissions in the energy sector are mainly CO_2 emissions from the combustion of fossil fuels and peat. The development of CO_2 emissions in the EU ETS sector is illustrated in Figure 5.5 for the years 1990–2025.

Figure 5.5 CO_2 emissions in the EU ETS sector according to the greenhouse gas inventory (1990–2011) and the WM projection (up to 2025)



Historically, district heating emissions have varied according to the heating demand (cold or warm winters). The emissions from condensing power have varied strongly depending on the hydro situation in the Nordic electricity market. In the WM projection for future years, the electricity import and export assumptions and the possible deficit in domestic power generation will influence the generation level of condensing power, and hence, the total emissions. The CO_2 emissions in district heating are declining steadily in the WM projection, whereas the industry's CO_2 emissions will remain rather stable.

The importance of CH_4 and N_2O emissions within the energy sector is quite small. Slightly less than 10 per cent of all CH_4 emissions come from the incomplete combustion of fuel, which is mainly caused by fireplaces and small heating boilers. CH_4 emissions from power and heating plants are quite small.

The development of emissions outside the EU ETS is presented in Figure 5.4 above. Non-ETS emissions within the energy sector (excluding transport) are mainly the result of using space heating for buildings, industry outside the EU ETS and machinery. For example, in agriculture and forestry the energy-related greenhouse gas emissions in 2010 were 2 million tonnes CO_2, of which machinery's share was 0.8 million tonnes CO_2. In the WM projection, the energy-related emissions, excluding machinery, will decline from 1.2 million tonnes CO_2 in 2010 to 0.8 million tonnes CO_2 in 2020. It is estimated that the emissions from forest and agriculture machinery will remain approximately at their current level, i.e. 0.7–0.8 million tonnes CO_2, even though the use of machinery is expected to increase over time. The reasons for this favourable development are more efficient equipment, more efficient use of the equipment and an increasing share of biofuels.

Transport

The WM projection for the transport sector includes all of the measures that were already being used within the transport sector to cut down on emissions at the beginning of the year 2013.

According to the WM projection, even though the total vehicle mileage will increase, the energy use as well as the emissions will start to decline in 2015 (Table 5.4). The emission reductions will be achieved by domestic and EU-wide policy measures, including promoting of the use of biofuels, improving vehicle technology and renewing the vehicle fleet, as well as by improving energy efficiency and directing the growth in passenger traffic volumes to more environmentally friendly transport modes. It is assumed that the use of biofuels will increase to a total of at least 12.5 per cent of the transport fuel sold in 2020 and that the growth in transport performances will remain at a moderate level, i.e. 0.5–1.5 per cent annually.

Table 5.4 Historical (1990-2011) and projected (2015-2030) greenhouse gas emissions from transport based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical						WM Projection			
	1990	1995	2000	2005	2010	2011	2015	2020	2025	2030
Total emissions, million tonnes CO_2 eq.	12.8	12.0	12.8	13.7	13.4	13.2	13.3	12.1	11.2	10.6
CO_2	12.5	11.7	12.6	13.5	13.2	13.0	13.0	11.9	11.0	10.4
CH_4	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
N_2O	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Industrial processes, solvent and other product use

The main factors affecting the development of emissions from industrial processes include changes in industrial production and measures applied for reducing emissions. The global recession temporarily reduced the emissions from industrial processes in 2009, after which they have increased again, but not to their previous level. From 2015 onwards, emissions are expected to increase (Table 5.5). CO_2 emissions from industrial processes are mainly caused by the manufacturing of iron and steel, cement, lime and hydrogen. In the WM projection, these emissions will slightly increase as industrial production increases. N_2O emissions will be small, only 0.2 million tonnes CO_2 eq. in 2020, and they will also slightly increase towards the year 2030.

The WM projection for F-gases includes the impacts of the EC regulation on F-gases (842/2006) and the EC directive relating to emissions from air-conditioning systems in motor vehicles (2006/40/EC). Emissions from refrigeration and air-conditioning equipment are expected to decline as a result of these measures and technical changes leading to smaller charges and decreased leakage. Emissions from electricity distribution equipment and foam blowing have declined as a result of voluntary actions on the part of the industries and it is assumed that they will remain close to the emission levels for recent years. Restrictions put into effect by the EC regulation have reduced emissions from aerosols and other sources, but the emissions are expected to start increasing again due to increased activity in the remaining source fields. Emissions from refrigeration and air-conditioning equipment account for close to 90 per cent of Finnish F-gas emissions, and therefore, the projected overall emission trend is declining.

Emissions from solvent and other product use are expected to remain at their present level according to the WM projection.

Table 5.5 Historical (1990-2011) and projected (2015-2030) greenhouse gas emissions from industrial processes and solvent and other product use based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical						WM Projection			
	1990	1995	2000	2005	2010	2011	2015	2020	2025	2030
Industrial processes										
Total emissions, million tonnes CO_2 eq.	5.1	4.7	5.6	6.4	5.8	5.6	5.5	5.7	5.7	5.8
CO_2	3.35	3.1	3.6	3.8	4.4	4.4	4.5	4.7	4.8	4.8
CH_4	0.01	0.01	0.01	0.01	0.01	0.01	0.0	0.0	0.0	0.0
N_2O	1.7	1.5	1.4	1.6	0.2	0.1	0.2	0.2	0.3	0.3
F-gases	0.1	0.1	0.6	0.9	1.2	1.1	0.8	0.7	0.6	0.6
Solvent and other product use										
Total emissions, million tonnes CO_2 eq.	0.18	0.14	0.12	0.11	0.07	0.07	0.1	0.1	0.1	0.1
CO_2	0.12	0.08	0.07	0.06	0.05	0.04	NE	NE	NE	NE
N_2O	0.06	0.06	0.05	0.05	0.03	0.03	NE	NE	NE	NE

Agriculture

In recent years, the changes in the emissions from the agriculture sector have been small. Under the WM projection, the emissions are expected to remain at their current level until the year 2020, but there will be small changes in the distribution of the different emission sources. The decline in livestock numbers will slightly lower the emissions from enteric fermentation and manure management. However, at the same time a slight increase in soil nitrous oxide emissions will cancel out that effect.

According to the WM projection, the total greenhouse gas emissions from agriculture will be 12 per cent lower in 2020 than in 1990 (Table 5.6). However, the largest decrease has occurred between 1990 and 2000. Between 2010 and 2020, the CH_4 emissions are projected to decrease by 5 per cent and N_2O emissions to increase by 1 per cent.

Energy-related emissions are reported in the energy sector and not included in the table.

Table 5.6 Historical (1990-2011) and projected (2015-2030) greenhouse gas emissions from agriculture based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical						WM Projection			
	1990	1995	2000	2005	2010	2011	2015	2020	2025	2030
Total emissions, million tonnes CO_2 eq.	6.7	6.1	5.9	5.8	6.0	5.9	5.9	5.9	5.9	5.7
CH_4	2.2	2.0	1.9	1.9	1.9	1.9	1.7	1.8	1.8	1.8
N_2O	4.5	4.1	3.9	3.9	4.0	4.0	4.1	4.1	4.1	4.0

LULUCF

The land use, land-use change and forestry sector (LULUCF) as a whole is expected to be a net sink in the WM projection (Table 5.7).

The WM projection for forestry is based on the National Forest Programme (NFP) 2015, which estimates that the carbon sink of forests (including trees and soil) will remain at a level of at least 10-20 million tonnes CO_2 eq. per annum by 2015. The estimate is based on the assumption that loggings will increase by 10–15 million cubic metres per year and that the use of wood for bioenergy will continue as defined in the national long-term climate and energy strategy and the NFP. The forest management reference level for the second commitment period of the Kyoto Protocol (2013-2020) is 19.3 million tonnes CO_2.

The government and stakeholders will continue to carry out joint initiatives to promote the use of wood as a renewable material that also contributes to climate change mitigation. The impact of harvested wood products on emissions varies annually. In the most recent inventory, harvested wood products were estimated to be a source of 0.65 million tonnes CO_2 eq. In the reference level calculations for the second commitment period of the Kyoto Protocol, the harvested wood products are a sink of 1.1 million tonnes CO_2.

With regard to agricultural soils, CO_2 emissions from croplands and grasslands are not expected to be subject to large changes by the year 2020 according to the WM projection. The uncertainties in these estimates are significant, and new methods are being developed to increase their accuracy.

Table 5.7 Historical (1990-2011) and projected (2015-2030) greenhouse gas emissions and removals from the LULUCF sector based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical						WM Projection			
	1990	1995	2000	2005	2010	2011	2015	2020	2025	2030
Total emissions and removals, million tonnes CO2 eq.	-15.2	-14.1	-20.5	-29.9	-24.6	-24.6	-11.9	-11.9	-11.9	-11.9
CO_2	-15.3	-14.3	-20.6	-30.1	-24.8	-24.8	-12.1	-12.1	-12.1	-12.1
CH_4	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
N_2O	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Waste

Greenhouse gas emission projections for the waste sector include CH_4 from landfills, CH_4 and N_2O emissions from composting and CH_4 and N_2O emissions from wastewater treatment. Projections for the waste sector do not include emissions from waste incineration, which are reported in the energy sector. According to the WM projection, greenhouse gas emissions from the waste sector will decrease (Table 5.8). The main reason for this is the implementation of the Landfill Directive and national legislation and strategies aimed at reducing the amount of waste and minimising the amount of waste disposed at landfills.

CH_4 emissions decline significantly in the WM projection: by the year 2020, they will be approximately one third the amount they were in the year 1990. This trend will also continue after 2020, and emissions in 2030 are projected to be 18 per cent below the 2020 level.

The N_2O emissions in the waste sector were 0.16 million tonnes CO_2 eq. in 2011 and are not expected to change much over time.

Table 5.8 Historical (1990-2011) and projected (2015-2030) greenhouse gas emissions from the waste sector based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical						WM Projection			
	1990	1995	2000	2005	2010	2011	2015	2020	2025	2030
Total emissions, million tonnes CO2 eq.	4.0	3.9	3.3	2.4	2.2	2.1	1.8	1.6	1.4	1.3
CH_4	3.8	3.7	3.1	2.2	2.0	2.0	1.7	1.4	1.3	1.2
N_2O	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

International bunkers

According to the most recent greenhouse gas emission inventory, the fuel consumption for international aviation was about 26,700 TJ and for international marine transportation 7,900 TJ in 2011. The annual growth rate by 2020 is estimated at 2 per cent for international marine transportation and 3 per cent for international aviation. Based on these assumptions, the total greenhouse gas emissions from bunker fuels are projected to be 3.3 million tonnes CO_2 eq. in 2020 (0.7 million tonnes from marine and 2.6 from aviation bunkers).

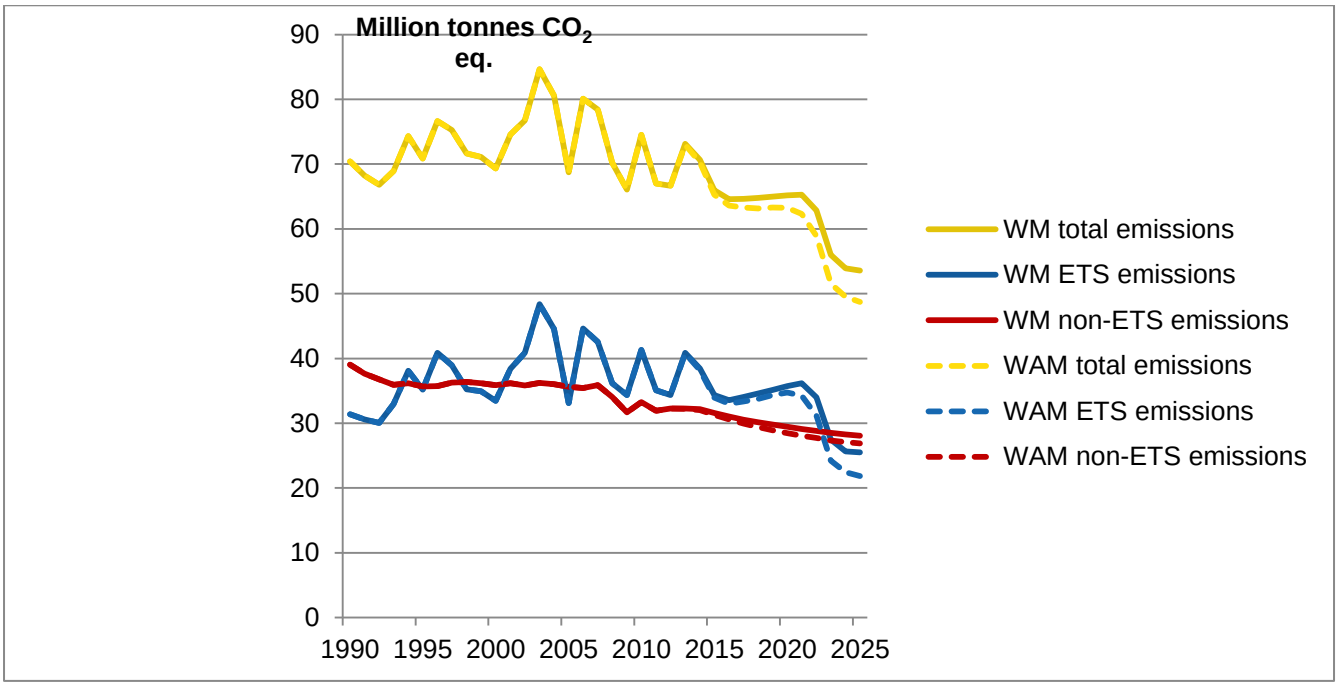
The projected emissions of marine and aviation bunkers do not take into account the impact of the measures presented in CTF Table 3 which aim at improving energy efficiency and increasing the use of alternative fuels.

5.3 With 'Additional Measures' projection

The effect of the policies and measures included in the WAM projection on the total greenhouse gas emissions is illustrated in Figure 5.6. Continuous lines portray the WM projection and dashed lines the WAM projection.

The total greenhouse gas emissions in 2020 are estimated to be 64 million tonnes CO_2 eq. in the WM projection and 62 million tonnes CO_2 eq. in the WAM projection. The additional emission reduction measures in the WAM projection will mainly affect the emissions trading sector. Many of the measures in WAM projection are primarily designed to meet the national renewable energy and energy efficiency targets and they will have positive effects on the security of the energy supply. While having a positive effect on the transport sector, the new biorefineries will increase the emissions of the emissions trading sector.

Figure 5.6 Greenhouse gas emissions in EU ETS and non-ETS sectors in the WAM projection (dashed lines) compared to the WM projection (solid lines) in the years 2012-2025 and historical emissions for 1990-2011 based on the most recent inventory



CTF Table 6(c) presents a summary of the WAM projection emissions by sector and by gas.

In the WAM projection, the heating energy consumption of residential and service buildings will decrease between 2012 and 2020 by approximately 9 per cent (6.5 TWh). By 2030, the consumption of heating energy will have decreased by 20 per cent (15 TWh) from 2012. The emission reductions due improvements in energy performance in renovations and alterations should be 0.5 million tonnes CO_2 in 2020 and 1.0 million tonnes CO_2 in 2030. Most of the emission impact falls on the EU ETS sector, while the improvements in energy efficiency will decrease the need for district heating and electricity.

In the transport sector, the estimated total emission reductions in the WAM projection is 0.6 million tonnes CO_2 in 2020 compared to the WM projection. The potential emission reduction impact of energy efficiency agreements included in the WAM projection is 0.3 million tonnes CO_2 eq. in 2020 compared to the WM projection. The emission reduction effects of promoting public transport, walking and cycling should total some 0.3 million tonnes CO_2 eq. in

2020. For public transport, the target is to reach an emission reduction rate of 0.15 million tonnes CO_2, and the same target applies to walking and cycling. The possible additional financial steering methods referred to in CTF Table 3 are not included in the WAM projection.

For F-gases, the WAM projection is based on the assumption that the European Commission's reassessment of the EC regulation on F-gases (842/2006) in 2011 will lead to additional regulatory measures. Further restrictions on the use of F-gases in refrigeration and air-conditioning equipment, foam blowing and aerosols are expected in all applications where it is technically feasible, and the changes should be in line with safety and health concerns. It is estimated that the emission reductions achieved by these additional measures will be 0.07 million tonnes CO_2 eq. in 2020 compared to the WM projection.

In the waste sector, the additional emission reductions are based on a drastic reduction of biowaste in landfills. However, as existing measures have reduced emissions significantly, the additional emission reductions are relatively modest (about 0.2 million tonnes CO_2 eq. in 2020 compared to the WM projection).

In agriculture and the LULUCF sectors, the WAM projection does not include any additional measures compared to the WM projection, and therefore, the two projections are identical for these sectors.

5.4 Total effect of policies and measures

In the estimate for the total effect of policies and measures (PaMs), the Business as Usual (BAU) scenario of the Finnish climate strategy from the year 2001 was used (denoted here as BAU*). The BAU scenario presents a development path without measures implemented after the year 2000. The scenario used 1999 as a starting point. The estimates for CH_4 and N_2O were modified for this assessment to take into account the changes in inventory methodologies by applying the percentage difference of the 1999 emissions in the most recent inventory and in the 2001 climate strategy to the 2010 and 2020 emissions estimates in the BAU scenario. In the case of CO_2, the original BAU scenario was modified to exclude emissions that are currently reported in the LULUCF sector (peat production and CO_2 from agricultural soils). In addition, the BAU estimate was modified to take into account the actual electricity imports in 2010 and the projected imports for 2020 in the WM projection (0 TWh); this was done using the sensitivity study for the 2001 climate strategy, in which the scenario was presented with different electricity import levels.

Based on the results presented in Table 5.9, the total effect of PaMs in 2010 was 6.1 million tonnes CO_2 eq., which means that the emissions in 2010 would have been 8 per cent higher without the PaMs implemented since the year 2000. According to the comparison of the BAU* scenario with the WM projection for 2020, the total effect of PaMs in 2020 will be 31.5 million tonnes CO_2 eq. (-33 per cent compared to the BAU* figure).

Table 5.9 Greenhouse gas emissions by gas in the BAU* scenario for 2010 and 2020, with the 2010 emissions based on the most recent inventory and the emissions for 2020 on the WM projection. The total effect of the policies and measures (PaMs) is calculated based on the difference between the inventory emissions and the BAU* (for 2010) and the difference between the WM projection and the BAU* (for 2020)

Emissions, million tonnes CO_2 eq.	BAU* 2010	2010 (inventory)	Total effect of PaMs in 2010	BAU* 2020	WM 2020	Total effect of PaMs in 2020
CO_2	67.0	63.6	-3.4	81.6	54.5	-27.1
CH_4	5.6	4.3	-1.3	5.0	3.6	-1.4
N_2O	6.7	5.4	-1.3	6.8	5.5	-1.3
F-gases	1.4	1.2	-0.2	2.4	0.7	-1.7
Total	80.6	74.5	-6.1 (-8%)	95.9	64.4	-31.5 (-33%)

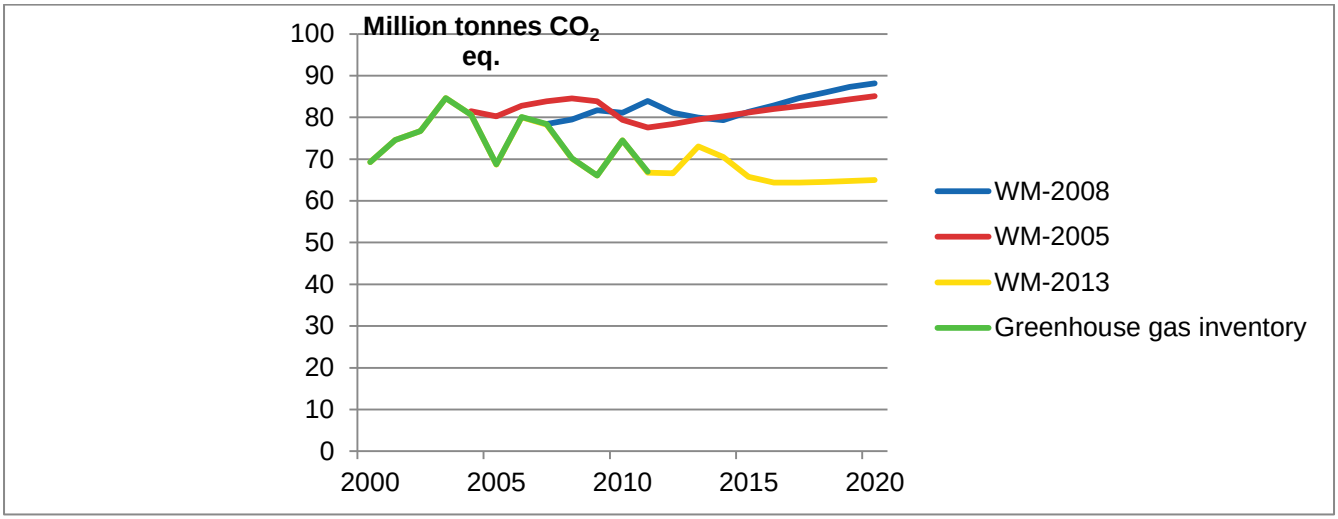
The aggregated estimates for the greenhouse gas reduction impacts of individual policies and measures presented in Chapter 4 are 15 and 33 million tonnes CO_2 eq. for 2010 and 2020 (without LULUCF), respectively. However, the impact estimates of individual policies and measures are not fully additive, which may result in an overestimation of the mitigation impact. On the other hand, the mitigation impact has not been estimated for all policies and measures.

The total effect of policies and measures contains noticeable uncertainties. The estimated range for the total effect of policies and measures implemented in Finland is 6−15 million tonnes CO_2 eq. for 2010. In 2020, the total effect of policies and measures will be approximately 30 million tonnes CO_2 eq. with existing measures, based on the two approaches described above.

Figure 5.7 shows Finland's greenhouse gas emissions in the WM projections in the last three national climate and energy strategies, i.e. strategies from the years 2005, 2008 and 2013. The WM projections in the 2005 and 2008 national climate and energy strategies projected 7–25 per cent higher emissions for 2010 and 2011 than those reported in the latest greenhouse gas inventory. This suggests that the recent additional measures have had a significant impact on the total emissions.

The main difference between the projections is that in the newest projection, many measures from previous WAM projections have been implemented and now included in the WM projection. The projections differ most compared to the Fifth National Communication in terms of road transport, space heating of buildings and renewable energy. In addition, the global recession and the structural adjustment of the Finnish forest industry have been taken into consideration in the 2013 strategy but not in the previous ones. The total effect of implementing additional measures can be seen in the emission development trend after 2015, which has levelled off in the most recent projection, whereas it continued to increase in the projections from 2005 and 2008. Yet another difference between the projections, one which clearly impacts the emissions, is the assumed start-up year for the nuclear plant unit Olkiluoto 3. The start-up year has been postponed several times, and the 2013 projection assumes that the unit will start up in 2015, whereas the strategies from 2005 and 2008 assumed production would already start in 2009–2010 and 2012, respectively. In the current WM projection, the emissions in 2020 are projected to be 24-26 per cent below the projected levels in the earlier projections.

Figure 5.7 Greenhouse gas emissions according to the most recent inventory for 1990-2011 and in the WM projections of the climate and energy strategies published in 2005, 2008 and 2013 for 2012-2020

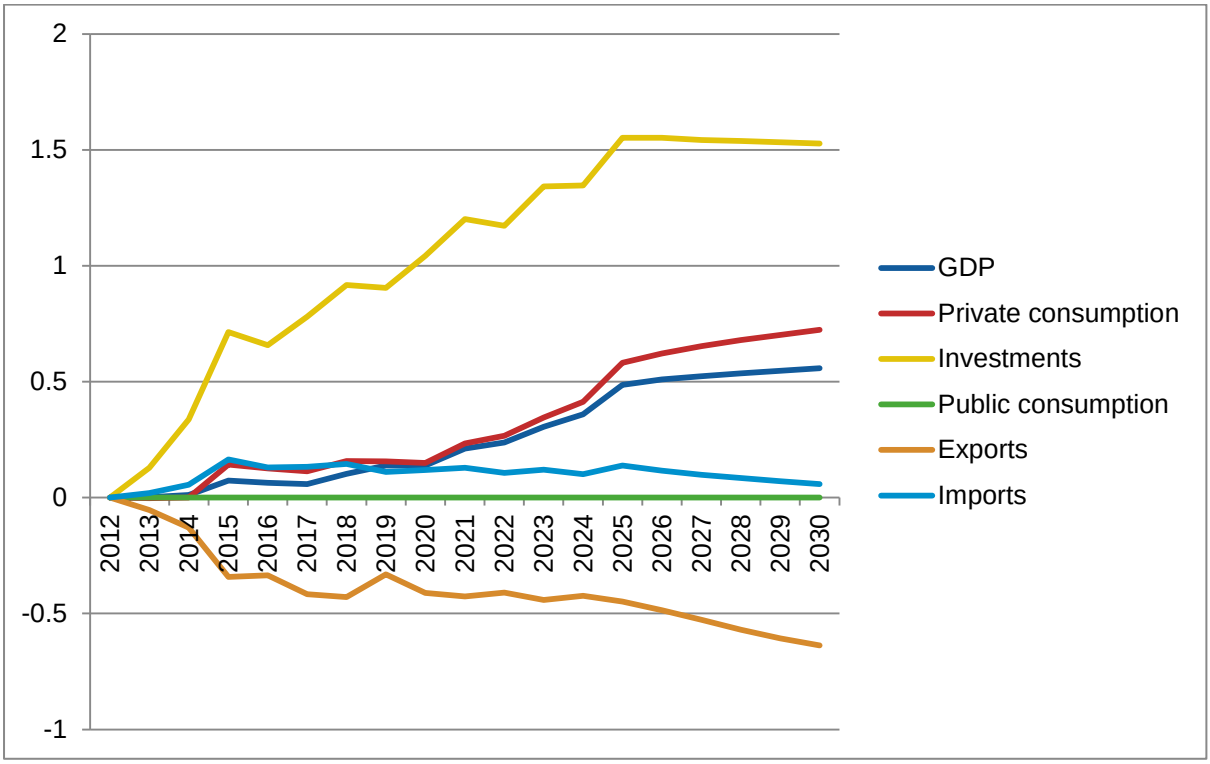


5.5 Economic impacts

The Government Institute for Economic Research (VATT) has studied the effects of the WAM projection on the Finnish economy using a dynamic, applied general equilibrium model (VATTAGE model). In the long run, it estimates that the measures used in the WAM projection will improve Finland's employment and energy self-sufficiency and increase the national product. The precondition for achieving the improved employment and increased national product is that the main part of the needed investments are market based, with the exception of the first biorefineries and the replacement of coal with renewables, which will require economic support. Wood biomass will also need to be available in sufficient quantities and at competitive prices.

Figure 5.8 illustrates the estimated effects of the WAM projection on the demand components of the national product compared to the WM projection.

Figure 5.8 Estimated changes in the demand components of the national product (WAM projection compared to the WM projection, per cent difference) in the years 2012-2020



The measures in the clean energy programme (included in the WAM projection, will require significant investment in the stock of equipment producing and consuming energy. According to initial estimates, the investment needs total approximately EUR 20,000 million. The largest investments concern nuclear power units that have been granted favourable decisions-in-principle, biorefineries and a plant for producing synthetic natural gas, as well as constructing additional wind power facilities. In addition, during the clean energy programme period, approximately EUR 6,000 million will be allocated to strengthening the electricity and gas networks, and investments will be made in cars that reduce traffic emissions.

5.6 Sensitivity analysis of the projections

In 2010, Finnish industry used 46 per cent of the country's total primary energy and 47 per cent of its electricity. The ongoing structural change in the forest industry is having a significant impact on the energy sector, including renewable energy production, energy consumption and greenhouse gas emissions. Iron and steel production is another energy-intensive branch, the development of which will impact the projections noticeably. Therefore, a sensitivity analysis has been made on how the changes in growth rates within energy-intensive industries will affect the overall energy balance and emissions in Finland. The studied industries consist of pulp and paper production and iron and steel production.

The sensitivity analysis compares the WM projection with two other projections, where the annual growth rates of pulp and paper and iron and steel production will be one percentage point higher and lower than expected in the WM projection (projections WM+ and WM–, respectively) from the year 2014 onwards. The main results for the sensitivity analysis are presented in Table 5.10.

The amount of electricity that is imported will significantly affect greenhouse gas emissions within the EU ETS sector. The yearly net import varies primarily according to the hydro situation in Norway and Sweden. Under the National Energy and Climate Strategy (2013), Finland aims to ensure it will have sufficient domestic electricity production

capacity to be able to cater to peak consumption levels and possible import disturbances. Net imports of electricity should decrease in the future, being 17 TWh in 2012, 6 TWh in 2015 and 0 TWh in 2020. In practice, the electricity market determines the imports and exports, and therefore, the energy policies of the neighbouring countries will impact whether Finland will be a net importer or exporter. Zero net imports of electricity in 2020 would mean about 8.3 million tonnes CO_2 eq. more in greenhouse gas emissions than a situation in which the net electricity import is 10 TWh, provided that the corresponding electricity is produced domestically with conventional condensing power.

Table 5.10 Main results for the sensitivity analysis on how the growth rate changes in energy-intensive industries affect the overall energy balance and CO_2 emissions

	2010	2015			2020		
	Statistics	WM	WM +	WM -	WM	WM +	WM -
Pulp and paper production (base year 2005 = 1,00)	0.95	0.91	0.93	0.89	0.95	1.02	0.89
Iron and steel production (base year 2005 = 1,00)	0.82	0.95	0.97	0.93	1.02	1.10	0.96
Primary energy consumption, TWh	407	420	422	417	433	443	424
Final energy consumption, TWh	322	320	322	319	325	332	319
Electricity consumption, TWh	87.7	90.4	90.9	89.9	93.8	95.9	92.0
Share of renewables in final energy consumption, %	32.2	34.0	34.1	33.9	38.8	39.1	38.4
CO_2 emissions, million tonnes CO_2 eq.	74.5	65.8	66.3	65.3	65.0	66.8	63.2
WM +: annual growth rates of pulp &paper and iron&steel production are 1 percentage point higher than in WM							
WM -: annual growth rates of pulp&paper and iron&steel production are 1 percentage point lower than in WM							

5.7 Supplementarity relating to the Kyoto Protocol mechanisms

According to the greenhouse gas inventory data for 2008–2011 and the preliminary data for 2012, the emissions in Finland during the first commitment period of the Kyoto Protocol were nearly 5 per cent (approximately 15.8 million tonnes CO_2 eq.) below Finland's assigned amount (approximately 355.0 million tonnes CO_2 eq.).

As of May 2013, the amount of Kyoto units obtained by Finland through the Kyoto Protocol mechanisms was 3.6 million tonnes CO_2 eq., whereas the amount of Kyoto units from JI projects implemented in Finland (which will be transferred outside Finland) was estimated at 1 million tonnes CO_2 eq.

This shows that the Kyoto target could have been met entirely by domestic actions, and therefore, that the use of Kyoto Mechanisms is supplemental to domestic actions.

Table 5.11 shows a preliminary estimate of Finland's national emissions during the first commitment period of the Kyoto Protocol and how Finland's assigned amount has been allocated to the emissions trading sector and the non-trading sector; it also shows the emissions in these sectors during the first commitment period. The entities in the trading sector have been returning units amounting to their emissions annually, and the surplus/deficit of units will remain with the entities. The allocation of units to the non-trading sector is computational. The final accounting of the emissions and assessment of Finland's compliance with the emission limitation commitment under the Kyoto Protocol will only be done after the 2014 greenhouse gas inventory has been submitted and reviewed at the end of the so-called

true-up period in 2015. However, significant changes in the emission estimates and the assessment of additionality are not expected.

Table 5.11 Preliminary assessment of accounting for Finland during the first commitment period of the Kyoto protocol

	2008	2009	2010	2011	2012 (Preliminary data)	Sum[1]
Total national emissions	**70.2**	**66.1**	**74.5**	**67.0**	**61.4**	**339.2**
Finland's assigned amount	**71.0**	**71.0**	**71.0**	**71.0**	**71.0**	**355.0**
Emissions trading sector						
Emissions[2]	36.2	34.4	41.3	35.1	29.5	176.4
Allocated units	36.5	37.1	37.9	38.0	38.1	187.6
Surplus/deficit of units[3]	+0.4	+2.7	-3.4	+2.9	+8.6	+11.2
Non-trading sector						
Emissions	34.1	31.7	33.3	32	31.9	162.8
Allocated units[4]	34.5	33.9	33.1	33.0	32.9	167.4
Surplus/deficit of units	+0.4	+2.2	-0.2	+1.1	+1.0	+4.6
Units from LULUCF activities and other mechanisms under the Kyoto Protocol						
Article 3, paragraphs 3 and 4 [5]	+0.6	+0.6	+0.6	+0.6	+0.6	+2.9
Acquisitions of units from JI and CDM[6]	+0.1	+0.4	+0.3	+0.5	+2.3	+3.6
Transfer of units from Finnish JI projects[7]					-1.0	-1.0
Surplus in Finland's account[8]	+1.1	+3.2	+0.7	+2.1	+3.9	+10.1

Due to rounding, the figures in the table may not always sum up.
1 Preliminary data/estimate.
2 Energy Market Authority press release 2.4.2013.
3 A surplus (positive number) means that entities have received units in excess, of the annual emissions, whereas a deficit (negative number) means the opposite.
4 Computational allocation, i.e. the difference between the average annual assigned amount minus the unit allocated to the trading sector.
5 Finland's forest management cap.
6 Units acquired by 14 May 2013 (source: Ministry of the Environment).
7 Estimate for the whole commitment period (source: Ministry of the Environment).
8 The units lost as a result of bankruptcies are not included.

5.8 Methodology

Approach and responsibilities

The WM and WAM projections presented in this chapter correspond to the projections of the National Energy and Climate Strategy, which was presented by the Government in March 2013. The preparation of the strategy was coordinated by the Ministry of Employment and the Economy under the Ministerial Working Group on Energy and Climate Policy.

The basis for the projections is a projection framework describing the future development of central factors and circumstances affecting the projections. The framework as well as sector-specific key assumptions and policy measures are described in the background report to the National Energy and Climate Strategy. The ministries most involved in preparing the framework and projections were the Ministry of Employment and the Economy, the Ministry of the Environment, the Ministry of Transport and Communications, the Ministry of Agriculture and Forestry, and the Ministry of Finance.

The sectoral projections and calculations were made by various experts within the contact network set up by the main ministries involved in drafting the climate policy. The main models and methods used in the work are briefly described in Annex 1. The Ministry of Employment and the Economy was responsible for the projections regarding the amount of energy used by industry, households and services and for the calculations regarding fuel and carbon dioxide emissions in the energy production sectors as a whole; it was also responsible for coordinating the calculations. The Ministry of the Environment was responsible for the projection regarding space heating, for the analysis of the regional and urban structure, and for emission projections and calculations for waste and machinery. The duty of the Ministry of Transport and Communications included making projections for fuel and electricity usage as well as emissions from the transport sector. The Ministry of Agriculture and Forestry oversaw the calculation of emissions and removals in the land use, land-use change and forestry sector.

Assumptions underlying calculations

A summary of key variables and assumptions is presented in CTF Table 5.

Finland's population will increase from the current 5.4 million to about 5.9 million by the year 2035. The age structure of the population will change significantly over the next couple of decades as the share of older age groups increases. The number of households is expected to increase from the current 2.5 million to approximately 2.9 million by 2035. At the same time, however, the average size of households will decrease. The number, structure and location of households will have an impact on energy demand.

GDP growth in the coming years will be well below the rate of growth experienced in the past, mainly due to the global economic recession. Economic growth is estimated to be 1.6 per cent per annum in the present decade and approximately 1.9 per cent per annum in the next decade. The Finnish economy is going through a major structural change, which is affecting the energy-intensive sectors of production in particular. The activities that will sustain growth in production are expected to be mining, machinery and equipment manufacturing, the retail trade and the public social services sector. The expected development of the economy by branch is illustrated in CTF Table 5.

The international fuel price estimates are taken from the IEA's World Energy Outlook publication (2012). The price of crude oil should constitute a rising trend with periodic fluctuations. Emission allowance prices are expected to rise in 2020 to EUR 18–25/ t CO_2. The primary energy by source, the energy sources for district heat and combined heat and power production, the electricity supply and the energy sources in the transport sector are presented in Tables 5.11–5.14.

In the transport sector, greenhouse gas emissions are influenced by a decline in specific energy consumption and, in particular, by an increased share of biofuels. In the WM projection, the average emissions of the passenger car fleet will be reduced by about 22 per cent by 2020 and by approximately 53 per cent by 2050 as a result of increased energy

efficiency. In addition, it is estimated that the share of bio-based fuels will increase to 12.5 per cent in 2020 and to 15 per cent in 2030.

The landfilling of waste will be increasingly replaced with recycling and energy recovery. In 2010, the amount of municipal waste incinerated at waste incineration plants was approximately 244,000 tonnes. The WM projection estimates that from 2020 onwards, the amount of municipal waste incinerated at waste incineration plants will be approximately 800,000 tonnes per annum. In addition, co-incineration plants are expected to use 300,000 tonnes of waste-based fuels annually. Waste co-incineration is included in the emissions trading sector.

Table 5.11 Primary energy by energy source and gross final energy in 2010 and in the WM projection for 2020-2030, TWh

	2010	2020	2025	2030
Fuels in the transport sector	50	48	45	42
Oil other	48	43	42	41
Coal [1]	52	50	24	22
Natural gas	41	37	33	31
Peat	26	16	13	13
Wood fuels from which	89	98	98	101
- black liquor etc	38	39	40	41
- bark and waste wood	18	18	18	18
- forest chips	14	25	24	27
- small scale combustion	18	15	15	14
- pellets	0.8	1	1.2	1.3
Nuclear	66	106	178	171
Hydro	13	14	15	15
Wind	0.3	6	6.5	7
Other	10	16	18	19
Import of electricity	11	0	-9	-3
Total primary energy	**407**	**433**	**463**	**459**
Gross final energy consumption	322	325	325	327

[1] hard coal, coke, blast furnace gas, coke oven gas

Table 5.12 Energy sources for district heat and combined heat and power production in 2010 and in the WM projection for 2020-2030, TWh

	2010	2020	2025	2030
Oil	3.2	2.2	2.2	1.9
Coal	14	10.4	9	7.6
Natural gas	23	19.5	17.5	15.6
Peat	12.2	7.8	8.5	8.9
Wood fuels	11	19.4	20.3	21.9
Other	2.7	5	5.4	5.6
Total	**66**	**64**	**63**	**62**

Table 5.13 Electricity supply in 2010 and in the WM projection for 2020-2030, TWh

	2010	2020	2025	2030
Hydro	12.7	14.2	14.6	14.8
Wind	0.3	6	6.5	7
CHP, district heating	17.8	17.2	16.8	16.4
CHP, industry	10.3	9.2	9.3	9.4
Nuclear	21.9	35	58.8	56.4
Condensing power	14.2	12.2	-8.5	-2.4
Net imports	10.5			
Total electricity supply	**88**	**94**	**98**	**102**

Table 5.14 Energy sources in transport in 2010 and in the WM projection for 2020-2030, TWh

	2010	2020	2025	2030
Petrol	18.7	14.2	12.6	11.8
Diesel	27.8	31.5	29.5	28.3
Other fuels	3.9	4	4.1	4.1
Electricity	0.7	1.1	1.8	2.9
Total	**51**	**51**	**48**	**47**

Changes compared to the Fifth National Communication

The models and methods used for the projections and impact assessment of policies and measures are described in Annex 1.

The models used for preparing the projections of the Sixth National Communication are basically the same as those used for the Fifth National Communication. A new model named REMA developed by VTT Technical Research Centre of Finland has been used in the Sixth National Communication for projections and calculations in the building sector. Further, a new impact assessment tool, IMPAKTI, developed by Benviroc Oy has been used for assessing the emission mitigation impact of measures promoting the use of renewable energy.

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

6.1 Provision of new and additional financial resources

Finland has integrated the goals and objectives of the UNFCCC and the Kyoto Protocol into its development policy, while taking into account the fact that economic and social developments and poverty eradication are the first and overriding priorities of the developing country Parties. Already in the Finnish development policy guidelines for the environment approved in 2009, it was stated that climate change mitigation and adaptation need to be addressed in all of the most important sectors of Finnish development cooperation. In the latest Development Policy Programme (2012), climate sustainability is one of the cross-cutting objectives of Finland's development policy and development cooperation. Therefore, besides providing funds to the operating entities of the financial mechanism of the UNFCCC as well as funds under the Kyoto Protocol, Finland provides support through bilateral, regional and other multilateral channels.

The primary goal of Finland is to support multiannual projects (both bilateral and multilateral) and make multiannual agreements with multilateral institutions. Besides reducing the administrative burden this approach also helps to improve predictability of funding. These multiannual projects and agreements are based on joint planning and dialogue between partners, and thus the support level can also be better tailored to the specific needs and helps to provide resources more adequately than when giving support in a more ad-hoc manner.

In the Copenhagen climate negotiations in 2009, Finland, as part of the EU, committed collectively with other developed countries to provide new and additional resources, approaching USD 30 billion for the period 2010–2012, with a balanced allocation for both climate adaptation and mitigation. Furthermore, within the context of meaningful mitigation actions and transparent implementation practices, developed countries committed themselves to the goal of jointly mobilising USD 100 billion dollars a year by 2020 to address the needs of developing countries. This funding is coming from a wide variety of sources, including public and private sources, bilateral and multilateral sources, and alternative sources of finance.

Finland's share of the EU's overall fast-start finance contribution was EUR 110 million during the years 2010–2012. It was decided that this contribution will be counted as Official Development Assistance (ODA), and it will be a part of the new, growing Finnish ODA during 2010–2012. Finland's development aid disbursements in 2008 were EUR 808 million, which was 0.43 per cent of its gross national income (GNI). ODA has continued to grow thereafter in real terms; in 2010, Finnish ODA reached EUR 1,006 million, which accounted for 0.55 per cent of GNI. In 2012, ODA was 0.53 per cent of GNI, which was equivalent to EUR 1,027 million.

After the Copenhagen fast-start finance pledge, Finland decided to use the year 2009 as a baseline for defining new and additional funding. The Finnish commitment of EUR 110 million was implemented through a net increase of Finnish funding directly allocated to developing countries' climate activities in 2010–2012 compared to the year 2009. The baseline figure for overall Finnish climate funding (grant) in 2009 was approximately EUR 26.8 million.

In 2010, the overall final figure disbursed was approximately EUR 41.7 million. Thus, the final fast-start finance figure (i.e. the net increase) in 2010 was about EUR 14.9 million. For 2011, the figures were approximately EUR 61.5 million in total and about EUR 34.7 million as fast-start finance. For 2012 the figures were about EUR 108.2 million and approximately EUR 81.5 million, respectively. During the fast-start finance years, Finland, following the EU reporting format, has tried to divide allocations between adaptation, mitigation and REDD+. During those years, mitigation support has been close to 50 per cent (excluding REDD+), the adaptation support's relative share has varied between 30 and 40 per cent and REDD+ related support between 10 and 20 per cent.

Finland has contributed additional resources to the Global Environment Facility (GEF) to prevent and mitigate global environmental problems in developing countries. Finland has allocated funds to the GEF since it was first established in 1991. During the fourth replenishment period (July 2006–June 2010), the contribution was EUR 7.8 million per

year, with the total Finnish contribution during the period being about EUR 31.2 million. During the current fifth replenishment period, Finland's contribution is EUR 57.3 million in total: EUR 15.0 million per year during the years 2010–2011 and EUR 13.7 million per year during the years 2012–2013.

The GEF divides the funds by environmental focal areas; according to the latest annual report, between the years 1991 and 2010, 32 per cent of the funds were allocated to the climate change focal area. To calculate the relevant part of climate change funding out of the overall Finnish yearly contribution to the GEF, Finland has used the climate change focal area target allocation outlined in the GEF Council document GEF/C.40/07, which includes half of the Sustainable Forest Management/REDD-Plus (SFM/REDD+) programme, totalling approximately 32.6 per cent.

6.2 Tracking climate finance

Finland uses the so-called Rio markers developed for the OECD Development Assistance Committee's Creditor Reporting System (OECD DAC CRS) to track adaptation and mitigation-related (and also biodiversity and desertification) finance based on the data provided in the CRS. As the markers give qualitative rather than quantitative information, there is a need for follow-up work in order to obtain quantitative results. To ensure that all climate change-related projects, or interventions to be exact, will be included, all of the projects that have an environmental marker in the system are checked. After obtaining a complete set of environment-related (i.e. climate change) projects, specialists at the Ministry for Foreign Affairs go through the projects, analysing the share of climate change projects relative to the total project disbursements. Depending on whether adaptation or mitigation is the principle objective or a significant objective, the share varies between 10 and 100 per cent. An important element in this phase is to make sure that the total sum of all Rio markers does not exceed 100 per cent in order to avoid double-counting. The core support to multilateral organisations is only taken into account when the organisation itself can provide data on exact thematic budget allocations.

6.3 Finance

In this section, information is provided on Finland's financial support for non-Annex I Parties to mitigate greenhouse gas emissions and adapt to climate change and for capacity building and technology transfer in the areas of mitigation and adaptation (CTF Table 7). Information on activities addressing in particular minimising the adverse impacts of response measures on developing countries is provided in Finland's Sixth National Communication.

Addressing the needs of NAI Parties

Finland follows the principles of the Paris Declaration on Aid Effectiveness signed by donor and partner developing countries, which stresses the ownership and alignment of the partner country in development cooperation. When giving bilateral support, Finland takes into account the Development Policy Programme and its priorities. Detailed project planning is done only after consulting with the partner countries. These country consultations are the tool used to engage in country planning based on the needs and priorities of the partner country. In multilateral institutions, developing countries participate in the board-level decision-making process, including priority setting. For example, at the GEF the country focal point reviews the project concepts and assesses if they are national priorities for GEF assistance. These practices ensure that the resources provided by Finland address the needs of non-Annex I Parties.

Private finance leveraged

The Finnish Fund for Industrial Cooperation Ltd (Finnfund) is a state-owned company that finances private projects in developing countries by providing long-term risk capital for profitable projects. The funding modalities include equity investments, loans and/or guarantees. It cooperates with Finnish and foreign companies, investors and financiers. As outlined in Finland's Fifth and Sixth National Communications, Finnfund and Finnpartnership (the Finnish Business Partnership Programme) are active in the climate change field. About half of all investments made in recent years can be regarded as climate finance because they have been used for renewable energy projects, as well as projects to pre-

vent deforestation, to support energy and material efficiency, or to improve the ability of poor people to adapt to the challenges posed by climate change. Since 2011, Finland has been able to include climate change co-operation and ODA-eligible co-operation projects with these institutions in its total climate funding figures. In 2011, Finnfund provided approximately EUR 10 million, which can be included in Finnish public climate funding, and Finnpartnership provided approximately EUR 0.1 million. According to rough estimates, the public funding through Finnfund's climate-related projects leverages private funding at a level at least four times that of public funding for the investment. The average and median ratio values during the past few years have been much higher: 17 and 15, respectively. Finnpartnership has not made climate-specific estimates, but during the years 2006–2009 the ratio was generally at least six times as great.

In addition, other climate finance and technology transfer activities presented below, such as the Energy and Environment Partnership (EEP) and contributions to the Nordic Climate Facility (NCF), have leveraged private finance.

In addition, Finland contributes to the Nordic Development Fund (NDF), which supports mitigation and adaptation projects (partly through the Nordic Climate Facility, NCF). The NDF is a joint multilateral development finance institution in Denmark, Finland, Iceland, Norway and Sweden, which has provided financing for climate change-related investments since 2009. The NCF is financed by the NDF and it facilitates the exchange of technology, know-how and innovative ideas between the Nordic countries and low-income countries in the area of climate change. NDF/NCF grant commitments to climate change throughout the reporting period were approximately EUR 130 million and their disbursements were more than EUR 50 million.

Multilateral assistance

Finland supports developing countries' climate actions through multilateral aid (CTF Table 7(a)), giving core support to, for example, the GEF, the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). In 2008, Finland decided to contribute EUR 7 million to the Readiness Fund of the World Bank's Forest Carbon Partnership Facility (FCPF); it contributed EUR 4 million in both 2011 and 2012, making the total contribution to the Readiness Fund EUR 15 million. Furthermore, in 2012 Finland provided EUR 0.5 million as start-up support to the Green Climate Fund (GCF).

Finland contributed EUR 4.1 million to the World Bank's Partnership for Market Readiness in November 2012. The objective of the Partnership is to develop carbon market capacity in developing countries and countries with economies in transition through developing and piloting carbon market instruments. Finland actively participates in the Partnership Assembly meetings to foster cost-effective climate change mitigation.

The Multilateral Development Banks have been working together and with the OECD DAC to harmonise their climate finance tracking systems. As a result of this work, Finland is able to include in its climate finance reporting for 2012 the portion of its core support to these banks that is climate relevant.

As an example of the thematic support provided through multilateral institutions, Finland has contributed EUR 3.5 million to the project 'Making agriculture part of the solution to climate change – Building capacities for Agriculture Mitigation', which was implemented by the Food and Agriculture Organization of the United Nations (FAO) for the years 2010–2014. The goal of the project is to enable countries to better realise opportunities for climate change mitigation in agriculture while at the same time improving food security and increasing the resilience of farming systems. Finland has also supported FAO's 'Sustainable Forest Management in Changing Climate' programme through multilateral and bilateral channels. Finland's overall support for the programme amounts to USD 30 million during the years 2009–2014. The programme has five pilot countries on three continents. It includes developing new methodologies, developing field tests and local capacities and also providing support for other processes, such as the United Nations collaborative initiative on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD).

Bilateral assistance to developing countries

The Finnish development policy emphasises that development in all countries should be ecologically, socially and economically sustainable. The legally binding obligations that come from the multilateral environmental agreements (MEAs) are taken into account in Finland's development policy. Providing assistance in the implementation of MEAs constitutes a long-term investment in building sustainable national development policies and achieving national and international environmental targets. From the development cooperation point of view, the implementation of UNFCCC objectives is one of the most important targets.

Finland supports projects and programmes that promote environmentally sustainable development in its partner countries and regions (CTF Table 7(b)). In the energy sector, for example, which is important in terms of economic development, solutions are being pursued for promoting the use of renewable natural resources.

The ratio varies according to the year, but generally, the bilateral co-operation projects have accounted for about one half of all Finnish climate funding.

The form of assistance varies between regions and programmes. The Energy and Environment Partnership (EEP) project, which began in Central America in 2003 and is now being replicated in the Mekong region, southern and eastern Africa, Indonesia and the Andes, accounts for a large part of the mitigation projects in the energy sector. Also, support for forestry projects is substantial.

With regard to adaptation, the most important element has been capacity building and conducting vulnerability assessments in partner countries. Finland has been very active in the field of meteorological co-operation. It has supported, for example, co-operation between the Finnish Meteorological Institute (FMI) and the South Pacific Regional Environmental Programme (SPREP) and the Pacific national meteorological services since 2009, which seeks to improve the capacity of national meteorological institutes to deliver high-quality weather and climate services, and thus, to respond to the challenges posed by climate change and extreme weather events. The project was continued in 2012 and extended until 2015; it now covers 14 Pacific island countries.

6.4 Technology development and transfer

Finland has specific programmes and financial arrangements for transferring environmentally sound technology to developing countries (see also CTF Table 8). These activities consist of transferring both 'soft' technologies, such as capacity building, creating information networks and enhancing training and research, and 'hard' technologies, such as the technology to control greenhouse gas emissions and for adaptation measures. The differences between these various technologies are not always clear. In developing countries, the private sector and entrepreneurs play a key role in economic development. During the reporting period, Finnfund financed renewable energy production projects in Laos, Thailand, Honduras, Sri Lanka and Cape Verde, as well as tree-planting projects in Tanzania and Uruguay. In addition, Finnfund has invested in the Central American Renewable Energy and Cleaner Production Facility (CAREC) and the Evolution One Fund, which are investing in renewable and clean technologies in Central America and southern Africa.

Finland also promotes business-to-business partnerships in environmentally sound technologies through Finnpartnership as part of a wider set of Aid for Trade interventions. In Zambia, Finland is the lead donor in the environmental sector as well as a donor facilitator within the Enhanced Integrated Framework. Finland also has multiple private sector development (PSD) related programmes and projects in Zambia, which enhance the mutual synergies between the environmental and PSD sectors.

Finland's development policy and development cooperation promote an inclusive green economy, for example, by creating public–private partnerships (PPP) for investments that promote development.

Finland also supports the Energy and Environment Partnership (EEP) with Central America, which has established various renewable energy and clean energy projects. The partnership has recently been expanded to southern Africa as well as to some areas in Asia.

Concessional credits are used primarily for environmental and infrastructure investments under national development programmes. They have been granted to various renewable energy projects, for example, to solar PV projects in Vietnam and Sri Lanka that provide basic energy and water services. In Vietnam, Honduras and Ghana, projects to expand the electricity grid in order to improve access to energy have been supported, and in China, district heating projects have been implemented to improve energy efficiency, reduce emissions and improve air quality in cities.

In 2001, the UNFCCC established the Expert Group on Technology Transfer (EGTT) to enhance the implementation of the convention and to advance the technology transfer activities under it. Since the establishment of the EGTT, Finland has participated actively in its work by providing expertise, leadership and financial resources. The latest Finnish chairmanship of the group was held during 2008.

The Technology Mechanism was established at COP 16 in Cancun. Since its establishment, Finland has been a member of its Technology Executive Committee, which replaced the EGTT. Finland has also been instrumental in decisions leading to the mobilisation of the Climate Technology Centre and Network (CTCN), which will come into operation in 2014.

Since 2004, Finland has participated in the International Energy Agency Climate Technology Initiative (IEA CTI), which is a multilateral initiative fostering international cooperation in the development and distribution of climate-friendly technologies and practices. The principal activities of the CTI include assessing technology needs, organising seminars and training courses, facilitating technology and disseminating information.

The publicly financed Finnish Funding Agency for Technology and Innovation (Tekes) also has programmes that include developing countries and focus on climate-friendly technology. In addition to other Finnish actors, Tekes cooperates in ERAfrica, a new European Union (EU) project aimed at promoting a unified European approach to collaborating with Africa in the field of science and technology research for innovation and sustainable development. ERAfrica forms part of the 7th Framework Programme suite of European research initiatives, and it has the primary objective of creating a 'European Research Area Network' for the African continent. Finland, together with several other EU countries, is united with African partners (South Africa, Kenya and Egypt) in a core consortium built around a mutual recognition of the value of unifying efforts to strengthen intercontinental research collaboration and promotion. In this regard, ERAfrica aims to serve as a template for interactions between Europe and Africa in the field of science and technology research and as a model for future cooperative ventures between the two continents.

6.5 Capacity building

Finland supports capacity building among non-Annex I parties in several types of projects (see also CTF Table 9). Most of the Finnish bilateral projects that have a climate-related objective as their principal or significant objective also include a capacity building component. Finland also supports several multilateral climate-related funds (such as LDCF, SCCF, FCPF and the World Bank's Partnership for Market Readiness), which include a strong capacity building component in their activities. As an example, Finland is one of the world leaders as a donor in supporting the capacity building of non-Annex I partner countries' hydro-meteorological services at all levels. Currently, the most important capacity support programmes for hydro-meteorological institutions are going on in the Pacific, Himalayan and Andean regions. Finland also supports FAO's programme on making agriculture part of the solution to climate change, in which capacity building has a prominent role. In addition, several of the technology transfer projects described above includes capacity building. Some examples of projects with strong capacity-building components are provided below.

For the past ten years, Finland has funded an international course on environmental law and diplomacy. This 'Course on Multilateral Environmental Agreements' is organised annually by the University of Eastern Finland in cooperation with UNEP and partners in developing countries. The course transfers past experience in the field of international environmental law to current and future negotiators of multilateral environmental agreements (MEAs). In addition to teaching environmental law, the course aims to foster contacts between developing and industrialised countries and thus support international environmental negotiations. The course specialises each year in different themes, and in 2013 the theme is natural resources.

Finland has also supported the Climate Change and Development Project (CCDP) implemented by the International Union for Conservation of Nature (IUCN) in three countries in eastern/southern Africa: Zambia, Mozambique and Tanzania. The five-year project (2008–2012) built on a one-year pilot phase implemented in Zambia in 2007, with the overall Finnish contribution being EUR 2.3 million. The overall goal of the CCDP was to achieve reduced vulnerability and an enhanced adaptive capacity to climate variability and change at the local and national levels. The project aimed to ensure that climate change-related policies and strategies would lead to adaptation activities that emphasise the role of forests and water resources in supporting people's livelihoods and farming systems.

The Southeast Asia Climate Change Network project was implemented by UNEP in 2008; it uses a regional networking approach to improve the development and exchange of knowledge among climate change focal points, national coordinating bodies and climate change professionals. The project supports the sharing of best practices and accelerates the transfer of climate-friendly technologies. The project assists countries in negotiations pertaining to agreements and helps them to carry out the practical measures associated with climate change. The goal is to strengthen the countries' potential to respond to the challenges posed by climate change over a wide spectrum. The overall support for the project is EUR 4.3 million for the years 2008–2013.

As climate change will most strongly affect the world's poorest people, and since most of them are women, one of the important themes has been mainstreaming gender considerations into the climate policy-making agenda. Since 2008, Finland has been supporting the project implemented by the Global Gender and Climate Alliance (GGCA) to strengthen the role of women and mainstream the gender perspective in global climate policy. Funding has been allocated to support women delegates' participation in climate negotiations. At the second stage, from 2010 onwards, support has also been targeted more concretely at the national adaptation programmes of action (NAPA) of developing countries and at helping to implement them. Support for the project will continue at least during the period 2012–2014. During this period, the emphasis of the project will be at the national level. Thus far, the total contribution has been EUR 6.8 million for the implementation period 2008–2014.

7 Other reporting matters

Information is included in Chapters 3 and 4.

ANNEX 1 Description of models and methods

Buildings

The EKOREM model is a bottom-up building stock calculation model developed by the unit of Construction Management and Economics at Tampere University of Technology and VTT Technical Research Centre of Finland. The calculation model is based on part D5 (2007) of the National Building Code of Finland: 'Calculation of energy needs for heating of buildings'. The model can be used to calculate energy consumption and greenhouse gas emissions and also to analyse the energy savings and greenhouse gas emission reduction potentials achieved by different policy scenarios. These scenarios can include building-related structural measures as well as changes in the energy production structure.

In the EKOREM model, the building stock is divided into building type categories, which are similar to those used by Statistics Finland, so that official building statistics can be used as a basis for the calculations. Building stock data can further be divided into different age classes to better describe the methods of construction in different eras. The model includes a great deal of descriptive data, such as U-values for structures, technical specifications for ventilation and information about electricity consumption. The model also includes heating system distributions for the different building types. These distributions and emission coefficients are used to determine greenhouse gas emissions (CO_2 eq.) for the studied building stock.

One of the main purposes of the model has been to produce assessments for the climate and energy policy reporting that show how developments in Finnish climate policies have affected the energy consumption and the greenhouse gas emissions of the Finnish building stock.

POLIREM is also a bottom-up building stock model. It covers less technical details than the EKOREM model. Instead, it takes into account the different primary energy sources in a more detailed manner than EKOREM. The POLIREM model is well suited to analysing the impacts of policy measures on emissions, the use of renewable energy resources and the division of impacts between the ETS and non-ETS sectors.

EKOREM calculation model,

http://webhotel2.tut.fi/ee/en/Tutkimus/ekorem.html

The REMA model developed by VTT Technical Research Centre of Finland is used for forecasting the developments in energy consumption for the building stock in Finland. It is a bottom-up model that uses representative building types (archetypes) for estimating energy usage in different segments of the building stock. Future developments are estimated using annual rates of new construction, renovations and removals from the building stock.

The REMA model includes a simplified model of the energy sector that allows for primary energy and CO_2 emission calculations. REMA is a light model with a degree of flexibility that makes it possible to test different contingencies and the sensitivities of scenarios with relative ease.

The REMA model does not include any dynamic modelling, and therefore, the results are based on predetermined parameters. Moreover, it does not take into account the costs or economic impacts of the policies.

The REMA model was also used to estimate the emission reduction impacts of policies and in the WAM projection, hereas the impacts of policies and measures in the WM projection were estimated using EKOREM and POLIREM models.

Energy production

The Ministry of Employment and the Economy prepares the projections for energy production using demand projections for each consumption sector as a basis. With the exception the energy used by industry, households and services, as well as the energy used for other, smaller consumption purposes, the demand projections are produced by other organisations using the models described in this section. The energy demand projections for industry and services are

determined by industrial production per product group (pulp and paper, basic metals), branch-specific economic growth (other industry, public and commercial services), specific energy use trends and expected energy-efficiency improvements. The household projection is based on population and household forecasts and the extensive surveys made by Adato Energy on electricity use in different households. The demand projection assumptions are based on statistics, expert judgements and surveys by consultants, research organisations and branch organisations.

The energy needed from power and heat generation plants (main activity producer plants) is based on the total electricity and heat demand, the calculated electricity and heat generated by the industry itself (autoproducer plants), as well as on assumptions about electricity net imports. Using the information on existing and planned power plants and their possible dismantling schedule, the need for new production capacity can be calculated. In the projections, the demand for new capacity is expected to be met with energy from the plants promoted by the various policies and measures (such as the feed-in-tariff for wind power). If there is still a deficit in electricity or the heating energy supply, it will be produced by a default technology and fuel mix.

CO_2 emission projections are obtained by multiplying fuel consumption by the emission factors. Historical emissions and amounts of fuel are used for calculating CH_4 and N_2O emissions.

The IMPAKTI calculation tool is used for calculating the emission mitigation impact of measures promoting the use of renewable energy. The IMPAKTI calculation tool is based on the assumption that forest chips, wind power and biogas from digesters will not be used without existing policies and measures. Therefore, the aggregated impact of policies and measures promoting the use of these energy sources is estimated based on the energy production (wind power and biogas plants) or fuel use (forest chips) and the assumptions about the energy source that is being replaced by the renewable energy source. It is assumed that forest chips will mainly replace peat in power and heat production and, to a small extent, other fuels. For agricultural farms, it is assumed that the use of forest chips will replace light fuel oil. It is assumed that the electricity produced by renewable energy sources (wind, biogas) will mainly replace marginal electricity, i.e. electricity produced by condensing power plants using fossil fuels for peat. However, as these marginal production modes may not be in operation at each point of time, it is assumed that the production of electricity using renewables can also replace other electricity generation modes or electricity imports. Therefore, the emission factor used for replaced electricity (600 t CO_2/GWh) is smaller than the emission factor used for electricity production in condensing power plants that use fossil fuels or peat (on average 850 t CO_2/GWh). The emission factor for electricity defined in the IMPAKTI calculation tool (600 t CO_2/GWh) is also used to estimate the mitigation impact of energy efficiency measures presented in Chapter 4.

Transport

The transport sector projections are compiled using the LIPASTO calculation system, which is also used to estimate emissions for the greenhouse gas inventory (see Finland's National Inventory Report for a description of the methodology). The LIPASTO calculation system includes four submodels: LIISA for road transportation, RAILI for railways, MEERI for waterborne transport and ILMI for air traffic. LIPASTO is compiled and updated by VTT Technical Research Centre of Finland. The ILMI submodel is compiled and updated by the Finnish Aviation Administration. The LIPASTO model covers emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), particles (PM), methane (CH_4), nitrous oxide (N_2O), sulphur dioxide (SO_2) and carbon dioxide (CO_2). The mileage projections for road transport are based on the Finnish Transport Agency's base forecast. Fuel consumption is assumed to decrease by 1.5 per cent in vehicles using petrol and by one per cent in diesel vehicles yearly. The changes in the vehicle fleet are taken into account based on the estimated annual sales of new vehicles and the scrappage rate. In rail transportation, the mileage development forecasts are based on the estimates given by the Finnish State Railways, VR Ltd. The developments in emission coefficients are based on research carried out at VTT and in other countries. The projection regarding future emissions from aviation is based on assumptions about the growth in the number of commercial flights and improvement rates for the energy efficiency of aircraft engines. The projection for waterborne transport emissions is based on estimates by the Finnish Transport Agency. The future development of the emissions coefficients for navigation is based on estimates and research results from other countries.

LIPASTO calculation system, http://lipasto.vtt.fi/indexe.htm

F-gases

The F-gas emission projections (including HFCs, PFCs and SF_6) are prepared by the Finnish Environment Institute.

The total F-gas emission projections are sums of the subsector emission scenarios. The F-gas emission sectors are as follows: refrigeration and air conditioning equipment, foam blowing and use of foam products, aerosols, electrical equipment and grouped emission sources (e.g. fixed fire fighting systems and semiconductor manufacturing). In the emission projections, the refrigeration and air conditioning sector is further divided into eleven subsectors. Each source category has a specific calculation method because of the differences in available data and background information.

Full descriptions of the use of F-gases in Finland as well as the documentation with abatement costs were first provided by Alaja in 2009. Since then, the emission projections have been updated in 2010 and 2012 based on information from the 2008−2011 emission inventories of F-gases, Gschrey and Schwarz (2009), TEAP (2009 and 2010) and Schwarz et al. (2011).

The sources of information that have been used in order to form scenarios for each subsector have been summarised by Mattinen et al. (2012).

Literature:

Alaja, T. (2009) Emission abatement options and cost effects for fluorinated greenhouse gases – Emission projections for fluorinated greenhouse gases up to 2050. Finnish Environment Institute (SYKE). http://www.ymparisto.fi/download.asp?contentid=113415&lan=fi

Gschrey, B. and Schwarz, W. (2009) Projections of global emissions of fluorinated greenhouse gases in 2050. Öko-Recherche On behalf of the German federal Environment Agency. Climate Change 17/2009.

Mattinen, Maija, Hildén, M. and Petäjä, J. (2012) Calculations of greenhouse gas emissions of waste sector and F-gases for policy scenarios in Finland. Finnish Environment Institute, Finnish Environment 18, Helsinki. http://www.ymparisto.fi/default.asp?contentid=410745&lan=en

Schwarz, W., Gschrey, B., Leisewitz, A., Herold, A., Gores, S. Papst, I., Usinger, J., Oppelt, D., Croiset, I, Pedersen, P.-H, Colbourne, D., Kauffeld, M., Kaar, K. and Lindborg, A. (2011) Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases; Final Report & Annexes to the Final Report. Prepared for the European Commission in the context of Service Contract No 070307/2009/548866/SER/C4. http://ec.europa.eu/clima/policies/f-gas/docs/report_en.pdf

Statistics Finland (2013) Greenhouse gas emissions in Finland 1990-2011. National Inventory Report under the UNFCCC and the Kyoto Protocol. http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/7383.php

TEAP (2009) Assessment of alternatives to HCFCs and HFCs and update of the TEAP 2005 supplement report data. Task Force Decision XX/8 Report. UNEP, May 2009. http://ozone.unep.org/teap/Reports/TEAP_Reports/teap-may-2009-decisionXX-8-task-force-report.pdf

TEAP (2010) TEAP 2010 progress report Volume 1. Assessment of HCFC and environmentally sound alternatives. Scoping study on alternatives to HCFC refrigerants under high ambient temperature conditions. UNEP, May 2010. http://www.unep.ch/ozone/assessment_Panels/TEAP/Reports/TEAP_Reports/teap-2010-progress-report-volume1-May2010.pdf

Agriculture

An economic model and several greenhouse gas calculation models were used to compile the projections for the agriculture sector (CH_4, N_2O) and croplands and grasslands in the LULUCF sector (CO_2).

Future agricultural production intensity was estimated using the agricultural sector model (Dremfia), which takes into account the prices of agricultural inputs and outputs and agricultural policy. The results from Dremfia were fed into the calculation models, which are used for the greenhouse gas emission inventory (see National Inventory Report for

details). Dremfia produced most of the input data for the greenhouse gas modelling: the area of cultivated soils, the use of mineral fertilizers and the numbers for the most important animal species. In addition, the development of some parameters in the future were estimated using expert judgments: the area of organic soils, the spread of manure management systems, the number of horses (slightly increasing population), sheep, fur animals, reindeer and turkeys (stable population), and developments in the weight of cattle and N excretion of animals.

The method and assumptions were done in the same way in previous National Communications. The method makes it possible to take into account all measures that are related to agricultural policies and it produces time series that are consistent with the reported emissions.

Waste

The Finnish Environment Institute calculates the projections for the waste sector.

The waste scenarios are based on statistics and modelling following IPCC guidelines. The scenario tool is thus primarily an accounting model, which is complemented with expert judgments on how rapidly the measures will affect the waste sector (Mattinen et al. 2012). The same basic modelling tool has been used for previous National Communications.

The scenario calculations are based on assumptions concerning developments in the amount of waste related to standard population projections and the rate at which new waste treatment facilities are introduced, in particular their incineration capacity, which will reduce the stream of waste to landfills. The modelling deals separately with solid municipal waste, municipal sludge, industrial sludge, industrial solid waste and building waste. Different treatments are considered separately (landfills, composting, incineration, recycling). Emissions from wastewater treatment and composting are dealt with separately, and methane collection from landfills is also taken into account. CH_4 and N_2O emissions are treated separately.

The modelling builds on aggregating information for the waste sector, and thus, there are only limited opportunities to project the detailed effects of individual policy measures in terms of emission reductions. So far, there has been only limited information on the costs and benefits of the measures included in the analyses. There are no direct overlaps with projections from other sectors, as the projections of the waste sector do not include emissions from waste incineration, which are reported in the energy sector.

Literature:

Mattinen, Maija, Hildén, M. and Petäjä, J. (2012) Calculations of greenhouse gas emissions of waste sector and F-gases for policy scenarios in Finland. Finnish Environment Institute, Finnish Environment 18, Helsinki. http://www.ymparisto.fi/default.asp?contentid=410745&lan=en

LULUCF

The development of the tree stock and drain (m^3) for the LULUCF sector projection is estimated using the MELA model. MELA is a forestry model consisting of two parts: 1) a forest simulator based on individual tree growth and development models, and 2) a linear optimisation package. The information on forest resources, which is based on the national forest inventory, is used as a basis for MELA. The model utilises the roundwood demand and information on stump prices produced by the SF-GTM model. The SF-GTM model is a partial equilibrium model depicting Finland's forestry sector: forestry, the forest industry and the forest product market. The MELA model also provides the input data for the Yasso model, which is used to project the changes in carbon stocks in mineral forest soils.

The projections for croplands and grasslands were compiled using the Dremfia model (see the section on agriculture above).

The MELA model is described in the document on forest management reference level calculations for Finland,

http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_finland_2011.pdf

Economic effects

The VATTAGE model is a dynamic AGE (applied general equilibrium) model developed and used by the Government Institute of Economic Research (VATT) for analysing economic effects. The distinguishing features of the model concern its dynamics. Three inter-temporal links connect consecutive periods in the model: (1) the accumulation of fixed capital, (2) the accumulation of financial claims and (3) lagged adjustment mechanisms, notably for the labour markets and for balancing the public sector budgets. Together, these mechanisms result in gradual adjustments to policy shocks to the economy.

In the model, capital is sector specific, which means that it takes time for an industry to adjust to the increased energy costs caused by emissions trading and increased energy taxes. In energy-intensive industries, a rise in energy costs lowers the return on capital, which slows down investments until a new equilibrium is reached. In other industries, similar effects are caused by a rise in domestic energy taxes. Some of the industries, however, gain from the subsidies granted to renewable energy, and even in energy-intensive industries, the subsidies can dampen the rise in costs if they can substitute renewable energy for fossil fuels.

The VATTAGE model assumes sluggish real-wage responses to policy shocks. Real wages will adjust sluggishly to deviations from expected equilibrium wage growth, with the result that in the short run, adjustments will occur partly through increased levels of unemployment. In the long run, wages will adjust fully to one-off shocks, and full employment will be restored. In the case of gradually tightening emission targets, however, the shocks are not one-off, implying sustained, above-equilibrium unemployment rates.

VATTAGE model,

http://www.vatt.fi/en/publications/latestPublications/publication/Publication_1345_id/832