Statistics Finland

Ympäristöministeriö
Miljöministeriet
Ministry of the Environment

Finland's Second Biennial Report
under the UNFCCC

17 December 2015

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1 Introduction

Finland's second biennial report (BR2) 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 2015[1].

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) and the EU's second biennial report under the UNFCCC.

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.

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.

[1] Finland's 2015 inventory submission under the UNFCCC was completed on 3 November 2015, see http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php

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[2]. The information is consistent with Finland's most recent annual inventory submission to the UNFCCC where more detailed information on the greenhouse gas emissions and their estimation can be found. Information on the greenhouse gas emissions and removals in the land use, land-use change and forestry (LULUCF) sector is also provided, even if this sector is not included in the EU joint target under the Convention.

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 Sixth National Communication and First Biennial Report under the UNFCCC (BR1).

2.1 Total greenhouse gas emissions and trends

Description and interpretation of emission trends for aggregated greenhouse gas emissions

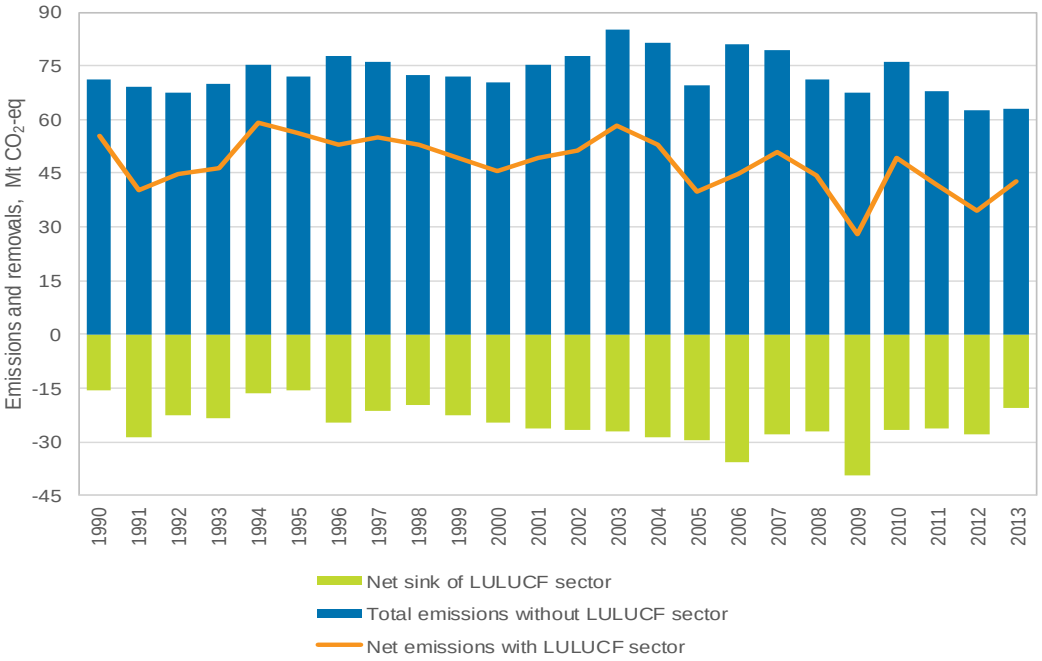
The greenhouse gas emissions trends for the period 1990 to 2013 by gas and by sector are presented in CTF Table 1.

In 2013, Finland's greenhouse gas emissions totalled 63.1 million tonnes of carbon dioxide equivalent (million tonnes CO_2 eq.). The total emissions in 2013 were approximately 12% (8.3 million tonnes) below the 1990 emissions level. Compared to 2012, the emissions increased by approximately 1%.

Figure 2.1 shows a time series of CO_2 equivalent emissions with and without the net removals in LULUCF sector in Finland during 1990–2013.

[2] 'Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories'. Decision 24/CP.19. (FCCC/CP/2013/10/Add.3).

Figure 2.1 Total national CO_2 equivalent emissions with and without the net removals in LULUCF sector in Finland million tonnes CO_2 eq)



Description and interpretation of emission trends by gas

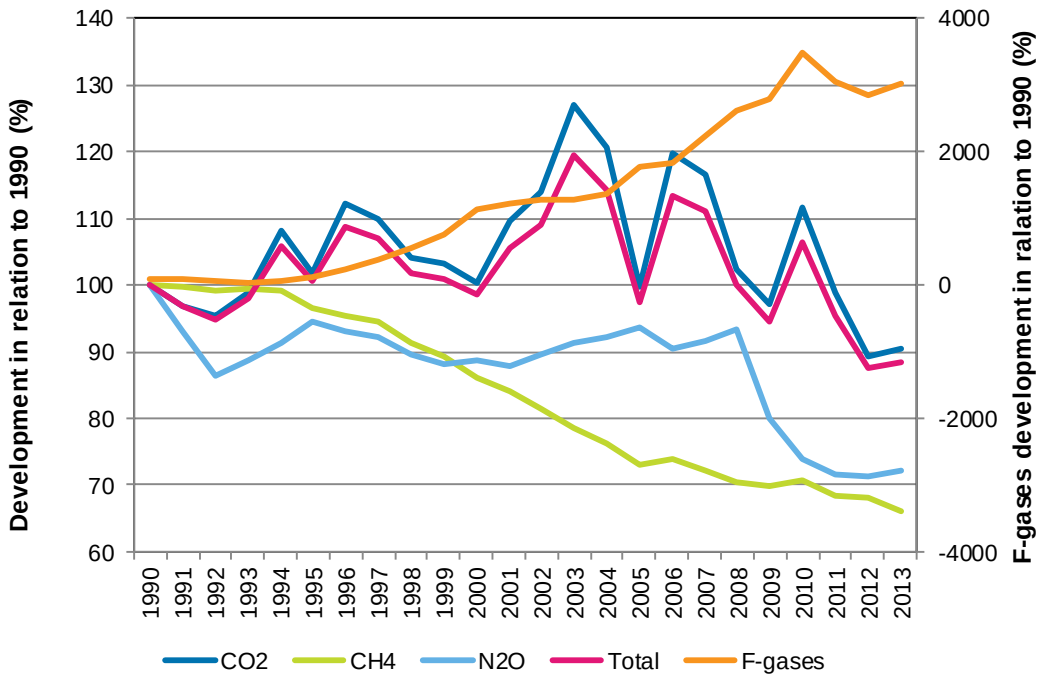
The development of the greenhouse gas emissions by gas is presented in CTF Table 1. The most important greenhouse gas in Finland is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions has varied from 80% to 85%. In absolute terms, CO_2 emissions have decreased 5.4 million tonnes (i.e. 10%) since 1990. Around 91% of all CO_2 emissions originate from the Energy sector in 2013. 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 34% from the 1990 level. This is mainly due to the improvements in waste treatment and a contraction in animal husbandry in the Agriculture sector.

Correspondingly, emissions of nitrous oxide (N_2O) have also decreased by 28%; 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 thirtyfold during 1990-2013. 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 greenhouse gases (CO_2, CH_4, N_2O and F-gases) 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

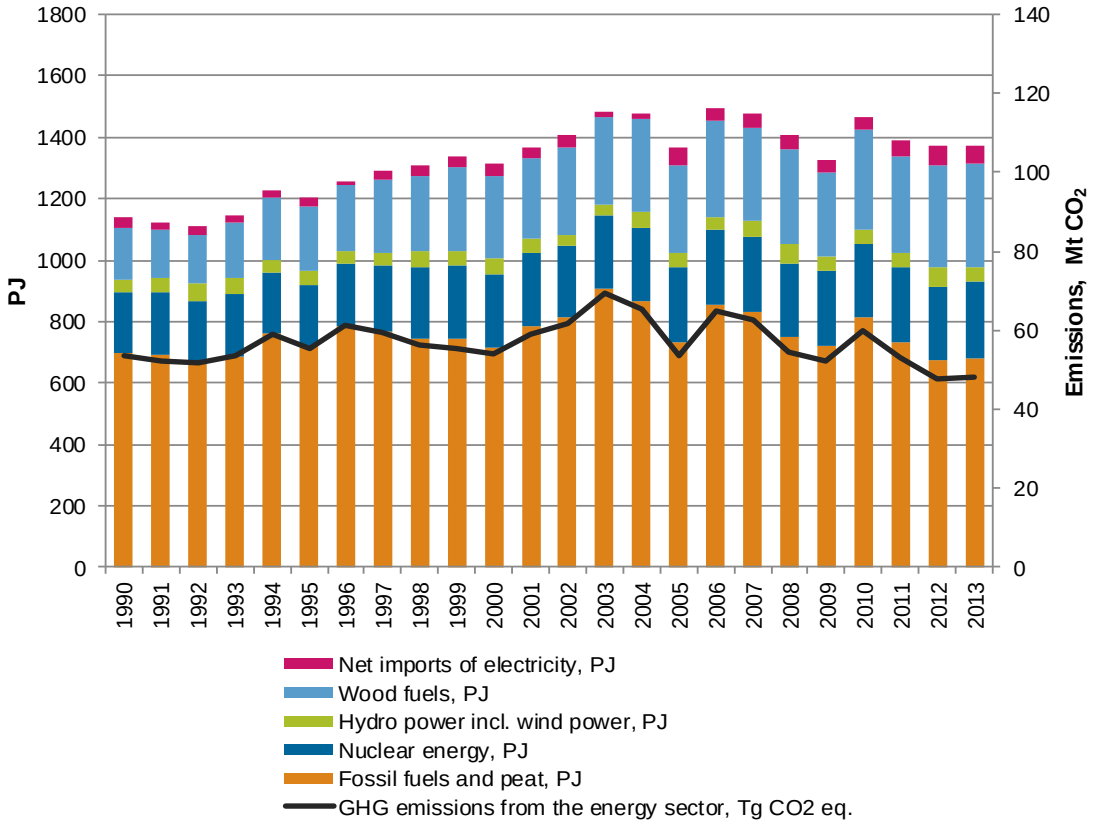
The development of the greenhouse gas emissions by sector is presented in CTF Table 1.

Energy

The energy sector is the most significant source of greenhouse gas emissions in Finland with a 77% share of the total emissions in 2013, being 48.4 million tonnes CO_2 eq. 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. 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 2013, the energy sector's emissions were about 10% below the 1990 level. The biggest reasons for decreasing emissions are the increased shares of wood fuels and net imports of electricity, which lowers the condensing power production.

Energy industries (mainly electricity and district heating production) caused approximately 46% of the total emissions in the energy sector in 2013. Emissions from the energy industries were 15% higher in 2013 than in 1990.

Figure 2.3 Development of total energy consumption by energy source (PJ) and the energy sector's greenhouse gas emissions (million tonnes CO_2 eq) in Finland (GHG Inventory and Energy Statistics, Yearbook)



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 2.3). Total consumption of energy in Finland amounted to 1.37 million terajoules (TJ) in 2013, which was on level with the previous year. Final consumption of energy went up by one per cent in industry and energy consumption in households decreased by six per cent. Energy consumption of transport was on level with the previous year.

The share of renewable energy of total energy consumption decreased in 2013 and stood at 31 per cent. The biggest decline was seen in the use of hydro power; the availability of hydro power declined in the Nordic countries in 2013 and the production of hydro power decreased by 24% in Finland. The use of forest chippings rose to a new record level in 2013, and 5% more was used than in 2012. EU targets for renewable energy are calculated relative to total final energy consumption; calculated in this manner, the share of renewable energy was 35% in Finland in 2013 based on preliminary data. Finland's target for the share of renewable energy is 38% of final energy consumption in 2020 (Energy supply and consumption, Statistics Finland).

The use of fossil fuels went up by 2% from the year before. Of fossil fuels, the use of natural gas fell by 7% and the use of peat by 12% from 2012. The consumption of coal (including hard coal, coke, and blast furnace and coke oven gas) increased by 23%. (Energy supply and consumption, Statistics Finland).

Total electricity consumption went down by 1% and amounted to 84 TWh in 2013. Of total electricity consumption, 81% was covered by domestic production and 19% by net imports of electricity from the Nordic countries and Russia (Figure 2.4). Net imports of electricity declined by 10% from the year before as the water situation in the Nordic countries was worse than in 2012 (Energy supply and consumption, Statistics Finland).

The production of electricity in Finland amounted to 68.3 TWh in 2013. The production grew by 1% from the previous year. Altogether 36% of the electricity produced in Finland was produced with renewable energy sources. Over one-half of this was produced with hydro power and almost all of the remainder with wood. 33% of the production of electricity was covered with nuclear power, 26% with fossil fuels and 4% with peat. The amount of electricity produced with fossil fuels and peat increased by 24% from the previous year, as the amount produced with hard coal went up by 50%. The increased production of condensing electricity raised the use of hard coal (Production of electricity and heat, Statistics Finland).

The production of district heat amounted to 34.5 TWh in 2013. The production decreased by 7% from the previous year. The need for the heating energy of buildings decreased due to the warmer weather than in the year before. According to the Finnish Meteorological Institute, heating degree days fell in all reference localities by at least five per cent from the previous year. Around 50% of district heat was produced with fossil fuels, whose use fell, however, by 11 per cent from one year ago. The use of renewable fuels in the production of district heat grew by 6% from the year before. District heat was produced most with wood fuels, hard coal and natural gas (Production of electricity and heat, Statistics Finland).

The production of industrial heat was 52.2 TWh in 2013. The production went down by 1% from the year before. The economic development of manufacturing weakened, so the use of industrial heat remained at a low level as in previous years. Over 70% 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 and other wood fuels. (Production of electricity and heat, Statistics Finland).

Manufacturing industries and construction produce much energy themselves. Their share of the energy-related emissions was around 18% in 2013. Emissions from manufacturing industries and construction have declined by 37% 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 were in 2013 at the same level than in 1990. 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. Emissions were at the highest level in 2007, they were 11% above the level of 1990. The worldwide economic downturn that began 2008 decreased the kilometrage of all transport modes. The share of transportation of energy-related emissions was one fourth in 2013.

Emissions from the residential sector have decreased by 47% and from commercial sectors by 53% compared with the 1990 levels. The decrease is mainly due to substitution of direct oil heating with district heating and electricity.

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

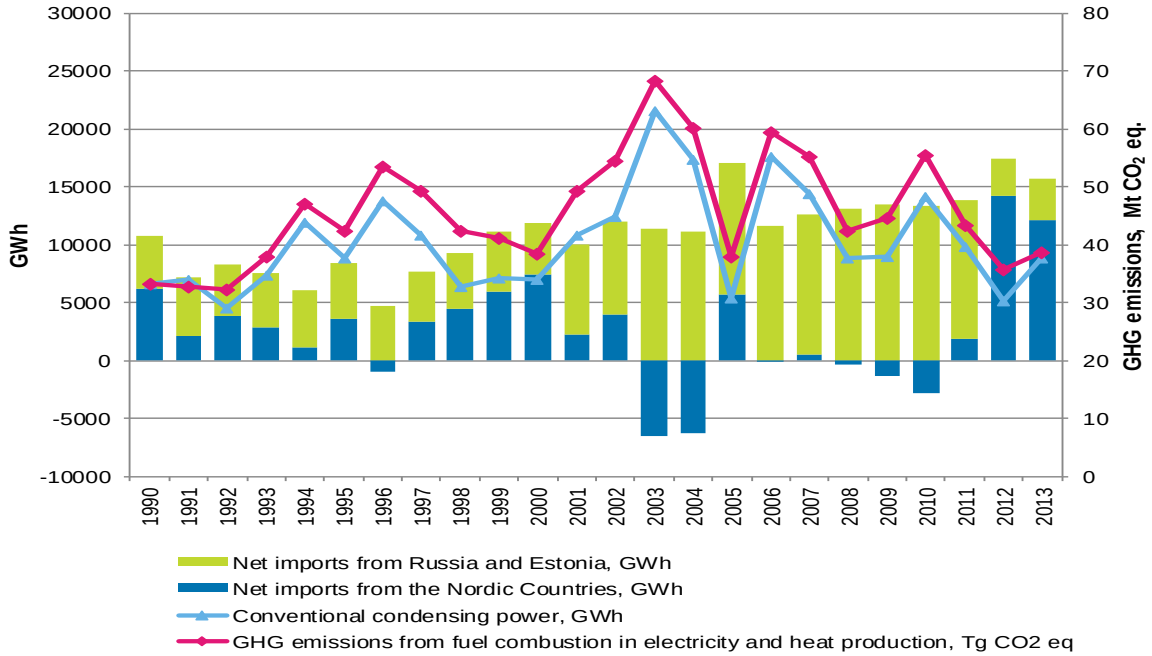
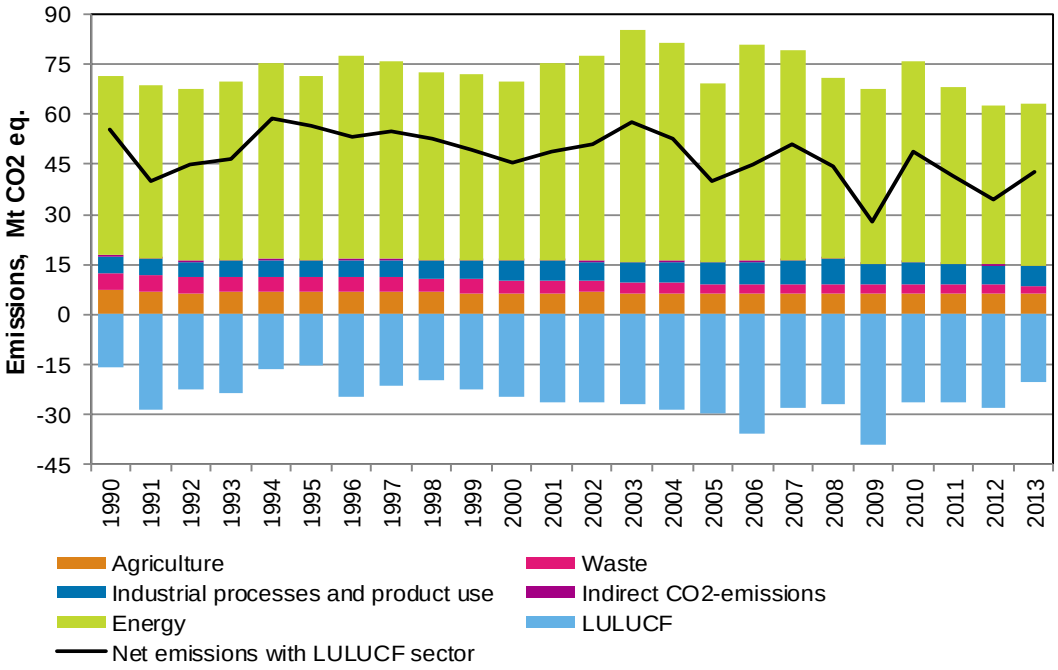


Figure 2.5 An overview of the development of the CO_2 equivalent emissions in the years 1990-2013 by IPCC source sector



Industrial Processes and product use

Emissions of industrial processes and product use were 6.0 million tonnes in 2013 and have increased by 11% (0.6 million tonnes CO_2 eq.) compared to 1990. 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 13% from 1990 to 2013, reasons are increased production of steel, hydrogen and use of limestone and dolomite. Methane emissions have decreased by 64%. Nitrous oxide emissions have fluctuated during the period 1990 to 2013; 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 1.4 million tonnes CO_2 eq. (86%).

The F-gas emissions are about thirtyfold 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 1.5 million tonnes 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.

Agriculture

Agriculture is the second most significant source of greenhouse gas emissions after the energy sector in Finland. In 2013, agricultural emissions accounted for 10% (6.3 million tonnes CO_2 eq.) of total emissions. Agricultural emissions have decreased by 15% (1.1 million tonnes CO_2 eq.) over the period 1990-2013. 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 42% decrease in the number of cattle since 1990 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 tenfold methane emissions compared with solid storage or pasture. Nitrous oxide emissions from manure management are smaller in slurry than in solid storage systems, which have 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 11% 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.

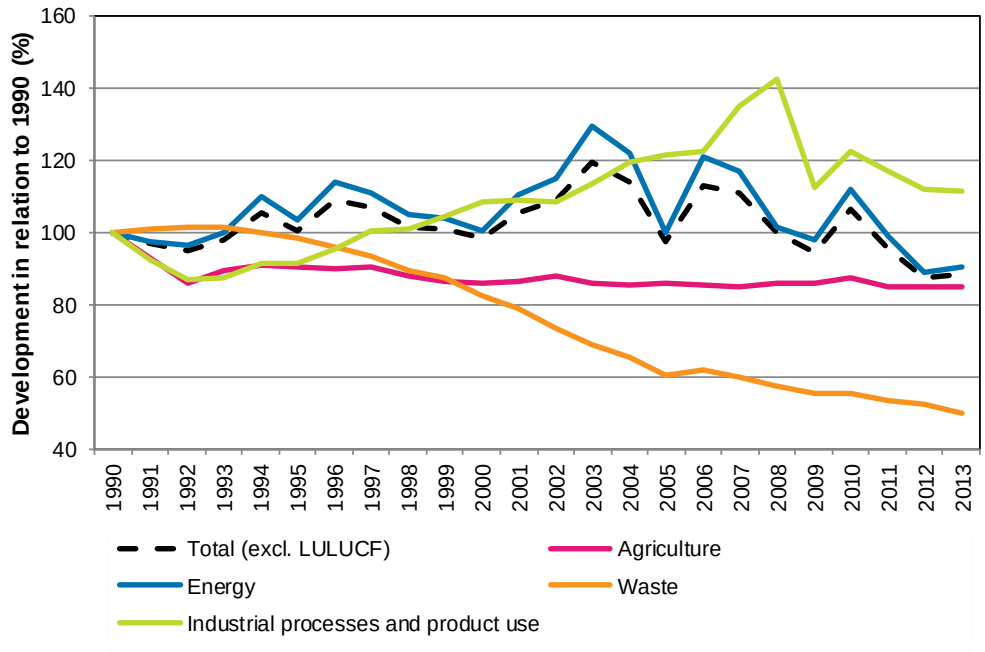
LULUCF

The LULUCF as a whole sector is a net sink in Finland. Between 1990–2013, this net sink has varied between 15.5 and 39.4 million tonnes CO_2 eq, which equals of approximately 22% to 58% of the annual emissions from other sectors. In 2013, the net sink was 20.4 million tonnes CO_2 eq. The determining factor is the balance of tree biomass growth and losses in Forest Land category. The increment of growing tree stock has increased 34% since 1990. Economic situation and the international market of forest industry products have brought about the amount of domestic commercial roundwood removals and caused the inter-annual fluctuation in the sink. The global economic downturn had a considerable negative effect on demand for forest-based industry products in 2009. In 2013, a slight economic upturn increased the demand of wood and forest industry products; commercial roundwood removals were at its highest level ever and produced a total drain of 79 million m^3 (Finnish Statistical Yearbook of Forestry 2014). Emissions from other land-use categories have been more stable. The greatest sources of emissions are drained organic soils on both forest and agricultural lands, together representing 14.7 million tonnes CO_2 eq in 2013. Minor emissions are reported from peat production areas, forest fires, and nitrogen fertilization of forests. Emissions from drained organic soils have a slight increasing trend in croplands and wetlands. Harvested wood products constituted a carbon sink of 4.4 million tonnes CO_2 eq. in 2013.

Waste

The waste sector accounted for 4% (2.3 million tonnes CO_2 eq.) of total Finnish greenhouse gas emissions in 2013. Emissions from the waste sector have declined quite constantly since 1990. The decrease of 2.3 million tonnes 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% 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.

Figure 2.6 Relative development of greenhouse gas emissions by main source category relative to the 1990 level (1990=100%)



Indirect emissions

The emissions trends of indirect greenhouse gases; nitrogen oxides, carbon monoxide and non-methane volatile organic compounds and sulphur oxide and other sulphur emissions calculated as sulphur dioxide, are presented in Figure 2.7.

Nitrogen oxides (NO_x) were generated in the energy, industrial, agriculture and LULUCF sectors. The energy sector is the most significant source, 97% of emissions are energy related. Emissions have decreased by 50% compared to 1990 and were 150 kilotonnes in 2013. The biggest decrease, 66%, has happened in the transport category due to the implementation of catalytic converters to cars and these emissions were 35% of the total emissions in 2013. Energy industries as well as manufacturing industries and construction generated both 25% of the emissions.

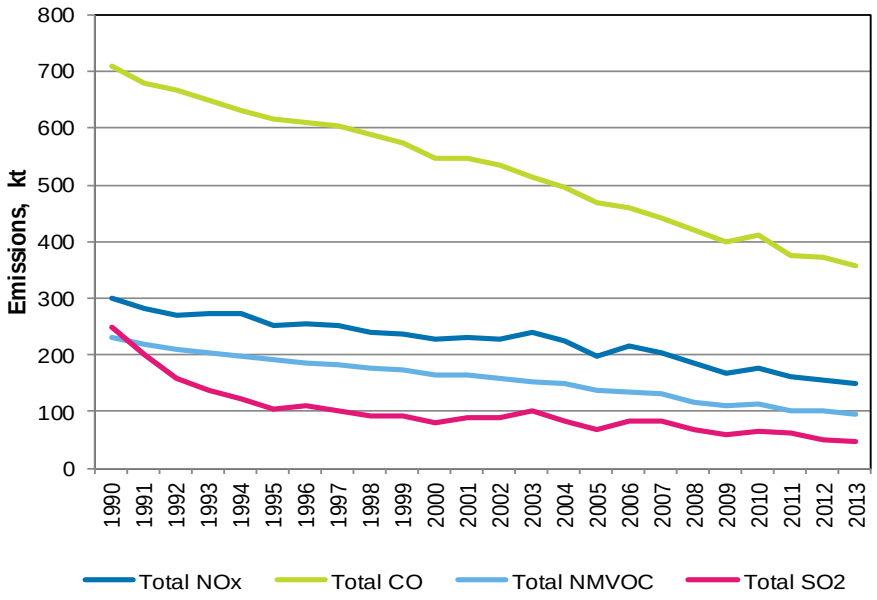
Carbon monoxide (CO) emissions, total 358 kilotonnes in 2013, originated almost exclusively in the energy sector, where transport generated 26% and other sectors (including small-scale combustion and off-road machinery) 58% of

the total emissions. Total carbon monoxide emissions have decreased by 50% compared to 1990 and the biggest part of this reduction is resulted from increased amount of cars with catalytic converters.

The **non-methane volatile organic compounds (NMVOC)** totalled 94 kilotonnes in 2013. In all, 73% of the total emissions were generated in the energy sector, 26% originated from industrial processes and product use. Total NMVOC emissions have decreased by 59% from 1990 to 2013, the greatest decline has taken place in industrial processes and product use sector, where emissions decreased by 67%.

The **sulphur dioxide (SO_2)** emissions totalled 48 kilotonnes in 2013out of which 76% originated in the energy sector, where energy industries generated 50% of the total emissions and manufacturing industries and construction 17%. Sulphur dioxide emissions have totally decreased 81% from 1990, reasons for that are increased use of less sulphur containing fuels and sulphur abatement technology in energy production.

Figure 2.7 Indirect greenhouse gas and sulphur dioxide emissions, kilotonnes



2.2 National inventory arrangements

Institutional arrangements

The requirements for national inventory arrangement are largely the same as the requirements for the national systems for greenhouse gas inventories under the Kyoto Protocol. The description of Finland's national inventory system presented here, meets the requirements for national inventory arrangements as contained in UNFCCC Annex I inventory reporting guidelines as well as those for national inventory systems under Article 5.1 of the Kyoto Protocol and defined in Decision 19/CMP.1. More details on the inventory arrangement can be found in Finland's latest inventory submission under the UNFCCC.

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. In 2015, the role of Statistics Finland as the national entity was enforced through the adoption of the Climate Law (609/2015).

Statistics Finland defines the placement of the inventory functions in its working order. Statistics Finland is in charge of the compilation of the national emission inventory and its quality management. As the national entity Statistics Finland also bears the responsibility for the general administration of the inventory and communication with the UNFCCC and the EU Commission, co-ordinates participation in the review of the inventory, and publishes and archives the inventory results.

Statistics Finland has access to data collected for administrative purposes. Hence by law, Statistics Finland has access to data collected under the EU ETS, regulation on fluorinated gases, the European EPRTR registry and energy statistics regulation. Access to EU ETS data is also ensured through the agreement between Statistics Finland and the Energy Authority. The EU ETS data and data collected under energy statistics regulation are significant data sources and used both directly and/or for verification in inventory compilation. The use of the EPRTR and data collected under the regulation on fluorinated greenhouse gases have a much more limited role in the inventory preparation.

Statistics Finland approves the inventory before the submissions to the UNFCCC and EU.

Various specialist organisations acting as parties to the inventory system are responsible for the inventory data of the different sectors (Table 2.1).

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), the Natural Resources Institute Finland (Luke) 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. Luke estimates the agricultural emissions, including the CO_2 emissions reported by the LULUCF sector and has the overall responsibility for estimates in the LULUCF sector. VTT Technical Research Centre of Finland provides transportation emissions data.

Table 2.1 Responsibility areas by expert organisations

Area		Organisations
CRF 1.A.	Stationary sources - fuel combustion in point sources, such as power plants, heating boilers, industrial combustion plants and processes	Statistics Finland
CRF 1.A.	Mobile sources (transport and off-road machinery)	Statistics Finland, VTT Technical Research Centre of Finland Ltd (as a purchased service)
CRF 1.A.	Other fuel combustion (agriculture, households, services, public sector, etc.)	Statistics Finland
CRF 1.B.	Fugitive emissions from energy production and distribution	Statistics Finland
CRF 2.	Emissions from industrial processes and product use	Statistics Finland
CRF 2.	Emissions of F-gases	Finnish Environment Institute
CRF 3.	Emissions from agriculture	Natural Resources Institute Finland (Luke)
CRF 4.	Emissions from land use, land-use change and forestry	Natural Resources Institute Finland
CRF 5.	Emissions from waste	Finnish Environment Institute
Indirect CO_2	Non-methane volatile organic compounds, NMVOC	Finnish Environment Institute
KP	Activities under Article 3, paragraphs 3 and 4 of the Kyoto Protocol (ARD and FM)	Natural Resources Institute Finland

All the participating organisations are represented in the inventory working group set up to support the process of producing annual inventories and the fulfilment of 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 four years at present.

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

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

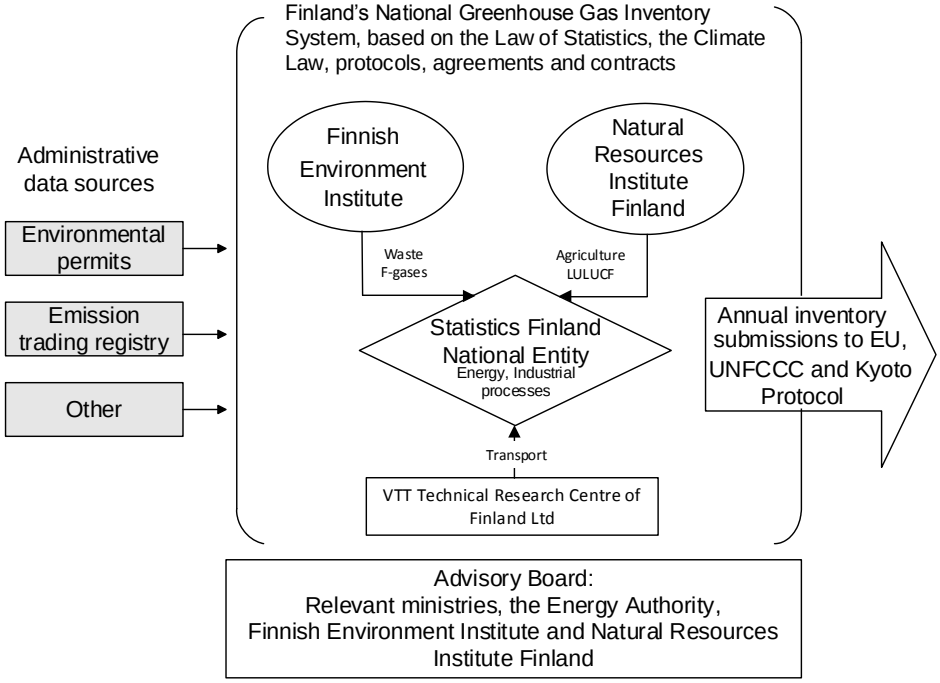
As an EU Member State, Finland reports annually also its greenhouse gas emissions to the European Commission. The EU mechanism for monitoring greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change (EU MMR, EU/525/2013) gives the legal basis for this reporting. The EU implementation of the EU monitoring mechanism is further defined in the Commission implementing regulation (EU/749/2014) on structure, format, submission process and review of information reported by Member States pursuant to regulation EU/525/2013. The EU regulations are consistent with the UNFCCC and Kyoto Protocol requirements for national greenhouse gas inventories but contain in addition complementary processes and requirements to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of national inventories by EU Member States and the Union greenhouse gas inventory:

The European Environment Agency (EEA) checks the quality of the draft inventory submissions of the EU Member States before submissions under the UNFCCC take place. An EU review is also implemented annually to ensure the compliance with the EU Burden Sharing Decision (ESD) which sets annual emission limitation targets for the non-ETS emissions in Member States (see further details in Chapter 3). The EU checks and reviews are strong quality assurance and verification measures for the UNFCCC submissions.

The Commission organises also meetings of a work group on annual inventories (WG 1 under the Climate Change Committee) at least twice a year to discuss the inventory submissions by Member States, results of the QA/QC checks and reviews as well as ways to improve the inventories. In addition, the Commission supported by the European Environment Agency (EEA) organises one or more workshops on specific inventory areas to present and discuss topical issues and ways to improve the inventory.

The EU monitoring mechanism provides the inventory compilers in the Member States information on requirements, methodologies, activity data and emission factor sources as well as fora a to exchange views and experiences on any inventory related issues.

Figure 2.8 National system for the greenhouse gas inventory in Finland



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 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 EU's greenhouse gas monitoring mechanism require Finland to submit annually a National Inventory Report (NIR) and Common Reporting Format (CRF) tables. The annual submission contains emission estimates for the second but last year, so that the 2015 submission contains estimates for the calendar year 2013.

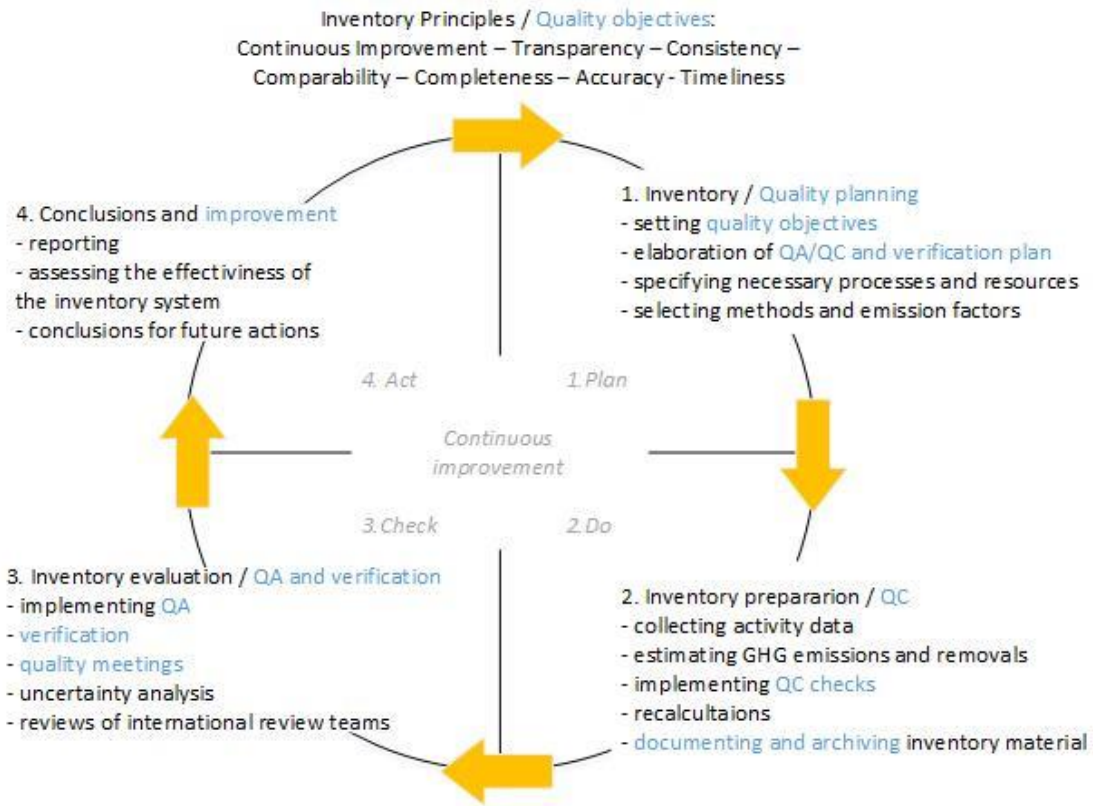
The organisation of the preparation and reporting of Finland's greenhouse gas inventory and the duties of its different parties are detailed in the previous Section. The expert organisations acting as the parties to the inventory system are in charge of the inventory data of the different reporting sectors. The expert organisations produce emission estimates following the division of labour defined in the agreements with Statistics Finland (Table 2.1) and according to the UNFCCC reporting guidelines. Statistics Finland compiles from the data produced by expert organisations national reporting and submits them to the UNFCCC Secretariat and to the European Commission.

The preparation of the annual inventory follows the schedule of the reporting. Under the EU MMR, the annual inventory is submitted to the Commission by 15 January. The Member States may complement and update their submission by 15 March. The greenhouse gas inventory is submitted to the UNFCCC Secretariat by 15 April. The joint EU inventory is compiled from the Member States' submissions and it is also supplied to the UNFCCC Secretariat by 15 April.

The Commission uses the inventory data submitted annually by Member States also when evaluating the progress of the Community and its Member States towards the set greenhouse gas emission objectives and commitments. The preparation schedules of the 2015 inventory submissions to the EU and UNFCCC have been exceptional. Due to the delay in the provision of a functional CRF Reporter all inventory submissions in 2015 were delayed significantly.

The annual inventory process set out in Figure 2.9 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 2.9 Annual inventory process



The methodologies, collection of activity data and choice of emission factors are consistent with the guidance in the 2006 IPCC Guidelines, the IPCC Good Practice Guidance reports and '2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands'.

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

The inventory planning stage includes the setting of quality objectives and elaboration of the QA/QC and verification plan for the coming inventory preparation, compilation and reporting work. In addition, a schedule of the coming inventory round is prepared and presented to the expert organisations. The schedule includes deadlines for example for QC checks of the inventory compilation and draft meeting schedules of the inventory working group and advisory board.

The setting of quality objectives is based on the inventory principles. Quality objectives (Table 2.2) are specified statements about the quality level that is aimed at in the inventory preparation 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.

Table 2.2 Quality objectives for all calculation sectors in the inventory

Quality objectives
1. Continuous improvement
1.1. Treatment of review feedback is systematic
1.2. Improvements promised in the National Inventory Report (NIR) are carried out
1.3. Improvement of the inventory is systematic
1.4. Inventory quality control (QC) procedures meet the requirements
1.5. Inventory quality assurance (QA) is appropriate and sufficient
1.6. Verification of the inventory meet the requirements
1.7. Known uncertainties of the inventory are taken into consideration when planning the improvement needs
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 (NIR) 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 quality objectives and the planned general and category-specific QA/QC and verification procedures regarding all sectors are set in the QA/QC plan. This is a document that specifies the actions, schedules and responsibilities in order to attain the quality objectives and to provide confidence in the Finnish national system's capability to deliver high-quality inventories. The QA/QC plan is written in Finnish, updated yearly and consists of instructions and a QA/QC form. Instructions include descriptions of, e.g., quality objectives, general and category-specific inventory QC checks, information on quality assurance and verification, schedules and responsible parties. The QA/QC form addresses the actions to be taken in each stage of the inventory preparation. Sectoral experts fill in the form the QA/QC and verification procedures performed, and results of the procedures. Discussions in the bilateral quality meetings are based on information documented on these forms. The QA/QC plan is part of the electronic quality manual of the inventory and archived according to the inventory unit's archive formation plan.

In addition to the general QA/QC plan, the expert organisations may use category-specific QC checklists. These lists are included in the internal documentation of the calculations.

The QC procedures used in Finland’s GHG inventory comply with the 2006 IPCC Guidelines. General inventory QC checks (2006 IPCC Guidelines, Vol 1, Chapter 6, Table 6.1) include routine checks of the integrity, correctness and completeness of the data, identification of errors and deficiencies and documentation and archiving of the inventory data and quality control actions. Category-specific QC checks including reviews of the activity data, emission factors and methods are applied on a case-by-case basis focusing on key categories and on categories where significant methodological changes or data revisions have taken place.

The QA reviews are performed after the implementation of QC procedures concerning the finalised inventory. The QA system comprises reviews and audits to assess the quality of the inventory and the inventory preparation and reporting process, to determine the conformity of the procedures taken and to 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 and external audits, peer reviews and UNFCCC and EU inventory reviews.

Emission and activity data are verified by comparing them with other available data compiled independently of the GHG inventory system. These include measurement and research projects and programmes initiated to support the inventory system, or for other purposes but producing information relevant to the inventory preparation.

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 as well as UNFCCC and EU review feedback and uncertainty analysis where relevant. In addition, the inventory unit and experts performing the inventory calculations follow the development of the sector. When technologies and practices change, or new activity or research data become available, they evaluate the need for improvements and recalculations to improve the inventory.

Finland's inventory system has a special procedure for the consideration and approval of the recalculations. If sectoral experts identify any needs for recalculations they contact inventory unit and provide comparison calculations and solid justification for the recalculation. The methodological changes are then communicated to the advisory board for evaluation, and approved by the inventory unit before adopted into the production.

As a part of the inventory improvement also the QA/QC and verification plan is checked and updated annually based on results received from the previous inventory round. In the implementation of the improvements, resources are prioritized based on the significance of the sources where needed. The results of the key category analysis are taken into account in assessing the significance.

Changes in Finland's GHG inventory arrangements since NC6 and BR1

Since 30 December 2013, the submission date for Finland's Sixth National Communication and first Biennial Report, 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.

The recently adopted Climate Change Act[3] enforces Statistics Finland's role as the national entity for Finland´s national greenhouse gas inventory.

The MTT Agrifood Research Finland, the Finnish Forest Research Institute, the Finnish Game and Fisheries Research Institute and the Information Centre of the Ministry of Agriculture and Forestry have been merged to Natural Resources Institute Finland (Luke). The new organisation started its operation 1 January 2015. The new organisation is responsible for the estimation of the emissions and removals in the agriculture and LULUCF sector. These responsibilities were previously divided by MTT Agrifood Research Finland and the Finnish Forest Research Institute.

Statistics Finland is in the process of updating its agreements with the ministries and expert organisations to take into account the changes in the inventory preparation in 2015 due to the implementation of the methodologies in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, as implemented by the updated UNFCCC reporting guidelines national greenhouse gas inventories by Annex I countries, and the implementation the Monitoring Mechanism Regulation (EU) 525/2013. The updates do not involve any significant changes in the inventory system. By the submission date of this report, Statistics Finland has updated the agreement with the Ministry of the Environment. The rest of the agreements will be updated within the first half of 2016.

[3] (609/2015)

3 Quantified economy-wide emission reduction target

3.1 Quantified economy-wide emission reduction target jointly with the European Union

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. Under the revised EU ETS Directive[4], one single EU ETS cap covers the EU Member States and the three participating non-EU Member States (Norway, Iceland and Liechtenstein). There are no further differentiated caps by country. For allowances allocated to the EU ETS sectors, annual caps have been set for the period from 2013 to 2020; these decrease by 1.74 % annually, starting from the average level of allowances issued by Member States for the second trading period (2008–2012). The annual caps imply interim targets for emission reductions in sectors covered by the EU ETS for each year until 2020. For further information on the EU ETS and for information on the use of flexible mechanisms in the EU ETS see the EU's Second Biennial Report under the UNFCCC, Section 4.2.2.

The EU Effort Sharing Decision (ESD)[5] establishes binding annual greenhouse gas emission targets for Member States for the period 2013–2020. The ESD covers the emissions from the non-emissions trading sector (non-ETS) calculated as the total national emissions without LULUCF minus the national emissions in EU Emission trading sector for the Member State in question. The CO_2 emissions from civil aviation are also excluded from the non-ETS emissions. The non-ETS emissions come from sources 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. The ESD sets Finland's reduction obligation for the sectors not covered by the EU ETS as 16 per cent of the 2005 emissions. This reduction obligation has been determined in CO_2 equivalent (eq) tonnes after the EU internal review of the 2012 greenhouse gas emission inventory submission in the Commission Decision 2013/163/EU. The decision sets annual emission allocation for each Member State for the year 2013 to 2020. The Commission Implementing Decision 2013/634/EU adjusts these annual emission allocations taking into account the changes in coverage of the EU Emission Trading System from 2013 on-wards. For Finland the annual adjustments increase the reduction commitment by 2020 to 21.1 per cent.

As these annual emission allocations are fixed in tonnes CO_2 eq based on the 2012 inventory submission, also the changes in the emissions due to the implementation of new UNFCCC reporting guidelines adopted in Warsaw 2013 (Decision 24/CP.19), which implement the use of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, change the actual emission reduction burden under the ESD. Finland has estimated its emissions reduction burden to increase by almost 2 percentage units by 2020. The Commission may revise the annual emission allocation if the impact of the use of the 2005 IPCC Guidelines and the change in the UNFCCC methodologies leads to a difference of more than 1% in a Member States total national greenhouse gas emissions relevant to the determination of the annual emission allocations under the ESD. This possible revision will be based on the Commissions' examination of the impacts by December 2016.

Finland's target path for non-ETS emissions in accordance with the ESD is given in Table 3.1.

[4] Directive 2009/29/EC

[5] Decision 406/2009/EC

Table 3.1 Finland's target for the non-ETS emission during 2013 to 2020 and the estimated corresponding emissions for the years 2013 and 2014

	2013	2014	2015	2016	2017	2018	2019	2020
Finland's target path (original allocation minus the amendment)	31.8	31.3	30.8	30.3	29.8	29.3	28.8	28.4
Non-ETS emissions	31.4	31.1[2]						
Distance to the target[1]	-0.4	-0.1						

[1] Distance to the target is expressed as negative number when actual emissions are below the target path

[2] Approximate data

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 with certain limitations. There is an annual limit of 3% of the greenhouse gas emissions in 2005 for the use of project-based credits for each Member State. If these are not used in any specific year, the unused part for that year can be transferred to other Member States or be carried over for own use until 2020.

As Finland fulfils additional criteria laid down in ESD Article 5(5) (d)[6], an additional use of credits is possible from projects in Least Developed Countries (LDCs) and Small Island Developing States (SIDS) up to an additional 1 % of their verified emissions in 2005. These credits cannot be carried over to subsequent years or transferred to other Member States.

A Member State that fails to meet its annual target under the ESD will be penalised with a deduction of the Member State's emission allocation for the following year equal to the amount of the excess emissions in the previous year multiplied by 1.08.

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. It includes also requirements for the increase of efficiency in the use of energy.

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

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

3.2 Other emission reduction targets

Kyoto Protocol

Finland is also implementing the second commitment period of the Kyoto Protocol to the UNFCCC (2013-2020). The EU, its Member States and Iceland are implementing its targets under the Kyoto Protocol jointly. Finland's target and progress towards the achievement of the target for the second commitment period of the Kyoto Protocol is reported annually in the national inventory report.

[6] The criteria referred to is that the Member State concerned has a renewable energies target for 2020 in excess of 30% as set out in EU Directive 2009/28/EC. Finland's renewable target under the mentioned directive is 38%.

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. The historical trend in the national total emissions without the LULUCF sector is the key indicator for progress in the achievement of the trend. The EU joint target under the Convention refers to greenhouse gas emissions of the EU-28 and the emissions are calculated as the sum of the emission of the Member States. The EU-28 emissions in 1990 without the LULUCF sector including the indirect CO_2 emissions were 5,689 million tonnes of CO_2 eq in 1990 and 4,481 million tonnes CO_2 in 2013 that is 21.2 per cent lower than in 1990. In 1990, Finland's total national emissions without the LULUCF sector including the indirect CO_2 emissions, 71.3 million tonnes CO_2 eq, were 1.3 per cent of the EU-28 emissions. In Finland, the corresponding emissions in 2013 were 63.1 million tonnes CO_2 eq (approximately 12 per cent lower than in 1990). Finland's emission trends 1990 – 2013 are reported in detail in CTF Table 1.

In the following sections, progress in achievement of quantified economy-wide emission reduction targets is described through mitigation actions planned, adopted and implemented for achieving the targets and commitments under Convention and EU's Climate and Energy Package. Information on the effects of the mitigation actions and progress in achievement of the target under the Convention, where available and relevant, has been included also in CTF Tables 3 and 4.

Emissions/removals in the LULUCF sector are not included in the EU target under the Convention. They are therefore not included in CTF Table 4 and CTF Table 4(a) is left empty. However, mitigation actions in the LULUCF sector are presented in CTF Table 3. Also, projections for the LULUCF sector are presented in Chapter 5 and national programmes of forest policy are described in Chapter 7.

Information on use of flexible mechanisms under the EU ETS on 2013 data will become public on installation level only in 2016. Under the ESD, the compliance assessment including any use of units from the flexibility mechanisms for the year 2013 will take place in 2016. Therefore, quantitative information on the use of flexible mechanisms has not been reported in CTF Table 4b.

Finland's EU ESD target is described in Section 3.1 and based on data published by Statistics Finland[7] the emissions reported to the UNFCCC for 2013 and approximated for 2014 Finland is on the path to fulfil its commitments related to the non-ETS sector emission reductions. Based on total national greenhouse gas emissions and EU ETS data for 2013, Finland would not be using units from the flexible mechanisms under the ESD, and hence the Convention, for 2013.

4.2 Mitigation actions and their effects

Sectoral policies and measures

Energy excluding transport

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. If nuclear power is counted as domestic energy (as is done in international practice), around one half of total energy comes from domestic sources. The major trend is a steady increase both absolutely and in relative terms in the use of renewable energy.

[7] http://www.stat.fi/til/khki/2013/khki_2013_2015-10-30_tie_001_en.html

The 'with measures' (WM) projection includes all energy policy measures in use at the end of 2014. 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 System

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 system may acquire a limited amount of international credits (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 and commercial airlines. Industrial processes currently count for one tenth and the emissions from commercial airlines about 3 per cent of EU ETS emissions in Finland.

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 2013 (Table 4.1). The share is clearly higher than the EU-28 average, which is around 45 per cent[8].

For the third trading period 2013-2020, there is a single EU-wide cap for the ETS sectors. The main method of allocation is auctioning, and free allowances are allocated on the basis of harmonised rules. In the EU ETS companies involved are responsible for their own emission balance and have the obligation to ensure that they possess a sufficient quantity of emission allowances to cover their emissions annually.

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 growth in ETS sector emissions in 2013 mainly stems from the widened scope of the ETS Directive.

A high share of the ETS sector emissions originate from the energy sector. A significant change in the electricity production in Finland is the upcoming commissioning of the new nuclear power unit Olkiluoto 3, expected in 2018. In addition, the operator Fennovoima has a decision-in-principle for the construction of a new nuclear power unit Hanhikivi 1.

[8] for more detail see, http://ec.europa.eu/clima/policies/ets/index_en.htm

Table 4.1 Greenhouse gas emissions in the plants included in the emission trading sector (ETS) and in the non-emission trading sector in 1990, 2005 and 2008-2012 in Finland, million tonnes CO_2 eq (a value for the non-ETS emissions is not provided for 1990). The ETS figures do not include emissions from aviation in the EU ETS as their coverage under trading scheme is not consistent with national greenhouse gas inventory.

	1990	2005	2008	2009	2010	2011	2012	2013	2014*
ETS	NA	33.1	36.2	34.4	41.3	35.1	29.5	31.5	28.8
of which energy	NA	29.5	31.8	30.8	37.3	31.0	25.7	27.5	25.0
industrial processes	NA	3.6	4.3	3.4	4.0	4.0	3.8	4.0	3.8
Non-ETS	NA	36.2	34.9	32.9	34.4	32.7	32.7	31.4	31.1
Domestic aviation (CO_2-emissions)	NA	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.2
Total national emissions	**71.4**	**69.6**	**71.4**	**67.5**	**75.9**	**68.1**	**62.4**	**63.1**	**60.1**

* preliminary data
NA = not applicable

Energy efficiency

Energy intensity of the Finnish economy is relatively high, which leads to relatively high per capita greenhouse gas emissions. Energy use, however, is efficient in international comparison, which implies that the high energy intensity can be explained by structural factors. As indicated by the country's northern location, Finland has a cold climate. The need for space heating, measured by average heating degree-days, is one of the highest in the world in the world. Additions to these factors that increase the energy intensity of Finland are the relatively large geographical area and sparse population.

In many energy conservation measures and in terms of the efficiency of energy use, Finland is among the leading countries in the world. Co-generation of heat and electricity, broad coverage of energy efficiency agreements, and the systematic implementation of energy audits are good examples of successful energy conservation measures.

On 4 February 2010, the Government passed a resolution on energy saving and energy efficiency measures for implementation during the current decade.[9] This Government decision was based on a June 2009 report by a broad-based Energy Efficiency Committee, appointed by the Ministry of Employment and the Economy.[10]

Energy-efficiency requirements designated for the public sector are liable for setting an example in promoting energy conservation. Other areas of focus include the development of an energy-efficient community structure and enhancement of energy efficiency in the heating of buildings, transport, household use, agriculture, industry, and the entire service sector.

The measures included in the Government decision extend until 2020, but the main emphasis was on measures due for implementation in 2010–2011. The majority of energy-saving measures are based on EU-wide solutions, regulations, and recommendations. Public financing is targeted inter alia at research and development activities and enhancement of competencies, whereas fiscal solutions emphasise motivating energy savings while ensuring the conditions needed for industry to operate solidly.

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.

[9] https://www.tem.fi/en/energy/energy_efficiency/government_decision_on_energy_efficiency_measures

[10] http://www.tem.fi/en/current_issues/press_releases/press_release_archive/year_2009/vast_savings_in_consumption_through_proposals_by_energy_efficiency_committee.95795.news

The Energy Efficiency Agreements 2008–2016 (http://www.energyefficiencyagreements.fi) are an important means of furthering energy efficiency in Finland. The agreement scheme will be extended so that it will serve implementation of the European Union's Energy Efficiency Directive (EED) 2012/27/EU. Finland has chosen alternative measures to fulfil EED Article 7 binding energy savings target and extensive energy efficiency agreements have an important role in the implementation.

The voluntary Energy Efficiency Agreements covering the following sectors are in force until 2016:

- industries (industry, private service sector, energy sector)
- municipal sector
- oil sector (oil-heating and distribution of liquid fuels)
- property and building sector (housing properties, commercial properties)
- transport (goods and public)
- farms.

Negotiations between the agreement parties have already started in 2015 to extend the ongoing energy efficiency agreement period for industries, municipal sector and oil sector from 2017 onwards to fulfil EED requirements and also having a possible option for further extension after 2020. Also the agreement for farms is under renegotiation for the period from 2015 to 2020.

The calculation of energy savings from energy efficiency agreements is based on energy-saving measures reported as implemented in the annual reports of companies and communities who have joined the agreements. The savings calculation excludes implemented measures proposed in energy audits to avoid overlapping. However, implemented measures related to the process industry energy audits and energy sector energy audits are included while those are only reported via energy efficiency agreements, and thus not included in the energy audit savings calculations.

The realised CO_2 emission reductions based on estimated annual energy saving are to reach 7.2 million tonnes/a in 2015 and 9.1 million tonnes/a in 2020. Most of the emission reductions, over 90%, are estimated to occur in the emissions trading sector due to the large share of electricity and district heat in energy savings. New savings are in ex-ante calculations estimated based on the realised average savings over the past agreement period. Life time of the energy savings has been taken into account in the calculations as also required in the Energy Efficiency Directive (EED) and Energy Service Directive (ESD).

Energy audits

The purpose of an energy audit is to analyse the energy use of the facility being audited, to work out the potential for energy savings and present a profitability calculation of saving proposals. Energy audits are also one important element in the implementation of energy efficiency agreements to figure out energy savings measures and energy savings potentials.

Energy audit subsidies for service buildings and of industrial and energy production facilities have been granted since 1992. The actual energy audit programme started in 1994. The Ministry of Employment and the Economy (MEE) provides subsidies for carrying out the energy auditing of the commercial and public buildings, and in industrial and energy sectors (since 2014 according to the restrictions based on EED Article 8 mandatory energy audits for large companies). The MEE also supports municipalities to carry out audits concerning promotion of renewable energy use in the municipality district (Renewable Energy Municipal Audit).

Audit programme includes promotion of audit activities, development and monitoring, the training and qualification of energy auditors, and the quality assurance of audits. The results of energy audit activities have been monitored through a separate monitoring system since 1994. More information on supported energy auditing can be found at

http://www.motiva.fi/en/areas_of_operation/energy_auditing/mee-supported_energy_auditing

The impact calculations of the energy audits makes use of information on the energy-saving potential of the measures proposed during energy audits, which is input into the energy audit database. Information on the implementation of these proposed measures is gathered through energy efficiency agreement’s annual reporting from all those who have signed up to the energy efficiency agreement.

The realised CO_2 emission reductions are estimated to reach 0.6 million tonnes/a in 2015 and 0.5 million tonnes/a in 2020. The vast majority of the emission reductions, almost 90%, are estimated to occur in the emissions trading sector due to the large share of electricity and district heat in energy savings.

The ex-ante estimate for 2020 is calculated based on an assumption that the subsidised energy audit programme continues. The calculations have not taken into account future possible changes in the energy audit programme savings related to the mandatory energy audit requirement in the EU's Energy Efficiency Directive (EED) for large companies since 2014. New savings are in ex-ante calculations estimated based on the realised average savings over the past years. Life time of the energy savings has been taken into account in the calculations as also required in the Energy Efficiency Directive and Energy Service Directive.

Energy efficiency of energy-related products

The Eco-design Directive (2009/125/EU) provides with consistent EU-wide rules for improving the environmental performance of energy related products (ERPs) through eco-design. The Energy Labelling Directive (2010/30/EU) harmonises national measures related to the publication of information on the consumption of energy and of other essential resources by energy-related products, thereby allowing consumers to choose appliances on the basis of their energy efficiency. The directives are implemented in Finland with the Act on Eco-design and Energy Labelling (1005/2008, amendment 1009/2010) which came into force on 1 December 2010.

The current requirements for energy efficiency of energy using products are estimated to lead to a minimum 4.3 TWh annual saving of electricity in 2020 with corresponding to CO_2 emission reductions of 2.5 million tonnes/a. The estimates have been made for each product group by calculating the difference in the baseline scenario and the policy scenario. The baseline scenario includes the autonomous development in energy efficiency and the policy scenario the impact of eco-design regulations.

Renewables

The share of the renewable energy sources in 2013 was 37% of the final energy consumption. The most significant part of the renewable energy supply comes from biomass, especially from the side-products of the forest industry. The remainder of renewable energy supply comes mainly from hydro power. The other renewable energy sources (biogas, heat pumps, wind power, other biofuels and recovered fuels' bio fraction) together equalled as much as hydro power in 2013. The goal in the Energy and Climate Strategy (2013) is to increase the share of renewable energy in final energy consumption to 38% by 2020, in line with the obligation set by the EU for Finland.

The current high level of wood utilization in forest industry forms a backbone in meeting renewable energy targets. During 2010 several measures to increase energy production based on renewable forms of energy were agreed by the Government's ministerial working group for climate and energy policy as a part of the renewable energy package. The package promoted in particular the use of forest chips and other wood-based energy alongside with wind power, biofuels in the transport sector and the increased utilisation of heat pumps.

The sliding feed-in tariff system for the production of electricity from renewable energy sources[11] came into force on 25 March 2011. The aid scheme concerns government support for electricity production based on wind power, biogas, forest chips and wood fuels. The feed-in tariff scheme contributes to meeting the national objective set by the EU for increasing the utilisation of renewable energy sources. This will be done by achieving the target set for wind power of 6 TWh of electricity by year 2020, as well as going most of the way towards achieving the forest chips objective of 25 TWh. Special policy measures are targeted at forest chips.

Renewable energy is also promoted through Energy Support Scheme (investment subsidy)[12]. It is a discretionary support to promote renewable energy and energy efficiency, and the support is granted according to the continuous submission scheme. Other measures that have been implemented to promote renewable energy include electricity tax subsidies, subsidies for harvesting of forest chips, information measures and, in terms of wind power, land-use planning.

[11] https://www.tem.fi/en/energy/renewable_energy_sources/feed-in_tariff_of_renewable_energy

[12] https://www.tem.fi/en/energy/energy_support

Promoting forest chips and wood fuels

In 2013, approximately 16 TWh of energy was produced using forest chips. The target by 2020 is 25 TWh. In order to promote the use of forest chips and wood fuels, operating aid and feed-in tariff systems were introduced.

Forest chip power plants are granted an operating aid in order to compensate the higher production costs of electricity in installations using forest chips instead of fossil fuels (peat). Forest chips are defined as category of fuel including fuel chips and log fuel. Forest chips must be made from crude wood which comes directly from forests. The capacity or number of installations is not limited. Forest chip plants can be industrial cogeneration plants, district heating cogeneration plants or condensing power plants. These plants can be existing plants, whereas wood fuel plants in the feed-in tariff scheme have to be new. It is estimated, that promoting forest chips will reduce CO_2 emissions by 9.7 million tonnes in 2020.

The feed-in tariff system for wood fuel cogeneration plants will be open for new installations until reaching the capacity target of 150 MVA and 50 installations. Wood fuel covers forest chips and wood residues and waste wood from wood processing industry.

Promoting wind power

In 2014, wind power production was 1.1 TWh. On November 5, 2015, wind power equalling 1,038 MVA had been approved in the system and 1,024 MVA had quota reservations from the system. In addition, Finland's first offshore wind farm has been granted a 20 million Euro investment subsidy. The planned total capacity of the wind farm is 40-44 MW. This project demonstrates wind power technologies suitable for winter conditions in the Baltic Sea area where for example ice conditions can be very challenging due to pack ice. It is estimated that promotion of wind power will reduce CO_2 emissions by 3.6 million tonnes in 2020.

Promoting biogas

Biogas production is supported through the feed-in tariff system. A biogas power plant can be accepted into the feed-in tariff scheme until the combined nominal capacity of generators in all biogas power plants within the scheme exceeds 19 MVA.

The historic use of and WM projection for renewable energy in Finland is shown in Figure 4.1 and Table 4.2.

Figure 4.1 Historic development and WM projection for renewable energy

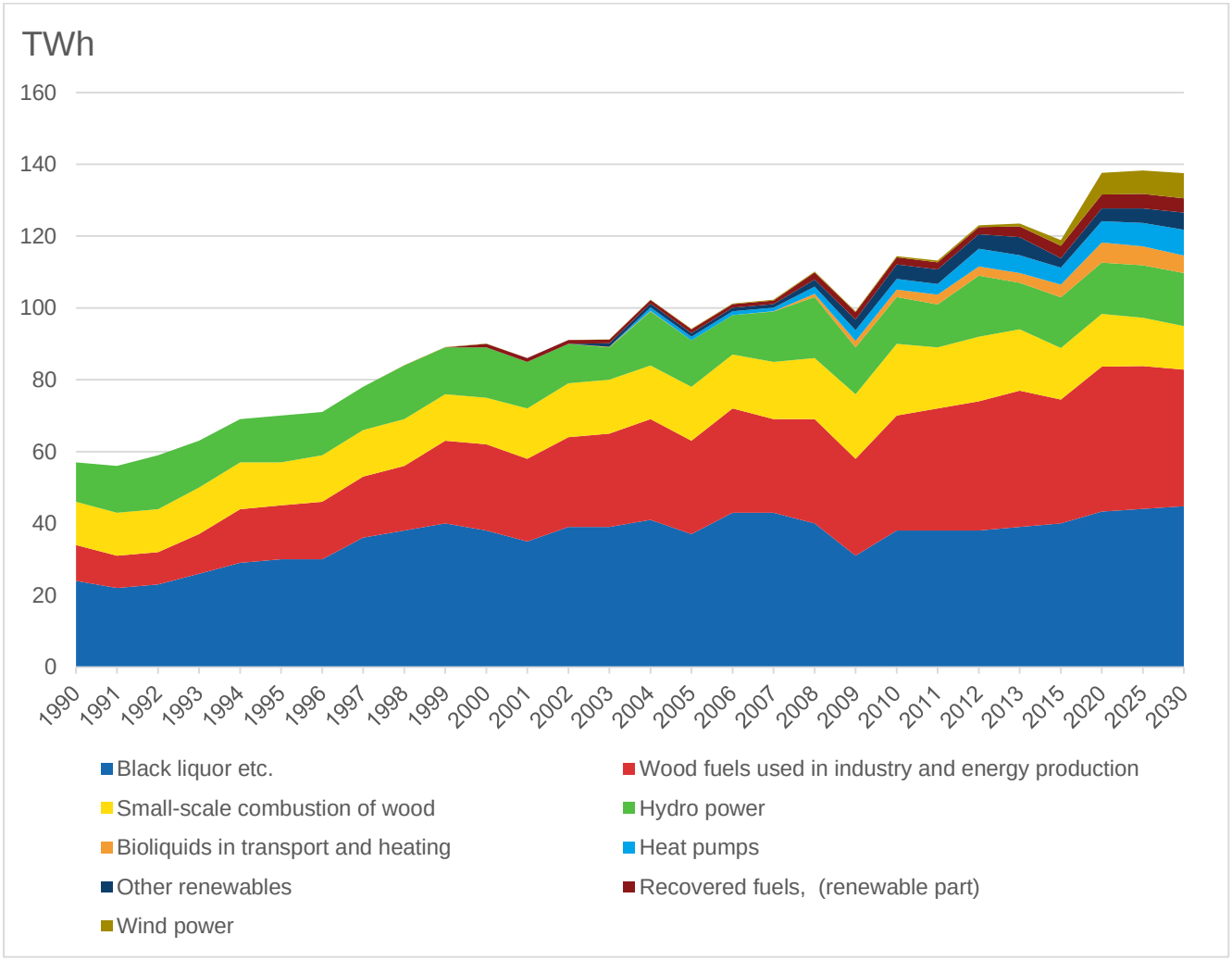


Table 4.2 Renewable energy in the WM projection, TWh

	2008	2009	2010	2011	2012	2013	2020	2025	2030
Renewable fuels related to industrial production									
Black liquor	39.9	30.6	37.7	37.5	37.7	39.1	43	44	45
Industrial wood residues	20.0	15.0	18.5	18.8	19.2	20.3	18	18	18
Total	**60**	**46**	**56**	**56**	**57**	**59**	**61**	**62**	**63**
Renewables targeted by policies									
Hydro power	16.9	12.6	12.7	12.3	16.7	12.7	14	15	15
Wind power	0.3	0.3	0.3	0.5	0.5	0.8	6	7	7
Forest chips	8.8	12.1	13.8	15.0	15.2	16.0	23	22	20
Small-scale combustion of wood	16.4	17.4	19.3	16.5	18.4	17.1	15	13	12
Heat pumps	1.9	2.6	3.0	3.5	4.5	4.6	6	7	7
Bioliquids in transport and heating	1.0	2.0	2.2	2.7	2.5	2.7	6	5	5
Biogas	0.5	0.5	0.5	0.6	0.7	0.7	1	1	1
Recovered fuels	1.7	1.6	1.7	1.6	2.2	2.6	4	4	4
Other	0.4	0.6	0.6	0.5	0.7	1.1	1	1	1
Total	**48**	**50**	**54**	**53**	**61**	**58**	**76**	**75**	**74**

Promotion of biofuels in transport is 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 75 TWh in 2013 (25 per cent of the total end use of energy).

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)[13] 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:

[13] (2002/91/EC)

- Act on Energy Certification of Buildings[14] and the Ministry of the Environment Decree on Energy Certification of Buildings[15]
- Act on Inspection of Air-conditioning Systems[16]
- Amendments to the Land Use and Building Act[17], which was expanded to cover energy efficiency requirements and details on how energy efficiency should be calculated.[18]

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)[19]. 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. Also due to the implementation of the Directive on the Energy Performance of Buildings, EPBD (2010/31/EU) the regulation for the energy efficiency of the existing building stock were given in February 2013 and this Ministry of the Environment Decree (4/13) on improving the energy performance of buildings undergoing renovation or alteration came into force in June 2013. New requirements are under preparation for nearly zero energy buildings.

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

[14] (487/2007)

[15] (765/2007)

[16] (489/2007)

[17] (1129/2008)

[18] (488/2007)

[19] (2010/31/EU)

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. The implementation is in progress. A follow up assessment was made in 2015 and focal measures were defined for the further progress.

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 focused on five actions for the years 2013–2014 that continued into 2015.

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.

The emission impacts of building-related policy measures have been evaluated using EKOREM, POLIREM and REMA 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 tonnes CO_2/GWh) and with a mean marginal emission coefficient in the case of electricity (600 tonnes CO_2/GWh). In the REMA model 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.

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. The emission reductions due to improvements in energy performance in renovations and alterations will be 0.5 million tonnes CO_2 in 2020 and 1.0 million tonnes CO_2 in 2030 (CTF Table 3). 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. Most of the emission reduction will take place in the EU ETS sector through the reduced use of district heat and electricity. 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.

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.

Policies and measures in the WAM projection

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

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 end of the year 2014. 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 Ltd and Motiva Ltd based on, for example, the results of the LIPASTO calculation model (http://lipasto.vtt.fi/), which is the model used to estimate emissions from the transport sector for the GHG inventory.

Promoting the use of biofuels

The national act on promotion of the use of biofuels for transport[20] implementing the EU biofuels directive[21] has been in force since 2008. Under the act, the annual minimum share of biofuels, measured from the total energy content of gasoline, diesel and biofuels delivered for consumption shall be 6% in 2011–2014 and then gradually raise to 20 % in 2020. This includes so-called double-counted biofuels (biofuels produced from waste, residues, non-food cellulosic material and lingo-cellulosic material). Double-counted biofuels can be counted twice in the calculation of the shares of renewable energies in transport). Biofuels accepted within the scope of the distribution obligation have been proven to meet the sustainability criteria. Smaller shares (0 to 5%) of biofuels have been added to diesel and petrol since 2002. In the beginning of 2011, 95E10 petrol with 10% share of biofuel was introduced to the market and it replaced 95E5.

In 2013 and 2014, around 6% of all transport fuels used were biofuels. The measure achieved a 0.7 million tonnes CO_2 reduction in transport-related greenhouse gas emissions in 2013 and an estimated 1.1 million tonnes CO_2 reduction in 2014. There is no data on the emission reduction effects of the measure over its full life-cycle.

It is expected that biofuels will account for 20% of all fuels consumed in transport in 2020. This would consist of first-generation biofuels (5% of all transport fuels sold) and second-generation biofuels (7.5% of all transport fuels sold). Biofuels would, in other words, replace 12.5% of fossil fuels in transport in 2020, but as the contribution of second-generation biofuels is considered to be twice that made by other biofuels, the calculated share of all transport biofuels

[20] (446/2007)

[21] (2003/30/EC)

would be 20% when estimated in accordance with the EU biofuels directive. This means that the related actual emission reduction in the transport sector would be around 1.7 million tonnes CO_2 in 2020.

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 144.8 g CO_2/km, in 2012 at 139.7 g CO_2/km, in 2013 at 132.4 g CO_2/km and in 2014 at 128.2 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.

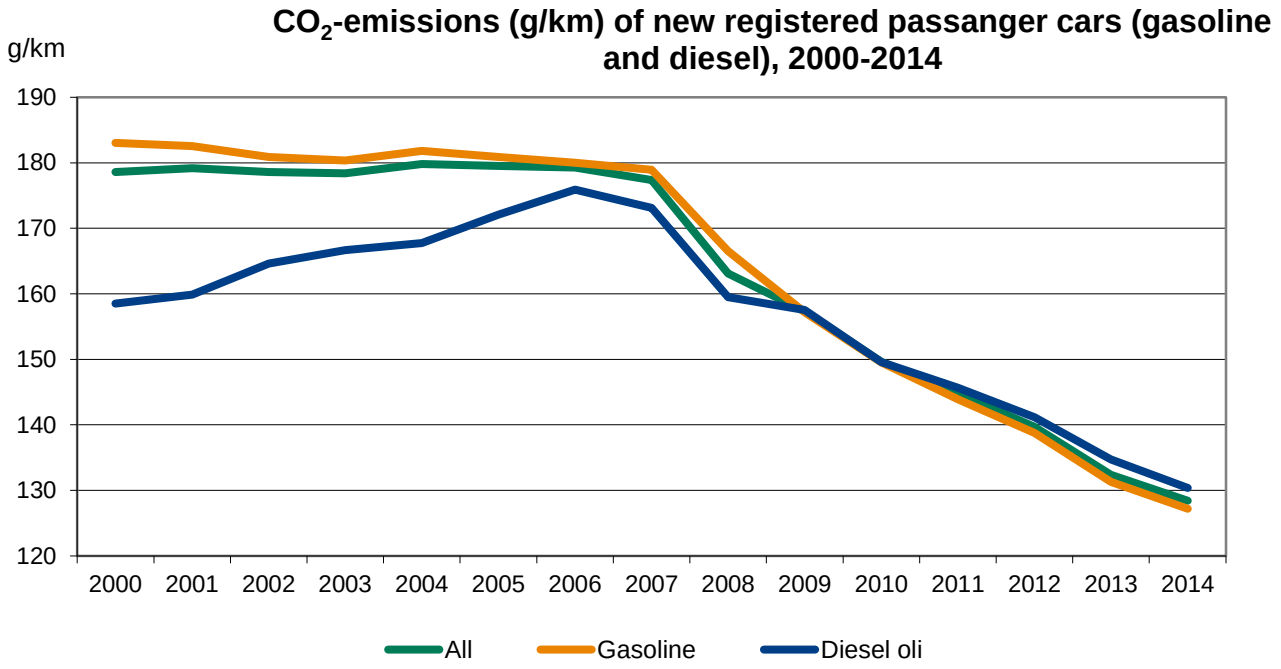
Car taxation was reformed in Finland in 2007 and in 2011. The tax on passenger vehicles was differentiated according to vehicle-specific emissions (g CO_2/km). The lowest tax rate (5 per cent) applies to cars with zero carbon dioxide emissions, while the highest tax rate (50 per cent) applies to cars with carbon dioxide emissions exceeding 360 g/km. The Vehicle Tax Act was also reformed in 2007, 2011 and 2015. 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 first two taxation reforms were beneficial to all low-emission cars, irrespective of the technology used. In the 2015 tax reform taxes of all vehicles were raised. Unfortunately also the tax of lower CO_2 emission passenger cars raised, and relatively more compared to high CO_2 emission vehicles. The basic part of the emission-based vehicle tax now varies between EUR 69.1 and 617.94 per year, depending on the car's specific carbon dioxide emissions.

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 enable potential car buyers to compare different car models based on fuel consumption and CO_2 emissions. (Address to the website: http://ekoake.autoalanverkkopalvelu.fi/?lang=en)

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 0.6 million CO_2 eq tonnes in 2020. According to Finland's First Biennial Report (2013) the estimation was as much as 2.1 million tonnes but since then the calculation methods have been checked, and therefore the new number is more accurate.

During the period 2000–2014, the average CO_2 emissions of new cars de-creased by some 28 per cent. The average CO_2 emissions in December 2014 were 127.2 g/km for new gasoline-driven passenger cars and 130.4 g/km for diesel-driven passenger cars (see Figure 4.2). A total of some 106,000 new cars were sold in 2014 (the goal was 150,000). The emission reduction effects of new low-emission cars were estimated at approximately 0.25 million tonnes CO_2 in 2014.

Figure 4.2 CO_2 emissions (g/km) of new registered cars (gasoline and diesel), 1993–2014)



In July 2012, the European Commission made a proposal to define modalities for reaching the 2020 target to reduce CO_2 emissions from light commercial vehicles, including vans. The proposal was adopted in March 2014. The adopted proposal transforms the target of 147 g/km set in Regulation No 510/2011 into an emission limit that is binding for manufacturers. Due to the new CO_2 target for new vans, the annual emission reduction for vans is estimated to be 0.027 million tonnes CO_2 eq in 2015, and 0.065 million tonnes CO_2 eq in 2020.

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 the other 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. The number of enterprises joined to the energy efficiency agreements has not increased as much as hoped for, but the energy efficiency of enterprises in the sector of transport and logistics has improved by training in eco-driving. 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 emphasizes 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 truck and bus drivers the annual CO_2 emission reduction of training in eco driving is estimated at 0.087 million tonnes by 2020 (for truck drivers 0.073 million tonnes, and for bus drivers 0.14 million tonnes).

The training in eco driving for private drivers have been included in basic driver training since 1994 and in the revised two-stage training since 1997. It is estimated that by eco driving the consumption of fuel can be reduced 8–20 per cent. It is estimated that the annual CO_2 emission reductions for private drivers will be 0.072 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.(MAL meaning Letters of intent for land use, traffic and housing. MAL letters of intent are agreements made by the state with city regions. MAL letters of intent support co-operation between the municipalities in the city regions and the state, with regard to controlling social structure as well as fitting together land use, housing and traffic especially in expanding centres.) 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.

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 (year 2011) 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.

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

Policies and measures in the WAM projection

The WAM projection does not include additional measures compared with the WM projection. In the National Climate and Energy Strategy some additional measures are presented: 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. These measures have not yet been realized.

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. These measures were implemented in the national legislation (Act 1113/2014) of Finland at the end of 2014. The impacts of these measures on the emissions of ships 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. Aviation ETS has been limited to intra-EEA

flights only for the period of 2013-2016. The aim of this limitation is to provide political support to negotiations of a global market-based measure to reduce aviation emissions, which is to be agreed at ICAO in 2016.

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. Anyway 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. 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 2 per cent of total emissions). Emissions from the use of HFC have increased 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)[22] and the EC directive relating to emissions from air-conditioning systems in motor vehicles (2006/40/EC)[23]. 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. After 2030 the emissions increase slightly due to increasing trend in the number of heat pumps and stationary air-conditioning equipment. 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. The emissions from these sources are expected to stay quite steady in the future. Emissions from refrigeration and air-conditioning equipment account for over 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

The WAM projection of F-gases is based on the assessed impacts of the new EC regulation on F-gases (517/2014) repealing the regulation 842/2006. The new regulation applies from 1 January 2015 and it strengthens further the existing measures. The key elements of the new regulation are based on a cap in 2015 and a phase down in the quantities of HFC's that can be placed on the EU market. The phase down reaches a 79% cut in 2030. In addition to limiting the sales of HFC's, a number of bans on the use of certain F-Gases in some new equipment have been introduced as well as a ban on the use of very high GWP HFC's for the servicing of certain types of refrigeration equipment.

It is estimated that the emission reduction achieved by these additional measures will be 0.04 million tonnes CO_2 eq. in 2020 compared to the WM projection. For other sources included under Industrial Processes the WM and WAM projections include the same policies and measures.

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 projection

The starting point of agriculture emission scenario is that domestic food production will be secured and maintained at the current level and mitigation policies are implemented where the most cost-efficient reduction potential exists. If food consumption habits remain as they are today, reduction in domestic agricultural production would not create a net reduction of emissions since it would only lead to increased food imports. In 2013, emissions in the Agriculture sector were 6.3 million tonnes CO_2 eq., roughly 10% of Finland's total emissions. Agriculture is the 2nd largest greenhouse gas emission source sector after the energy sector. Emissions in the sector are divided between nitrous oxide released from soils (53% of the total), methane from enteric fermentation (33%) and methane and nitrous oxide from manure management (12%). Agricultural energy and land use emissions are reported in their respective sectors. As a result of different factors described below, the emissions from agriculture have decreased by 15% over the period 1990-2013, mainly due to reduced use of mineral fertilizers and to some extent due to better manure management. In recent years the changes have been minimal.

The cultivated area, selection of crops and animal numbers are largely driven by the Common Agricultural Policy (CAP): Common rules for direct support schemes under CAP[24]. Though the aid is mainly decoupled from the production,

[22] (842/2006)

[23] (2006/40/EC)

[24] (EC(2009)73)

changes in agricultural policy and farming subsidies have had a significant influence on the economic structure of Finnish farms. The CAP has been renewed for the time period 2014-2020[25]. As from 2015 new environmental requirements are incorporated into the single payments under the Common Agricultural Policy of the EU. It was decided that 30 per cent of the direct payments are tied to the so-called greening measures. There are three greening measures that the farmers must implement in their eligible area. Greening measures are: crop diversification, maintenance of permanent grassland and ecological focus area.

The Rural Development Programme for Mainland Finland 2014-2020 was approved by the Commission in December 2014. The Programme includes several measures for climate change mitigation and adaptation: environment payment for injection of slurry, recycling of nutrients and organic matter, environment management of grassland, plant cover on arable land in winter and use of organic mulch for horticulture crops and seed potato to increase the amount of carbon in arable soil. Agricultural investment aid may be targeted to controlled subsurface drainage and more efficient handling, storage and use of manure. Whether there is enough funding available for the different purposes depends on the number of applications submitted. Implementation started in 2015.

Nitrates directive[26] is a part of cross-compliance which is implemented in whole Finland. The reduced use of nitrogen fertilisers and improved manure management resulting from the measures defined in the directive has decreased, not only nutrient losses to water systems, but also the greenhouse gas emissions. For example, the use of mineral fertilisers has decreased by 40% (based on sales statistics) between 1990-2013.

Policies and measures in the WAM projection

The Climate Programme for Finnish Agriculture ("Steps towards environmentally-friendly food"[27]) was finalized in November 2014. It aims to further enhance the sustainability of the Finnish food system, which is founded on profitable food production and responsible consumption. The objective is to improve the energy and material efficiency and reduce emissions per litre or kilo of production. The Programme presents a total of 76 measures to facilitate the adaptation of food production and consumption to climate change and/ or to mitigate the change.

Summary of policies and measures

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

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[28], the Waste Directive[29] and, most recently, the Waste Framework Directive[30]. The first Waste Tax Act[31] entered into force in 1996 for municipal landfills. The tax level per tonne of waste has increased from EUR

[25] (EC(2013)1305 and EC(2013)1307)

[26] (EEC(1991)676)

[27] http://mmm.fi/documents/1410837/1890227/Climate_programme_agriculture_WEB_03072015.pdf/

[28] (Directive 1999/31/EC)

[29] (Directive 2006/12/EC)

[30] (Directive 2008/98/EC)

[31] (495/1996)

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[32] 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[33] 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[34] 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, 2013).

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 and the revision of the Decree on landfills, 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

Currently there are no additional measures for the waste sector. A new national waste plan is under preparation and is expected to be ready by the end of 2016.

Further emission reductions in the waste sector are difficult to achieve after the drastic reduction of biowaste in landfills. Further waste-related reductions in emissions are achieved through the use of waste for energy production, but these measures fall under energy production, not the waste sector.

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:

[32] (1126/2010)

[33] (2000/532/EC)

[34] (646/2011)

- 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

The Government changed the structure of energy taxes on fuel for transport and heat and power plants on 1 January 2011. The taxation now takes account of the energy content, carbon dioxide emissions and local/particle emissions that have adverse health effects.

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 the liquid fuels, the energy content is based on the heating values (MJ/litre) used in Directive 2009/28/EC (latter RES-directive).

The CO_2 tax is based on the CO_2 emissions of the fuel in question. The weight of levies on carbon dioxide 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 evaluation of the CO_2 content of biofuels is based on their treatment in the RES-directive. A flat rate tax reduction of 50% is applied to all biofuels that meet the sustainability criteria of the RES Directive. The so-called second-generation biofuels, as defined in Art 21 (2) of RES-Directive (biomass originated from waste and residues), will be totally exempted from the CO_2 tax. The CO_2 tax does not apply to wood and other biomass (solid or gaseous) used in energy production.

Tax on natural gas has been increased gradually until 2015 when it reached the same tax level as other heating fuels like coal and light and heavy fuel oil. In addition, peat has been subject to a tax since 2011. The tax level for peat was raised gradually: It was 1.9 EUR/MWh in 2011 and 4.9 EUR/MWh in 2013 and 2014. In the beginning of 2015 it was lowered by 1.5 Euros into 3.4 EUR/MWh. The tax level for peat is lower than for other heating fuels.

Carbon dioxide levies for fossil fuels used in combined electricity and heat production are lowered by 50%. This was done to avoid overlapping carbon dioxide steering (taxation and ETS) and to improve the competitiveness in combined electricity and heat production relative to separate heat production.

The changes in the taxation of fuel for transport were made as neutrally as possible in terms of the yield. The tax difference between the tax levels of gasoline and diesel is taken into account by collecting tax on the basis of driving power applied to passenger cars and lorries.

A system of quality gradation has been introduced for transport fuels that create fewer local/particle emissions that are harmful to health than other fuels. In transport fuels, the quality gradation system will apply to second generation diesel. In the case of natural gas and biogas, the emission benefits to the local environment are taken into account in terms of a lower level of taxes on driving power.

Sulphur-free light fuel oil used in heating and machinery is taxed at a lower rate than fuel with sulphur. Lighter taxation of gasoline used in small utility engines, such as chain saws and lawnmowers, aims at reducing the harmful health effects of the exhaust emissions of small utility engines.

From the beginning of 2011 the electricity tax for industry (tax class II) has been raised from 0.263 c/kWh to 0.703 c/kWh. Tax subsidies for renewable electricity production were discontinued in January 2011.

Energy prices are market based, and consumer prices reflect the changes in market prices. The Government does not have any instruments to directly influence the price setting for energy products. However, through energy taxation advantages have been given to industry in the form of a lower electricity tax and a tax refund system for energy intensive industries. In addition, farmers are entitled to excise duty refunds for electricity and oil products used for agricultural purposes and the energy tax refunds for agriculture have been increased to offset the raise in taxation in agriculture.

The purpose of higher energy taxes and structural changes to the tax bases is to mitigate greenhouse gas emissions and enhance environmental integrity. The tax raises seek to encourage the saving of energy and to improve energy efficiency. The tax increases for fossil fuels and peat improve competitiveness and promote the use of renewable energy. The new tax structure is objective and neutral in technical terms. It fosters fuels and technological solutions that create lower emissions.

Table 4.3 Excise duty on fuels and electricity in Finland

		Product category	Energy content tax	Carbon dioxide tax	Strategic stockpile fee	Total
Motor gasoline	c/l	10	51.20	16.25	0.68	68.13
Small engine gasoline	c/l	11	31.20	16.25	0.68	48.13
Bioethanol	c/l	20	33.60	10.67	0.68	44.95
Bioethanol R	c/l	21	33.60	5.33	0.68	39.61
Bioethanol T	c/l	22	33.60	0.00	0.68	34.28
MTBE	c/l	23	41.60	13.21	0.68	55.49
MTBE R	c/l	24	41.60	11.75	0.68	54.03
MTBE T	c/l	25	41.60	10.30	0.68	52.58
TAME	c/l	26	44.80	14.22	0.68	59.70
TAME R	c/l	27	44.80	12.94	0.68	58.42
TAME T	c/l	28	44.80	11.66	0.68	57.14
ETBE	c/l	29	43.20	13.72	0.68	57.60
ETBE R	c/l	30	43.20	11.18	0.68	55.06
ETBE T	c/l	31	43.20	8.64	0.68	52.52
TAEE	c/l	32	46.40	14.73	0.68	61.81
TAEE R	c/l	33	46.40	12.59	0.68	59.67
TAEE T	c/l	34	46.40	10.46	0.68	57.54
Biogasoline	c/l	38	51.20	16.25	0.68	68.13
Biogasoline R	c/l	39	51.20	8.13	0.68	60.01
Biogasoline T	c/l	40	51.20	0.00	0.68	51.88
Ethanol-diesel	c/l	47	14.53	10.90	0.35	25.78

		Product category	Energy content tax	Carbon dioxide tax	Strategic stockpile fee	Total
Ethanol-diesel R	c/l	48	14.53	5.99	0.35	20.87
Ethanol-diesel T	c/l	49	14.53	1.07	0.35	15.95
Diesel oil	c/l	50	31.65	18.61	0.35	50.61
Diesel oil para	c/l	51	24.89	17.58	0.35	42.82
Biodiesel oil	c/l	52	29.01	17.06	0.35	46.42
Biodiesel oil R	c/l	53	29.01	8.53	0.35	37.89
Biodiesel oil T	c/l	54	29.01	0.00	0.35	29.36
Biodiesel oil P	c/l	55	24.89	17.58	0.35	42.82
Biodiesel oil P R	c/l	56	24.89	8.79	0.35	34.03
Biodiesel oil P T	c/l	57	24.89	0.00	0.35	25.24
Light fuel oil	c/l	60	9.30	11.74	0.35	21.39
Light fuel oil, sulphur-free	c/l	61	6.65	11.74	0.35	18.74
Biofuel oil	c/l	62	6.65	11.74	0.35	18.74
Biofuel oil R	c/l	63	6.65	5.87	0.35	12.87
Biofuel oil T	c/l	64	6.65	0.00	0.35	7.00
Heavy fuel oil	c/kg	71	7.59	14.25	0.28	22.12
Kerosene-type jet fuel	c/l	81	55.68	17.99	0.35	74.02
Aviation gasoline	c/l	91	50.72	16.10	0.68	67.50
Methanol	c/l	100	25.60	8.13	0.68	34.41
Methanol R	c/l	101	25.60	4.06	0.68	30.34
Methanol T	c/l	102	25.60	0.00	0.68	26.28

Table 4.4 Excise duty on fuels and electricity in Finland

Product	Product category	Energy content tax	Carbon dioxide tax	Strategic stockpile fee	Total
Coal, coal brickets, solid fuels produced from coal (EUR/t)	1	47.10	106.14	1.18	154.42
Natural gas (EUR/MWh)					
1.1.2011 – 31.12.2012	2	3.00	5.94	0.084	9.024
1.1.2013 – 31.12.2014	2	4.45	6.93	0.084	11.464
1.1.2015 –	2	6.65	8.71	0.084	15.444

Table 4.5 Excise duty on fuels and electricity in Finland

Product	Product category	Energy content tax	Strategic stockpile fee	Total
Electricity (c/kWh)				
-tax class I	1	2.24	0.013	2.253
-tax class II	2	0.69	0.013	0.703
Tall oil (c/kg)	3	22.12	0	22.12
Fuel peat (EUR/MWh)				
1.1.2011 – 31.12.2012	4	1.90	0	1.90
1.1.2013 – 31.12.2014	4	4.90	0	4.90
1.1.2015 –	4	3.40	0	3.40

Table 4.6 Energy content and CO_2 emission values for different fuels

	Lower heating value	CO_2 emissions, g/MJ
Gasoline	32 MJ/l	72.9
Bio ethanol	21 MJ/l	(72.9)
Diesel	36 MJ/l	73.6
Bio diesel	33 MJ/l	(73.6)
Gas oil	42.7 MJ/kg	74.1
Heavy fuel oil	41.1 MJ/kg	78.8
Coal	25.5 MJ/kg	94.6
Natural gas	50 MJ/kg	55.0
Peat	10.1 MJ/kg	105.9

It should be noted that the emission factors presented in Table 4.6 are used in taxation and may to some extent differ from the emission factors used in actual emission calculations.

Use of Kyoto mechanisms

In the EU emissions trading scheme, companies may use emission units (CERs and ERUs) from projects reducing emissions in other countries (so-called project mechanisms) to meet their emission reduction obligations. Finland can also use CERs and ERUs in a limited way (see Section 3.1) to meet its emission reduction requirements under the EU Effort Sharing Decision. The State 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 limitation and reduction commitments.

The Act on the use of the Kyoto mechanisms (109/2007) lays out the administrative framework that enables both the State and others to participate in project activities in accordance with the Kyoto mechanisms and in emissions trading pursuant to the Kyoto Protocol, and the acquisition of the Kyoto emission units with these mechanisms. The act came into force on 12 February 2007. The rights and obligations of the operators concerning the use of CERs and ERUs deriving from the Linking Directive (2004/101/EC) have been implemented in connection with amendments to the Emissions Trading Act (108/2007). The Act on the use of the Kyoto mechanisms also stipulates that the emission trading registry already established by the Emissions Trading Act acts as a national registry which keeps a record of the emission units as required by the implementation of the Kyoto Protocol.

The Ministry of Employment and the Economy is responsible for the coordination of the mechanisms policy, legislation and budgetary appropriations for the purchase programme. The Ministry of the Environment is the holder of the national account of emission units and responsible for JI operations and international emissions trading. The Ministry for Foreign Affairs is responsible for CDM operations. The national registry and its activities pertain to the Emissions Market Authority, which is part of the result-orientated management of the Ministry of Employment and the Economy.

The strategy of the purchase programme for the Kyoto Protocol`s first commitment period (2008-2012) was updated in the end of 2007. It was approved by the Ministerial working group on Climate and Energy Policy in February 2008. The State purchase programme for Kyoto Protocol`s second commitment period (2013-2020) was approved in November 2008 by the same ministerial working group. The overall budget for the procurement of project units from the Kyoto mechanisms for both first and second commitment period is approximately 70 million Euros. Approximately 20 million Euros were invested already in CDM/JI pilot programme, which operated from 1999 until early 2006. The rest have been allocated in years 2005-2012.

Finland committed about 12.2 million Euros through 10 bilateral projects for the purchase of project units during the first commitment period of the Kyoto Protocol. Two of these projects will continue in second commitment period. Beside these bilateral projects, Finland invested in multilateral funds. These funds were: World Bank's Prototype Carbon Fund (PCF), Nordic Environmental Financing Corporation's (NEFCO) Testing Ground Facility (TGF), European Bank for Reconstruction and Development's Multilateral Carbon Credit Fund (MCCF), Asian Development Bank's Asia Pacific Carbon Fund, Nordic Environment Finance Corporations NEFCO Carbon Fund and Asian Development Bank's Future Carbon Fund.

No decision on the use of Kyoto mechanisms for compliance purposes in the second commitment period of the Kyoto Protocol has been made. Finland's Kyoto mechanism purchase program covers the period 2006-2020. In the first Kyoto commitment period Finland procured approximately 6 million tonnes CO_2 eq of project units. These will be carried over to the second commitment period. The Kyoto mechanisms purchase program will continue to deliver project units during second commitment period through existing investments in carbon funds and two bilateral CDM projects. These are expected to deliver about 4 million tonnes CO_2 eq of project units during the second commitment period.

The use of the Kyoto mechanisms is supplementary to domestic actions for cutting greenhouse gas emissions

Effect of policies and measures on longer term trends

In the summer of 2013, the Finnish government set a parliamentary committee to prepare an energy and climate roadmap towards 2050. The Committee had two representatives from all political parties represented in Parliament, and it published its report, i.e. Energy and Climate Roadmap 2050, in October 2014. The roadmap serves as a strategic-level guide and studies the alternative options and key questions. The committee also gave their comments to influence future policy, and the comments are significant as they represent a political consensus (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

Finland's Energy and Climate Roadmap 2050 serves as a strategic-level guide and gives the comments of the Parliamentary Committee on Energy and Climate Issues to influence future policy. For example, some of the key messages have been summarized below:

"Concerted efforts must be made to reduce greenhouse gases in all sectors despite some sectors or areas of industry having lesser or greater potential to produce these emissions. For example, in order to meet the targets set for reducing emissions, the energy system must be changed virtually emission-free by 2050; however, many industrial emissions can only be significantly reduced if carbon capture and storage (CCS) technology can be effectively commercialised. In working towards the goal of reducing greenhouse gases by 80-95%, Finland must in any case increase the use of renewable energy sources - particularly domestic bioenergy - and capitalise on the potential of increasing energy efficiency and developing cleantech solutions in all areas of industry. Finland must also work hard to ensure adequate energy self-sufficiency and security of supply. Moreover, the Finnish state and its municipalities must comprehensively commit to reducing carbon emissions in all activities.

When striving to mitigate climate change it is important that all parties limit their emissions. Finland must take an active role in various fora towards negotiating and agreeing upon an effective international commitment to tackling climate-related issues. Such involvement can further level the global playing field and help preserve the key position of energy-intensive industry within the Finnish economy. Consequently, export opportunities for Finnish cleantech enterprises would also be increased."

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.

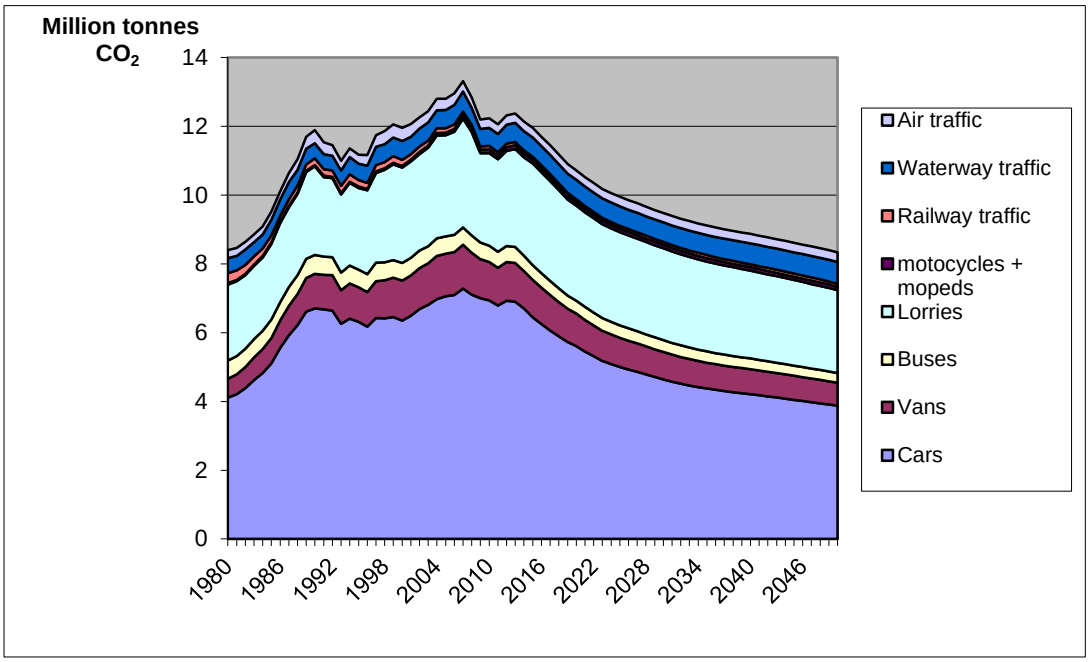
Investments in the energy infrastructure have long lifetimes. Therefore, measures that promote investments in renewable energy and improve the competitiveness of renewable energy sources will reduce greenhouse gas emissions in the longer term. This applies also to measures that would in principal contribute 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 greenhouse gas emissions within the transport sector were studied. The first phase of the project produced a baseline scenario for CO_2 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 4.3, 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 greenhouse gas emission reductions, and which, in contrast, will have only marginal impacts in the longer term.

Figure 4.3 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 6th National Communication and First Biennial Report.

After the Parliamentary elections in 2015 the Finnish Government has been newly appointed. There have been some changes in the composition of ministerial working groups, as well. The preparations for a new strategy on energy and climate policy are taking place, headed by the Ministry of the Employment and the Economy. The implementation of

the Climate Change Act starts with the preparations for a Medium-term plan for climate change policy. This work will be coordinated by the Ministry of the Environment.

The national inventory system of Finland is described in Chapter II. The National System was established 1.1.2005 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 new Monitoring Mechanism Regulation (MMR, Regulation (EU) 525/2013 and Commission Implementing Regulation (EU) No 749/2014. 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.

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

All 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.

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 or CTF table 4(a)II.

There are currently no decisions on the use of market-based mechanisms under the Convention.

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. The data on the non-ETS emissions in 2013 and preliminary data for 2014 indicate that this will be case for these years. However, this will be confirmed only after the review of the inventory submissions in 2015 and 2016.

5 Projections

5.1 Overview of WM and WAM projections

The projections presented here and in the other reporting tools are based on the National Energy and Climate Strategy (2013) and its scenarios, although in several cases assumptions have been updated or extended. The emissions in the inventory year 2012 as submitted to the UNFCCC on 15.4.2014 was used as a starting point for the projections. In this report, the historical data has been updated to correspond to the 2015 inventory submission. However, the impact of the changes in the inventory estimates to the projected emissions has not been updated for all projected emissions.

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) include additional measures in the sectors of agriculture and for F-gases. In the energy sector, transport sector, industrial processes (excl. F gases), LULUCF and waste sector, the WAM projection does currently not include any additional emission reductions compared to the WM projection, and therefore, the two projections are identical for these sectors.

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 1.2 per cent in the period 2012 - 2020 and slightly higher, 1.7 per cent, in the 2020s. The Finnish economy is experiencing a structural change, where the outlook of energy intensive industries in particular differs from the past.

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

It is assumed that Finland's fifth nuclear power plant unit will be completed in late 2018 One additional nuclear power plant unit will be operational during the 2020s. Finland is currently heavily dependent on electricity imports. One of the aims of the Government is to improve the self-sufficiency in terms of the nation's electricity supply. In the projections, it is assumed that the electricity net imports will decrease significantly from its current level. The development of the primary energy supply in the WM projection is shown in Figure 5.1.

Figure 5.1 Historical development (1990-2014) and WM projection (up to 2030) of the primary energy supply

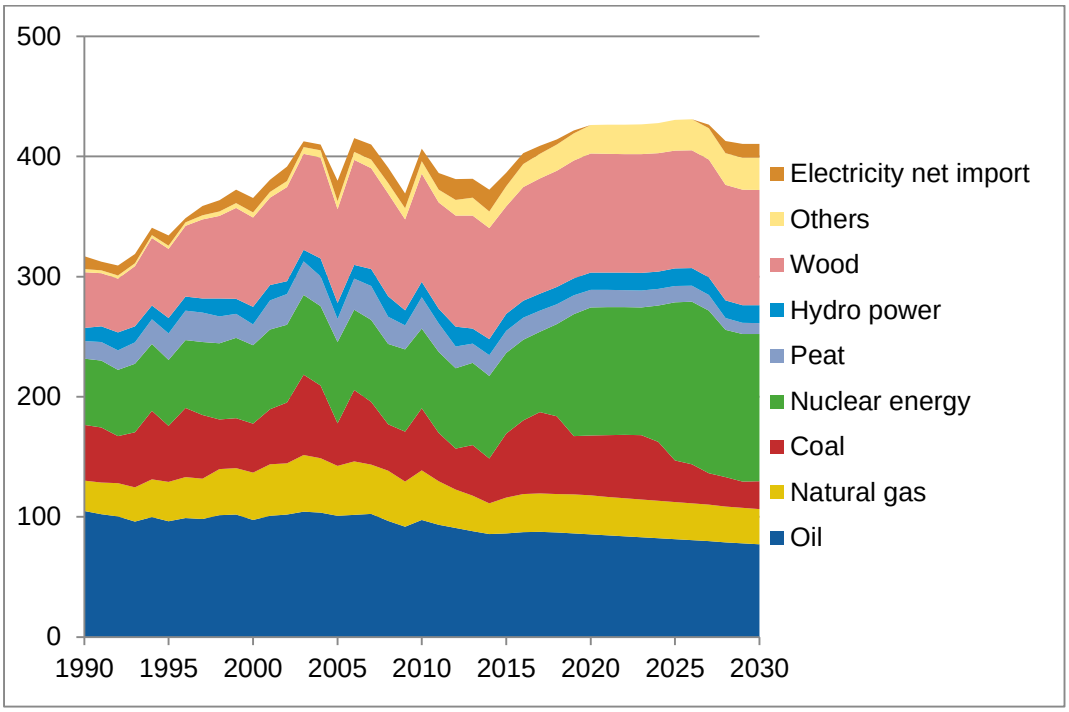


Table 5.1 shows a summary of the main assumptions of the WM projection for 2020–2020. Numerical values for key variables and assumptions are presented in CTF Table 5. The assumptions regarding international fuel prices on the world market are consistent with the latest estimates of the International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

Table 5.1 Assumptions of the WM projection

Parameter	Trend 2020–2030
GDP growth	1.7 per cent annually
Structure of the economy	Increasing share of services
Structure of industry	Less capital and energy intensive
Population growth	Increasing slowly, 0.4 per cent annually
Population structure	Ageing
Technology development	Gradual introduction of improved and more efficient technology

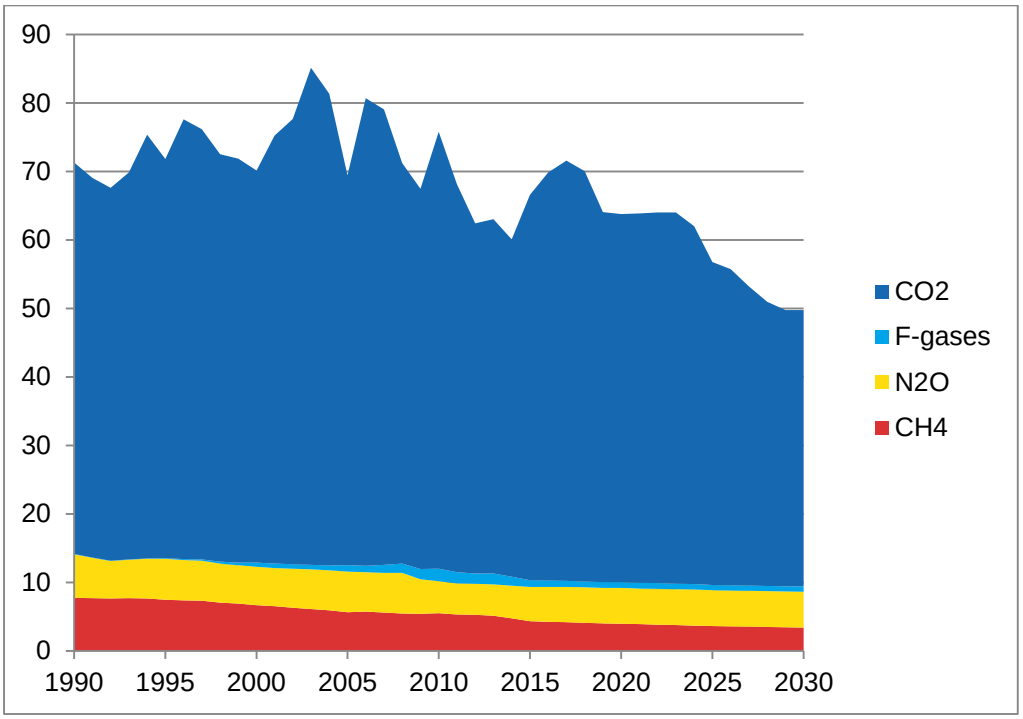
5.2 'With Measures' projection

Total effects

Total emissions in the WM projection for the years 1990–2030 are shown in Figure 5.2 Compared with the base year of 1990, the total greenhouse gas emissions are expected to be 10 per cent lower in 2020 and 30 per cent lower in 2030. Correspondingly, the CO_2 emissions are projected to be 6 per cent lower in 2020 and 29 per cent lower in 2030. CH_4 emissions are expected to continue to decline steadily, whereas N_2O emissions are projected to remain at current levels,

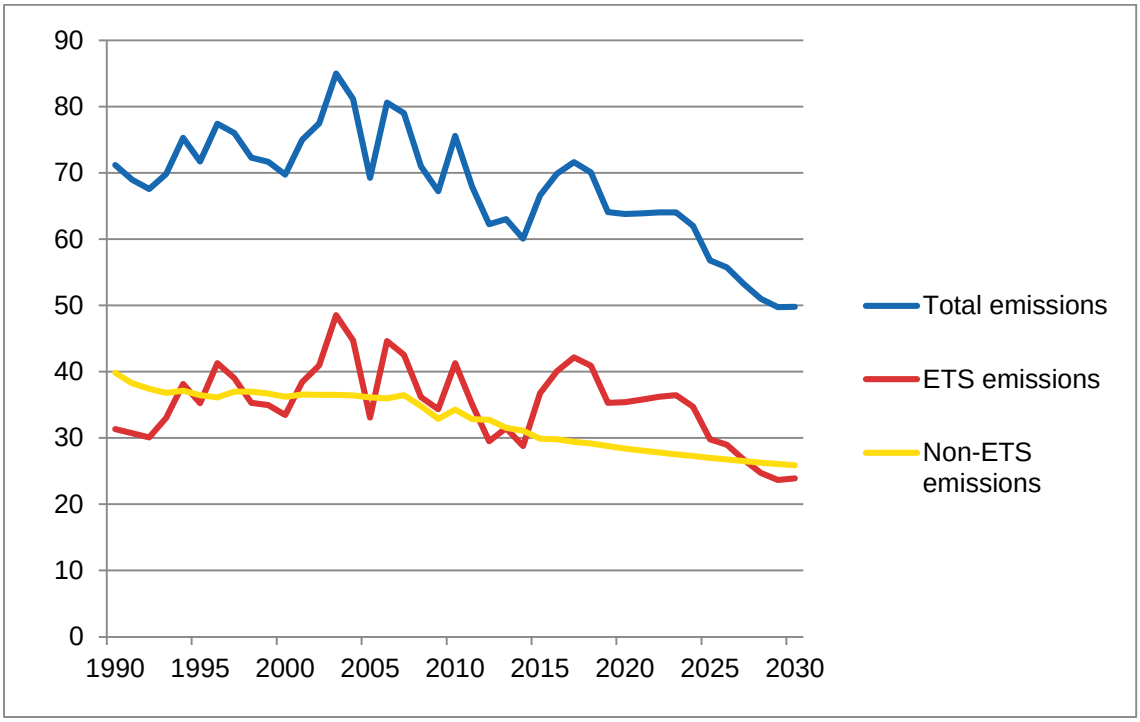
which is one fifth lower than in 1990. Numerical information on sector specific GHG emissions and emissions per gas in the WM projection is presented in CTF Table 6(a).

Figure 5.2 Greenhouse gas emissions by gas according to the latest greenhouse gas emission inventory (1990-2013) and the WM projection (up to 2030)



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 2013, emissions in the EU ETS sector equalled the emissions in the non-ETS sector, both being 50 per cent of the total GHG emissions. The split is expected to remain roughly the same during the current decade. In the WM projection, a new nuclear power unit will reduce the EU ETS emissions by the mid 2020s.

Figure 5.3 Greenhouse gas emissions according to the latest greenhouse gas emission inventory (1990-2013) and the WM projection (up to 2030) in the EU ETS and non-ETS sectors



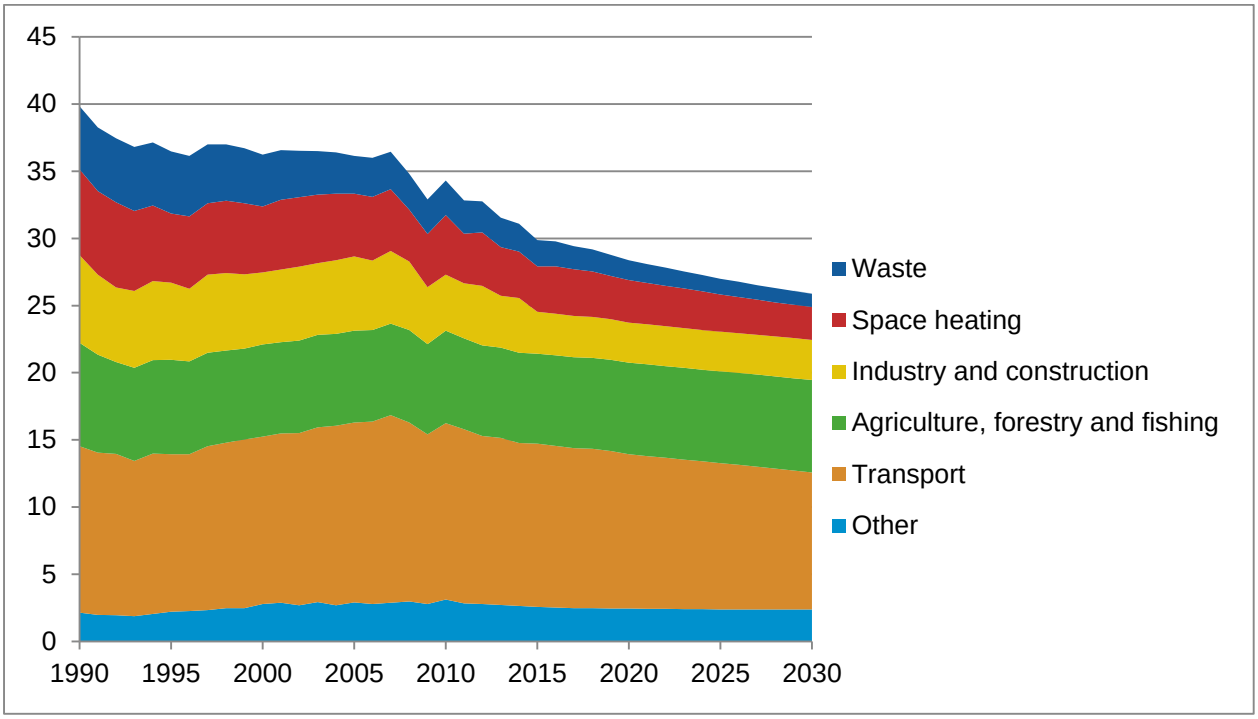
The development of total emissions with regard to the number of inhabitants, primary energy use and economic development is presented in Table 5.2.

Table 5.2 Greenhouse gas emission intensity based on the latest greenhouse gas inventory for 2010 and 2013 and the WM projection for 2020 and 2030

	2010	2013	2020	2030
Emissions per capita, tonnes CO_2 eq. /capita	14.1	11.6	11.3	8.5
Emissions per GDP, kg CO_2 eq./EUR	0.55	0.46	0.42	0.28
Emissions per primary energy, tonnes CO_2 eq./MWh	0.19	0.17	0.15	0.12

The emissions from the non-ETS sector have steadily decreased since 1990, and the decrease is expected to continue (Figure 5.4). According to the WM projection, the emissions from the non-ETS sector in the year 2020 will be 21 per cent below the 2005 level, which is sufficient for reaching the target set by the EU Climate and Energy Package.

Figure 5.4 Emissions in the non-ETS sector by category (1990–2013) based on the latest greenhouse gas inventory and the WM projection (up to 2030)



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 and heat production will be introduced by the start-up of the nuclear power plant unit currently under construction in 2018, one more unit 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.

Factors affecting the future energy demand are first of all energy efficiency measures, but also structural changes within the industry. The emissions from space heating are decreasing 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.

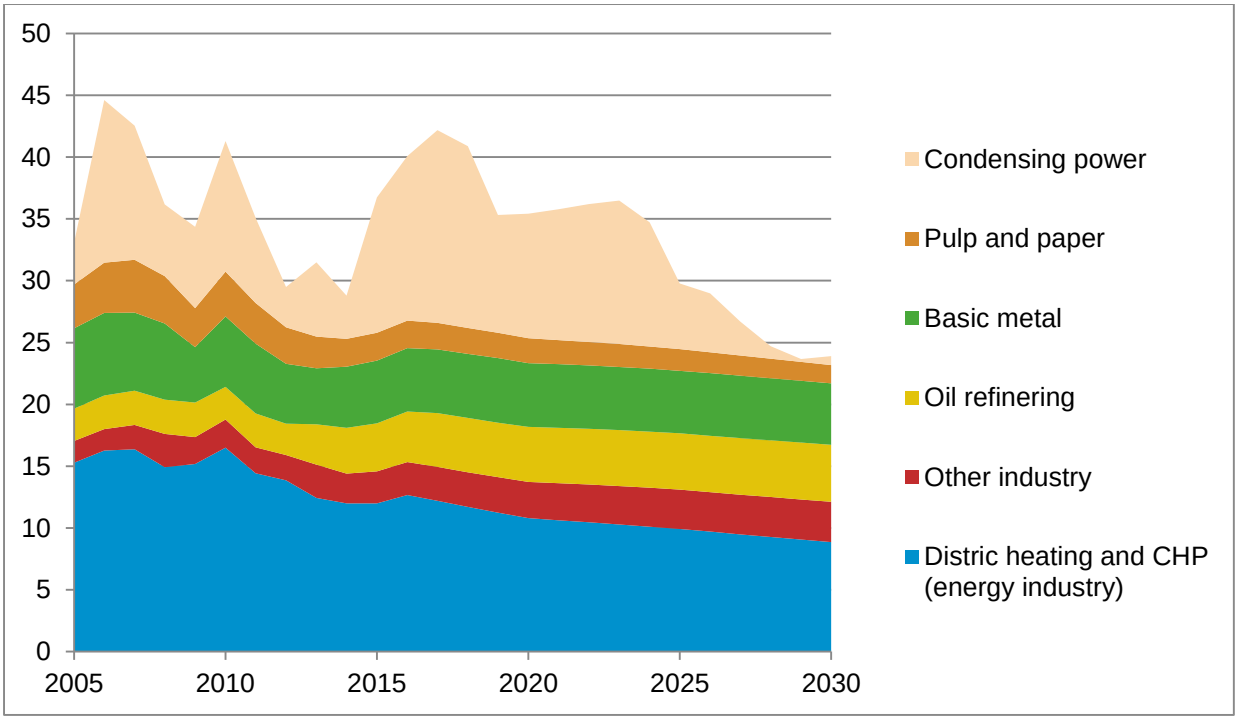
Table 5.3 Historical (1990-2013) and projected (up to 2030) greenhouse gas emissions from the energy sector (excluding transport) based on the latest inventory and the WM projection, respectively

	Historical								WM Projection	
	1990	1995	2000	2005	2010	2011	2012	2013	2020	2030
Total emissions, million tonnes CO_2 eq.	41.5	44.0	41.8	40.7	47.4	40.4	35.4	36.3	38.4	25.9
CO_2	40.8	43.3	41.0	39.8	46.3	39.5	34.5	35.4	37.2	24.8
CH_4	0.3	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4
N_2O	0.4	0.4	0.5	0.5	0.6	0.5	0.5	0.5	0.8*	0.7*

* Due to the changes in the level of the historical emissions between the 2014 and 2015, the N_2O emissions in the WM projection are likely overestimated

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 1990–2030.

Figure 5.5 CO_2 emissions in the EU ETS sector according to the greenhouse gas inventory (1990–2013) and the WM projection (up to 2030)



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.

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 2015.

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 (1990-2013) and projected (2020-2030) 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	2012	2013	2020	2030
Total emissions, million tonnes CO_2 eq	12.1	11.3	12.1	12.9	12.7	12.5	12.2	12.1	11.7	10.5
CO_2	11.8	11.1	11.9	12.8	12.6	12.4	12.1	12.0	11.6	10.3
CH_4	0.1	0.1	0.1	0.04	0.03	0.03	0.02	0.02	0.03	0.03
N_2O	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

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 manufacture 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 concerning 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 due to these measures and technical changes that will lead to smaller charges and decreased leakage. After 2030 the emissions increase slightly due to increasing trend in the number of heat pumps and stationary air-conditioning equipment. 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. The emissions from these sources are expected to stay quite steady in the future. Emissions from refrigeration and air-

conditioning equipment account for over 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 (1990-2013) 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	2012	2013	2020	2030
Total emissions, million tonnes CO_2 eq.	5.4	4.9	5.8	6.6	6.6	6.3	6.0	6.0	5.9	6.1
CO_2	3.7	3.4	3.9	4.1	4.6	4.5	4.3	4.1	4.8	5.1
CH_4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N_2O	1.7	1.5	1.4	1.6	0.2	0.2	0.2	0.2	0.2	0.3
F-gases	0.1	0.1	0.6	0.9	1.8	1.6	1.5	1.6	0.8	0.8

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 15 per cent lower in 2020 than in 1990 (Table 5.6). However, the largest decrease in the emissions has occurred between 1990 and 2000. Between 2013 and 2020, the CH_4 emissions are projected to decrease by 14 per cent and N_2O emissions to increase by 10 per cent. Energy-related emissions are reported in the energy sector and not included in the table.

Table 5.6 Historical (1990-2013) and projected (2020-2030) 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	2012	2013	2020	2030
Total emissions, million tonnes CO_2 eq.	7.5	6.8	6.4	6.4	6.5	6.4	6.3	6.3	6.3	6.4
CO_2	0.6	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
CH_4	2.8	2.5	2.5	2.5	2.6	2.5	2.5	2.5	2.2	2.1
N_2O	4.0	3.7	3.6	3.6	3.7	3.6	3.6	3.6	4.0	4.1

LULUCF

The biggest sink category in the LULUCF sector is forest land, 26.4 million tonnes CO_2 eq in 2013. According to the National Forest Inventory (NFI) the annual increment of growing stock has been increasing since 1970's reaching its

current level of 104 million cubic metres, of which 97 million cubic metres is in commercially managed forests. The high fluctuation in net biomass removals in the forest land category during the period 1990-2013 was mainly caused by the changes in the international market of forest industry products, which affected the amount of domestic commercial roundwood fellings. The impact of harvested wood products varies annually. The definition of forest used in national scenarios differs slightly from the FAO definition used in greenhouse gas inventory. Using the national definition, i.e. the 10th National Forest Inventory, Finland has 20 million hectares of productive forest land, while according to the FAO definition the figure is 22 million hectares.

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), which is also supported by other projections estimated by the Natural Resources Institute (Luke). It is estimated that the carbon sink of forests (incl. trees and soil) will remain at a level of at least 10-20 million tonnes CO_2 eq per year by 2015, if the logging increases by 10-15 million cubic metres a year as is targeted.

National Forest Strategy (NFS) 2025[35] was approved by the Government in February 2015. NFS sets the targets for sustainable forest management and the use of timber. NFS also contains sets of necessary actions to achieve the targets. The impact NFS on greenhouse gas emissions has not been included in the WM projection. Estimated decrease of the forest sink is largely due to anticipated increase in demand for wood based energy and products.

Table 5.7 Historical (1990-2013) and projected (2020-2030) 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	2012	2013	2020	2030
Total emissions and removals, million tonnes CO_2 eq.	-15.8	-15.5	-24.5	-29.6	-26.7	-26.2	-27.9	-20.4	---*	---*
CO_2	-18.6	-18.2	-27.2	-32.1	-28.9	-28.4	-30.1	-22.6	-10.1	-6.4
CH_4	1.5	1.5	1.4	1.2	1.0	0.9	0.9	0.9	---*	---*
N_2O	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	---*	---*

* WM projections do not include CH_4 and N_2O emissions as they are reported for the first time in the inventory submitted in 2015. Exported harvested wood products (HWP) are included in the historical changes in carbon storage as recommended by the new reporting guidelines but are not yet included in the projections.

Waste

Greenhouse gas emission projections for the waste sector include CH_4 from landfills, CH_4 and N_2O emissions from biological treatment of waste 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.

[35] http://mmm.fi/en/forests/strategies-and-programmes/national-forest-strategy

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 0.1 million tonnes CO_2 eq. in 2013 and are not expected to change much over time.

Table 5.8 Historical (1990-2013) and projected (2020-2030) 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	2012	2013	2020	2030
Total emissions, million tonnes CO_2 eq.	4.7	4.6	3.9	2.9	2.6	2.5	2.5	2.3	1.5	1.0
CH_4	4.6	4.5	3.7	2.7	2.5	2.4	2.3	2.2	1.4	0.9
N_2O	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

International bunkers

According to the most recent greenhouse gas emission inventory, the fuel consumption for international aviation was about 26,629 TJ and for international marine transportation 4,825 TJ in 2013. 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 and using the emissions in 2013 as the basis, the total greenhouse gas emissions from bunker fuels are projected to be 2.9 million tonnes CO_2 eq. in 2020 (0.4 million tonnes from marine and 2.5 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

In the energy including transport, industrial processes and product use (excluding F gases), LULUCF and waste sector, the WAM projection does currently not include any additional emission reductions compared to the WM projection, and therefore, the two projections are identical for these sectors.

The WAM projection of F-gases is based on the assessed impacts of the new EC regulation on F-gases (517/2014) repealing the regulation 842/2006. The new regulation strengthens the existing measures and will lead to additional emission reductions. Key drivers behind the emission reductions are a phase down of HFC's that can be placed on the EU market and some additional bans on the use of HFC's in certain applications. It is estimated that the emission reductions achieved by these additional measures will be 0.04 million tonnes CO_2 eq. in 2020 compared to the WM projection.

In Agriculture WAM projection includes The Climate Programme for Agriculture ("Steps towards environmentally-friendly food") which was finalized in November 2014. It aims to further enhance the sustainability of the Finnish food system, which is founded on profitable food production and responsible consumption. The objective is to improve the energy and material efficiency and reduce emissions per litre or kilo of production. The Programme presents a total of 76 measures to facilitate the adaptation of food production and consumption to climate change and/ or to mitigate the change. It is estimated that these additional measures reduce emissions with 0.14 million tonnes CO_2 eq. in 2020 and with 0.16 million tonnes CO_2 eq. in 2030.

Emissions in the agriculture sector according to the WAM projection in million tonnes CO_2 eq are presented in Table 5.9.

Table 5.9 Historical (2013) and projected (2020-2030) greenhouse gas emissions from the agriculture sector based on the latest greenhouse gas inventory and the WAM projection, respectively

	Historical	Projected		
	2013	2020	2025	2030
Total emissions, million tonnes CO_2 eq.	6.3	6.2	6.2	6.2
CO_2	0.2	0.2	0.2	0.2
CH_4	2.5	2.1	2.1	2.0
N_2O	3.6	3.9	3.9	4.0

The total greenhouse gas emissions are estimated to be 63.6 million tonnes CO_2 eq. in 2020 and 49.3 million tonnes CO_2 eq. in 2030 in the WAM projection. Corresponding values in the WM projection are 63.8 and 49.8, respectively.

5.4 Total effect of policies and measures

The total effect of policies and measures (PaMs) is illustrated with the aggregated estimates for the greenhouse gas reduction impacts of individual policies and measures presented in Chapter 4. For 2015 and 2020, the total effect is 16 and 37 million tonnes CO_2 eq. (without LULUCF), respectively. However, the total effect of policies and measures contains uncertainties. 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.

5.5 Economic impacts

No economic impact assessment has been carried out for the WEM or WAM scenarios of this reporting. In May 2014, however, VTT Technical Research Centre of Finland and the Government Institute for Economic Research (VATT) completed a study assessing the impact of the EU's 2030 Climate and Energy Framework on Finland's energy system and national economy.

As a starting point to that study, the EU's reduction goal for the greenhouse gas emissions under the ESD sector is 30 % from the 2005 level in accordance with the European Commission's proposal in January 2014. In the study, calculations were made using three different scenarios, where Finland's emission reduction goal at the ESD sector was 32, 36 or 40 %. The impact of the EU's 2030 Climate and Energy Framework on Finland's national economy was assessed using the VATTAGE model for the macro economy developed by the Government Institute for Economic Research (VATT), taking into account the results of the of the energy system modelling made by VTT.

In the VATTAGE model, capital is sector-specific and it therefore takes time for an industry to adjust to the increased energy costs caused by emission trading and increased energy taxes. In energy-intensive industries the rise of energy costs lowers the rental 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 of costs if they can substitute renewable energy for fossil fuels.

According to VATT, the impact of the action package appears to remain moderate with regard to the national economy, if the goals set for Finland can be achieved primarily through the increased use of biofuels. The calculations were based on the biofuels used being produced from domestic wood based raw materials. The assumption was that biorefineries would increase Finland's refinery capacity, which would open up possibilities for an increase in the export of refined petroleum products.

The proposed climate policy would increase pressure for an EU-level price increase, and it would reduce the purchasing power of households. In the different scenarios, the purchasing power of households in Finland would be reduced by around 0.3 to 1 per cent, and the trade balance would shrink by a couple of hundred million euros. Furthermore, employment would decline by 0.1 to 0.4 per cent, depending on the development of real wages and the assumed emissions goals, and the Finnish GDP would be reduced by around 0.7 per cent at most. However, there are still uncertainties in the estimates.

More information on the study and its results is available in press release (in English) and final report (in Finnish) at

http://www.vttresearch.com/media/news/increase-in-the-use-of-biofuels-the-most-cost-effective-way-for-finland-to-achieve-the-goals-of-the-eus-2030-climate-and-energy-package

5.6 Sensitivity analysis of the projections

In 2012, the Finnish industry used 45 % of the country's final energy and 46 % of 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 carried out on how the changes in energy intensive industries' growth rates affect the overall energy balance and emissions in Finland. The studied industries comprise of pulp and paper production and iron and steel production.

The sensitivity analysis compares the with existing measures projection (WM) with two scenarios, where the annual growth rates of pulp & paper and iron & steel production are 1 percentage points higher and lower than in the WM scenario (scenarios WM+ and WM-, respectively) from year 2014 onwards. The main results for the sensitivity analysis are presented in Table 5.10.

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

	2012	2020			2030		
	Statistics	WM	WM +	WM -	WM	WM +	WM -
Pulp and paper production (base year 2012 = 1,00)	1.00	1.05	1.13	0.98	1.10	1.31	0.93
Iron and steel production (base year 2012 = 1,00)	1.00	1.20	1.27	1.13	1.22	1.43	1.04
Primary energy consumption, TWh	381	426	436	417	411	436	393
Final energy consumption, TWh	306	315	322	309	309	326	295
Electricity consumption, TWh	85	93	95	91	98	103	94
Share of renewables in final energy consumption, %	35	41	42	41	42	44	41
Greenhouse gas emissions, million tonnes CO_2 eq.	62	63	65	62	53	53	47

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

5.8 Methodology

Approach and responsibilities

The WM and WAM projections are strongly based on the National Energy and Climate Strategy (2013) and its scenarios, although in many cases assumptions have been updated or extended. 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.

At an early stage of preparing the Energy and Climate Strategy, a common framework was determined for the baseline scenario. The framework was determined in a collaborative manner between the relevant ministries and was approved by the ministerial working group on energy and climate policy. The framework comprised several parameters related to economic growth, population growth, international climate policy, and price of energy. The framework also included assumptions on the future use of different sources of energy and waste treatment, among others things.

All ministries used the common framework while contributing to the Strategy and its baseline scenario. Furthermore, under the coordination of Ministry of Employment and the Economy, interrelated assumptions were discussed and decided between the relevant ministries and government agencies. The common framework as well as sector-specific key assumptions and policy measures are described in the background report to the National Energy and Climate Strategy (in Finnish). 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 both for the Strategy and WM and WAM by various experts at the ministries and contracted expert organisations. In the cases where WM and WAM projections required extending or updating assumptions affecting several sectors, the ministries or expert organisations agreed on these together. Sector-specific assumptions that were not available in the above mentioned sources are selected based on the expertise of the ministries or expert organisations and rely on other relevant strategies, plans and research reports as much as possible. The main models and methods used in the work are briefly described in Annex 1.

Regarding the specific sectors, the responsibilities were as follows:

- the Ministry of Employment and the Economy: energy use of industry, services and households, industrial processes, over-all energy consumption and production. (Material covering energy-efficiency related policies and measures in these sectors were based on information that was used in reporting activities to the EU in 2015 and for which Energy Authority was responsible.)
- the Ministry of the Environment: F-gases, waste and energy use in buildings
- the Ministry of Agriculture and Forestry: agriculture, land use, land use change and forestry (LULUCF)
- the Ministry of Transport and Communications: transport
- the Ministry of Finance: taxation, short-term economic development

Assumptions underlying calculations

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

Finland's population will increase from the current 5.5 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.

The economy is expected to recover in the coming years after several years of economic recession. The economic growth is estimated to be 1.7 – 1.8 per cent per annum in the following years and in the next decade. The expected development of the economy by branch is illustrated in CTF Table 5.

The international fuel price estimates are the EU recommended harmonised values for reporting on greenhouse gas projections 2015. Emission allowance price assumption for 2020 is EUR 10/tonne 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 18 per cent by 2020 and by approximately 33 per cent by 2030 compared to year 2013 as a result of increased energy. In addition, it is estimated that the actual share of bio-based fuels will increase to 12.5 per cent by 2020.

Landfilling of waste is increasingly replaced with recycling and energy recovery. In 2010, the amount of municipal waste incinerated at waste incineration plants was approximately 244,000 tonnes and in 2013 it exceeded 800,000 tonnes. The WM projection estimates that from 2017 onwards, the amount of municipal waste incinerated at waste incineration plants will be close to 1400,000 tonnes per annum then remaining at this level. 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 2013 and in the WM projection for 2020-2030, TWh

	2013	**2020**	**2025**	**2030**
Fuels in the transport sector	49	49	46	44
Oil other	39	37	35	33
Coal [1]	37	56	40	29
Natural gas	30	32	31	29
Peat	16	15	14	9
Wood fuels	92	99	97	95
Nuclear	69	106	132	123
Hydro	13	14	15	15
Wind	1	6	7	7
Other	19	18	19	21
Import of electricity	16	0	0	12
Total primary energy	**381**	**426**	**430**	**411**
Gross final energy consumption	300	315	313	309

[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 2013 and in the WM projection for 2020-2030, TWh

	2013	2020	2025	2030
Oil	3	1	1	1
Coal	15	9	8	7
Natural gas	16	17	16	14
Peat	9	7	6	5
Wood fuels	18	18	17	16
Other	6	6	6	6
Total	**68**	**59**	**54**	**50**

Table 5.13 Electricity supply in 2013 and in the WM projection for 2020-2030, TWh

	2013	2020	2025	2030
Hydro	13	14	15	15
Wind	1	6	7	7
CHP, district heating	14	16	14	13
CHP, industry	9	9	9	9
Nuclear	23	35	43	40
Condensing power	9	13	7	13
Net imports	16			
Total electricity supply	**84**	**93**	**96**	**98**

Table 5.14 Energy sources in transport in 2013 and in the WM projection for 2020-2030, TWh

	2013	2020	2025	2030
Petrol	17	15	13	11
Diesel	29	30	29	27
Other fuels	3	4	4	5
Electricity	1	1	1	2
Total	**50**	**50**	**48**	**45**

Changes compared to the Sixth National Communication and the First Biennial Report

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 Second Biennial Report are basically the same as those used for the Sixth National Communication and the First Biennial Report.

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.

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.

While the fast-start finance period is now over, the international public climate finance that Finland has provided has continued to grow compared to the base year used for fast-start finance. The total allocations were about EUR 94 million in 2013 and EUR 116 million in 2014. The division between mitigation and adaptation support varies according to the year, in 2013 about 56 % was allocated to mitigation and about 44 % to adaptation, and in 2014 about 54 % and about 46 %, respectively. Additionally, during the reporting period Finland's government channelled all revenues from the auctioning of ETS allowances to Official Development Assistance activities, including climate finance.

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 fifth replenishment period, Finland's contribution was 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 negotiations for the sixth replenishment period (July 2014 – June 2018) ended in spring 2014 during which Finland pledged EUR 65 million.

The GEF divides the funds by environmental focal areas; according to the latest annual report, between the years 1991 and 2012, 31 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 GEF5, Finland has used the climate change focal area target allocation outlined in the GEF Council document GEF/C.40/07 including half of the Sustainable Forest Management/REDD-Plus (SFM/REDD+) programme allocation, totalling approximately 32.6 per cent. For GEF6 reporting Finland uses shares based on the indicative focal area programming targets as agreed in the replenishment negotiations (about 28 %). However, it should be noted that according to GEF reports as much as 55 % of the total funding was climate relevant in 2013, which gives better picture of the multiple benefits achieved through GEF funding.

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. Depending on whether adaptation or mitigation is the principle objective or a significant objective, the share varies between 10 and 100 per cent. Based on the project document or relevant documentation from multilateral organisations (e.g. budget information or agreed strategies) the

desk officer gives coefficients for the markers. 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). Related to response measures, Finland strives to implement its commitments under the Kyoto Protocol in such a way that social, environmental and economic impacts on other countries, and on developing countries in particular, are minimised. Finland supports developing countries by helping them to build their capacities and develop their economic infrastructure, thus helping them diversify their economies and improve energy production. For example, through the Energy and Environment Partnership Programme (EEP), Finland supports the participating developing countries in developing, adopting and scaling-up appropriate and affordable renewable energy and energy efficiency technologies for improved energy access and local employment. More information on specific activities addressing in particular minimising the adverse impacts of response measures on developing countries is provided in Finland's Sixth National Communication and in Chapter 15 of Finland's most recent national inventory report[36].

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, including related to enhancement of endogenous capacities and technologies. 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

As there are no appropriate data collection systems in place and due to confidentiality clauses related to some private sector data at the moment Finland does not estimate nor report regularly climate related private finance mobilized. Finland focuses instead at the moment to following and actively participating, when possible, to the multilateral discussions on the subject. However, in 2013 a very rough estimation was made, based on which Finland could mobilize yearly about USD 0.5–1.8 billion private climate finance to developing countries. This estimation was made using the analyses by Stadelmann and Michaelowa (2011[37]) and should be taken only as a very initial estimation, which may not be comparable to other estimations.

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[36] http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php

[37] Stadelmann, M., Roberts, J.T. and Michaelowa, A. (2011a). Accounting of Private Climate Finance. Types of Finance, Data Gaps and the 100 Billion Dollar Question. Working Paper. Climate Strategies, Cambridge.

Stadelmann, M., Castro, P. and Michaelowa, A. (2011b). Mobilising Private Finance for Low Carbon Devel-opment: Tackling Barriers to Investments in Developing Countries and Accounting of Private Climate Finance Flows. Cambridge: Climate Strategies.

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 prevent 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. During the reporting period, Finnfund provided approximately in total EUR 28 million, which can be included in Finnish public climate funding, and Finnpartnership provided approximately EUR 0.2 million. According to rough estimates, the public funding through Finnfund's climate-related projects leverages private funding at a level at about two to three times that of Finnfund's funding for the investment, and the ratio can even be higher. Finnpartnership has not made climate-specific estimates, but during the years 2007-2010 the ratio was generally at least six times as great.

Other climate finance and technology transfer activities presented below, such as the Energy and Environment Partnership (EEP), have also leveraged private finance. In the case of the EEP it has leveraged private finance at about 50% co-financing share.

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 during 2013-2014 approved grant financing for 27 projects for a total value of EUR 78.5 million. Disbursements of grants and credits amounted to EUR 82 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 until the end of this reporting period 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). Additionally, in the Initial Resource Mobilisation process Finland announced its aim to support the GCF in the 2015-2018 period, in total, with EUR 80 million and pledged EUR 34.7 million for 2015.

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. In the period 2013-2014 the PMR Partnership Assembly approved grants totalling USD 35 million to build carbon market capacity in Chile, Costa Rica, China, Mexico, Turkey, Indonesia, Thailand, Columbia, Morocco and Vietnam. These countries' national capacity to design and build carbon market instruments has increase through policy-support, information products, workshops and training, etc.

Stadelmann, M., Roberts, J.T. and Michaelowa, A. (2011c). Is there a leverage paradox in climate finance? Working Paper. Climate Strategies, Cambridge.

Stadelmann, M., and Michaelowa, A. (2013). Contribution of the Private Sector to Climate Change Long-Term-Finance: An assessment of private climate finance mobilized by Switzerland. Final Report for the Swiss Federal Office for the Environment.

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 has included in its climate finance reporting from 2012 onwards 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 6.4 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 2010–2015. 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. The programme focuses on innovative approaches for forest resource inventory and monitoring, national forest carbon stock assessment, building capacity, and delivering good practices and methods on sustainable forest management at the national level. Finland's overall support for the programme amounts to EUR 20.6 million during the years 2009-2014. The programme has five pilot countries on three continents. It includes developing new innovative methodologies for national forest inventory as well as conducting the inventories developing local capacities and creating a new data system for data processing, storing and dissemination[38]. This enables countries to be able to in the future benefit from the so-called REDD+ mechanism.

Furthermore, Finland supported the Adaptation for Smallholder Agriculture Programme (ASAP) launched by the International Fund for Agricultural Development (IFAD) with EUR 5 million in 2014. The programme channels climate finance to smallholder farmers so they can access the information tools and technologies that help build their resilience to climate change. The programme is working in more than thirty developing countries, using climate finance to make rural development programmes more climate-resilient.

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 close to 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 has since been 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. Upgrading the electric grid in Dar es Salaam will enhance reliability and reduce losses, improving distribution efficiency and alleviating the need for back-up diesel generators. 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.

[38] http://www.openforis.org/

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.

Similar to climate finance in general (see above Chapter 6.3. Finance; Private finance leveraged) , at the moment it is possible to report only about public interventions on technology transfer as well about some that are leveraged with public support, but Finland cannot report activities undertaken purely in the private sector. However, as an example the industrial equipment manufacturer ABB has engaged in an agreement with the UN Sustainable Energy for All –initiative to provide know-how on energy efficient standards and legislation for industrial motors and transformers.

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 Kenya, Honduras and Jordan, as well as tree-planting projects in Tanzania, Ghana, Sierra Leone and Uganda. In addition, Finnfund has invested in several funds, which are investing in renewable and clean technologies in Central America and 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), a challenge fund financing which has established various renewable energy and clean energy projects throughout the world. The partnership has recently completed its activities in Central America and Indonesia, and currently implementing second phase scale up in southern & eastern Africa, Andes and Mekong countries.

Concessional credits are used primarily for environmental and infrastructure investments under national development programmes. They have been granted to waste disposal plant with the landfill gas collection system in Vietnam, 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, Kenya and Ghana, projects to improve electricity distribution 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 came 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. During the reporting period it was decided that the collaboration will finish in 2015.

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), including the UNFCCC. 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: in 2013 the theme was natural resources and in 2014 the theme was environmental security. Both courses included components related to climate change.

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, the project was extended during the reporting period with no-cost extension phase and continues through the end of 2015.

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. During the third phase (2012-2014), the emphasis of the project was at the national level. Finally, the project was continued during the reporting period with two more years (until summer 2016). The 4th phase continues to promote women's leadership through e.g. the Women Delegates Fund; engage with UNFCCC e.g. through capacity building; and strengthen the GGCA Secretariat. The total contribution for the four phases is EUR 8.9 million.

The project co-operation between Finland and the South Centre in the field of climate change started in 2011. The project in question run through the years 2011-2013 with total support of EUR 700 000. The general objectives of the programme were firstly, at the national level, to assist developing countries in national preparations for engagement in national and international climate change policies and actions; and secondly, at the international level, to assist developing countries to engage constructively and effectively in developing and shaping the international policy framework of cooperation in addressing the global climate crisis. In 2014 the cooperation was continued with three years with broader over-arching theme being strengthening sustainable development globally and in developing countries, climate change still being one of the sub-themes.

7 Other reporting matters

7.1 Introduction

In this chapter Finland reports additional information by describing the newly adopted Climate Change Act and by giving more details on the sectoral programs relevant to climate change mitigation.

7.2 The Climate Change Act (609/2015)

The Finnish Parliament approved the Climate Change Act in March 2015 and it entered into force 1st June 2015. The act is meant to serve as a tool for the Government and Parliament to reach the emissions reduction targets in the most cost-efficient and systematic way possible. It sets an emissions reduction target of 80 % by 2050 compared to 1990 levels. The act contains provisions on a planning system for climate change policy which is formed by Medium-term and Long-term Plans, as well as a National Adaptation Plan for climate change. In addition, the Government is obliged to issue regular reports on the implementation of climate policies to the Parliament in form of Annual Climate Change Reports. The act includes also provisions on the duties of a multidisciplinary expert body, Finland´s Climate Panel, in support of the planning of climate policy.

7.3 The Finnish national adaptation strategy

The Finnish national adaptation strategy was revised in 2014. The new National Adaptation Plan for Climate Change 2022[39] was approved as a government resolution in November 2014. More detailed information will be included in the Finnish 7th National Communication.

7.4 Sectoral Programs

Resolution on Energy Saving and Energy Efficiency

Energy intensity of the Finnish economy is relatively high, which leads to relatively high per capita greenhouse gas emissions. Energy use, however, is efficient in international comparison, which implies that the high energy intensity can be explained by structural factors. As indicated by the country's northern location, Finland has a cold climate. The need for space heating, measured by average heating degree-days, is higher than that for any other country in the world. In addition to this factors that increase the energy intensity of Finland are relatively large geographical area and sparse population.

In many energy conservation measures and in terms of the efficiency of energy use, Finland is among the leading countries in the world. Co-generation of heat and electricity, broad coverage of energy efficiency agreements, and the systematic implementation of energy audits are good examples of successful energy conservation measures.

On 4 February 2010, the Government passed a resolution on energy saving and energy efficiency measures for implementation during the current decade. This Government decision was based on a June 2009 report by a broad-based Energy Efficiency Committee, appointed by the Ministry of Employment and the Economy.

Energy-efficiency requirements designated the public sector as liable for setting an example in promoting energy conservation. Other areas of focus included the development of an energy-efficient community structure and enhancement of energy-efficiency in the heating of buildings, transport, household use, agriculture, industry, and the entire service sector.

[39] http://mmm.fi/documents/1410837/1888935/MMM-%23193086-v1-Finland_s_National_climate_Change_Adaptation_Plan_2022.pdf/

The measures included in the Government decision extend until 2020, but the main emphasis was on measures due for implementation in 2010-2011. The majority of energy-saving measures are based on EU-wide solutions, regulations, and recommendations. Public financing is targeted inter alia at research and development activities and enhancement of competencies, whereas fiscal solutions emphasize motivating energy savings while ensuring the conditions needed for industry to operate solidly.

Package of Obligations Concerning Renewable Energy

Finland is one of the world's leading users of renewable energy sources, especially bioenergy. The most important renewable energy sources include bioenergy (wood and wood-based fuels in particular), hydropower, wind power, ground heat and solar energy. In order to further increase the share of renewable energy, the Government's ministerial working group for climate and energy policy agreed in 2010 on the contents of an extensive package of obligations concerning renewable energy. This package promotes the use of forest chips and other wood-based energy, wind power, the use of transport bio-fuels, and the increasing utilization of heat pumps.

Renewable energy is one of the most significant means by which Finland's climate targets can be achieved. Finland's obligation set by the European Union is to increase the share of renewable energy to 38 per cent of final energy consumption in 2020. In 2013 the share of renewable energy was 35 per cent of final energy consumption.

The Climate Policy Programme for the Transport Sector

The climate policy programme of the administrative sector of the Ministry of Transport and Communications was completed in March 2009. The programme was updated in November 2013. The aim of this programme is to reduce greenhouse gas emissions from domestic transport by 15% by 2020 from their 2005 level, in accordance with Finland's national and international commitments. In 2020, greenhouse gas emissions from domestic transport must be no more than about 11.2 million tonnes (currently approx. 13 million tonnes). The goal for energy consumption in transport is to halt the growth in this consumption and to shift transport energy consumption onto a declining track before 2020. In 2020, final energy consumption by domestic transport must be no more than 48 TWh (currently approximately 50 TWh).

The emissions reduction measures will focus especially on road traffic, which offers the greatest potential for reducing emissions. The reduction goals for greenhouse gas emissions from international aviation and shipping will be outlined in the negotiations on a new global climate treaty, and the mechanisms for reducing emissions will be developed by the ICAO and the IMO. The EU's current emissions reduction systems (incl. aviation emissions trading) will be re-evaluated at the same time.

The following measures will be taken to achieve the climate policy aims of the administrative sector:

- the use of alternative propulsion systems will be promoted,
- the vehicle fleet will be renewed,
- energy efficiency in transport will be improved,
- the growth of passenger traffic volumes in urban areas will be directed to more environmentally friendly transport modes,
- the attainment of Finland's climate policy objectives will be supported by information society and communications policy, and
- if the climate policy objective in the transport sector will not be achieved through the measures 1-4, traffic volumes and the modal split will be influenced by additional/supplementary economic steering measures, such as fuel taxes, car taxes and road user charges.

It has to be noticed that this strategy has been prepared by the Ministry of Transport and Communications, and it is not a programme of the Finnish Government.

Energy-Smart Built Environment 2017 (ERA17)

Improving the built environment, including the transport systems, plays a key role in reducing greenhouse gas emissions and mitigating climate change. The ERA 17 Action Plan proposed originally 31 actions to reduce emissions in the built

environment, to improve energy efficiency and to promote the use of renewable energy. The overall target of the programme is to create an "energy-smart built environment" which is energy-efficient, low in emissions and provides a high-quality living and working environment for all. The Action Plan put together 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 in general. The programme has focused to five actions for years 2013-2014. The programme is ongoing.

Strategy for Repair and Renovation for Buildings 2007-2017

Renovation and retrofitting of buildings will increase rapidly in Finland in the next two decades. The reason for this is that, among other things, a large part of the building stock will need improvements to the physical condition or in energy efficiency. Such an increase in repair and renovation work will require considerable development and changes in the property and building sectors. The program presented an implementation plan for the Strategy for Repair and Renovation 2007-2017, Implementation plan (2009) and the Government Resolution on Renovation (2008).

The implementation plan consists of thirteen measures for action, defining the aims and concrete measures to be taken. The actions include, e.g. the development of a maintenance culture, improvement in energy efficiency, improvement of know-how and dissemination of knowledge, developing the material and resource efficiency, and development of renovation services. Research and communication play an important role in the implementation of the strategy. The program was made up in co-operation with the Ministry of the Environment and the Finnish real estate and construction branch, research institutions and the public administration in general. The responsibility for implementation of the strategy is broadly spread among the actors of the property and building sectors. The implementation is ongoing.

The Climate Policy Programme for Agriculture

The Climate Programme for Agriculture ("Steps towards environmentally-friendly food")[40] was finalized in November 2014.

The Climate Programme for Finnish Agriculture prepared by the Ministry of Agriculture and Forestry aims to further enhance the sustainability of the Finnish food system, which is founded on profitable food production and responsible consumption. By improving sustainability in a comprehensive way it is also possible to increase the profitability of production. The objective is to improve the energy and material efficiency and reduce emissions per litre or kilogram of production.

The Climate Programme for Finnish Agriculture presents a total of 76 measures to facilitate the adaptation of food production and consumption to climate change and/ or to mitigate the change.

Society's commitment to Sustainable Development

Finland's national sustainable development work is carried out in line with the policies of the United Nations, the European Union, the Arctic Council and the Nordic Council of Ministers. The Finnish National Commission on Sustainable Development is responsible for adapting international sustainable development goals into Finland's national policies.

Finland's national strategy for sustainable development "Towards sustainable choices - A nationally and globally sustainable Finland" has been revised in 2013. Along with the revision of the strategy, a national concept "Society's Commitment to Sustainability" was launched in December 2013. It has been prepared by a wide-ranging strategy group.

Through the Commitment, the Government and the administration, in collaboration with various societal actors, pledge to promote sustainable development in all their work and operations. The Commitment´s one objective is a carbon-neutral society which is meant to be achieved by following the national roadmap towards a carbon-neutral society by

[40] http://mmm.fi/documents/1410837/1890227/Climate_programme_agriculture_WEB_03072015.pdf/

the year 2050. The central measures to be undertaken for reaching this objective are improving energy efficiency, increasing the share of renewable energy sources, and developing the low-carbon sectors of the economy. The results of the sustainable development work will be tracked through a national indicator programme.

The Finnish Bioeconomy Strategy

The goal of the Finnish Government is to increase the yield of the bioeconomy from the present 60 billion Euro to 100 billion Euro and to create 100,000 new bioeconomy jobs by 2025. These targets are included in government resolution on 5 May 2014, which is aimed at spurring renewal in Finnish business and industry, and spurring economic growth in the new important fields of the bioeconomy and cleantech.

Attached to the government resolution is the Finnish Bioeconomy Strategy[41], which was prepared as a collaborative effort between several ministries, administrative branches and other participants. Thanks to the abundance of renewable resources, high level of expertise and industrial strength, Finland has excellent potential to be a global forerunner in bioeconomy.

The four focal points of the strategy are 1) creating a competitive operating environment for growth in the bioeconomy, 2) creating new bioeconomy business activities through risk financing, bold experiments, and transcending boundaries between different sectors, 3) upgrading the bioeconomy knowledge base by developing education and research activities and 4) securing the availability of biomass, a functioning market for raw materials, and the sustainability of use.

Government Strategy to Promote Cleantech Business in Finland

In May 2014, the Finnish Government published a cleantech strategy, whose goal is to accelerate growth in Finnish cleantech business and to renew the traditional industry through innovations in clean technology. The vision is that in 2020 Finland will be a global superpower in the cleantech business. Achieving the vision requires maintaining cooperation between administrations. The cleantech business based on energy and environmental technology is one of the focus areas of Finland's business policy together with bioeconomy and digitalization.

The cleantech strategy sets several ambitious goals for the growth of the cleantech sector. In order to meet the goals, the strategy introduces four so-called priority actions, which promote the development, commercialisation and implementation of companies' cleantech innovations. For example, the priority actions include making cleantech the spearhead theme of the country brand and creating cleantech demonstration environments. Several measures are presented to implement the priority actions.

In order to meet the growth goals, the cleantech strategy also introduces four actions to develop the operating environment of cleantech business. This encourages companies to engage in innovative and sustainable business and promotes the market access of the new cleantech solutions. The development actions include clarifying and speeding up the slow and complicated licensing processes as well as securing the foundation of skills and knowledge through research and education.

National Forest Strategy 2025

A new National Forest Strategy (NFS) 2025[42] was adopted by the Government in February 2015 and it sets main objectives for the forest sector until 2025. The Strategy continues the long tradition of holistic sustainable forest management in Finland and sets out objectives and strategic projects for the Finnish forest sector. The National Forest Strategy replaced the previous National Forest Programme 2015 as the main national forest policy document.

[41] http://mmm.fi/forests/strategies-and-programmes/finnish-bioeconomy-strategy

[42] http://mmm.fi/en/forests/strategies-and-programmes/national-forest-strategy

The vision of the Strategy is "Sustainable forest management is a source of growing welfare". The three strategic objectives to make the vision come true are: 1) Finland is a competitive operating environment for forest-based business, 2) Forest-based business and activities and their structures are renewed and diversified and 3) Forests are in active, economically, ecologically and socially sustainable, and diverse use. The strategy is implemented by a total of eleven strategic projects. Those to be considered as the key projects include the development of electronic information and customer services for private forest owners and creating new incentive schemes for promoting entry of timber to the market. The key projects include also improvement of nature management in commercial forests. Forests will play a key part of the Finnish bioeconomy and therefore the NFS aims to increase the use of wood to replace fossil resources with renewable biomass. At the same time the objective is to keep the climate mitigation role of forest sinks by maintaining the level of at least 10-17 million tonnes CO_2 eq. yearly sequestration in Finnish forests. In addition, the government and stakeholders continue to carry out joint initiatives to promote the use of wood as a renewable material contributing also to the climate change mitigation.

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 tonnes 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 tonnes CO_2/GWh). The emission factor for electricity defined in the IMPAKTI calculation tool (600 tonnes 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 (http://lipasto.vtt.fi/indexe.htm), 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 three submodels: LIISA for road transportation, RAILI for railways and MEERI for waterborne transport. LIPASTO is compiled and updated by VTT Technical Research Centre of Finland. Emissions in the air traffic sector are estimated by Statistics Finland based on data by Eurocontrol and Finavia. The corresponding projections are made by the Ministry of transport and communications in collaboration with Statistics Finland and Finavia. 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 gasoline 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.

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

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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