Statistics Finland

Ympäristöministeriö
Miljöministeriet
Ministry of the Environment

Finland's Third Biennial Report
under the UNFCCC

13 December 2017

Contents

1 Introduction

Finland's third 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. The additional requirements for reporting of financial information in biennial reports in Decision 9/CP.21 have also been taken into account.

Information provided on greenhouse gas emissions and trends is consistent with the information in Finland's greenhouse gas inventory submission in 2017[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 in the EU's third biennial report under the UNFCCC, which also addresses progress in meeting the joint target.

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 (CTF) 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, and Decision 9/CP.21, has been submitted to the UNFCCC using the CTF application.

[1] Finland's 2017 greenhouse gas inventory submission under the UNFCCC, http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.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 Second Biennial Report (BR2) under the UNFCCC.

2.1 Total greenhouse gas emissions and trends

The greenhouse gas emissions trends for the period 1990 to 2015 by gas and by sector are presented in CTF Table 1. In 2015, Finland's greenhouse gas emissions totalled 55.6 million tonnes of carbon dioxide equivalent (million tonnes CO_2 eq.). The total emissions in 2015 were approximately 22 per cent (15.7 million tonnes) below the 1990 emissions level. Compared to 2014, the emissions decreased by approximately six per cent (3.6 million tonnes). The emission trends by sector are presented in Figure 2.1 and described in detail in Section 2.2.

Statistics Finland also published instant preliminary data on the greenhouse gas emissions for 2016 in May 2017[3]. The total emissions of greenhouse gases in 2016 corresponded with 58.8 million tonnes of CO_2 eq. Emissions grew by six per cent compared with the previous year but were still 18 per cent lower than in 1990. The instant preliminary data are calculated using rougher data and methodologies than are used for the inventory data in the last inventory submission to the UNFCCC. Therefore, the submitted inventory data (1990 to 2015) are presented and used as the basis for the documentation and conclusions in all chapters in this national communication.

The energy sector is by far the largest producer of greenhouse gas emissions in Finland. The energy sector includes emissions from fuels used to generate energy, including fuel used in transport and the fugitive emissions related to the production, distribution and consumption of fuels. In 2015, the energy sector accounted for 73 per cent of Finland's total greenhouse gas emissions (Figure 2.2). The second largest source of emissions was agriculture, with a share of approximately 12 per cent. Emissions from industrial processes and product use amounted to approximately 11 per cent. Emissions from industrial processes refer to sector emissions that result from the use of raw materials in industrial processes. Emissions from the waste sector amounted to four per cent of total emissions. The contribution of indirect CO_2 emissions from atmospheric oxidation of CH_4 and NMVOCs to the Finnish greenhouse gas emissions is small, about 0.1% of the total greenhouse gas emissions in Finland.

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[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).

[3] http://www.stat.fi/til/khki/2016/khki_2016_2017-05-24_tie_001_en.html

Figure 2.1 Greenhouse gas emissions and removals in Finland by reporting sector (million tonnes CO_2 eq.) and net CO_2 equivalent emissions (emissions plus removals). Emissions are positive and removals negative quantities.

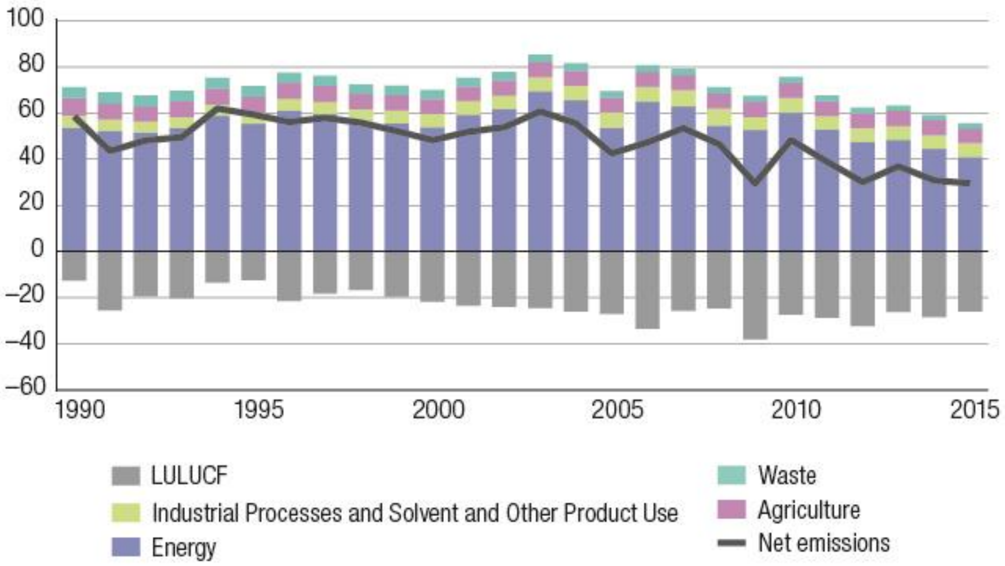
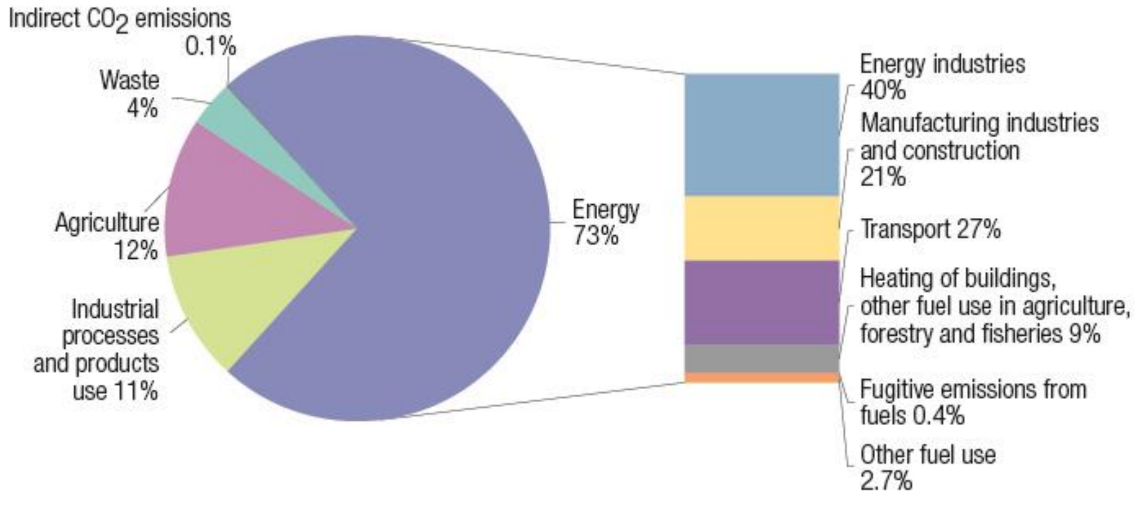


Figure 2.2 Finland's greenhouse gas emissions by sector in 2015 (LULUCF sector excluded). Due to independent rounding, the sums do not add up.



The land use, land-use change and forestry (LULUCF) sector is a net sink in Finland. The net sink has varied from approximately 15 to 55 per cent of the total annual emissions from other sectors during 1990 to 2015. Forests (trees and soil) absorb a significant proportion of Finland's carbon dioxide emissions. The most important components of the forest sink are the increment of growing stock and the harvest removals. The growth has increased since 1990 from 78 million m^3 to 105.5 million m^3. There is less fluctuation in the growth than in the harvest rates between years. In 2015, the total drain was 82 million m^3 being still at a very high level.

The most important greenhouse gas in Finland is carbon dioxide. The share of CO_2 emissions in total greenhouse gas emissions has varied from 80 per cent to 85 per cent. In absolute terms, CO_2 emissions have decreased by 12.7 million tonnes (i.e. 22 per cent) since 1990. Around 90 per cent of all CO_2 emissions originated from the energy sector in 2015.

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 37 per cent from the 1990 level. This is mainly due to the improvements in the waste sector and a contraction in animal husbandry in the agricultural sector. Correspondingly, emissions of nitrous oxide (N_2O) have also decreased by 27 per cent; the greatest decline occurred in 2009 when the implementation of a N_2O abatement technology in nitric acid production reduced emissions significantly. Another reason for the decrease of N_2O emissions is the reduced nitrogen fertilisation of agricultural fields. In 2015, the F gas emissions (HFCs, PFCs and SF6) were nearly 35 times higher than the emissions for 1995 (the base year for F gas emissions). A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F gases in many applications.

The majority of the CO_2 emissions originate from energy production based on the combustion of fossil fuels and peat. Peat is not a fossil fuel as such, but lifecycle studies indicate that the climate effects of peat combustion are comparable with those of fossil fuels. The CO_2 emissions from wood combustion are not included in the total national emissions but are reported separately. CO_2 emissions from combustion in energy production totalled 40 million tonnes in 2015. The production and use of energy also generate methane and nitrous oxide emissions. The majority of methane emissions originated from the waste and agricultural sectors in 2015. The majority of nitrous oxide emissions originated from agriculture. F-gas emissions originate from the consumption of halocarbons (HFCs and PFCs) and SF_6 and are reported in the industrial processes and product use sector.

Finland's annual greenhouse gas emissions have varied considerably due to changes in electricity imports and the production of fossil-fuel-based condensing power. In addition, emissions are influenced each year by the economic situation in the country's energy intensive industries, weather conditions and the volumes of energy produced using renewable energy sources (see trends by sector in Figure 2.3).

The trend in greenhouse gas emissions relative to Finland's gross domestic product (GDP) has been declining (Figure 2.4), although annual variations have been large. In the early 1990s, the GHG/GDP ratio rose almost 15 per cent above the 1990 level. This was largely due to the economic recession, which led to a steeper fall in the GDP than in emissions. In 2015, the GHG /GDP ratio was more than 45 per cent below the 1990 level, indicating that the greenhouse gas intensity of the economy has decreased.

Figure 2.3 Relative development of greenhouse gas emissions by main category relative to the 1990 level (1990=100%)

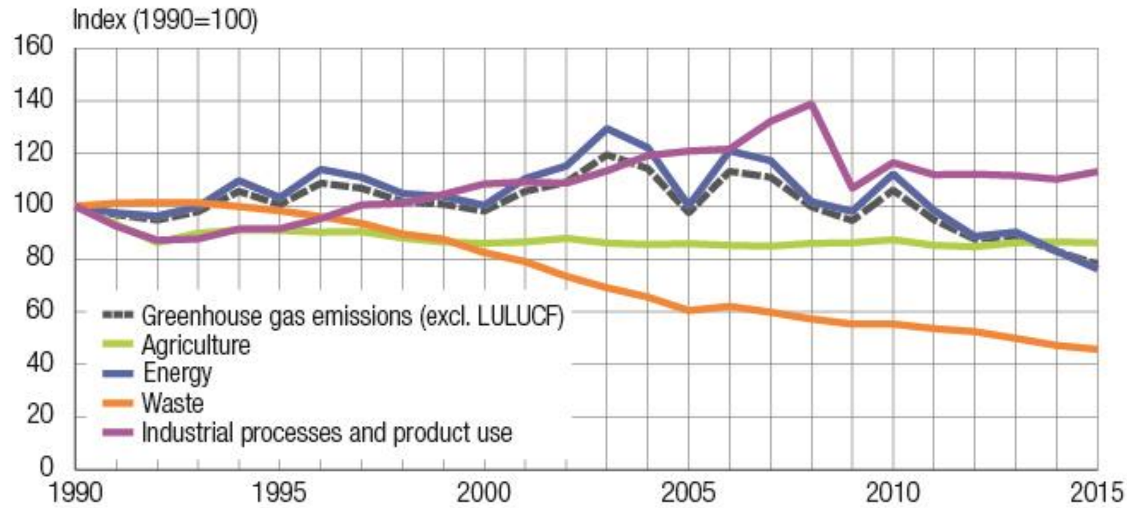
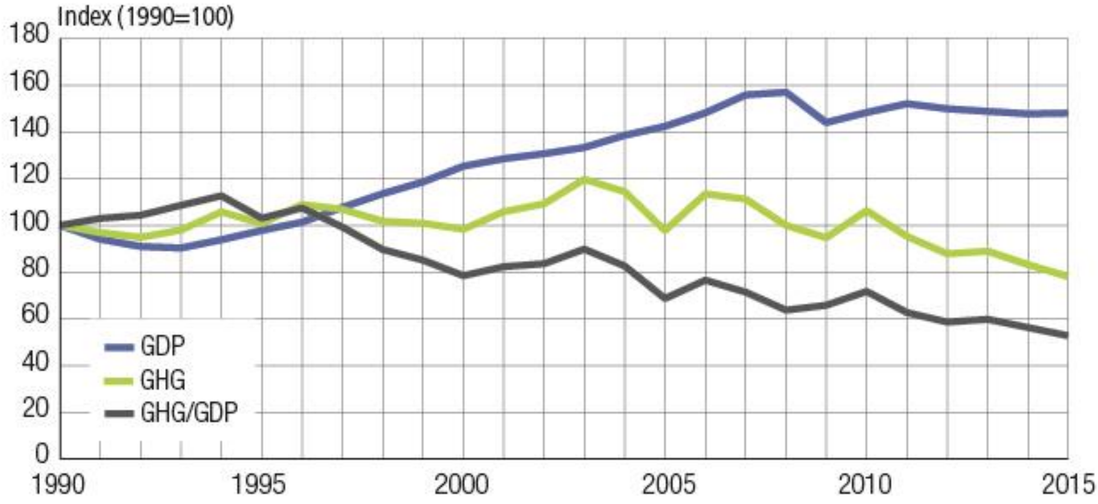


Figure 2.4 Greenhouse gas emissions relative to GDP, 1990 to 2015, excluding the LULUCF sector (Index, 1990 = 100)



2.2 Greenhouse gas emissions by sector

2.2.1 Energy

Similarly to other industrialised countries, Finland's biggest source of greenhouse gas emissions is the energy sector. The cold climate, long distances and energy-intensive industries are apparent in the high emissions volumes of the energy sector. In 2015, its share of total greenhouse gas emissions, including transport, was 73 per cent (40.8 million tonnes CO_2 eq.). Energy sector emissions can be divided into emissions resulting from fossil fuel combustion and fugitive emissions from fuels. The majority of the sector's emissions result from fuel combustion. Fugitive emissions make up only 0.4 per cent of the total emissions of the sector.

Energy sector emissions show strong annual variation in accordance with the amount of energy used and the proportion of imported electricity. This variation has been the principal feature of the overall trend in emissions since 1990. Emissions from the energy sector are strongly affected by the availability of hydropower on the Nordic electricity market. If the annual precipitation in the Nordic countries is lower than usual, hydropower will become scarce and Finland's net imports of electricity will decrease. During such years, Finland has generated additional electricity using coal and peat in condensing power production for its own needs and also for sale on the Nordic electricity market. This can be seen directly in the emissions of the energy sector (Figure 2.5).

In 2015, energy sector emissions were almost eight per cent lower than in 2014, and they were 24 per cent lower than the 1990 level. CO_2 emissions in the energy sector decreased more than the total use of energy (Figure 2.6). Total energy consumption in Finland amounted to 1.3 petajoules (PJ) in 2015, which was three per cent less than in 2014. The biggest reasons for decreasing emissions are the increased shares of forest-based fuels and net imports of electricity, which lowers the condensing power production.

Figure 2.5 Greenhouse gas emissions in the energy sector, 1990 to 2015

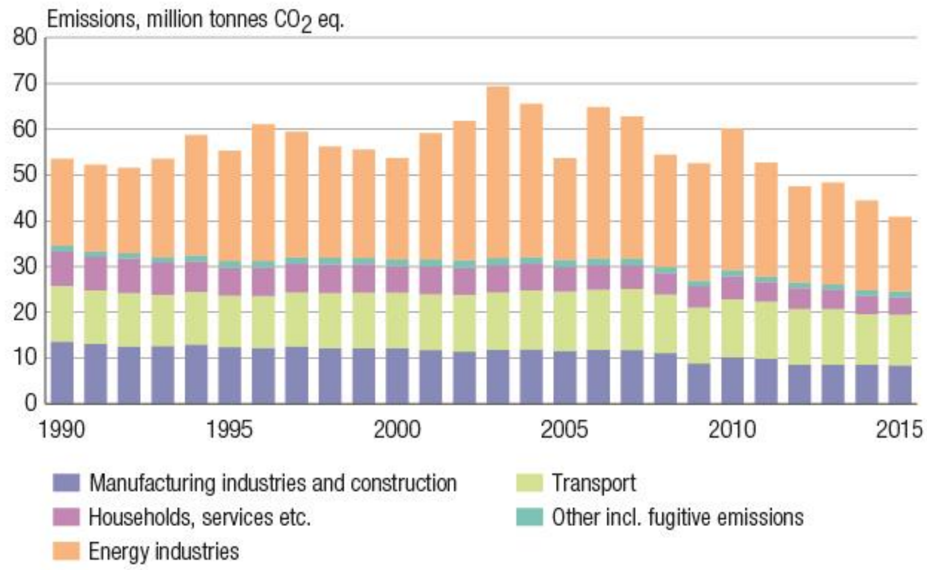
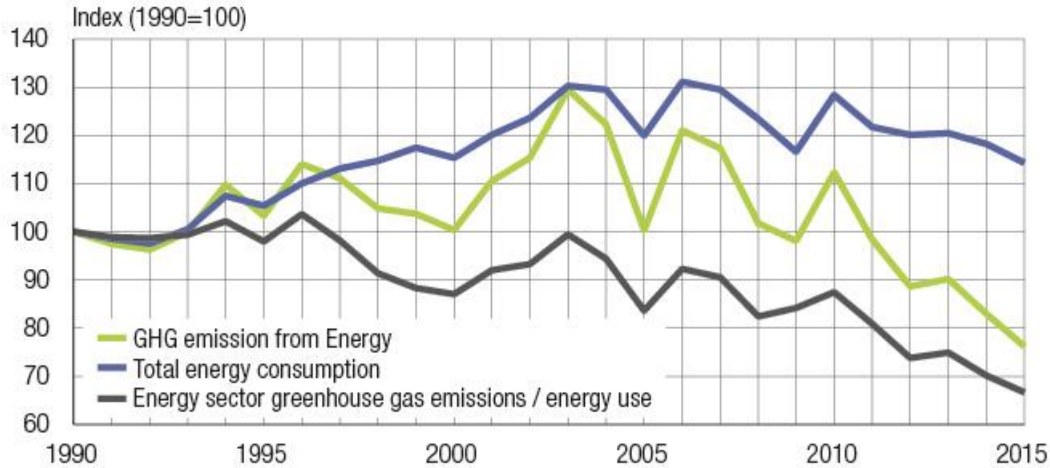


Figure 2.6 Total energy use relative to energy sector greenhouse gas emissions, 1990 to 2015

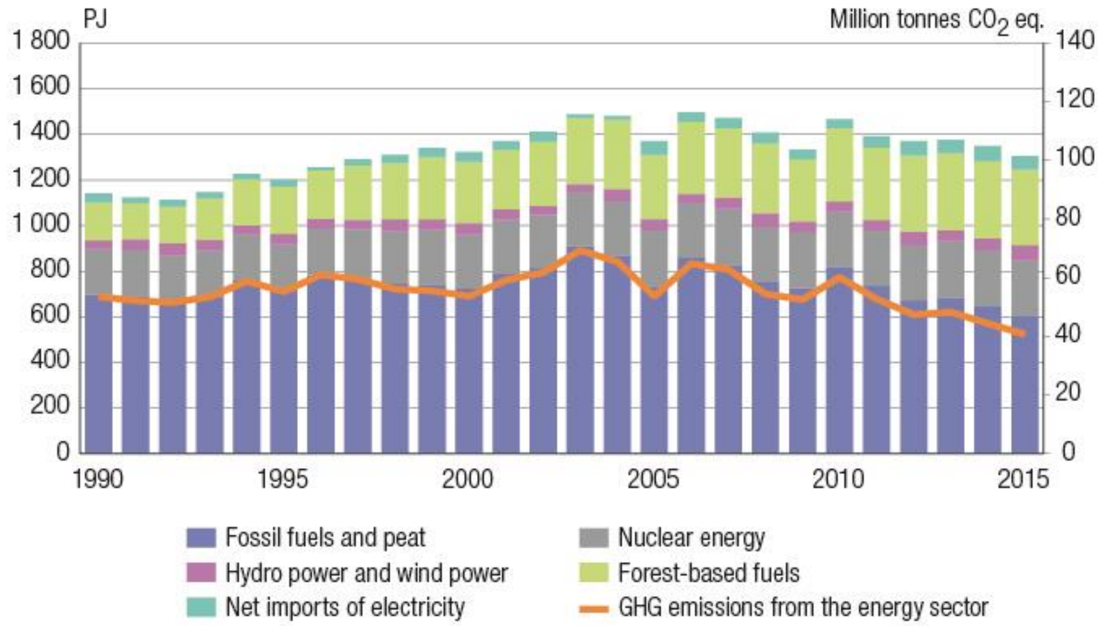


Between 2014 and 2015, the use of renewable energy sources increased by two per cent and that of fossil fuels decreased by eight per cent. Final energy consumption in transport remained at the same level and energy consumption in space heating decreased by five per cent from the year before. Final consumption in manufacturing contracted by two per cent. The share of renewable energy in total energy consumption grew to 35 per cent in 2015. The share of forest-based fuels in Finland's total energy consumption continued to grow and was 25 per cent in 2015. EU targets for renewable energy are calculated relative to total final energy consumption. Estimated in this manner, the share of renewable energy was over 39 per cent in Finland in 2015. Finland's target for the share of renewable energy is 38 per cent of final energy consumption in 2020, which was reached for the first time in 2014.

The use of fossil fuels went down by eight per cent from the year before. The use of natural gas fell by 14 per cent and that of peat by five per cent from the year before. The consumption of coal (including hard coal, coke, and blast furnace and coke oven gas) decreased by 20 per cent. In 2015, the production of electricity in Finland amounted to 66.2 terawatt hours (TWh). Production went up by one per cent from the year before. In turn, total electricity consumption went down by one per cent and amounted to 82.5 TWh. Of total electricity consumption, 80 per cent was covered by domestic production and 20 per cent by net imports of electricity from the Nordic countries, Russia and Estonia. Net imports of electricity declined by nine per cent from the year before. Thirty two per cent of domestic electricity production was based on combined heat and power production.

Of all electricity production, 29.5 TWh were produced with renewable energy sources, which is the biggest amount ever. Forty five per cent of electricity production was covered with renewable energy sources, which is the largest share since the 1970s. Over one-half of the electricity produced with renewable energy sources was produced with hydro power, nearly one-tenth with wind power and almost all of the remainder with forest-based fuels. Hydro power was used for producing 16.6 TWh of electricity. More electricity than this has been produced with hydro power only in 2008 and 2012. Seventeen per cent of electricity was produced with fossil fuels, four per cent with peat and 34 per cent with nuclear power (Figure 2.7).

Figure 2.7 Total energy use by energy source (PJ) and energy sector greenhouse gas emissions (million tonnes CO_2 eq.), 1990 to 2015



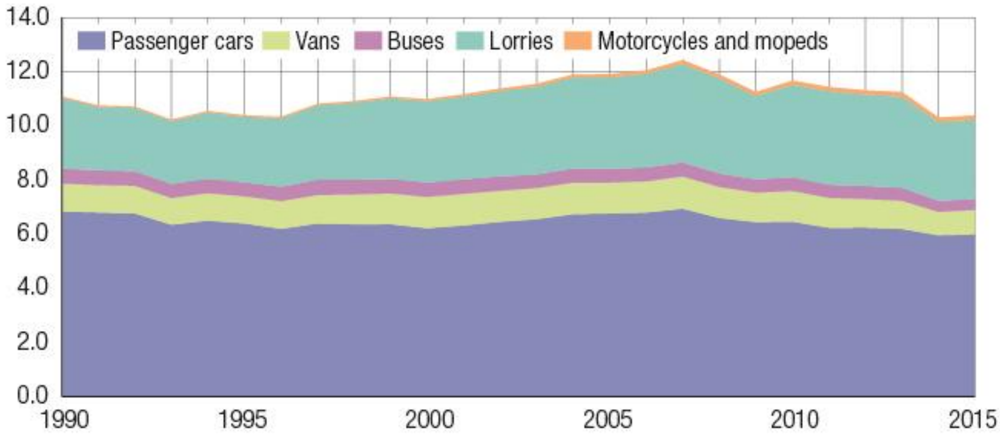
In 2015, greenhouse gas emissions from energy industries amounted to 16.2 million tonnes and manufacturing industries and construction amounted to 8.4 million tonnes CO_2 eq. The share of energy industries was 40 per cent of the energy sector's total emissions. The corresponding share was 20 per cent for manufacturing industries and construction. These two subsectors together accounted for 44 per cent of total greenhouse gas emissions of Finland.

Emissions from the fuels used by different industries have fallen by 24 per cent compared with the emission levels in 1990. This is the result of increased use of biomass by the forest industry in particular. Emissions attributable to energy use by individual households and the service sector accounted for approximately nine per cent of Finland's total emissions. These emissions are down significantly from the 1990 levels. The service sector's emissions have decreased by as much as 58 per cent, and those by households by 60 per cent. This is the result of the changeover from oil heating to district or electric heating (in which case emissions are allocated to energy production plants).

2.2.2 Transport

In 2015, greenhouse gas emissions from transportation amounted to 11.1 million tonnes CO_2 equivalent. Compared to 2014, emissions increased less than one percent in 2015. The changes in activity and in the share of biofuels were small. The emission level in the transport sector has fluctuated between 11 to 13 million tonnes CO_2 eq. during 1990–2015 being eight per cent lower in 2015 than in 1990. The share of the transport sector in total greenhouse gas emissions was approximately 17 per cent (12.1 million tonnes CO_2) in 1990 and 20 per cent in 2015. Road transportation is the most important emission source in transport, covering over 94 per cent of the sector's emissions in 2015. The distribution of road transportation emissions by vehicle type 1990 to 2015 is presented in Figure 2.8.

Figure 2.8 Road transport greenhouse gas emissions by vehicle type, 1990 to 2015 (million tonnes of CO_2 eq.)



During 1990 to 2015, road transport emissions decreased by six per cent regardless of the growth in traffic kilometrage during the same period (Figure 2.9). After the recession in the early 1990s, emissions from road transport increased until 2007 due to the increased kilometrage. In 2008, the emissions deviated from the upward trend. The worldwide economic downturn decreased the kilometrage of all transport modes. At the same time, the change in Finland to CO_2-based taxation of cars caused a transition from gasoline to diesel cars and lowered the specific fuel consumption of new cars, both gasoline and diesel. The downward trend in emissions since 2010 is due to the growing share of biofuels used in road transport and improving fuel efficiency of vehicles. However, Finland's per capita CO_2 emissions from transport are higher than in many other EU countries owing primarily to the long distances, transport-intensive industries and travel to and from free-time residences. The CO_2 emissions per kilometre driven have decreased both for passenger cars and other vehicles (Figure 2.10). The energy efficiency of new registered cars began to improve in the 1990s, and during 1993 to 2015 the vehicle-specific CO_2 emissions of new registered passenger cars fell 37 per cent (Figure 2.11).

Figure 2.9 Development of traffic volume (vehicle-kilometres, passenger cars and other vehicles) and GDP, 1990 to 2015

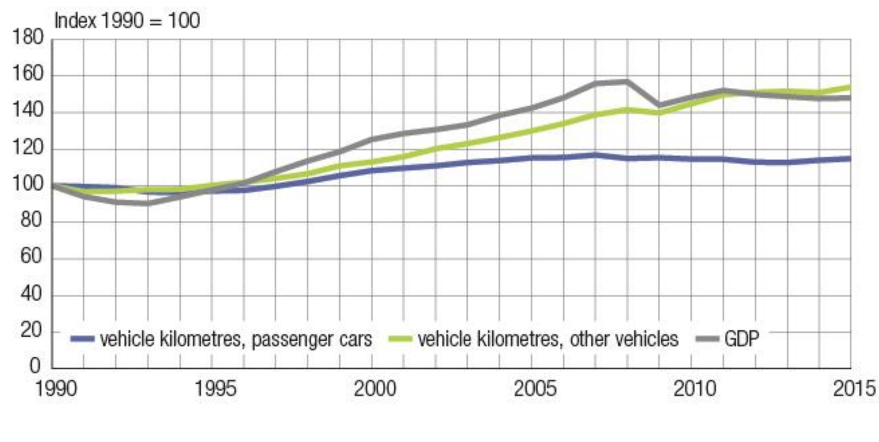


Figure 2.10 Relative development of CO_2 emissions from cars and other vehicles, 1990 to 2015 (Index, 1990 = 100)

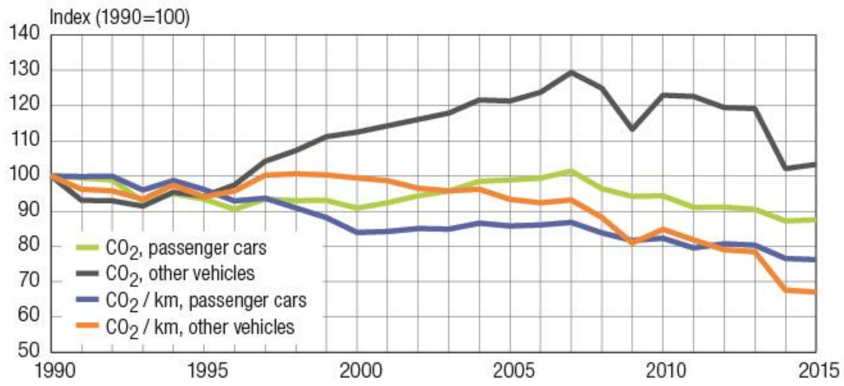
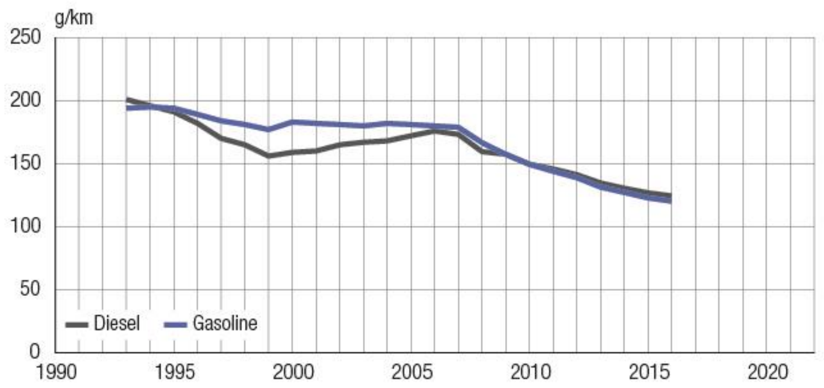


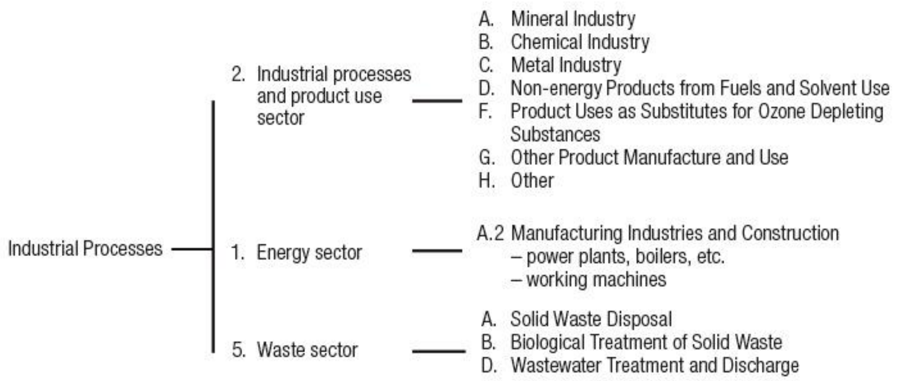
Figure 2.11 CO_2 emissions (g/km) of new registered cars (gasoline and diesel), 1993 to 2015



2.2.3 Industrial Processes and product use

Greenhouse gas emissions from industrial processes and product use contributed 11 per cent to the total greenhouse gas emissions in Finland in 2015, totaling 6.1 million tonnes CO_2 eq. The most important greenhouse gas emission sources of industrial processes and product use in 2015 were CO_2 emissions from iron and steel, hydrogen and cement production with 3.9, 1.4 and 0.8 per cent shares of total national greenhouse gas emissions, respectively. Emissions related to industrial processes and product use are reported also under the energy and LULUCF sectors (see Figure 2.12).

Figure 2.12 Reporting categories of emissions from industrial process sources in the national greenhouse gas inventory



CO_2 emissions were also generated in lime, glass, phosphoric acid, zinc, copper and nickel production, as well as in the use of limestone, dolomite, soda ash, lubricant, paraffin vax and urea-based catalyst. Small amounts of methane (CH_4) were generated in coke production in the iron and steel industry and nitrous oxide (N_2O) emissions were generated in nitric acid production and from product use. Indirect CO_2 emissions from CH_4 and NMVOC (non-methane volatile organic compounds) emissions are reported aggregated in national totals.

Fluorinated greenhouse gases, or F gases, are reported under industrial processes. They are used to replace ozone-depleting substances in refrigeration and cooling devices, as well as in air conditioning devices and as aerosols, and they accounted for 2.9 per cent of the total national greenhouse gas emissions and 26 per cent of the greenhouse gas emissions of industrial processes and other product use in 2015.

The emissions resulting from industrial processes and product (Figure 2.13) use are mostly affected by changes in production output, as they depend on the use of raw materials and production volumes.

The implementation of N_2O abatement technology in nitric acid production plants in 2009 has reduced the emissions from the chemical industry significantly. In the period from 1990 to 2015, the largest relative change occurred in F-gas emissions, which have increased about thirtyfold (Figure 2.14).

Figure 2.13 Greenhouse gas emissions from industrial processes, 1990 to 2015

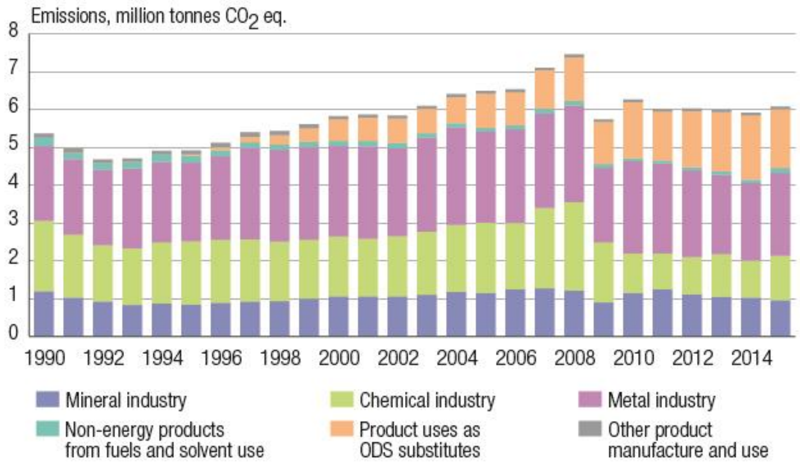
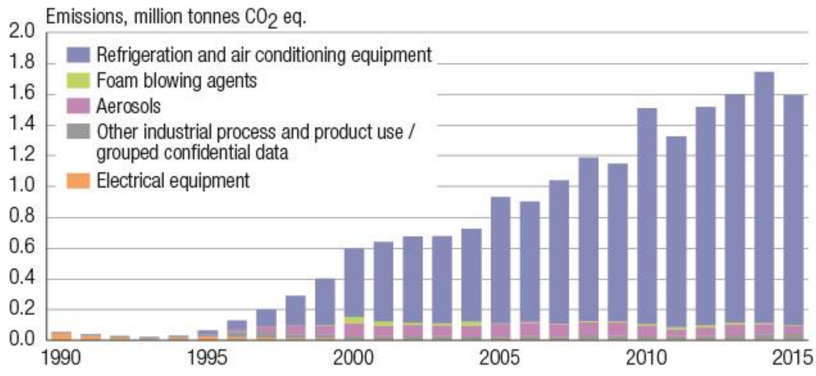


Figure 2.14 F-gas emissions, 1990 to 2015



Emissions of industrial processes and product use have increased by 13 per cent (0.7 million tonnes CO_2 eq.) since 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 1990 in 1996. After that the overall trend in emissions was increasing until the emissions decreased rapidly in 2009. The decrease was due to the economic downturn as the demand for industrial products diminished. Emissions started to grow again along with production after the recession in 2010 but have not reached the peak level in 2008.

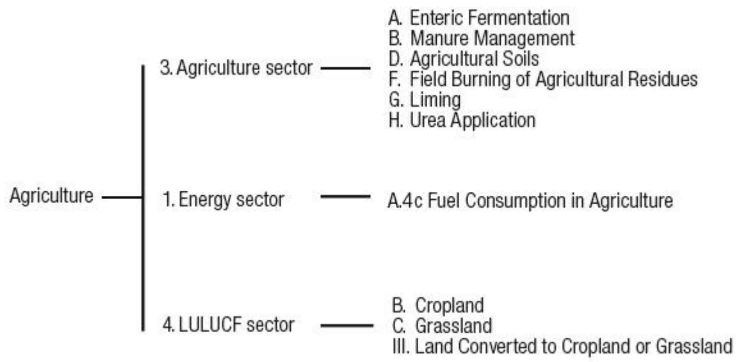
The CO_2 emissions were 15 per cent higher in 2015 than in 1990. The reasons are increased production of steel, hydrogen and use of limestone and dolomite. Methane emissions have decreased by 63 per cent, in the respective time period. Nitrous oxide emissions have fluctuated during 1990 to 2015. First, a fast decrease due to the closing of a nitric acid production plant and after that a slow increase of emissions. A second fast decrease that started in 2009 originated from the implementation of a new N_2O abatement technology in nitric acid production and the decreased demand of fertilisers. Since 1990, nitrous oxide emissions have decreased by 1.3 million tonnes CO_2 eq. (83%).

2.2.4 Agriculture

Emissions from the agriculture sector were approximately 6.5 million tonnes CO_2 eq. in 2015. Emissions reported under the agricultural sector include methane (CH_4) emissions from the enteric fermentation of domestic livestock, manure management and crop residue burning, as well as nitrous oxide (N_2O) emissions from manure management and direct and indirect N_2O emissions from agricultural soils and crop residue burning. Also CO_2 emissions from liming and urea fertilization are included.

Emissions related to agriculture are reported also in other sectors of the greenhouse gas inventory such as under the energy and LULUCF sectors (Figure 2.15).

Figure 2.15 Agricultural sources of emissions and their reporting in the CRF categories in the national greenhouse gas inventory

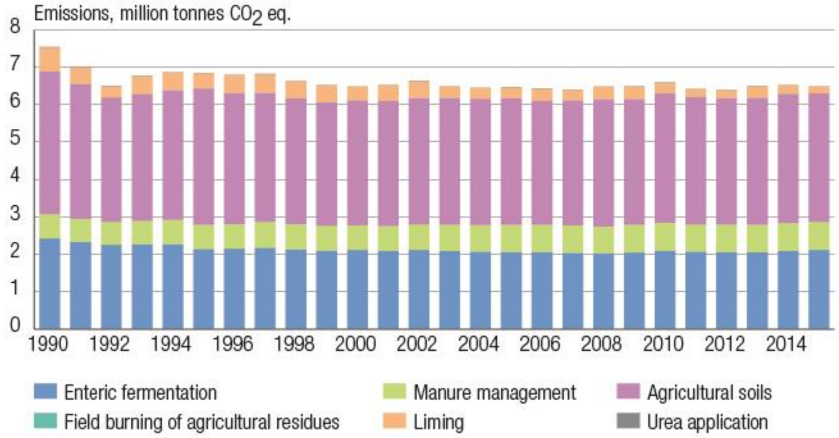


The agricultural sector accounted for approximately 12 per cent of Finland's total greenhouse gas emissions in 2015. In 2015, methane emissions from enteric fermentation were 33 per cent, methane emissions from manure management seven per cent, nitrous oxide emissions from manure management four per cent and nitrous oxide emissions from agricultural managed soils 53 per cent of total agricultural emissions. Liming and application of urea comprise three per cent of emissions, the share of field burning of agricultural crop residues totals 0.04 per cent.

Most of the CH_4 emissions from enteric fermentation are generated by cattle, but emissions generated by horses, pigs, sheep, goats, fur animals and reindeer are also reported. Most of the N_2O emissions from the agriculture sector are direct and indirect N_2O emissions from agricultural soils.

Emissions in the Agriculture sector have decreased by about 14 per cent over the period 1990 to 2015 (Figure 2.16). The reduced use of nitrogen fertilisers and improved manure management resulting from measures taken by farmers as part of an agri-environmental programme aiming to minimise nutrient loading to water courses have decreased the emissions. The amount of mineral fertilisers used has decreased by 37 per cent from 1990 to 2015, which is the most important factor in the emission reduction. The decrease in N_2O emissions from agricultural soils was 10 per cent in 2015 compared with the 1990 level. Structural changes in agriculture have resulted in an increase in farm size and a decrease in the numbers of domestic livestock. The decrease in the number of livestock is visible in the lower CH_4 emissions from enteric fermentation (Figure 2.16). The emissions have not decreased in proportion to the drop in the number of livestock, because milk and meat output and emissions per animal have increased.

Figure 2.16 Greenhouse gas emissions from agriculture, 1990 to 2015*



* The CH_4 and N_2O emissions from field burning of agricultural residues, as well as CO_2 emissions from urea application are very small and, therefore, not discernible in the figure.

2.2.5 LULUCF

Finland reports both greenhouse gas emissions and removals in the LULUCF sector. Removals refer to the absorption of CO_2 from the atmosphere by carbon sinks, such as plant biomass or soil. Changes in carbon stocks in six land-use categories covering the whole of Finland are reported in this sector. In accordance with the IPCC guidelines, the changes in different carbon pools, which include above and below-ground biomass, dead wood, litter and soil, are reported for each category. In addition, carbon stock changes of harvested wood products and emissions originating from other sources are reported in this sector, such as CH_4 and N_2O emissions from drained organic forest soils and managed wetlands such as peat extraction areas, emissions from the burning of biomass (forest fires and controlled burning), emissions from nitrogen fertilization of forest land and N_2O emissions resulting from land-use change. Emissions and removals are not reported for unmanaged wetlands and other land.

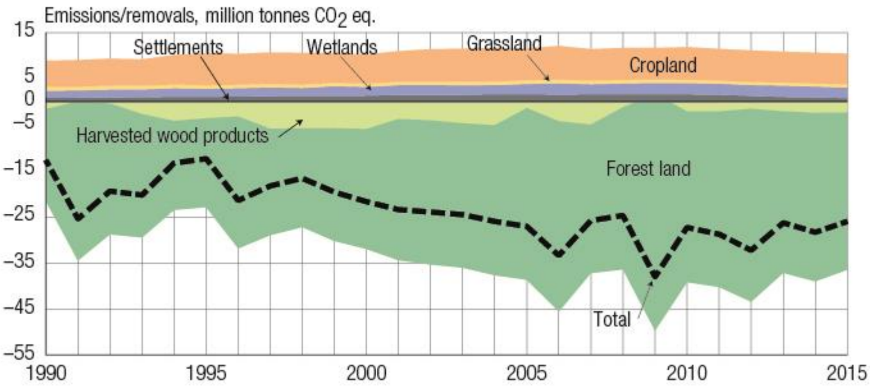
In 2015, the LULUCF sector as a whole acted as a CO_2 sink for –26.0 million tonnes CO_2 eq. because the total emissions resulting from the sector were smaller than the total removals. The sink in 2015 was 47 per cent of total national emissions excluding the LULUCF sector. In forest land, the largest sink in 2015 was tree biomass: –30.3 million tonnes CO_2 eq. Mineral forest soils were a sink of –12.0 million tonnes CO_2 eq., whereas organic forest soils were a source of 6.2 million tonnes CO_2 eq. Other emission sources in the forest land category are methane and nitrogen oxide emission from drained organic forest lands (2.0 million tonnes CO_2 eq.), nitrogen fertilisation (0.013 million tonnes CO_2 eq.) and biomass burning (0.002 million tonnes CO_2 eq.).

Forest growth has increased steadily since 1990 owing to factors such as the large proportion of young forest at a strong growth phase and silvicultural measures. Felling volumes have varied according to the market situation and demand. In 2015, roundwood removals reached 68 million m^3 being the highest ever. In Finland, all forests are classified as managed forests. Consequently, nature reserves are also included in the reporting.

Even though the LULUCF sector has clearly been a net carbon sink, the sector also produces significant emissions. The largest emissions come from drained organic soils of forests and croplands. Other emission sources in the LULUCF sector include grasslands, peat production areas, forest fires and nitrogen fertilization of forests.

The trend in emissions and removals from the different land-use categories reported in the LULUCF sector is presented in Figure 2.17.

Figure 2.17 Greenhouse gas emissions (positive values) and removals (negative values) in the LULUCF sector, 1990 to 2015



Harvested wood products

The Harvested Wood Products (HWP) pool was a net sink of 2.3 million tonnes CO_2 in 2015. HWP has been a net sink for the whole reported time series except in 1991 and 2009.

HWP is reported as a carbon stock change in production-based HWP stocks originating from wood harvested in Finland divided in two categories: HWP produced and consumed domestically and HWP produced and exported. HWP comprise of solid wood products (sawn wood and wood panels) and paper products (wood pulp). The production quantity of pulp was used as a proxy for paper and paperboard production. In Finland, 98.7 per cent of wood pulp is used for paper and paperboard production, and 1.3 per cent (part of dissolving wood pulp) for textile and hygiene products, which are exported (percentages are for 2013). Wood pulp production for other purposes than paper and paperboard started mainly in 2012. The annual change of HWP in domestic solid waste disposal sites (SWDS) is not calculated.

2.2.6 Waste

Methane (CH_4) emissions from landfills and CH_4 and N_2O emissions from biological treatment of solid waste and wastewater treatment are reported under the waste sector (Figure 2.18). Greenhouse gas emissions from the combustion of waste are reported fully in the energy sector, as waste incineration without energy recovery is almost non-existent. Waste sector emissions amounted to 2.1 million tonnes CO_2 eq. in 2015, which accounts for approximately four per cent of Finland’s total emissions.

CH_4 emissions from landfills are the most important greenhouse gas emissions in the waste sector. Solid waste disposal on land contributes nearly 83 per cent, wastewater treatment about 12 per cent and biological treatment (composting and anaerobic digestion) five per cent to the sector’s total emissions. Compared to 2014, emissions decreased by three per cent in 2015 and since 1990, these emissions have decreased by 54 per cent. A new Waste Act entered into force in 1994, which has led to a reduction in methane emissions from landfill sites (Figure 2.19). The Waste Act has cut back on the volume of waste deposited at landfills by promoting recycling and reuse, as well as energy use of waste materials. The recovery of landfill gas has also increased significantly since 1990. Currently, nearly one-third of the methane generated at landfills is recovered. The economic recession of the early 1990s also reduced consumption and waste volumes during that period. CH_4 emissions from landfills are expected to decrease further due to the implementation of EU and national policies and measures (see Chapter 4).

Figure 2.18 Reporting categories of emissions from waste handling in the national greenhouse gas inventory

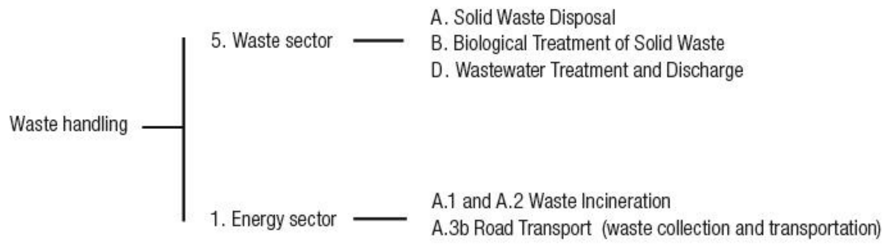
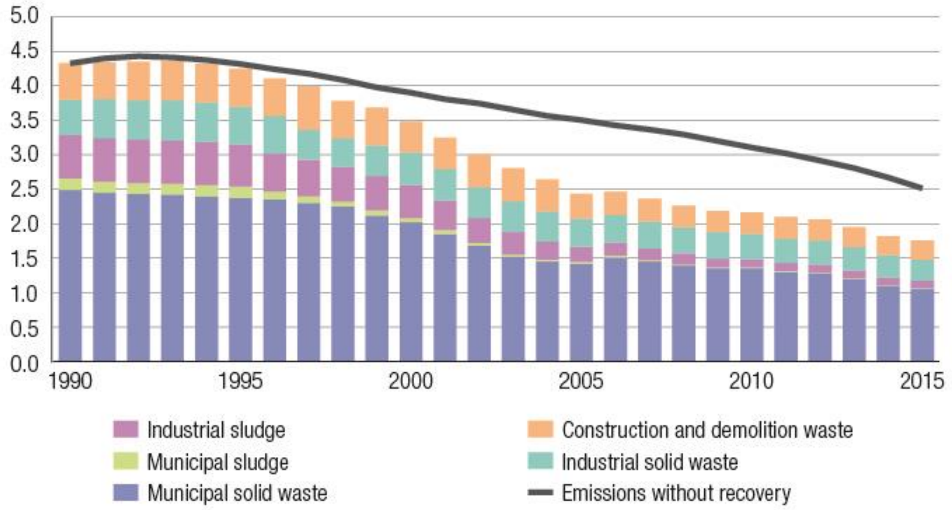


Figure 2.19 Methane emissions from solid waste disposal on land, 1990 to 2015



Emissions from wastewater treatment have also been successfully reduced by 15 per cent compared with the situation in 1990. The reduction in emissions has been affected by, for example, increasingly efficient treatment of wastewater (also in sparsely populated areas), as well as a lower nitrogen burden released from industrial wastewaters into bodies of water.

Emissions from composting have more than doubled since 1990, being five per cent of the waste sector's emissions in 2015. The reason for this is increased composting of waste, especially in semi-urban areas, due to separate collection of organic waste. Emissions from anaerobic digestion have also increased significantly in recent years due to the same reason as the increase in emissions from composting. Yet, this emission source is very small being 0.3 per cent of the waste sector's emissions in 2015.

2.3 National inventory arrangements

2.3.1 Institutional, legal and procedural arrangements

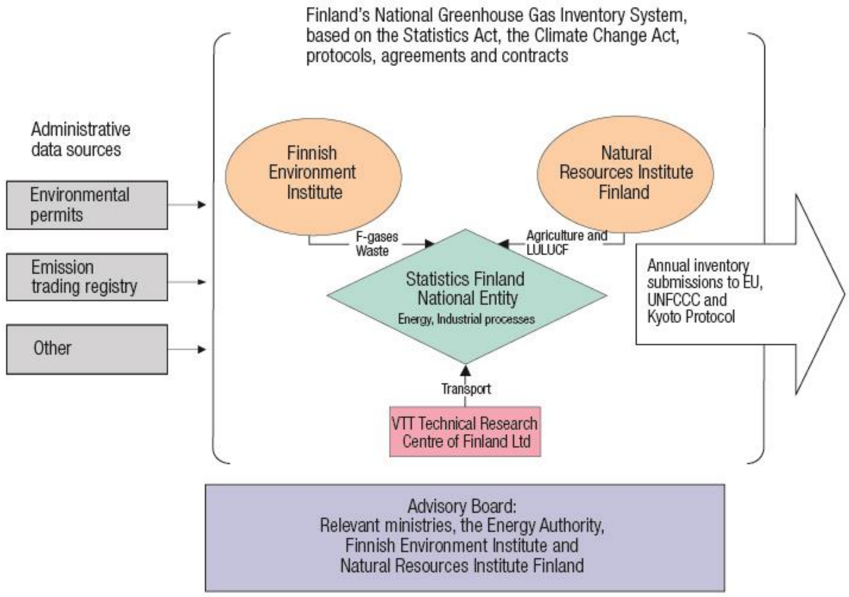
According to the Government resolution of 30 January 2003 on the organisation of climate policy activities of Government authorities, Statistics Finland assumed the responsibilities of the national entity for Finland's greenhouse gas inventory from the beginning of 2005. In 2015, the role of Statistics Finland as the national entity was enforced through the adoption of the Climate Change Act[4].

In Finland, the national system is established on a permanent footing and it guides the development of mission calculation in the manner required by the UNFCCC and the Kyoto Protocol. The national system is based on laws and regulations concerning Statistics Finland, on agreements between the inventory unit and expert organisations on the production of emission and removal estimates, as well as related documentation. Statistics Finland also has agreements on cooperation and support to the expert organisations participating in Finland's national system with relevant ministries. The national system is designed and operated to ensure the transparency, consistency, comparability, completeness, accuracy and timeliness of greenhouse gas emission inventories. The quality requirements are fulfilled by consistently implementing the inventory quality management procedures. The national system for the greenhouse gas inventory in Finland is presented in Figure 2.20.

The contact person for the national entity and its designated representative with overall responsibility for the national inventory at Statistics Finland is:

Dr Riitta Pipatti,
POB 6 A, FI-00022 Statistics Finland
Tel: + 358 29 551 3543
Email: riitta.pipatti@stat.fi

Figure 2.20 National system for the greenhouse gas inventory in Finland



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Statistics Finland as the national entity for the inventory

In its activity as the national entity for the greenhouse gas inventory, the Statistics Finland Act[5] and its amendment[6], and the Statistics Act[7] and its amendment[8] are applied. Statistics Finland defines the placement of the inventory functions in its working order. The advisory board of the greenhouse gas inventory set up by Statistics Finland ensures collaboration and information exchange in issues related to the reporting of greenhouse gas emissions under the UNFCCC, the Kyoto Protocol and the EU. The advisory board reviews planned and implemented changes in the inventory and the achieved quality. It approves changes to the division of tasks between the expert organisations preparing the inventory. In addition, the advisory board promotes research and review projects related to the development of the inventory and reporting, as well as gives recommendations on participation in international cooperation in this area (UNFCCC, IPCC and EU). The advisory board is composed of representatives from the expert organisations and the responsible Government ministries.

Statistics Finland is in charge of the compilation of the national emission inventory and its quality management in the manner intended in the Kyoto Protocol. In addition, Statistics Finland calculates the estimates for the energy and industrial processes (except for F gases: HFCs, PFCs and SF_6) sectors. 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, coordinates 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 the 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. The draft inventory submission to the EU on 15 January is presented to the advisory board, and before submitting the final inventory to UNFCCC on 15 April, the national inventory report is sent to the inter-ministerial network on climate policy issues for comments.

Responsibilities of the expert organisations

Finland's inventory system includes, in addition to Statistics Finland, the expert organisations the Finnish Environment Institute and the Natural Resources Institute Finland (Luke). Statistics Finland also acquires parts of the inventory as purchased services from VTT (VTT Technical Research Centre of Finland Ltd). Up to 2009, Finavia (former Civil Aviation Administration) provided emission data on aviation to the inventory. In 2010, Finavia's status in Finland's inventory system changed. Finavia no longer performs the calculations and is not responsible for the related calculations. Statistics Finland has overtaken this task and has been responsible for the calculations since 2010. Finavia continues to support Statistics Finland in the task by providing Statistics Finland with expert advice.

The agreements between Statistics Finland and the expert organisations define the division of responsibilities (sectors/categories covered) and tasks related to uncertainty and key category analyses, QA/QC and reviews. They also

[5] 48/1992

[6] 901/2002

[7] 280/2004

[8] 361/2013

specify the procedures and schedules for the annual inventory process coordinated by Statistics Finland. The responsibilities to estimate and report emissions/removals from different sectors/categories of the different expert organisations are based on established practices for the preparation and compilation of the greenhouse gas emission inventory. The scope of these responsibilities is presented in Table 2.1.

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 producing the estimates for the different reporting sectors, and ensures the implementation of the QA/QC and verification process of the inventory.

Table 2.1 Responsibility areas (Common Reporting Format category) and organisation

Area		Organisations
CRF 1.A.	Stationary sources, including 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), Finavia (inventory years 1990 to 2010)
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 (Luke)
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 (Luke)

The role of responsible ministries and the Energy Authority in the national system

The resources of the national system for the participating expert organisations are channelled through the relevant ministries' performance management (Ministry of the Environment and Ministry of Agriculture and Forestry). In addition, other ministries participating in the preparation of the climate policy advance in their administrative branch that the data collected while performing public administration duties can be used in the emission inventory.

In accordance with the Government resolution, the ministries are responsible for producing the information needed for international reporting on the contents, enforcement and effects of the climate strategy. Statistics Finland assists in the technical preparation of policy reporting. Statistics Finland technically compiles the National Communications and the biennial reports under the UNFCCC. Separate agreements have been made on the division of responsibilities and cooperation between Statistics Finland and the ministries.

The Energy Authority is the National Emissions Trading Authority in Finland. It supervises the monitoring and reporting of the emissions data under the European Emission Trading Scheme (EU ETS) and international emissions trading under the Kyoto Protocol. The Energy Authority provides the necessary information on emission reduction units, certified emission reductions, temporary certified emission reductions, long-term certified emission reductions and assigned amount units and removals units for annual inventory submissions in accordance with the guidelines for preparation of information under Article 7 of the Kyoto Protocol. This reporting is done using so-called standard electronic tables (SEF) and documentation provided in the National Inventory Report or made publicly available at the website of the Energy Authority. Statistics Finland and the Energy Authority have an agreement on the respective responsibilities.

2.3.2 Annual inventory process

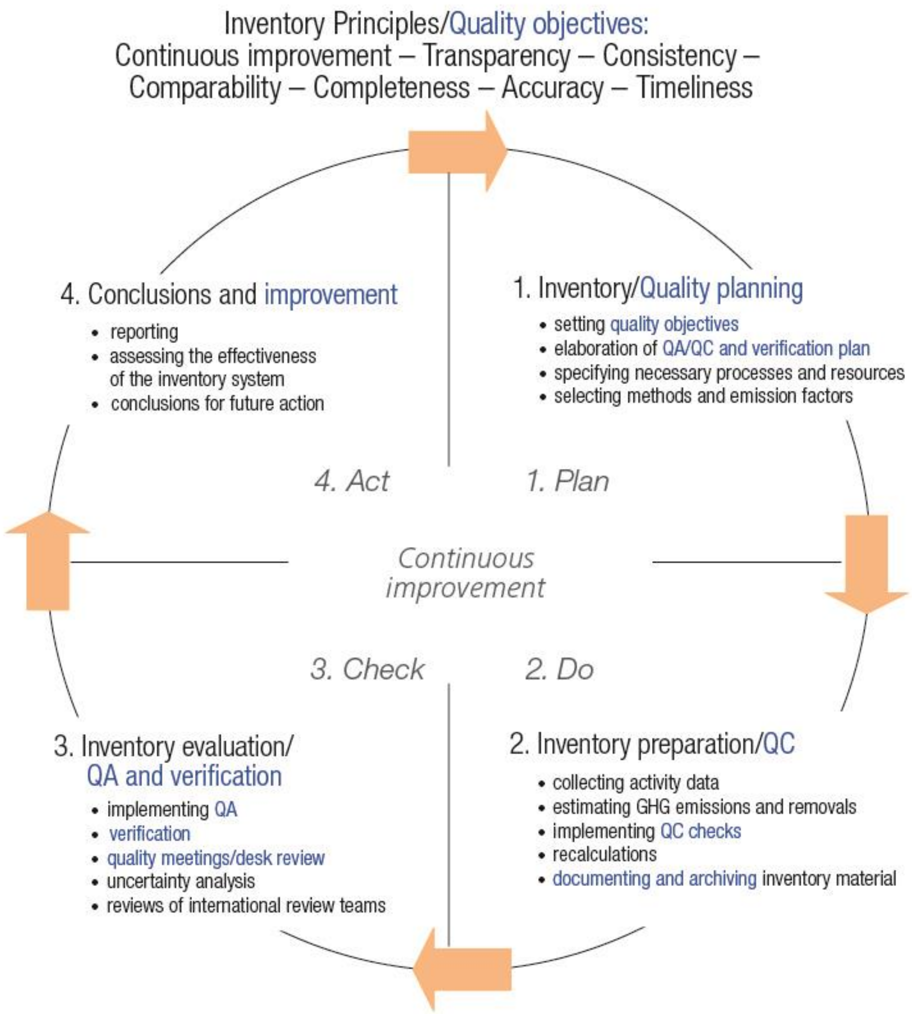
The annual inventory process set out in Figure 2.21 illustrates at a general level how the inventory is produced within the national system. The quality of the output is ensured by inventory experts during compilation and reporting. The quality control and quality assurance elements are integrated into the inventory production system, which means that each stage of the inventory process includes relevant procedures for quality management (see also Section 2.3.3).

The methodologies, collection of activity data and choice of emission factors are consistent with the guidance in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

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 the subcategories that are the most important in terms of level and trend of the emissions. This list forms the basis for discussions with the sectoral experts on the quality of the estimates and possible needs for improvement on the calculation methodology. 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.

Figure 2.21 Inventory process and QA/QC management of the inventory



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 Guidelines and the recommendations in the UNFCCC and EU 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 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.

2.3.3 Quality management

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

The starting point for accomplishing a high-quality GHG inventory is consideration of the expectations and requirements directed at the inventory. The quality requirements set for the annual inventories – transparency, consistency, comparability, completeness, accuracy, timeliness and continuous improvement – are fulfilled by implementing the QA/QC process consistently in conjunction with the inventory process (Figure 2.21). 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.

The inventory process consists of four main stages: planning, preparation, evaluation and improvement (PDCA cycle) and aims at continuous improvement. A clear set of documents is produced on the different work phases of the inventory. The documentation ensures the transparency of the inventory: it enables external evaluation of the inventory and, where necessary, its replication.

Statistics Finland has the overall responsibility for the GHG inventory in Finland, including the responsibility for coordinating the quality management measures at national level. The quality coordinator steers and facilitates the quality assurance and quality control (QA/QC) and verification process, and elaborates the QA/QC and verification plan. The expert organisations contributing to the production of emission or removal estimates are responsible for the quality of their own inventory calculations. Experts on each inventory sector implement and document the QA/QC and verification procedures.

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. 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 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.

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 annually, 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 the QA/QC and verification procedures performed, and the results of the procedures in the form. Discussions in the bilateral quality meetings or feedback given during the quality desk reviews are based on information documented on these forms.

Table 2.2 The quality objectives regarding all calculation sectors for 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 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 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 general and category-specific QC procedures are performed by the experts during inventory calculation and compilation according to the QA/QC and verification plan. 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 or quality desk reviews, internal and external audits, peer reviews, EU MMR comparisons and UNFCCC and EU inventory reviews. In addition, emission and activity data can be 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 that produce 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. The methodological changes are communicated to the advisory board for evaluation, and approved by the inventory unit before adopted into production (see also Section 2.3.2).

2.3.4 Changes in Finland's GHG inventory arrangements since BR2

Since the submission of Finland' Second 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.

Statistics Finland has updated most of its agreements with ministries and expert organisations to take into account the changes in the inventory preparation since 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 the second biennial report, Statistics Finland had updated the agreement with the Ministry of the Environment. During 2016-2017 the agreements with the Ministry of Employment and the Economy, the Ministry of Agriculture, the Natural Resources institute and the Finnish Environment Institute and the VTT Ltd were updated. The agreements with the Ministry of Transport and Communication/Transport Agency (Trafi) and the Energy Agency will be updated in 2017/2018.

Since 2017, Finland has changed the way how it conducts the annual internal quality meetings of greenhouse gas inventory. The national entity conducts quality meetings only for sectors or reporting areas with significant changes or planned improvements. For the other sectors and areas, the quality coordinator conducts quality desk-reviews (more details can be found in Finland's most recent national inventory report, Section 1.6). The aim of the change is to allow more time to be allocated for the assessment of significant changes and improvements in the time period during which the quality meetings and quality reviews need to be conducted.

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 2020[9]. 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). The most recent EU National Communication and its third Biennial Report give additional information on how the joint target is being fulfilled by the EU and its Member States.

Under the Climate and Energy Package 2020, 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[10], 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 Third Biennial Report under the UNFCCC.

The EU Effort Sharing Decision (ESD)[11] 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 onwards.

In 2017, the annual emissions allocation of the EU Member States were further adjusted[12] to take into account changes introduced by the implementation of the 2006 IPCC guidelines for national greenhouse gas inventories on the emissions levels in the inventory as these guidelines were applied in inventory reporting after the annual emission allocations under the ESD were agreed upon. The adjustments which in-creased Finland's annual emission allocations with more than one percentage unit will apply only to the ESD commitments for the years 2017 to 2020. Finland's target under the ESD, which is also Finland's contribution to the EU's joint target under the UNFCCC, is presented in detail in Table 3.1.

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[9] https://ec.europa.eu/clima/policies/strategies/2020_en

[10] Directive 2009/29/EC

[11] Decision 406/2009/EC

[12] Decision 2017/1471/EU

Table 3.1 Finland's target path for non-ETS emissions in accordance with the EU Effort Sharing Decision

	2013	2014	2015	2016	2017	2018	2019	2020
Finland's annual emission allocations including adjustments due to changes in the EU ETS coverage	31.8	31.3	30.8	30.3	29.8	29.3	28.8	28.4
Finland's annual emission allocations including also adjustments due to implementation of the 2006 IPCC guidelines					30.2	29.6	29 1	28.5

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)[13], 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. Information on mitigation actions by Finland to achieve its target in provided in Chapter 4. Section 4.8 addresses the progress Finland has made towards meeting its emission reduction target.

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.

3.2 Other emission reduction targets

3.2.1 Paris Agreement and the EU Climate and Energy Package 2030

The Paris Agreement was adopted in December 2015 and entered into force in November 2016. The EU ratified the agreement in October. The Finnish national ratification was completed in November 2016.

The EU's joint nationally determined contribution under the Paris Agreement is to reduce the greenhouse gas emissions by 40 per cent by 2030 from the 1990 level. The details of the effort sharing between the Member States, including Finland, are under preparation in the EU.

By the European Council conclusions in 2014, the EU is committed to reducing total greenhouse gas emissions by at least 40 per cent by 2030, compared to 1990. The reduction target from the 2005 levels in the emissions trading sector is 43 per cent and in the non-emissions trading sector it is 30 per cent. The share of renewable energy in the EU is to be increased by 27 per cent and energy efficiency improved, indicatively, by 27 per cent. Legislative proposals for implementation and effort sharing between the Member States have been presented by the Commission in 2015 and 2016. In addition to the reform of the EU's emission trading scheme ETS and the Effort Sharing on non-ETS emissions, for the first time also the land-use, land-use change and forestry sector will be included in the EU's climate policy package. In

[13] 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%.

the Effort Sharing Regulation, Finland's proposed target for emission reductions in 2030 compared to the 2005 level is 39 per cent. The legislative package includes flexibility mechanisms that allow Member States to achieve their targets in a cost-efficient manner. Negotiations on these legislative proposals are currently underway.

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.

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 target. 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 5,647 million tonnes of CO_2 eq in 1990 and 4,310 million tonnes CO_2 in 2015 that is 23.7 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 1990. In Finland, the corresponding emissions in 2015 were 55.6 million tonnes CO_2 eq (22.1 per cent lower than in 1990). Finland's emission trends 1990 – 2015 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 (policies and measures) planned, adopted and implemented for achieving the targets and commitments under Convention and EU's Climate and Energy Package 2020. A summary of the progress Finland has made towards its emission reduction target is presented in Section 4.7. 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.

The mitigation actions presented are based on the National Energy and Climate Strategy for 2030 and the Medium-term Climate Change Policy Plan. The Energy and Climate Strategy was presented by the Government in November 2016. The Medium-term Climate Change Policy Plan was approved in September 2017. The mitigation actions are presented separately for the 'With Measures' projection (WM) and the 'With Additional Measures (WAM)' projection (see Section 5.1).

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 described in Section 4.2 below and presented in CTF Table 3. Also, projections for the LULUCF sector are presented in Chapter 5.

4.2 Mitigation actions and their effects

The mitigation actions, or policies and measures, and their effects are presented in detail in CTF table 3 and described by sector in the sections below.

Finland has made efforts to improve the information on the effects of the policies and measures. For some policies and measures, the effects have been provided separately for the impact on total national emission and for the non-ETS sector. The these cases, the values for the non-ETS sector are provided in brackets in CTF Table 3. For some individual measures Finland has not been able to provide quantified estimates on the impacts on the national emissions. The are marked with NA (not avialable) in the CTF table 3. There are various reasons why it has not been possible to make the estimates, such as the complexity and overlaps with other measures (for example, the EU ETS), the measure is still in a phase where the details of implementation are not known (for example, measures related to international bunkers), the policy or measure targets heteregenious groups and/or many actors with different responses to the measure, or where measurement of the effect is difficult (for example, measures providing advice and information).

For measures targeting F gas emissions and measures in the waste sector, only aggregate estimates of the policies and measures are provided to avoid double counting and to improve the accuracy of the estimated effects. The impacts of the individual measures are marked with IE (included elsewhere) in the CTF Table 3 and the aggregated estimates are provided in separate rows.

4.2.1 Energy

Policies and measures in the WM projection

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

The 'with measures' (WM) projection includes all energy policy measures implemented before autumn 2016. 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 emissions.

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 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 efficient measures 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 sections. A list summarising the policies and measures and their effects can be found in CTF table 3. Energy taxation and tax-related subsidies are described in Section 4.3.

EU Emissions Trading Scheme

The EU ETS has been operating since 2005 and is the most important economic steering method for reducing emissions at both the domestic and EU level. The EU ETS is included in the WM projection. It is considered here as a domestic measure, even though entities with emission ceilings participating in the scheme acquire emission units (AAUs, CERs and ERUs) through trading. The EU ETS covered only CO_2 emissions until the year 2012, when N_2O and PFC emissions from certain industries were also included. In addition to emissions from energy production and use, the EU ETS also includes emissions from industrial processes. Industrial processes currently count for more than one tenth of EU ETS emissions in Finland (Table 4.1).

The share of EU ETS emissions with respect to the total greenhouse gas emissions in Finland was 46 to 50 per cent between the years 2013 and 2015 (Table 4.1). This share is clearly higher than the EU-28 average, which is around 40 per cent.

Table 4.1 Greenhouse gas emissions in the emission trading (ETS) sector and non-emission trading sector in Finland in 2005, 2008 to 2010, 2013, 2014 and 2015, million tonnes CO_2 eq. The ETS figures do not include emissions from aviation in the EU ETS as their coverage under the trading scheme is not consistent with the national greenhouse gas inventory. Also, total national emissions (also for 1990) and emissions from domestic aviation are presented.

	1990	2005	2008	2009	2010	2013	2014	2015
ETS	NA	33.1	36.2	34.4	41.3	31.5	28.8	25.5
of which energy	NA	29.6	31.8	30.9	37.3	27.6	25.1	21.6
industrial processes	NA	3.5	4.3	3.4	4.1	3.9	3.7	3.9
Non-ETS	NA	36.2	34.7	32.8	34.1	31.5	30.2	29.9
Domestic aviation	NA	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Total	71.3	69.6	71.2	67.4	75.7	63.2	59.1	55.6

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. A steady decrease is also foreseen in the future in the emissions from district heating and combined heat and power (CHP) production. Several condensing power plants have been decommissioned or moth-balled in recent years. The emissions from industry are not expected to change dramatically. Consequently, the EU ETS sector emissions are expected to decrease in the future. This is partly the result of the EU ETS making emission-free production of electricity and heat more competitive and partly the result of promotion of renewables and energy efficiency. However, some yearly variations to this trend can occur due to variations, for example, in the Nordic energy market and in weather conditions.

Energy efficiency

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

Energy efficiency agreements and energy audits (see below) and subsidies for developing and implementing energy efficient technology and innovative modes of operation are important for reaching the energy efficiency targets. The Government Decision also includes measures that aim to cause a behavioural change and, in the longer term, to effect a fundamental change in society through education, research and development.

Voluntary energy efficiency agreements

Since the 1990s, Finland has employed a voluntary energy efficiency agreement scheme for companies and municipalities. Voluntary measures, such as energy efficiency agreements, energy audits and sector or measure-specific programmes, have already resulted in significant energy savings. Energy efficiency agreements covered approximately 65 per cent of the total energy consumption in Finland at the end of 2016.

The third generation of energy efficiency agreements for industries, municipalities, property and building sector and the oil sector have commenced for the period 2017 to 2025[14]. They are mainly the responsibility of the Ministry of Economic Affairs and Employment. Responsibility for the action plan for rental housing properties in the property and building sector agreement lies in the Ministry of the Environment. These agreements are the successors of the second agreement generation in 2008 to 2016 (rental housing properties 2010 to 2016, commercial properties 2011 to 2016) and the first generation of agreements in 1997 to 2007 (then called energy conservation agreements).

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14 http://www.energiatehokkuussopimukset2017–2025.fi/en/

In 2010, an energy efficiency agreement was also launched in the agriculture sector under the Ministry of Agriculture and Forestry. The agreement was updated in 2016 for the period 2016 to 2020. Farms have received energy advice in the scope of the Farm Energy Programme in 2010 to 2015. In 2015 to 2020 energy advice is given in the sphere of the Rural Development Programme for Mainland Finland[15]. Energy efficiency measures in agriculture are farm reparcelling to cut down energy use in farm traffic, support to fresh grain silos where energy use for drying of grain is avoided as well as support to investments to unheated cattle buildings and heat recovery from pig slurry, see CTF Table 3.

Total annual savings in force from measures implemented under the energy efficiency agreements since 1997 within the industry, energy, municipal, property and building sectors were approximately 16.6 TWh per year at the end of 2015. Almost 85 per cent of these savings came from end use sectors and one fourth of the savings were electricity. The savings were equal to about 4.5 per cent of Finland's total energy consumption (362 TWh in 2015). Additional energy savings have been achieved as a result of the energy efficiency agreement for the oil sector, covering oil heated buildings, amounted to 1.4 TWh energy savings in 2015.

CO_2 reductions under the industrial, municipal, property and building, and oil sectors energy efficiency agreements were in total approximately 6.3 million tonnes CO_2 per year at the end of 2015 (based on a marginal emissions rate of 600 kg CO_2/MWh for electricity). It is estimated that by the end of 2020, the emissions reduction will be 7.9 million CO_2 tonnes per year, and 8.4 million tonnes per year by 2030 when taking into account the start of the new agreements period at the beginning of 2017 (see CTF Table 3).

The energy efficiency agreements are especially important for implementing the Energy Efficiency Directive (EED)[16]. Monitoring and calculation methods for energy efficiency agreements are described in Annex 2 of the National Energy Efficiency Action Plans (NEEAPs) of the Energy Efficiency Directive[17].

Energy audits

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

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

Since June 2014, energy audit activities are divided into two categories: mandatory energy audits for all large companies governed by the Energy Efficiency Act[18] based on the requirements in the EU Energy Efficiency Directive and voluntary subsidised energy audits for other operators (the Energy Audit Programme). Subsidies cannot anymore be granted for large companies under the mandatory energy audit requirement.

The Energy Audit Programme is a voluntary programme. The Ministry of Economic Affairs and Employment provides a 40 to 50 per cent subsidy for conducting energy audits on commercial and public buildings and in the industrial and energy sectors provided that the applicants do not fall into the scope of the mandatory audits. It also supports municipalities to carry out audits concerning the promotion of renewable energy use within the municipality's territory (Renewable Energy Municipal Audit). Apart from energy audits subsidised by the Ministry of Economic Affairs and Employment, there are energy audits intended for farms which are subsidised by the Ministry of Agriculture and Forestry.

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[15] The programme covers the territory of Finland excluding the Åland Islands

[16] 2012/27/EC

[17] https://ec.europa.eu/energy/sites/ener/files/documents/fi_neeap_2017_en.pdf

[18] 1429/2014

By the end of 2015, the estimated savings in energy achieved by conducting voluntary energy audits in the service, municipal and industry sectors were approximately 1.8 TWh per year. About 90 per cent of the savings originated in the industry sector. The corresponding CO_2 reduction was 0.56 million tonnes CO_2 per year (based on a marginal emissions rate of 600 kg CO_2/MWh for electricity). The emissions reduction of the energy efficiency measures conducted based on the proposals in the voluntary energy audits is estimated to be 0.33 million CO_2 tonnes per year by the end of 2020 and 0.28 million tonnes per year by the end of 2025. While a vast majority of the energy audits are implemented in connection with the energy efficiency agreements, overlap in energy savings and emission reductions has been removed in the estimates and the results are additive.

Monitoring and calculation methods for the voluntary energy audit programme are described for different sectors in Annex 2 of the National Energy Efficiency Action Plans (NEEAPs) of the Energy Efficiency Directive [29].

Renewable energy

Finland aims to increase the share of renewable energy in final energy consumption to 38 per cent by 2020 (this was reached in 2014 and the share was 39.3 per cent in 2015). This increase in the share has been achieved by reducing energy consumption and increasing the use of renewables. Forest-based fuels, liquid biofuels, wind power and heat pumps will contribute most to the target.

The sliding feed-in tariff system for the production of electricity from renewable energy sources came into force on 25 March 2011 under a Government Decree (Production Aid Act). The subsidy varies on the basis of a three-month electricity market price or the market price of emission allowances. The aid scheme concerns government support for electricity production based on wind power, biogas, forest chips and other forest-based fuels.[19]

The Production Aid Act was amended in 2015 in order to ensure a controlled closure of the feed-in tariff scheme. In August 2017, some 2,000 MVA of wind power had been approved for the feed-in tariff scheme. Due to the amendments made to the Production Aid Act, the total capacity of wind power plants approved to the feed-in tariff scheme will not reach the original target of 2,500 MVA, but is estimated to be approximately 2,300 MVA.

Finland’s first offshore wind farm was granted a EUR 20 million investment subsidy in 2014 and was completed in 2017 having a total capacity of 40 MW. This project aims to demonstrate 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.

The objective is to increase the production of wind power to five TWh by the year 2020. In 2015, the wind power production was approximately 2.3 TWh and in 2016 approximately 3.1 TWh.

The effect on emissions has been estimated based on the assumption that wind power reduces the need to produce electricity mainly in condensing power plants using fossil fuels and peat (for more information on the IMPAKTI calculation tool used to estimate the emission reduction impacts of renewables, see Section 5.8). Using a marginal emission coefficient of 600 t CO_2/GWh, the promotion of wind power will reduce the emissions in 2020 by three million tonnes CO_2 (see CTF Table 3). The reduction will occur totally in the ETS sector. The estimate includes the impact of all policies and measures promoting wind power (including the impact of the feed-in tariff).

Increasing the use of forest chips in multi-fuel boilers is the most central and cost-efficient way of increasing the use of renewable energy in the generation of power and heat. The use of forest chips will replace the use of other fuels (mainly peat) in heat and power production and heating oil on farms. The estimated emission reduction achieved due to the use of forest chips is 7.6 million tonnes in 2020 and 9.9 million tonnes in 2030.

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

[19] 258/2011

management.

Other measures to promote renewables include improving the logistics for harvesting and transporting forest chips and furthering the emergence of local heat entrepreneurs. Wind power will be advanced by reducing barriers for wind power investment and by enabling demonstration projects for off-shore wind power. The historic use of and WM projection for renewable energy in Finland is shown in Figure 4.1 and Table 4.2.

Figure 4.1 Historic development and WM projection for renewable energy, TWh

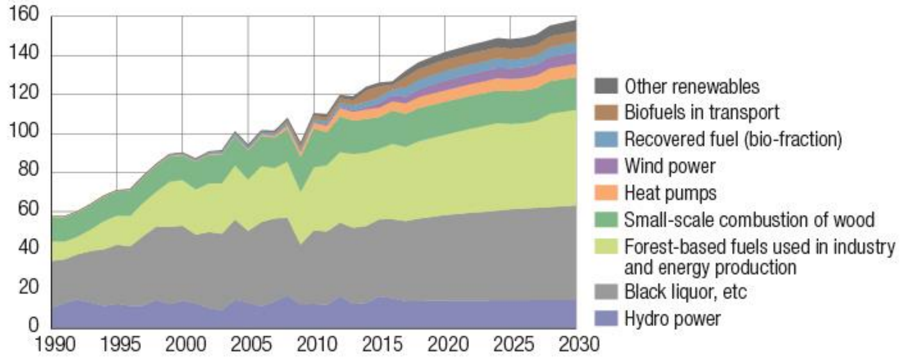

Table 4.2 Historic development and WM projection for renewable energy, TWh

	2005	2010	2015	2020	2025	2030
Black liquor and other concentrated liquors	36.7	37.7	39.5	44	47	48
Industrial wood residues	21.2	19.8	21.7	21	22	24
Forest chips	6.0	13.8	15.8	22	24	29
Small-scale combustion of wood excl. forest chips	14.2	18.6	14.9	17	17	17
Hydro power	13.4	12.7	16.6	14	15	15
Heat pumps	0.6	2.9	4.8	6	6	7
Wind power	0.2	0.3	2.3	5	5	6
Biofuels for transport	0.0	1.7	5.7	6	6	5
Recovered fuel (bio-fraction)	1.3	1.7	3.2	5	5	5
Other renewables	0.7	1.3	1.6	2	2	2
Total	**94.3**	**110.5**	**126.1**	**142**	**148**	**158**

Renewable energy policies and measures for the transport sector are described in Section 4.2.2.

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 72 TWh in 2015 (25 per cent of the total end use of energy). Slightly less than 30 TWh of the space heating belongs to the non-ETS sector. Non-ETS CO_2 emissions from the energy used to heat buildings have been less than 3.5 million tonnes annually. These emissions mainly cover the use of light fuel oil (and to a very small extent, natural gas) in buildings, as well as the fuels used in small district heating plants. The non-CO_2 emissions from energy use in buildings are much smaller, approximately 0.2 million tonnes CO_2 eq. annually. Most of these emissions are CH_4 emissions from wood combustion.

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

The Directive on the Energy Performance of Buildings (EPBD)[20] aims to reduce CO_2 emissions by improving the energy efficiency of buildings. The directive was implemented in Finland by a regulation that came into force at the beginning of 2008. This legislation on the energy efficiency of buildings includes the following:

- Act on Energy Certification of Buildings[21]
- The Ministry of the Environment Decree on Energy Certification of Buildings[22]
- Act on Inspection of Air-conditioning Systems[23]
- Amendments to the Land Use and Building Act,[24] which was expanded to cover energy efficiency requirements and details on how energy efficiency should be calculated[25].

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 (2003) 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).[26] The 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 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, the regulation for the energy efficiency of the existing building stock was given in February 2013 and this Ministry of the Environment Decree[27] on improving the energy performance of buildings undergoing renovation or alteration came into force in June 2013.

The Government has supported energy efficiency improvements in renovation and investment in low-carbon heating systems through various subsidies. Low-carbon heating systems utilise renewable energy sources, especially ground heat and forest-based energy (pellets, small-scale firewood). Due to the overall reductions in the Government’s budget, these subsidies have now been ceased.

The State also supports the low-income households with an optional subsidy of 25 per cent covering costs for improving energy economics and using renewable energy sources in heating. A tax incentive scheme for domestic employment of various service providers has been in effect since 2001. A household may deduct 15 per cent of personnel salary costs or 45 per cent of company-provided services from personal taxation. Although the deduction can be applied to various type of work carried within a household, the emphasis has been on encouraging households to make improvements and alterations in heating system and installing systems using renewable energy sources. At the moment, the annual maximum for tax deduction is EUR 2,400/person.

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[20] 2002/91/EC

[21] 487/2007

[22] 765/2007

[23] 489/2007

[24] 1129/2008

[25] 488/2007

[26] 2010/31/EU

[27] 4/2013

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 building maintenance issues.

Systematic and well-timed building 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 increases rapidly in Finland and will continue to do so in the next two decades. The reason is that, among other things, a large amount of the building stock needs improvements in their physical condition or in their energy efficiency. Such an increase in repair and renovation work will require considerable development and changes in the property and building sectors. In order to address the expected challenges, the Ministry of the Environment has 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 to 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 ongoing. In 2015 a follow-up was made. As a result, many effective actions were recognised and the programme was estimated to have reached its aims in a good manner. For the following years, focus areas were defined: promoting planned real estate management, improving the cost efficiency and customer-orientation of renovation services and developing skills for repair work and its education.

Improving the built environment, including the transport systems, thus plays a key role in reducing greenhouse gas emissions and mitigating climate change. The Energy-Smart Built Environment 2017 (ERA17) action plan originally proposed 31 necessary actions for reducing emissions in the built environment, for improving energy efficiency and for promoting the use of renewable energy. The overall target of the programme is to create an ‘energy-smart built environment’ that is energy-efficient and low in emissions and that provides a high-quality living and working environment. The action plan combined simultaneous and former programmes and was drawn up as a joint effort by the Ministry of the Environment, the Finnish Innovation Fund (Sitra) and the Finnish Funding Agency for Technology (Tekes) and in collaboration with the business sector, research institutions and the public administration. The programme has focused on land use, decentralised energy production, building policies, use and ownership of real estate and know-how for the years 2013 to 2014. The actions within the programme were continued for 2015 to 2017. The programme is ongoing and it ends in 2017. For the last year of action, weight is put on spreading good practices and assessing the procedure.

The emission impacts of building-related policy measures have been evaluated using EKOREM and POLIREM calculation models (see Section 5.8) 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 (235 kg CO_2/MWh) and with a mean marginal emission coefficient in the case of electricity (600 kg CO_2/MWh).

The emission reduction impacts of the policy measures are presented in Table 4.3. The regulation for the energy performance of new buildings entails the largest emission reductions, namely 3.8 million tonnes CO_2 by 2020 and 6.7 million tonnes CO_2 by 2030. Most of the emission reduction will take place in the EU ETS sector through the reduced use of electricity and district heat.

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 to 2012.

Due to the implementation of the Directive on the Energy Performance of Buildings (Recast), the regulation for the energy efficiency of the existing building stock was put into effect on 27 February 2013. It is estimated that the emission reductions due to improvements in energy performance in renovations and alterations will be 0.4 million tonnes CO_2 in 2020 and 1.0 million tonnes CO_2 in 2030. Energy efficiency improvements are related to the normal lifecycle of buildings and are thus realised during long periods of time in connection with other renovations and alterations. Most of the emission impact is due to the reduced use of district heating and electricity produced in the ETS sector. It is estimated that the emission reductions in the non-ETS sector will be quite modest, namely 0.06 million tonnes CO_2 in 2020 and 0.1 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.

Building 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.

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

Policies and measures in the WAM projection

Renewable energy supply

Operating aid for renewable energy based on a tendering process will be introduced as a transition period solution. In 2018 to 2020, a tendering process that concerns electricity production of two TWh will be organised. The details of the tendering process will be published later.

Energy use in residential and other buildings

In the building sector, additional measures are under preparation. Nearly zero-energy (NZEB) regulations for new buildings will enter into force in 2018. According to the Government report on the National Energy and Climate Strategy for 2030 there is an obligation to blend 10 per cent of bioliquids into light fuel oil used for heating of buildings. A decision of the types of policy instruments which are going to be applied to fulfil this PAM have not been made yet. A commitment to phase out oil heating in the public sector is included in the Medium-term Climate Change Policy Plan.

Machinery

The Government report on the National Energy and Climate Strategy for 2030 includes an obligation to blend 10 per cent of bioliquids into light fuel oil used for machinery. A decision of the types of policy instruments which are going to be applied to fulfil this PAM has not been made yet.

Additional measures are included in the Medium-term Climate Change Policy Plan, mainly to improve energy efficiency. The measures include, for example, the following:

- Promotion of biogas in machinery
- Changes in the taxation of light fuel oil
- Promotion of energy efficient and low emission machinery through public procurements
- Promotion of energy efficient use of machinery through information and advisory action
- Strengthening of the information base related to machinery.

Phase-out of coal

The National Energy and Climate Strategy for 2030 outlines that Finland will phase out the use of coal for energy by 2030. No new power plants burning hard or brown coal will be built, nor will any replacement investments based on coal be made. Once the existing plants based on pulverised fuel combustion have been decommissioned, coal will only be used as a backup fuel in exceptional situations.

During the current government term, a bill will be prepared for the transition period during which the use of coal for energy use is phased out. The bill will take into account aspects related to the security of energy supply and emergencies.

There has been a declining trend in the use of coal for energy for over 10 years, and the calculations of the basic scenario indicate that this trend continues. Without additional measures, the share of coal is estimated to be some 1 to 2 per cent of the total energy consumption, i.e. 3 to 7 TWh, in 2030.

Summary of policies and measures

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

4.2.2 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 in June 2016. 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 compared to 2005. The measures also contribute to achieving the EU's Effort Sharing Decision target.

The WM projection contains the following measures: 1) promoting the use of biofuels within the transport sector, 2) improving the energy-efficiency of vehicles, and 3) improving the energy-efficiency of transport system by promoting the choices of more environmentally friendly modes of transport and curbing the growth of vehicle kilometres. It is assumed that the growth in transport performances needs to stay at a moderate level (0.5 to 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 based on, for example, the results of the LIPASTO calculation model, which is the model used to estimate emissions from the transport sector for the greenhouse gas inventory. The methods used for impact assessment are documented in Finland's second National Energy Efficiency Action Plan (NEEAP 4).

Promoting the use of biofuels

The amendment to the national act on promoting the use of biofuels within the transport sector[28] came into force on 1

[28] 446/2007

January 2011. The biofuel distribution obligation was six per cent for 2011 to 2014, followed by a phased increase to 20 per cent by 2020. The energy content of second-generation biofuels (biofuels produced, for example, from waste material) is taken into account as double its actual energy content when calculating the share of biofuels for the purposes of the distribution obligation.

In 2015, approximately 12 per cent of all transport fuels used were biofuels in actual terms. The measure achieved an estimated 1.5 million tonnes CO_2 reduction in transport-related greenhouse gas emissions in 2015. It is expected that biofuels will account for 20 per cent (double counting included) of all fuels consumed in transport in 2020. This would consist of first-generation biofuels (seven per cent of all road transport fuels sold) and second-generation biofuels (6.5 per cent of all road transport fuels sold). Biofuels would, in other words, replace 13.5 per cent 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 road transport biofuels would be 20 per cent. This means that the related emission reduction in the transport sector would be an estimated 1.6 to 1.7 million tonnes of CO_2 in 2020 depending on the eventual biofuels consumption.

Improving the energy-efficiency of vehicles

In the Climate Policy Programme for the Transport Sector, the aim for improving the energy-efficiency of vehicles is that by 2020 specific emissions of new cars sold in Finland would be near the EU target (95 g/km; the current level in 2015 was at around 124 g/km and in 2016 around 121 g/km), and that the rate of vehicle fleet renewal would be around six to seven per cent a year. In the updated programme, the target is also that 50 per cent of new cars sold will be able to use alternative fuels in 2020.

The regulation of the European Parliament and of the Council[29] setting emission performance standards for new passenger cars (a binding CO_2 standard for passenger cars) entered into force in June 2009. The objective of the regulation is to establish manufacturer-specific emission performance standards for new passenger cars registered in the Community. It sets the target for the average CO_2 emissions for new passenger cars at 95 g/km by 2020. A corresponding regulation[30] for light commercial vehicles 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 Union. Furthermore, the European Commission has initiated the work for proposals for CO_2 emission targets for new cars for the period beyond 2020 until 2030. The Commission is also making preparations for legislation on monitoring and reporting of heavy-duty vehicle fuel consumption and CO_2 emissions.

In Finland, the tax on passenger vehicles consists of several elements that are differentiated according to vehicle-specific emissions (CO_2 g/km). Initially, at the event of the first registration, a one-time tax (“Car Tax”) is paid. For that registration tax, the lowest tax rate (3.8 per cent) applies to cars with zero CO_2 emissions, while the highest tax rate (50 per cent) applies to cars with CO_2 emissions exceeding 360 g/km. Furthermore, the basic part of the vehicle tax, which is paid annually, is also differentiated according to CO_2 emissions of each vehicle similarly to the registration tax. This basic part of the emission-based annual vehicle tax is EUR 106 to 654 per year, depending on the car’s specific CO_2 emissions. The second part of the annual tax is based on the type of fuel the cars uses. Petrol-fuelled cars have no additional tax. Cars fuelled with diesel, methane or electricity have an additional annual tax (fuel fee) that is relative to the mass of the car (“mass in running order”), but not to the specific CO_2 rate itself. However, the CO_2 rate and vehicle mass have a certain correlation.

Finland has also been active to provide people with more information about the CO_2 emissions of passenger cars. Examples of this include the energy label for cars, the online car comparison engine produced by the Finnish Transport Safety Agency Trafi, which enables potential car buyers or used-car owners to compare different car models based on

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[29] 2009/443/EU

[30] 2011/510/EU

fuel consumption and CO_2 emissions[31] and the Choosing a Car website[32].

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 can be as much as 2.1 million tonnes in 2020.

During the period 2007 to 2015, the average CO_2 emissions of new cars decreased by some 30 per cent. The average CO_2 emissions in 2015 were 123 g/km for new petrol-driven passenger cars and 127 g/km for diesel-driven passenger cars (see Chapter 3, Figure 3.11). A total of some 109,000 new cars were sold in 2015 (the goal was 150,000). The emission reduction effects of new low-emission cars were estimated at approximately 0.2 million tonnes CO_2 in 2015 and 0.3 million tonnes CO_2 in 2016.

Improving the energy-efficiency of the transport system

According to the Climate Policy Programme for the Transport Sector, the energy efficiency in transport should be improved. This can be achieved through means such as energy efficiency agreements (2008–2016), eco-driving, and public sector vehicle and transport service procurement. Energy efficiency in the transport sector can also be improved by developing new services. Intelligent transport and the use of information technology (IT) will help to improve both the traffic safety and fluency as well as achieving the environmental targets in the transport sector. It also creates significant business opportunities for companies.

At the beginning of 2017, the energy efficiency agreements in the transport sector were substituted with the Responsibility Model[33], the target of which is to promote responsible and sustainable transportation. The Responsibility Model is a voluntary based management system taking into account finance, safety, quality and environmental aspects, including energy efficiency. The Responsibility Model has been developed by the transport administration in cooperation with the transport sector.

In 2013, the Ministry of Transport and Communication prepared a decree[34] on new maximum masses and dimensions of heavy goods vehicles and vehicle combinations. The decree raises the maximum allowed height of a vehicle from 4.2 to 4.4 meters and the maximum allowed mass from 60 to 76 tonnes. The decree entered into force on 1 October 2013. The goal of this update was to improve the energy efficiency in road freight transport and consequently to improve Finland's economic competitiveness as well. The update is also estimated to reduce the total CO_2 emissions in the transport sector by around 1.5 per cent annually.

According to the National Energy and Climate Strategy, the aim is to reduce the number of car journeys with no passengers but only the driver, and to halt the increase in the use of passenger cars in urban areas regardless of growth in population. For that aim, the current self-service market, where people own a vehicle and self-cater for their transport and mobility needs, has to be replaced by a service market, where people do not own vehicles anymore, but buy transport and mobility services.

In practice, the development of new service models and the revolution of the transport market will be promoted by reforming and relaxing the current legislation on the transport market through the introduction of a unified regulatory act (Transport Code). The Transport Code will provide a better response to user needs, facilitate companies' access to the market and promote the interoperability of different parts of the system. At the same time, the deployment of new technologies, digitalisation and new business concepts will be encouraged. The reform will be implemented in three stages. The first stage includes provisions on road transport and better interaction between all modes of transport. Later stages include provisions on air, sea and rail transport markets, as well as on transportation services. The first phase of the reform is intended to enter into force on 1 July 2018, to enable the transport sector to prepare for the new rules. The

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31 http://autovertaamo.trafi.fi/?lang=en

32 https://www.motiva.fi/ratkaisut/kestava_liikenne_ja_liikkuminen/nain_liikut_viisaasti/valitse_auto_viisaasti (only in Finnish)

33 https://www.trafi.fi/en/road/commercial_transport/responsibility_model_for_road_transport_enterprises

34 407/2013

Transport Code envisages that essential data on transport services are made open, laying down provisions for the interoperability of different ticket and payment systems. This is expected to facilitate combinations of different transport services.

Another measure to improve the energy efficiency of the transport system is to coordinate transport and land use as well as promote the conditions for walking, cycling and public transport, especially in urban areas. The target is a 30 per cent increase in the number of journeys taken by walking and cycling by 2030, and a notable reduction in the short-range car use.

Finland's Public Transport Act[35] was reformed in 2009 to comply with the requirements of the EU's 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 the transition period, competent authorities must organise public transport in their area. In the implementation of the Public Transport Act, particular attention is paid to introducing a nation-wide 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 passenger rate of public transport. The year 2016 was record breaking for public transport in large and mid-sized cities: the number of public transport journeys increased by as much as 14 per cent. A national strategy and implementation plan for the promotion of walking and cycling, covering the period 2011 to 2020, was released in 2011. This strategy is aimed at increasing the share of trips made walking or cycling. The target is that by 2020, the share of walking and cycling rises from the current 32 per cent to 35 to 38 per cent in the modal split, and the proportion of short trips made by passenger cars decreases correspondingly.

The popularity of public transport, walking and cycling is also promoted through Mobility Management, which was made a national-level project in 2010. Mobility Management is a broad concept, the objective of which is to reduce dependence on the private car for personal transport. The basic means of achieving this are offering better information about alternative transport modes and more attractive services. The central aim is to encourage actors that generate traffic to develop various ways to promote public transport, cycling, walking, car pooling and car sharing. The Mobility Management work at the regional level has been supported through R&D calls for projects, and through a EUR 0.9 million appropriation included in the 2015 and 2016 Budgets.

Policies and measures in the WAM projection

CTF Table 3 sets out the main policies and measures included in the WAM projection for the transport sector. The WAM projection is based on the National Energy and Climate Strategy for 2030 and contains the following measures: 1) promoting the use of biofuels in the transport sector (additional measure), 2) improving the energy-efficiency of vehicles (additional measures), and 3) improving the energy-efficiency of the transport system (additional measure).

Promoting the use of biofuels (additional measure) includes increasing the physical share of biofuel energy content in all fuels sold for road transport (30 per cent by 2030). It has been estimated that the additional potential emission reduction effects of the use of biofuels in the transport sector will be as much as 1.5 million tonnes CO_2 by 2030.

Improving the energy-efficiency of vehicles (additional measures) includes very stringent CO_2 standards for new cars and light commercial vehicles (i.e. reaching 64 g CO_2/km for cars and 106 g CO_2/km for light commercial vehicles in 2030). It has been estimated that the emission reduction effects of improving the energy-efficiency of vehicles will total around one million tonnes CO_2 by 2030.

Improving the energy-efficiency of the transport system (additional measure) includes reducing the number of car journeys with only the driver, and to halt the increase in the use of passenger cars in urban areas regardless of a growth in population. It has been estimated that the emission reduction effects of improving the energy-efficiency of the transport system will be as much as 0.3 million tonnes CO_2 by 2030.

[35] 869/2009

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

4.2.3 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. At the ICAO Assembly in October 2016, a global carbon offsetting scheme for international aviation was adopted. By this decision, aviation became the first industrial sector to have a global market-based measure scheme in place. Under the Carbon Offsetting Scheme for International Aviation (CORSIA), aircraft operators will be required to purchase offsets for the growth in CO_2 emissions covered by the scheme. CORSIA aims to address any annual increase in total CO_2 emissions from international civil aviation above 2020 levels.

In July 2011, 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 regulation has 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[36] of Finland at the end of 2014. The impacts of these measures on the emissions of ships have not yet been evaluated.

At EU level, the Regulation on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport (MRV Regulation)[37] entered into force in 2015. In August 2017, companies shall submit ship-specific monitoring plans to verifiers for approval. The first monitoring year will be 2018. From 2019, by 30 April each year, companies shall submit to the Commission verified annual emission reports. Aviation has been included in the EU emissions trading scheme (EU ETS) since 2012. Between 2013 and 2016, the EU ETS covered flights between aerodromes located in the member states of the European Economic Area. In February 2017, the European Commission proposed to continue the intra-EEA scope beyond 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 three per cent reduction below the 2005 level of aviation CO_2 emissions in 2012, and will deliver a five per cent reduction below the 2005 level of aviation CO_2 emissions for the period 2013 to 2020.

As a member of the European Union, Finland is implementing the EU ETS for aviation. In 2016 Finland issued 493,036 aviation emission allowances free of charge to aircraft operators administered by the Finnish Transport Safety Agency and sold 110,500 aviation emission allowances at the common auction platform. Intra-EEA emissions of aircraft operators administered by Finland amounted to 988,675 tonnes of CO_2 in 2016. The Ministry of Transport and Communications is actively involved in EU policymaking to enhance the effectiveness of the EU ETS for aviation.
As a Member of the EU and European Civil Aviation Conference ECAC, Finland has submitted its State Action Plan

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[36] 1113/2014

[37] 2015/757/EU

for International Aviation CO_2 Emissions in order to communicate to ICAO information on Finland's activities to address CO_2 emissions from international civil aviation.

Policies and measures in the WAM projection

The Directive of the European Parliament and of the Council on the deployment of alternative fuels infrastructure entered into force in October 2014[38]. According to the Directive, all Member States must draft a national policy framework for the development of an alternative transport fuel market and deployment of a related infrastructure by November 2016. The national policy framework must specify the alternative transport fuels and their distribution infrastructure targets for 2020 and 2030 as well as the measures by means of which the targets will be achieved.

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.

The working group's proposal for a plan for a distribution network for alternative transport fuels was published in November 2016. According to the proposal, in maritime transport the objective is to decrease greenhouse gas emissions by 40 per cent by 2050 (compared to 1990) with measures including the use of LNG (liquefied natural gas) and biofuels. In aviation the objective is 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.

At IMO member states have come to an agreement on a three-step approach to decreasing greenhouse gas emissions from international shipping. The first step is to compile data on fuel consumption, following the mandatory data collection system (DCS). The second step is to analyse the data and the third step is to consider how to reduce GHG emissions from international shipping. During the Marine Environment Protection Committee session (MEPC70) in 2016 IMO member states also approved a Roadmap for Developing a Comprehensive IMO Strategy on Reduction of GHG emissions from Ships. The Strategy should be finalised by MEPC72 in 2018. According to the Roadmap, by 2023 IMO member states should come to an agreement on a final strategy on short, medium, and long-term measures, taking into account the results from the IMO Data Collection System.

The Black Carbon (BC) emissions also have a huge impact on climate change, especially in the polar areas. Finland is committed to decreasing BC emissions in the polar regions and supports legally binding regulations on black carbon that are currently lacking in the Polar Code. The Finnish Transport Safety Agency Trafi together with the Finnish Meteorological Institute (FMI) and VTT Technical Research Centre of Finland Ltd are conducting studies to test the candidate measuring methods and collect data on BC emissions from shipping. Preliminary results are introduced in IMO, but more research work is needed before any regulations to limit BC emissions can be considered.

Summary of policies and measures

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

4.2.4 Industrial processes and product use

The most significant CO_2 emissions from industrial processes and product use are included in the EU ETS and are covered in Section 4.5.1. 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 and product use. Since 2013, nitric acid production is included in the EU ETS, and therefore, the mitigation impact of measures relating N_2O emissions has not been estimated for future years. Therefore, the policies and measures described in this section are those mitigating F-gases.

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[38] 2014/94/EU

Policies and measures in the WM projection

The amount of emissions from F-gases (HFC, PFC, SF_6) was about three per cent of total emissions in 2015. 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 peak level of SF_6 emissions. The most important regulations affecting the amount of these gases are the F-gas regulation[39] and the directive relating to HFC emissions from air-conditioning systems in motor vehicles.[40] Also, technical development has affected the development of emissions. F-gases are not produced in Finland.

The WM projection for F-gases includes the impacts of the EC regulation and the EC directive referred to above. Emissions from refrigeration and air conditioning equipment are expected to decline due to measures and technical changes leading to smaller charges and decreased leakage implemented under these regulations. Key drivers of the F-gas regulation in cutting the emissions are the phase down of HFCs that can be placed on the EU market and the bans on the use of HFCs in different applications. They will lead to a replacement of HFCs with low GWP alternatives in most applications.

Emissions from electricity distribution equipment have declined heavily as a result of voluntary actions by the industries. Only a slight increase in emissions is assumed in the future but the peak level of emissions in the 1990s will not be reached. Restrictions forced by the EC regulation have a decreasing effect on emissions from foam blowing, aerosols and other sources. The emissions from foam blowing and aerosols are expected to decrease in the future. The emissions from other sources are expected to stay quite steady. Emissions from refrigeration and air-conditioning equipment account for more than 90 per cent of Finnish F-gas emissions, and therefore the projected overall emission trend is declining.

The mitigation measures have been 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 additional measures that are expected to promote the alternative low GWP non-HFC technologies in the refrigeration and air conditioning equipment sector in addition to the F-gas regulation. These additional measures include criteria for public procurement that are related to F-gases and information and education campaigns.

It is estimated that the emission reduction achieved by these additional measures will be 0.3 million tonnes CO_2 eq. in 2030.

Summary of policies and measures

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

4.2.5 Agriculture

Policies and measures in the WM projection

Finnish agricultural policy is based on the view that the competitive disadvantage due to natural conditions (such as the short growing period, low temperatures, frosts and problematic drainage conditions) must be compensated for in order to have profitable domestic production and to make agriculture sustainable and multifunctional. The objectives of sustainable and multifunctional agriculture include taking into account greenhouse gas emissions, the possible need for adaptation measures and other environmental and socio-economic aspects. These objectives can be reached through the

[39] 2014/517/EC

[40] 2006/40/EC

Common Agricultural Policy (CAP) of the EU as well as through national measures. According to conclusions made by the European Council, agricultural production should continue in all areas of the Community.

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

Annual CH_4 and N_2O emissions from agriculture have fallen by 14 per cent over the period 1990 to 2015 mainly due to a decrease in the number of livestock and in nitrogen fertilisation. Changes in agricultural policy and farming subsidies have had a significant influence on agricultural activities, and hence, on the emissions from this sector.

There are measures in the CAP aiming to reduce greenhouse gas emissions. The agri-environmental payment programme has been part of the Rural Development Programme for Mainland Finland[41] 2007 to 2013. In the new Rural Development Programme for Mainland Finland 2014 to 2020 the agri-environmental payment programme is replaced by environmental compensation payments. They are essential tools for promoting sustainable development in agriculture, and 86 to 90 per cent of Finnish farmers have participated in them.[42] Their objectives are to decrease the nutrient load on the environment, especially on surface and ground waters, and to preserve plant and animal biodiversity and the rural landscape. The measures also aim to maintain or improve the productive capacity of agricultural land and reduce greenhouse gas and other air emissions as well as to adapt to climate change. One measure to reduce emissions from organic soils is support to long-term cultivation of grass on organic soils.

In the Rural Development Programme 2014 to 2020 there are several measures for climate change mitigation and adaptation: environment compensation payments for incorporation of slurry, recycling of nutrients and organic matter, environment management of grassland, cultivation of catch crops, 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 can be targeted to controlled subsurface drainage and more efficient handling, storage and use of manure. There is also a support system for investments in renewable energy, for example, in biogas plants. As a part of the programme advisory services will be provided regarding the cross-compliance conditions, greening payments, climate change mitigation and adaptation, biodiversity, protection of water and soil, environment payments, maintaining agricultural land, organic production and issues related to environmental efficiency, including more efficient energy use and renewable energies. Implementation of the Rural Development Programme 2014 to 2020 started in 2015.

The Climate Programme for Agriculture (“Steps towards environmentally-friendly food”)[43] was finalised in November 2014 and it is under implementation. 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 climate change. Key measures identified in the Climate Programme for mitigation are carbon sequestration into soil, measures relating to the use of peatlands, handling and treatment of manure, more accurate nitrogen fertilization, improvements in energy efficiency, and production and consumption of renewable energy.

Making use of the agricultural nutrients project[44] is a three-year pilot programme (2016 to 2018). This programme is part of the government key project for the circular economy, introduced in the government programme. It conveys information

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41 The programme covers the territory of Finland excluding the Åland Islands.

42 Rural Development Programme for Mainland Finland 2014–2020 is based on a European Parliament and Council Regulation (EU) no 1303/2013 and 1305/2013)

43 http://mmm.fi/documents/1410837/1867349/Climate_programme_agriculture_WEB_03072015.pdf/1a6f135c-068c-48aa-ad00-787562628314

44 http://mmm.fi/en/recyclenutrients

on the funding possibilities related to the recycling of nutrients and essential research knowledge to practical operators. It identifies the bottlenecks in nutrient recycling and facilitates their elimination as well as promotes the networking and new experiments of nutrient recycling operators. It is also possible to fund advanced nutrient recycling investments.

The Rural Development Programmes for Mainland Finland have been the main instruments to implement climate change mitigation and adaptation measures in the agriculture sector. Rural Development programmes are evaluated as defined in the Parliament and Council regulation[45]. At programme level Finland has defined an evaluation plan and an implementation plan for evaluating climate change issues.

Policies and measures in the WAM projection

New measures are identified in the Medium-term Climate Change Policy Plan. The Sector Plan for agriculture includes activities relating to reducing emissions from organic soils, for example, intensification of long-term grass cultivation and afforestation on organic soils. There are also new measures to replace fossil fuels with biogas in agriculture.

Summary of policies and measures

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

4.2.6 Land use, land-use change and forestry

Policies and measures in the WM projection

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

- Conserving and enhancing carbon storages and sinks
- Creating new carbon storages and sinks
- Substitution, i.e. replacing fossil-based energy, raw materials and products with renewable biomass.

The LULUCF sector as a whole acts as a net sink in Finland because the emissions under this sector are smaller than the removals. This net sink from the LULUCF sector can vary greatly from one year to the next: in the period 1990 to 2015, it was between 12.4 and 38.0 million tonnes CO_2 eq. In 2015, the net sink was 26.0 million tonnes CO_2 eq.
The largest sink in the LULUCF sector is forest land. The tree growth removes more CO_2 from the atmosphere than is released as the result of harvesting and natural mortality. In 2015, the net removals were 30.3 million tonnes CO_2 eq. These net removals have varied much annually, from 19.3 to 51.3 million tonnes CO_2 eq. during the period 1990 to 2015. The interannual variation is mainly due to changes in forest harvesting levels.

According to the National Forest Inventory, the annual increment of growing stock has been increasing since the 1970s, reaching its current level of 105 million cubic metres, of which 99 million cubic metres is in commercially managed forests.

Finland's forest policy aims at sustainable forest management, and the policy measures include legislation, the National Forest Strategy 2025 (NFS), financial support and extensive public forestry organisations. More information on these is provided in Finland's Seventh National Communication, Section 4.4.

The studies by the Finnish Natural Resources Institute (Luke) indicate that Finnish forests will act as a net sink in the future, too. The objective for the forests' carbon sink (incl. trees and soil) set out in the NFS is to maintain the sink at a level of at least 13.5 to 20 million tonnes CO_2 eq. per year up to 2025. The harvesting of wood is targeted to increase by 10 to 15 million cubic metres a year. The objectives and measures in the National Energy and Climate Strategy for 2030 are consistent with the policy defined in the NFS regarding the increase in industrial roundwood and energy wood, and

[45] 1305/2013/EU (rural development regulation)

they will help achieve the target set by the directives on promoting the use of energy from renewable sources.[46] The global economic development will greatly influence the achievements of the NFS goals.

The national measures are set out in the NFS[47]. The measures, consistent with the National Energy and Climate Strategy for 2030, include implementing the following strategic projects in order to secure the climatic advantages provided by forests and to ensure the availability of renewable raw materials:

- Forest-related information and e-services of the future. The project will develop a next-generation forest related information system and a process for keeping the information resources up to date.
- Statistics on the renewing forest-based business and activities. Collection of statistics on the interfaces between the forest, energy and chemical industries, nature tourism, forestry-related services and other forest-based business and ecosystem services will be improved.
- Development of active forest management, entry of timber to the market and forest ownership structure. Underpinned by studies, forestry taxation and legislation will be developed to support active forest management, entry of timber to the market and a change in the forest ownership structure.
- New incentive schemes and resource-efficient forest management. The project will prepare a future incentive scheme for forest management that promotes active and resource efficient forest use and welfare derived from non-market benefits.

With regard to agricultural soils, CO_2 emissions and removals from croplands and grasslands are not expected to be subject to large changes in the WM projection by 2030. The CO_2 emission reductions due to increasing the area of perennial crops on organic soils and due to other measures in the Rural Development Programme (see Section 4.2.5) are presented in CTF Table 3.

Policies and measures in the WAM projection

For cropland and grassland the measures in the National Energy and Climate Strategy for 2030 include developing farming to increase sinks and launching a relating pilot project, developing measures to monitor soil carbon sequestration in agricultural soils and studying the influence of CAP to soil carbon and prepare proposals how in the renewal of CAP, farmers could be encouraged to increase sinks.

Measures which are identified in the Medium-term Climate Change Policy Plan relating to reducing emissions from organic soils from the agriculture sector also have effects on emissions from the LULUCF sector.

Summary of policies and measures

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

4.2.7 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,[48] Waste Directive[49] and Waste Framework Directive.[50] The first Waste Tax Act[51] entered into

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[46] 2001/77/EC and 2009/28/EC

[47] http://mmm.fi/en/nfs

[48] 1999/31/EC

[49] 2006/12/EC

[50] 2008/98/EC

[51] 495/1996

force in 1996 for municipal landfills. The tax level per tonne of waste has increased from EUR 15.15/t in 1996 to EUR 23/t in 2003, EUR 30/t in 2005 and EUR 40/t in 2011. A new Waste Tax Act[52] 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[53] regarding what to include in 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. In 2015 it was raised to EUR 55 per tonne[54], and in 2016 to EUR 70 per tonne.

Enforcement of the Waste Act[55] and the Decree on Waste[56] will continue to increase recycling and recovery, thus further replacing landfilling, and will contribute to reducing greenhouse gas emissions as well. The Decree on Packaging and Packaging Waste[57] is also intended to increase recycling. The restrictions on landfilling of biodegradable municipal waste have been made stricter over a number of years. The Decree on Landfills[58] generally restricts the amount of biodegradable and other organic waste to less than 10 per cent total organic carbon (TOC) after 2016 except for building waste where the 10 per cent rule enters into force in 2020. From 2016 until the end of 2019, the limit value for organic carbon content in building waste is set to 15 per cent. These restrictions are expected to increase incineration of waste from current levels. According to the National Energy and Climate Strategy for 2030, additional efforts will be taken to enforce the restrictions on the landfilling of biodegradable waste.

The monitoring of the effectiveness of the policies and measures affecting waste are based on statistics and modelling that follows 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 1990 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 1990 would represent the average emission level without measures. This assumption is conservative as the amount of waste would probably have changed and the gradual accumulation of waste would have increased CH_4 emissions. The average emissions from the waste sector in 1990 to 1995 were approximately 4.7 million tonnes CO_2 eq but by 2010 significant reductions of more than 2 million tonnes CO_2 eq had been achieved.

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 were 54 per cent lower in 2015 than in 1990 and will decrease further in the WM projection (See Chapter 5, Table 5.9). The main reason for this is the implementation of the Landfill Directive and national legislation and strategies that aim at reducing the amount of waste and minimising the amount of waste delivered to the landfills. The reform of the waste legislation, previously reported in the WAM projection, has now been included in the WM projection, leading to an additional reduction in emissions relative to those reported earlier. Currently no additional measures are scheduled for the waste sector. Hence, there is no separate WAM projection.

Summary of policies and measures

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

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[52] 1126/2010

[53] 2000/532/EC

[54] 1072/2014

[55] 646/2011

[56] 179/2012

[57] 518/2014

[58] 331/2013

4.2.8 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 significant solutions that concern cutting emissions in the urban structure are associated with sustainable urban development: the urban structure and effective functioning of urban subregions, coordination of land use and transport, creating preconditions for renewable energy production and enabling a low-emission lifestyle. In urban subregions, the preconditions for this include good public transport services and a network of pedestrian and cycling routes, a living and well-functioning city centre and good accessibility of recreational and green areas. Effective urban subregions are a prerequisite for a thriving business life and Finland's competitiveness. There may be significant differences between the practical solutions used to reduce emissions in different parts of the country.

Preconditions for increasing wind power production include coordinating wind power construction with land use in the surrounding areas, giving sufficient consideration for negative impacts and ensuring local acceptability. In order to promote planning, the Land-Use and Building Act contains specific provisions on local master plans that apply to wind power construction directly. Rapid progress has been made in recent years in land-use planning for wind power construction. An amendment to the Land-Use and Building Act (1.4.2017) for the installation and construction of solar panels and solar collectors harmonises and streamlines the permit procedure so that permit consideration would only be required for solar panels or collectors that have significant impacts on the townscape or the environment.

The most recent National Energy and Climate Strategy for 2030 includes policy objectives that aim to minimise greenhouse gas emissions related to land use and the urban structure.

The National Energy and Climate Strategy for 2030 specifies the following policy objectives in relation to the spatial structure and related land-use planning:

- The effectiveness of land use and mobility in urban subregions will be promoted by developing legislation and the land-use planning system, by updating the national land use objectives, and through agreements between the central government and municipalities. Transport infrastructure implementation will be linked to land-use planning and construction with the aim of reducing emissions.
- In growing urban subregions, new construction will primarily be directed to areas with existing services and public transport. Outside growing urban centres, land use steering will be developed taking into account the need to develop areas, new trends of the natural resources economy and the strive for local energy production. Rural centres and villages will be strengthened to safeguard the local availability of services.
- In land-use planning and construction, and when making efforts to develop the steering of these sectors, preparation is made for utilising solar power.

In land-use planning, Finland will prepare to utilise extensively the country's wind power potential. In order to minimise the negative impacts of wind power plants, an effort will primarily be made to centralised wind power construction in large units at a sufficient distance from permanent housing.

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 in the energy sector, for example, through its effects on transport and the heating of buildings. 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.

4.3 Energy taxation and related measures

4.3.1 Energy taxation

Energy taxes are a substantial revenue source for the Government. They generate around EUR 4,600 million annually, or more than 10 per cent of the Government tax revenue. Over the past ten years, energy taxes have been increasing steadily in terms of the amount generated and as a share of the total tax revenue. Energy taxation is a key instrument of the Government's energy and climate policy.

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

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

Furthermore, a reduced energy content tax is applied to fuel grades that are better in terms of local emissions than traditional fossil fuels. Local emissions are emissions causing health effects in nearby areas like NO_x and particle emissions. The reduction corresponds to the imputed value of the emission benefit in accordance with the principles set out in the EU Directive[59] on the promotion of clean and energy-efficient road transport vehicles.

Energy taxation rules include exemptions and reduced tax rates resulting in tax expenditure. Fuel for commercial aviation and shipping are not taxed. Peat is taxed at a lower rate.

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

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

A further tax applied to diesel-driven vehicles is the annual propelling-force tax, which is, on average, EUR 420 per diesel vehicle. The annual propelling-force tax is levied to achieve the tax burden required by the environmental tax model, that is, to compensate the difference between the taxation of diesel and gasoline.

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[59] 2009/33/EC

Table 4.3 Energy taxes in Finland

Date	Energy taxes, strategic stockpile fees and oil pollution fees *												
	Fuels 1)							Electricity					
								Consumption		Production			
	Motor gasoline, unleaded 2)	Diesel fuel 3)	Light fuel oil 12)	Heavy fuel oil	11) Hard coal	Natural gas	Peat	Electricity, I 4)	Electricity, II 5)	Nuclear power	Hydro power	Imports
	c/l		c/kg		€/t	c/nm³	€/MWh	c/kWh				
Excise taxes 10)												
1.1.1990	21.53	16.82	0.34	0.34	2.69	0.17	0.34	-	-	-	-	-
1.1.1995	45.12	27.5	3.02	3.12	19.53	0.94	0.59	-	-	0.4	0.07	0.37
1.7.2005	58.08	31.59	6.71	5.68	43.52	1.82	-	0.73	0.44	-	-	-
1.1.2007	58.08	31.59	6.71	5.68	43.52	1.82	-	0.73	0.22	-	-	-
1.1.2008	62.02	36.05	8.35	6.42	49.32	2.016	-	0.87	0.25	-	-	-
1.1.2011	62.02	36.05	15.7	18.51	126.91	8.94	1.9	1.69	0.69	-	-	-
1.1.2012	64.36	46.6	15.7	18.51	126.91	8.94	1.9	1.69	0.69	-	-	-
1.1.2013	64.36	46.6	15.99	18.93	131.53	11.38	4.9	1.69	0.69	-	-	-
1.1.2014	66.61	49.31	15.99	18.93	131.53	11.38	4.9	1.89	0.69			
1.1.2015	67.45	50.26	18.39	21.84	153.24	15.36	3.4	2.24	0.69			
1.1.2016	67.45	50.26	21.05	25.08	177.36	17.34	3.4	2.24	0.69			
1.4.2016	67.45	50.26	21.05	25.08	177.36	17.34	1.9	2.24	0.69			
1.1.2017	69.57	52.67	22.52	26.83	189.84	18.53	1.9	2.24	0.69			
Energy content tax 8)												
1.1.2011	50.36	-	7.7	8.79	54.54	3	-	-	-	-	-	-
1.1.2012	50.36	30.7	7.7	8.79	54.54	3	-	-	-	-	-	-
1.1.2013	50.36	30.7	6.65	7.59	47.1	4.45	-	-	-	-	-	-
1.1.2014	50.36	30.7	6.65	7.59	47.1	4.45	-	-	-	-	-	-
1.1.2015	51.2	31.65	6.65	7.59	47.1	6.65	-	-	-	-	-	-
1.1.2016	51.2	31.65	6.65	7.59	47.1	6.65	-	-	-	-	-	-
1.1.2017	52.19	32.77	7.05	8.05	49.93	7.05	-	-	-	-	-	-

Date	Energy taxes, strategic stockpile fees and oil pollution fees *											
	Fuels 1)							**Electricity**				
								Consumption		**Production**		
	Motor gasoline, unleaded 2)	Diesel fuel 3)	Light fuel oil 12)	Heavy fuel oil	11) Hard coal	Natural gas	Peat	Electricity, I 4)	Electricity, II 5)	Nuclear power	Hydro power	Imports
	c/l		c/kg		€/t	c/nm³	€/MWh			c/kWh		
Carbon di-oxide tax 9)												
1.1.2011	11.66	-	8	9.72	72.37	5.94	-	-	-	-	-	-
1.1.2012	14	15.9	8	9.72	72.37	5.94	-	-	-	-	-	-
1.1.2013	14	15.9	9.34	11.34	84.43	6.93	-	-	-	-	-	-
1.1.2014	16.25	18.61	9.34	11.34	84.43	6.93	-	-	-	-	-	-
1.1.2015	16.25	18.61	11.74	14.25	106.14	8.71						
1.1.2016	16.25	18.61	14.4	17.49	130.26	10.69						
1.1.2017	17.38	19.9	15.47	18.78	139.91	11.48						
Energy tax 7)												
1.1.2011	-	-	-	-	-	-	1.9	1.69	0.69	-	-	-
1.1.2013	-	-	-	-	-	-	4.9	1.69	0.69			
1.1.2014	-	-	-	-	-	-	4.9	1.89	0.69			
1.1.2015	-	-	-	-	-	-	3.4	2.24	0.69			
1.1.2016	-	-	-	-	-	-	3.4	2.24	0.69			
1.4.2016	-	-	-	-	-	-	1.9	2.24	0.69			
1.1.2017	-	-	-	-	-	-	1.9	2.24	0.69			
Strategic stockpile fees												
1.7.1984	0.72	0.39	0.39	0.32	1.48	-	-	-	-	-	-	-
1.1.1997	0.68	0.35	0.35	0.28	1.18	0.084	-	0.013	0.013	-	-	-

Date	Energy taxes, strategic stockpile fees and oil pollution fees *											
	Fuels 1)							Electricity				
								Consumption		Production		
	Motor gasoline, unleaded 2)	Diesel fuel 3)	Light fuel oil 12)	Heavy fuel oil	11) Hard coal	Natural gas	Peat	Electricity, I 4)	Electricity, II 5)	Nuclear power	Hydro power	Imports
	c/l		c/kg		€/t	c/nm³	€/MWh	c/kWh				
Oil pollution fees 6)												
1.1.1990	0.28	0.031	0.031	0.037	-	-	-	-	-	-	-	-
1.1.2005	0.038	0.042	0.042	0.05	-	-	-	-	-	-	-	-
1.1.2010	0.113	0.126	0.126	0.15	-	-	-	-	-	-	-	-

1) Fuels in electricity production tax-exempt since 1 January 1997
2) Reformulated, since 1 January 1993, also sulphur-free since 1 September 2004. Fossil fuel
3) Sulphur-free, sulphur content < 50 ppm since 1 July 1993, sulphur content < 10 ppm since 1 September 2004. Fossil fuel.
4) Tax class I: others
5) Tax class II: industry, data centres, mining, professional greenhouses (also agriculture through tax rebates)
6) Fee for imported oil and oil products: EUR 1.50/t
7) Energy tax included in excise taxes
8) Energy content tax included in excise taxes
9) Carbon dioxide tax included in excise taxes
10) Excise taxes contain energy content tax, carbon dioxide tax, and energy tax
11) Excise taxes for hard coal is in the heat production. In CHP use excise tax is lower
12) Fossil fuel. Sulphur free
* see the full tax table: http://ec.europa.eu/taxation_customs/tedb/taxDetails.html?id=4077/1496136747
All rates based on energy content, local emissions and CO2 emissions. For example, liquid biofuels have a lower tax rate per litre thanks to lower energy content and emissions.

4.3.2 Government expenditure on energy and climate policy

Government appropriations for the energy and climate policy are discussed and the relevant decisions are made within the central government spending limits in the General Government Fiscal Plan, coordinated with other expenditure needs of the public economy.

Table 4.4 shows a compilation of funding related to the energy and climate policy for 2017 to 2030 in the budget for 2017 and the General Government Fiscal Plan for 2017 to 2020. Table 4.5 provides initial estimates of the completely new funding needs arising from the new measures proposed in the National Energy and Climate Strategy for 2030 in 2017 to 2020 and 2021 to 2030. A significant part of strategy implementation costs would be realised after 2020.

The most important new funding needs arise from subsidising renewable energy. It is proposed that the current energy aid scheme be continued after 2020, and a general increase of EUR five million is proposed in the relevant budget authority.

Table 4.4 Funding under the current General Government Fiscal Plan in accordance with the Government report on the National Energy and Climate Strategy for 2030

	EUR million				
	2017	**2018**	**2019**	**2020**	**2021-2030**
Appropriation					**Total**
MINISTRY OF ECONOMIC AFFAIRS AND EMPLOYMENT					
Investment subsidies for renewable energy and new energy technologies	40	40			
Operating aid for electricity from renewable energy sources	245	305	305	245	1340
MINISTRY OF AGRICULTURE AND FORESTRY					
Rural Development Programme:					
Certain agri-environment payment measures					
Balanced use of nutrients 1)	103.2	103.2	103.2	103.2	
Incorporation of slurry into fields 1)	7.4	7.4	7.4	7.4	
Control of runoff waters 1)	6.0	6.0	6.0	6.0	
Environment management grasslands 1)	35.4	35.4	35.4	35.4	
Wetland management 1)	0.5	0.5	0.5	0.5	
Advice 1)	4.0	4.0	4.0	4.0	
Renewable energy investments	9.0	9.0	9.0	9.0	
TOTAL appropriations (national funding)	**385**	**445**	**405**	**345**	**1340**

1) Contains 42 per cent of EU co-funding

Budget authority					
MINISTRY OF ECONOMIC AFFAIRS AND EMPLOYMENT					
Energy aid (32.60.40.)	35	35	35	35	
TOTAL budget authority	**35**	**35**	**35**	**35**	**0**

Table 4.5 Estimate of new funding needs arising from the proposed measures

Appropriation	EUR million 2017	2018	2019	2020	2021-2030 Total
MINISTRY OF THE ENVIRONMENT					
Piloting of digital mobility services. Ministry of the Environment + Ministry of Transport and Communications	0.5	0.5	0.5	0.5	
Market experiments related to low-carbon business and service platforms (e.g. former railway stations as hubs)	2.5	2.5	2.5	2.5	
Guidance by information to promote wood construction		2	2	2	
MINISTRY OF AGRICULTURE AND FORESTRY					
Additional needs of R&D related to sink policy measures	0.75				
MINISTRY OF ECONOMIC AFFAIRS AND EMPLOYMENT					
Production aid for renewable electricity (new aid scheme based on a tendering process)				13	265
MINISTRY OF TRANSPORT AND COMMUNICATIONS					
Promoting energy-efficient vehicles (electricity and gas)		25	25	25	25
TOTAL appropriations	**4**	**30**	**30**	**43**	**290**
Budget authority					
MINISTRY OF ECONOMIC AFFAIRS AND EMPLOYMENT					
Energy aid		5	5	5	400
Major new energy technology projects (incl. biorefineries)			60	60	240
TOTAL appropriations	**0**	**5**	**65**	**65**	**640**

4.4 Use of Kyoto mechanisms

The use of Kyoto mechanisms is one option for Finland to meet its national emission reduction commitments of the Kyoto Protocol. It includes the use of project mechanisms (the Clean Development Mechanism (CDM) and Joint Implementation (JI)) or acquiring assigned amount units (AAU) through international emissions trading. Certified emission reduction units from the clean development mechanism and emission reduction units from joint implementation projects, can be used to fulfil the targets under the EU ETS and EU Effort Sharing Decision also with certain limitations (see section 3.1).

Finland's Government activities to provide Kyoto mechanisms started in the form of the CDM/JI pilot programme from 1999 until early 2006, followed by the Kyoto mechanism purchase programme that covers the period 2006 to 2020. The total budget for the acquisition of emission reductions from the Kyoto Protocol flexible mechanisms has been approximately EUR 70 million. The programme includes 10 bilateral projects and investments in several multilateral carbon funds.
In total, in the first Kyoto commitment period Finland procured approximately 6.2 million tonnes of project units. These units have been carried over to the second commitment period. The Kyoto mechanisms purchase programme will continue to deliver project units until 2020 through existing investments in carbon funds and one ongoing bilateral CDM project. A total of four million tonnes of project units are expected to be generated by the end of 2020. No decision on the use of Kyoto mechanisms for compliance purposes in the second commitment period of the Kyoto Protocol has been made. According to the National Energy and Climate Strategy for 2030 and the Medium-term Climate Change Policy Plan, the non-ETS Sector may meet its emission reduction target without the use of units from mechanisms.

In the EU emissions trading scheme, companies may partly meet their emission reduction obligations by using international credits from the Clean Development Mechanism (CDM) and Joint Implementation (JI). In the first Kyoto commitment period the operators used 12.3 million tonnes CERs and 4.1 million tonnes ERUs.

In the period 2008 to 2020, stationary installations and aircraft operators have an International Credit Entitlement (ICE) limit in use, i.e. the installations/aircraft operators can exchange eligible credits (CER/ERU) up to the maximum amount allowed by EU legislation. The allowances (EUAs) obtained in exchange can be used freely for compliance and trading. For the Finnish operators the Credit Entitlement limit is totally about six million tonnes.

4.5 Effect of policies and measures on longer term trends

The Government's Foresight Report on Long-term Climate and Energy Policy (published in 2009) highlighted possible paths towards a low-carbon Finland. Also, the report of the parliamentary committee from 2014, the Energy and Climate Roadmap 2050, analysed the means of constructing a low-carbon society and achieving an 80 to 95 per cent reduction in greenhouse gas emissions from the 1990 level in Finland by 2050. The background material for the 2014 roadmap included four scenarios on alternative development paths for a low-carbon society up to 2050 made by the Low Carbon Finland 2050 platform research project.

A large proportion of current Finnish climate and energy policies also contributes 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 also yields 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.

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. 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, also have long-term emission reduction effects provided that the measure has triggered investments.

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.

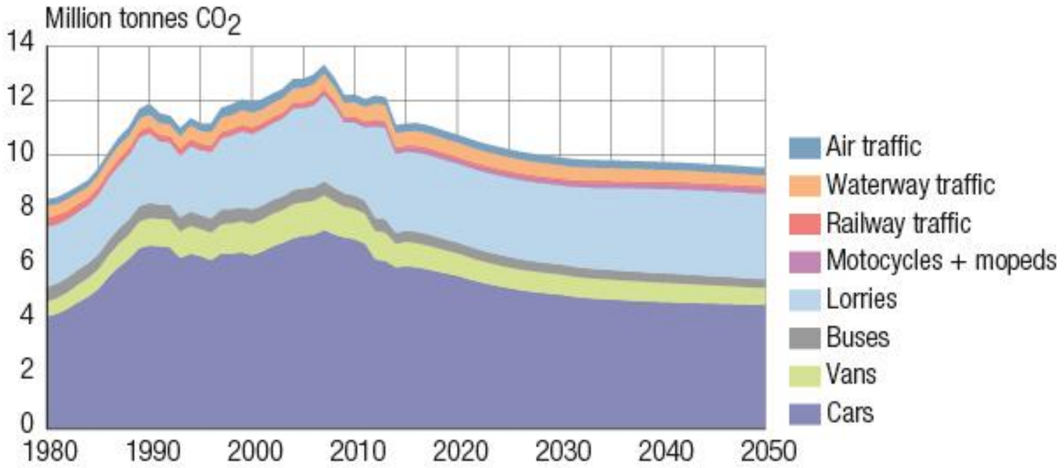
The impact of policies and measures on the longer-term trend (up to 2050) in greenhouse gas emissions from transport have been studied in the ILARI project (2010 to 2012) and its updates (2015 and 2016). The impacts of different policy packages have been compared to a baseline scenario based on statistics and forecasts on transport volumes and vehicle fleets provided by the Finnish Transport Agency and the Finnish Transport Safety Agency, energy efficiency forecasts for 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.

In the 2015 update the difference between the projected transport volumes and actual reporting by the Finnish Transport Agency were taken into account. This resulted in a decrease in the previously estimated passenger car vehicle kilometres. Furthermore, the transport volumes for heavy goods vehicles were adjusted to be higher and the development of the energy efficiency was re-evaluated to be more modest than previously estimated.

According to the projections, transport volumes continue to grow over the forecast period, whereas the GHG emissions start to decline at the end of the current decade (see Figure 4.2). The main reasons for emission reductions are the use of biofuels, development in vehicle technology and CO2-based taxation. The effect is greatest on passenger cars. Emissions from heavy goods vehicles are expected to grow slightly due to economic growth and more modest energy efficiency expectations.

Uncertainties in the projections include reaching the vehicle energy efficiency targets, the renewal rate of the vehicle fleet and the use of alternative fuels.

Figure 4.2 Projection on longer-term trend in the greenhouse gas emissions in transport



4.6 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 Second Biennial Report. The present domestic institutional arrangement are described Finland's 7th National communication.

Climate policy is increasingly being integrated with the decision-making processes in energy production, transport, agriculture, forestry and land-use and other planning. For example, the transport sector has its own climate policy programme. Finland was one of the first countries to prepare a national climate adaptation strategy in 2005. The strategy was evaluated in 2013 and the new Climate Change Adaptation Plan 2022 was based on the conclusions of the evaluation (more on the Adaptation Plan in Finland's 7th National Communication, Section 6.2.3). In addition, climate and energy issues are being taken into consideration in Society's Commitment to Sustainability, which was updated by the National Commission on Sustainable Development in 2016. With this commitment, the public sector, together with other actors, pledges to promote sustainable development in all its work and operations. The commitment was updated to respond to the new global agenda for sustainable development, the UN Agenda 2030. In February 2017, the Government gave a report to the Parliament on the implementation of the UN 2030 Agenda for Sustainable Development. The aim is a carbon-neutral, resource-wise and competent Finland.

The Finnish Government completed its work on a new strategy on energy and climate policy in 2016. Also, Finnish Government reports to the Parliament once in a year, among other things, the progress of agreed measures in the energy sector. In terms of the reporting on policies and measures, including on their implementation and effects on emissions, and projections to the European Commission, and to the UNFCCC, the Ministry of Economic Affairs and Employment is responsible for overall co-ordination and compilation of information from different sectors The sectoral ministries are responsible for the projections and impact assessments concerning their own field. Several expert organisations assist in acquiring data and in the assessments of policies and measures and modelling sector-specific projections. The network of officials gives the final approval concerning the information in the reporting tools and paper report to be submitted.

The latest reporting requirements in the energy and climate sector were imposed by the Climate Change Act of 2015. The Climate Change Act entered into force in June 2015, establishing a framework for long-term and cost-effective planning and monitoring of climate policy in Finland. The climate change policy planning system includes a medium-term climate change policy plan as well as a long-term climate change policy plan and a national adaptation plan for climate change. The first medium term climate change policy plan was approved in 2017. The preparation of the Medium-term Climate Change Policy Plan and the Government's annual climate change report was coordinated by the Ministry of Environment and all relevant ministries were involved in the work. 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. This reporting will start in 2019. The act includes also provisions on the duties of a multidisciplinary expert body, Finland´s Climate Change Panel, in support of the planning of climate policy.

Information on the latest energy and climate strategy, Government Report on National Energy and Climate Strategy for 2030, and the first medium-term plan, Medium-term Climate Change Plan for 2030, is given in Chapter 4 of Finland's 7th National Communication, which describes also the tasks and work of the Climate Change Panel.

Statistics Finland is the national entity responsible for compiling the Finnish greenhouse gas inventory. Statistics Finland publishes the greenhouse gas inventory data three times every year. The publications include information on monitoring progress with Finland's commitments to reduce its greenhouse gas emissions under the EU and the Kyoto Protocol. The national inventory system and changes made to it since the previous biennial report are described in Chapter 2 of this report.

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

Finland's total national greenhouse gas emission without the LULUCF sector are presented in the CTF Table 4. The emissions in 2015 (55.6 million tonnes CO_2 eq.), the most recent inventory year in the latest inventory submission to the UNFCCC, are 22 per cent lower than in the base year 1990 (71.3 million tonnes CO_2 eq.) The estimated total impact of mitigation actions on the emission trend is presented in Section 5.4. The total reduction in the emissions due the implemented policies and measures in 2015 is estimated to be around 20 million tonnes.

The emissions from the LULUCF sector are not included in the EU joint target, or Finland's contribution to the emission reduction under this target under the UNFCCC, and therefore not given in the CTF Tables 4 and 4(a)I but are presented in CTF Table 1 . In Finland, the LULUCF sector has been a net sink in the period 1990 – 2015, the net removals in 2015 (26.0 million tonnes CO_2 eq.) where about twice as high as those in 1990 (12.7 million tonnes CO_2 eq.).

The total national greenhouse gas emissions with the LULUCF sector where almost 50 per cent lower in 2015 (29.6 million tonnes CO_2 eq.) than in 1990 (58.6 million tonnes CO_2 eq.).

Finland's national level emission level target, as part the joint EU target, is reduce its non-ETS emissions so that the emissions are below the target path (the target is presented in more detail in Section 3.1 and Table 3.1). The progress made in achieving this target is illustrated in the Table 4.6.

Table 4.6 Finland's target path for non-ETS emissions in accordance with the EU Effort Sharing Decision and corresponding emissions for the years 2013 to 2015 (2016 emission data are preliminary).

	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Finland's annual emission allocations including adjustments due to changes in the EU ETS coverage	31.8	31.3	30.8	30.3	29.8	29.3	28.8	28.4
Finland's annual emission allocations including also adjustments due to implementation of the 2006 IPCC guidelines					30.2	29.6	29.1	28.5
Non-ETS emissions[1]	31.6	30.1	29.9	31.3[3]				
Distance to the target[2]	-0.2	-1.1	-0,9	1,0[3]				

[1] Due to the annual implementation of the EU ESD, the emissions used for assessing compliance are not updated after the compliance assessment. Hence the emissions may differ from the most recent inventory data.

[2] Distance to the target is expressed as a negative number when actual emissions are below annual emission allocations

[3] Approximate data

The data in table 4.6 show that Finland has fulfilled its annual target for 2013 to 2015. Under the ESD, the compliance assessment for the year 2013 was finalised in 2017. Finland met its 2013 ESD target with domestic measures. This will be the case also for the years 2014 and 2015. The EU ESD reviews for these years have been completed and the compliance assessment is in progress. For the year 2016, the preliminary data indicate that Finland will need to use emissions allocations left over and transferred from the years 2013 – 2015 to future target years to meet the ESD target (see Table 3.1 in the previous chapter). The final and reviewed inventory estimates for 2016 will be available only in 2018.

Finland has not reported on use of market mechanisms in Table 4 or 4(b) as the above target is foreseen to be met with domestic policies and measures (see also Section 4.4. Use of Kyoto Mechanisms).

Information on the use of flexible mechanisms under the EU ETS (EU-wide measure, see Chapter 3) is reported in the EU's Third Biennial Report under the UNFCCC.

5 Projections

5.1 Overview of WM and WAM projections

The projections presented in this chapter are based on the National Energy and Climate Strategy for 2030 and the Medium-term Climate Change Policy Plan. The Energy and Climate Strategy was presented by the Government in November 2016. The Medium-term Climate Change Policy Plan was approved in September 2017. The projections were formulated in 2016 and 2017 by a working group consisting of experts from ministries that are central to Finland's climate policy.

The 'With Measures' projection (WM) describes a development in which the energy and climate related policy measures already implemented and adopted are continued. The WM projection represents a development path that would be likely to take place if no new energy or climate policy measures were adopted. Most of the measures included in the WAM projection of the Sixth National Communication have been implemented and are now part of the WM projection. The most significant new, implemented policy measures affecting future emissions compared to the Sixth National Communication are a regulation ensuring improvements of energy and resource efficiency in renovation and alteration of buildings and a new regulation reducing the amount of organic waste disposed to landfills.

In previous National Communications it has been assumed that Finland will be self-sufficient in electricity on a yearly basis from 2020 onwards. During the last years domestic conventional generation capacity has, however, been shut down and while Finland is part of the integrated Nordic-Baltic electricity market self-sufficiency in electricity supply is no longer a feasible aim nor a reasonable assumption. This change in the assumptions affects the emission projections (both WM and WAM projections) by cutting and smoothening out the total emissions.

The 'With Additional Measures' projection (WAM) includes a set of cost-efficient additional energy and climate policy measures that the Government has agreed upon in order to attain the targets specified in the Government Programme and adopted in the EU for 2030.

The WAM projection includes new measures particularly to reduce the use of fossil fuels, to promote renewable energy, to improve energy efficiency as well as to further reduce greenhouse gas emissions in the non-energy sectors. These WAM measures are described in Chapter 4.

Economic growth and the change in the structure of the economy play a key role in the estimation of energy consumption and emissions. The rate of economic growth is determined by the growth rates of labour input and average labour productivity. In the long term, economic growth is determined almost solely by the growth of labour productivity, because labour input cannot grow without bounds. In the short and medium term, however, factors affecting labour input growth matter, too, because changes in labour input affect directly the potential output of the economy. In Finland, the ageing population is the single most significant factor in terms of its effect on labour input and thus development of the national economy in the short and medium term. 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 5.5 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 2.6 million to 3.0 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 VATT Institute for Economic Research[60].

In 2016, the Finnish economy returned to a growth path after a long period of recession that began in 2009. The growth has been driven by increase in private consumption and recovery of public and private investment. Foreign trade still accounts for a very significant share of total output, even though the level of exports has not yet returned to the same level as in years preceding the global recession in 2009. The Finnish economy has experienced a structural change in the 2010s, where the

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[60] http://vatt.fi/suomen-talous-2015-2030-laskelmia-politiikkatoimien-vaikutuksista

role of services has increased and traditional industries have been forced to adapt to changes in global demand and competition. The Government is carrying out major reforms in order to cut expenditures of the public sector and to bring the Finnish economy onto a path of sustainable growth and higher employment. The impact of the reforms is included in the economic growth assumptions of the WM and WAM projections. Due to the Government's reforms the economic growth expectation after 2020 is clearly higher than in the assumptions used in the Sixth National Communication. The starting level is due to the prolonged recession, however, lower. The economy is expected to reach the same level as in the projections of the Sixth National Communication around 2030.

Gross final energy consumption is levelled off in the projections as a result of increased energy efficiency in all sectors. The WAM projection includes additional energy efficiency measures particularly in transport, but also an increased energy use in biorefineries. Altogether the gross final consumption level is therefore about the same in the WAM projection as in the WM projection – just over 310 TWh in the 2020s .Nevertheless, the energy related emissions are substantially lower in the WAM projection. The lower emissions are the result of policy measures that replace fossil fuels with renewables and electricity.

Despite the flat final consumption projection the primary energy consumption varies clearly in the projections. The main reason for this is the substantial changes in domestic nuclear power production (increase in late 2010s and mid-2020, decreases in the late 2020s), which replaces or is replaced by electricity import. Expressed in primary energy, the value of nuclear power is three-fold that of imported electricity, despite the same amount of electricity fed to consumption. The development of the primary energy supply in the WM projection is shown in Figure 5.1.

Table 5.1 shows a summary of the main assumptions of the WM projection for 2016 to 2030. Numerical values for key variables and assumptions are presented in Section 5.8. The assumptions regarding international fuel prices on the world market are consistent with the estimates of the International Energy Agency (IEA 2015).

Figure 5.1. Historical development (1990 to 2015) and WM projection (up to 2030) of the primary energy supply, TWh

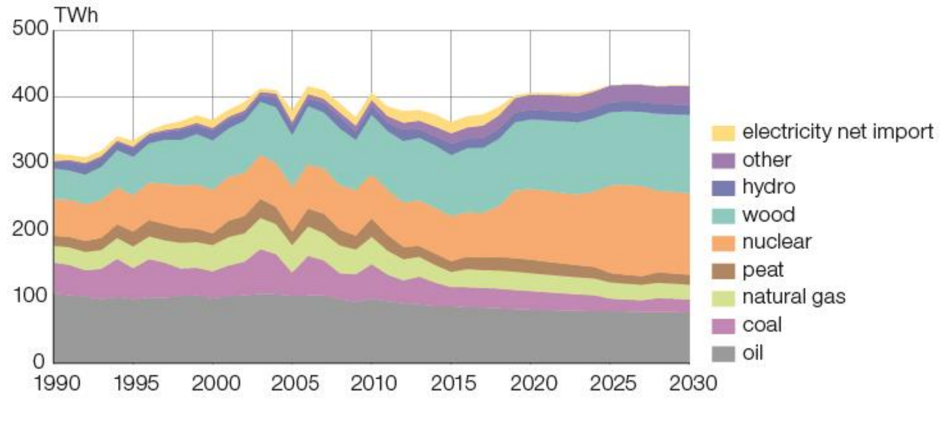


Table 5.1 Assumptions of the WM projection

Parameter	Trend 2016 to 2030
GDP growth	2.3 per cent annually
Structure of economy	Increasing share of services
Structure of industry	Less capital and energy intensive
Population growth	Increasing 0.4 per cent annually
Population structure	Ageing
Technology development	Gradual introduction of improved and more energy efficient technology

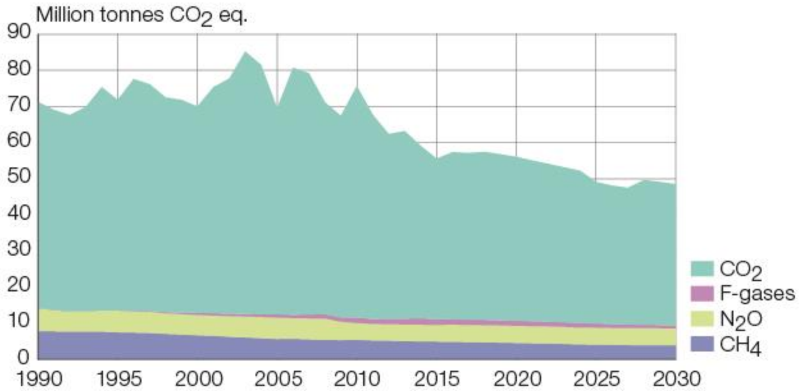
5.2 ‘With Measures’ projection

5.2.1 Total effects

Total emissions in the WM projection for the years 1990 to 2030 are shown in Figure 5.2 (total emissions without the LULUCF sector)[61] and Table 5.2 (without and with the LULUCF sector). Compared with the base year of 1990, the total greenhouse gas emissions without LULUCF are projected to be 21 per cent lower in 2020 and 32 per cent lower in 2030. Correspondingly, the CO_2 emissions are projected to be 20 per cent lower in 2020 and 31 per cent lower in 2030. CH_4 emissions are expected to continue to decline steadily being 42 per cent lower in 2020 and 51 per cent lower in 2030 than in 1990. N_2O emissions are projected to remain at current levels, which is one fourth lower than in 1990. The amount of emissions from F-gases is small and expected to decrease in the coming years.

The split of greenhouse gas emissions between the EU ETS sector and the non-ETS sector is illustrated in Figure 5.3. The emissions in the EU ETS sector have reached their peak in the mid-2000s and are expected to decline further. In 2015, emissions in the EU ETS sector counted for 46 per cent of the total greenhouse gas emissions, whereas the non-ETS sector counted for 54 per cent. 2015 was warmer than average years, which reduced the heating demand and lowered the emission level of the EU ETS sector more than the emission level of the non-ETS sector. The split between EU ETS and non-ETS sector emissions is expected to remain roughly in the same order of magnitude during the current and next decade even though a slightly slower decline in the non-ETS emissions is expected.

Figure 5.2 Greenhouse gas emissions without LULUCF by gas according to the latest greenhouse gas emission inventory (1990 to 2015) and the WM projection (up to 2030), million tonnes CO_2 eq.



61 Unless otherwise specified, total emissions refer to total national emissions without LULUCF

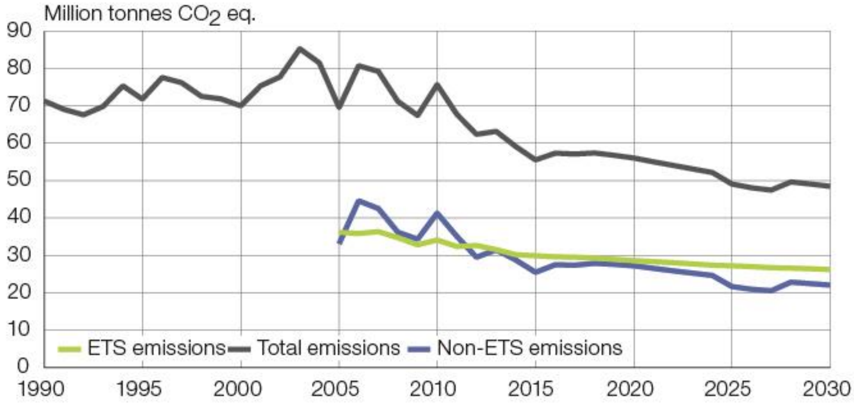
Table 5.2 Greenhouse gas emissions according to the most recent inventory data (1990 to 2015) and the WM projection (2020 to 2030)

	GHG emissions and removals (kilotonnes CO_2 eq.)								
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Sector									
1. Energy	53 558	55 328	53 755	53 715	60 166	40 816	41 441	34 870	34 509
2. Industrial processes and product use	5 370	4 914	5 827	6 497	6 260	6 076	6 349	6 471	6 493
3. Agriculture	7 525	6 838	6 466	6 457	6 576	6 481	6 611	6 446	6 378
4. Land use, land-use change and forestry	-12 672	-12 369	-21 710	-27 068	-27 297	-25 991	-10 644	-4 274	-4 211
5. Waste	4 672	4 596	3 850	2 823	2 583	2 134	1 629	1 311	1 112
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gas									
CO_2 emissions without net CO_2 from LULUCF	56 949	58 124	57 026	57 031	64 007	44 382	45 392	39 204	39 157
CO_2 emissions with net CO_2 from LULUCF	41 466	43 026	32 679	27 473	34 449	16 205	35 468	35 795	35 814
CH_4 emissions without CH_4 from LULUCF	7 746	7 448	6 614	5 576	5 373	4 875	4 498	4 069	3 817
CH_4 emissions with CH_4 from LULUCF	9 285	8 903	7 963	6 783	6 352	5 795	4 771	4 208	3 952
N_2O emissions without N_2O from LULUCF	6 377	6 040	5 660	5 956	4 696	4 659	4 757	4 700	4 727
N_2O emissions with N_2O from LULUCF	7 649	7 314	6 948	7 239	5 979	5 925	6 064	5 996	6 013
HFCs	0	27	559	892	1 485	1 547	1 343	1 085	751
PFCs	0	0.4	13	16	1	7	4	4	4
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	52	37	26	22	22	38	36	37	38
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	71 125	71 676	69 899	69 493	75 585	55 507	56 031	49 098	48 493
Total (with LULUCF)	58 453	59 307	48 189	42 425	48 288	29 516	45 387	44 825	44 272
Indirect CO_2 emissions[1])	165	129	104	85	69	52			
Total (without LULUCF, with indirect)	**71 291**	**71 805**	**70 003**	**69 578**	**75 654**	**55 559**	**NE**	**NE**	**NE**
Total (with LULUCF, with indirect)	**58 618**	**59 436**	**48 293**	**42 510**	**48 356**	**29 568**	**NE**	**NE**	**NE**

NO = not occurring, NE = not estimated

[1]) Indirect emissions are not included in the above emissions/removal estimates by sector and gas

Figure 5.3. The split of greenhouse gas emissions between the EU ETS sector and the non-ETS sector (2005 to 2015) based on the latest greenhouse gas inventory and the WM projection (up to 2030). The development of the total emissions without the LULUCF sector is also presented



The emissions from the non-ETS sector have steadily decreased since 2005 and the decrease is expected to continue (Figure 5.4). In the WM projection, the emissions from the non-ETS sector in 2020 are 15 per cent and in 2030 22 per cent below the 2005 level when taking into account the change of scope of the EU ETS. The development of the emissions by branch in the EU ETS sector for the years 2005 to 2030 is illustrated in Figure 5.5. The curves include both energy and process related emissions from sources included in the EU ETS in 2013.

Figure 5.4 Emissions in the non-ETS sector (corresponding to EU ETS scope of 2013) by category (2005 to 2015) based on the latest greenhouse gas inventory and the WM projection (up to 2030)

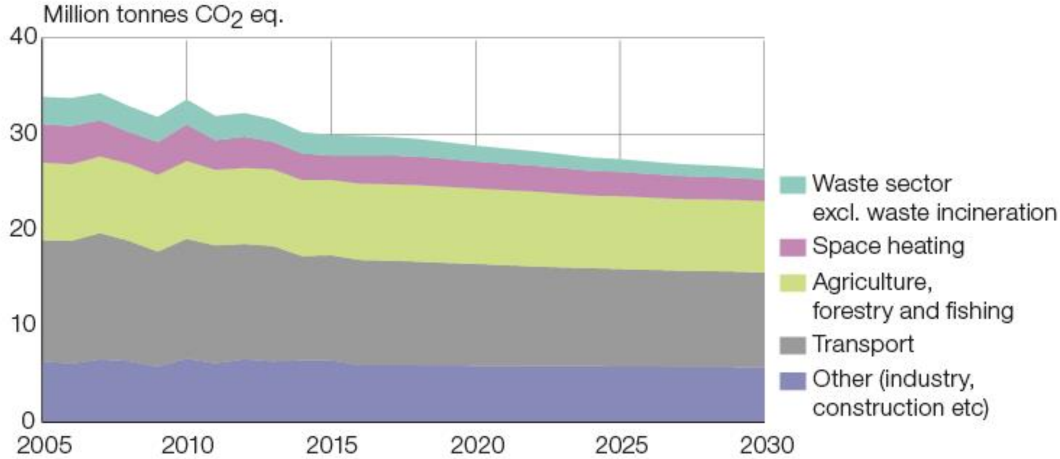
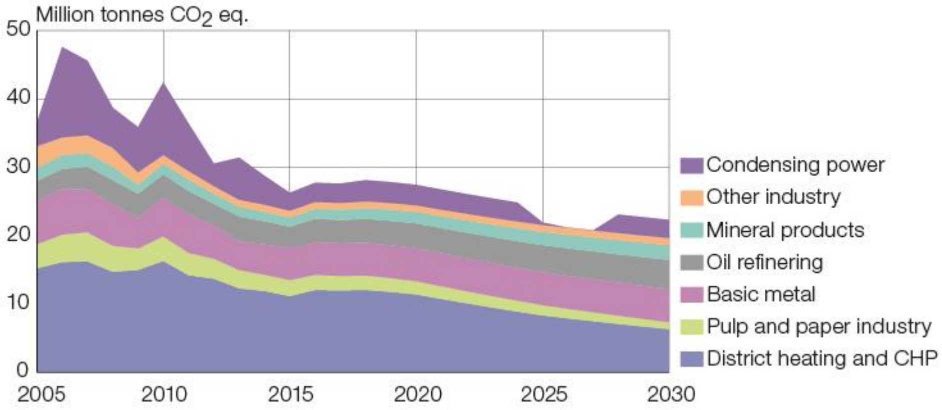


Figure 5.5 Emissions in the EU ETS (corresponding to EU ETS scope of 2013) sector according to the greenhouse gas inventory (2005 to 2015) and the WM projection (up to 2030)



The development of total emissions with regard to the number of inhabitants, primary energy use and economic development is presented in Table 5.3.

Table 5.3 Greenhouse gas emission intensity based on the latest greenhouse gas inventory for 2010 to 2015 and the WM projection for 2020 to 2030

	2010	2015	2020	2025	2030
Emissions per capita, tonnes CO_2 eq. /capita	14.1	10.1	10.0	8.5	8.3
Emissions per GDP, kg CO_2 eq./EUR	0.40	0.30	0.32	0.25	0.22
Emissions per primary energy, tonnes CO_2 eq./MWh	0.19	0.15	0.14	0.12	0.12

5.2.2 Sectoral emissions

Energy

The energy sector is strongly affected by policy measures to reduce the emissions, to enhance energy efficiency and to increase the share of renewable energy sources. Both the supply and demand sides are facing significant changes, part of the changes results from policy measures, part from technological development and development of the energy and fuel markets. As many of the changes involve or concern investments like power plants, the effects are robust and long lasting.

In the WM projection, the most significant future changes in electricity and heat production are the start-up in 2018 of a 1600 MW nuclear power plant unit currently under construction, one additional nuclear power plant unit in the mid-2020s and the increase in the use of renewable energy sources, mainly wind power and biomass in CHP plants. All these changes reduce emissions. In the WM projection, Finland remains a net importer of electricity during the projected period except for a few years right after mid-2020s when Finland can be self-sufficient in power supply. During that period the generation from the new nuclear and wind power plants is expected to replace some domestic conventional power generation resulting in a reduction of domestic greenhouse gas emissions.

Factors affecting the future energy demand are first of all energy efficiency measures, but also the economic development and structural changes within the industry. According to the WM projection, energy used for heating of residential and service sector buildings is decreasing even though the volume of buildings is expected to increase continuously.

The emissions from space heating are decreasing even faster than the energy demand due to the increased use of renewable energy. District heat production from heat-only plants is expected slightly to increase its share at the expense of combined heat and power production, which is struggling with the feasibility due to low electricity prices.

The historical and projected emissions from the energy sector (excl. transport) in the WM projection are presented in Table 5.4. The emissions in the energy sector are mainly CO_2 emissions from the combustion of fossil fuels and peat. Most of the energy production as well as the industrial energy use belong to the EU Emission Trading Scheme (see Figure 5.5).

Table 5.4 Historical (1990 to 2015) and projected (2020 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	2015	2020	2025	2030
Total emissions, million tonnes CO_2 eq.	41.3	43.8	41.5	40.6	47.3	29.6	30.7	24.6	24.5
CO_2	40.7	43.2	40.8	39.9	46.5	28.9	29.8	23.7	23.6
CH_4	0.3	0.2	0.2	0.2	0.3	0.2	0.4	0.4	0.4
N_2O	0.4	0.4	0.5	0.5	0.6	0.5	0.5	0.5	0.5

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. Future years are in the projections assumed to be standard years (i.e. long-term average plus impact of climate change) with respect to heating demand and hydro levels. Full load hours equalling average historical figures are assumed for condensing power. In reality, the emissions will continue to vary from one year to another but to a lesser extent due to decreased specific emissions in both district heat and power generation. The CO_2 emissions from both district heating and industrial energy use are declining steadily in the WM projection.

The importance of CH_4 and N_2O emissions within the energy sector is quite small. Less than 10 per cent of all CH_4 emissions in Finland come from incomplete combustion of fuel, which is mainly caused by fireplaces and small heating boilers. CH_4 emissions from power and heating plants are 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 fossil fuels for machinery and driers, space heating of buildings and industry outside the EU ETS. In the WM projection, the emissions from individual heating of residential and commercial buildings decline from 2 million tonnes CO_2 eq. to 1.4 million tonnes CO_2 eq. in 2030. The emissions from machinery are expected to remain approximately at their current level, i.e. 2.4 to 2.5 million tonnes CO_2 eq., even though the use of machinery is expected to increase over time. The reasons for this favourable development are more efficient equipment and a more efficient use of the equipment. Also the emissions from non-ETS industrial energy use stay around the current level of 0.6 million tonnes CO_2 eq. in the WM projection despite an increase in activity. The energy-related emissions from agriculture and forestry are today 1.4 million tonnes CO_2 out of which 0.8 million tonnes CO_2 eq. comes from machinery. By 2030 the energy-related emissions in agriculture and forestry are expected to decrease to 1.1 million tonnes CO_2 eq. The expected energy savings from energy advice within agriculture are 24 GWh/a and the corresponding CO_2 emission reductions 6 kt/a in 2020. In 2030, the estimated energy savings impact is 40 GWh/a and emission reductions 10 kt/a assuming same activity levels beyond 2020.

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 in June 2016 (see also Section 4.5.2).

According to the WM projection, even though the total vehicle mileage will increase, the emissions are expected to decline by 2020 (Table 5.5). 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 13.5 per cent of the road transport fuel sold in 2020 and that the growth in transport performances will remain at a moderate level, i.e. 0.5 to 1.5 per cent annually.

Table 5.5 Historical (1990 to 2015) and projected (2020 to 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	2015	2020	2025	2030
Total emissions, million tonnes CO_2 eq.	12.1	11.3	12.1	12.9	12.7	11.1	10.8	10.3	10.0
CO_2	11.8	11.1	11.9	12.8	12.6	11.0	10.6	10.2	9.9
CH_4	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
N_2O	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Industrial processes and other product use

The main factors affecting the development of emissions from industrial processes and product use include changes in industrial production and measures applied for reducing emissions. The global recession reduced the emissions from the sector in 2009, after which they have stayed at an approximately 20 per cent lower level compared to the peak year 2008.

In the WM projection the emissions are expected to increase slightly until mid-2020s as industrial production increases (Table 5.6). CO_2 emissions from industrial processes are mainly caused by the manufacturing of iron and steel, cement, lime and hydrogen. 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.

Table 5.6 Historical (1990 to 2015) and projected (2020 to 2030) greenhouse gas emissions from industrial processes and other product use based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical						WM projection		
	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total emissions, million tonnes CO_2 eq.	5.4	4.9	5.8	6.5	6.3	6.1	6.3	6.5	6.5
CO_2	3.7	3.4	3.9	4.0	4.6	4.2	4.7	5.1	5.4
CH_4	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
N_2O	1.7	1.5	1.4	1.6	0.2	0.3	0.2	0.2	0.3
F-gases	0.0	0.0	0.6	0.9	1.5	1.6	1.4	1.1	0.8

The WM projection for F-gases includes the impacts of the EU regulation on F-gases[62] and the EC directive relating to emissions from air-conditioning systems in motor vehicles[63]. Emissions from refrigeration and air-conditioning equipment are expected to decline as a result of these measures and technical changes leading to smaller charges and decreased leakage. Emissions from electricity distribution equipment have declined heavily as a result of voluntary actions of the industries. A slight increase of emissions is assumed in the future but the peak level of emissions in the 1990's will not be reached. Restrictions forced by the EU regulation have a decreasing effect on emissions from foam blowing, aerosols

62 2014/517/EU

63 2006/40/EC

and other sources. The emissions from foam blowing and aerosols are expected to decrease in the future. The emissions from other sources are expected to stay quite steady. Emissions from refrigeration and air-conditioning equipment account for more than 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.

Agriculture

In recent years, the changes in the emissions from agriculture have been small. Under the WM projection, the emissions are expected to increase slightly (two per cent between 2005 and 2020), as nitrogen (N) and organic soils are estimated to be increasing sources (Table 5.7).The decline in livestock numbers and N fertilization will slightly lower the total emissions after 2020 and the total greenhouse gas emissions from agriculture will be one per cent lower in 2030 compared to 2005.

Energy-related emissions related to agriculture are reported in the energy sector and not included in Table 5.7.

Table 5.7 Historical (1990 to 2015) and projected (2020 to 2030) greenhouse gas emissions from agriculture based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical						Projected		
	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total emissions, million tonnes CO_2 eq	7.5	6.8	6.5	6.5	6.5	6.5	6.6	6.4	6.4
CO_2	0.6	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2
CH_4	2.8	2.5	2.5	2.5	2.6	2.6	2.6	2.5	2.4
N_2O	4.1	3.9	3.6	3.6	3.7	3.7	3.8	3.7	3.7

LULUCF

The land use, land-use change and forestry sector (LULUCF) as a whole is expected to be a net sink in the WM projection (Table 5.8).

Table 5.8 Historical (1990 to 2015) and projected (2020 to 2030) greenhouse gas emissions and removals from the LULUCF sector based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical						Projected		
	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total emissions and removals, million tonnes CO_2 eq.	-12.7	-12.4	-21.7	-27.1	-27.3	-26.0	-10.6	-4.3	-4.2
CO_2	-15.5	-15.1	-24.3	-29.6	-29.6	-28.2	-12.2	-5.7	-5.6
CH_4	1.5	1.5	1.3	1.2	1.0	0.9	0.3	0.1	0.1
N_2O	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3

The WM projection for forestry is based on the National Forest Strategy (NFS) 2025, which estimates that the carbon sink of forests (including trees and soil but excluding HWP) will remain at a level of at least 13.5 to 20 million tonnes CO_2 eq. per annum during the period 2025 to 2030. The estimate is based on the assumption that loggings will increase by 10 to 15 million cubic metres per year and that the use of wood for bioenergy will continue as defined in the National Energy and Climate Strategy and the NFS.

The government and stakeholders will continue to carry out joint initiatives to promote the use of wood as a renewable material that also contributes to climate change mitigation.

The impact of harvested wood products on emissions varies annually. In the most recent inventory, harvested wood products were estimated to be a sink of 2.3 million tonnes CO_2 eq in 2015.[64] In the WM projection, the HWP sink has been assumed to remain at the 2015 level during 2020 to 2030.

With regard to agricultural soils, CO_2 emissions and removals from croplands and grasslands are not expected to be subject to large changes by the year 2030 according to the WM projection.

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 5.9). The main reason for this is the implementation of the Landfill Directive[65] and national legislation[66] and strategies aimed at reducing the amount of waste and minimising the amount of waste disposed at landfills.

Table 5.9 Historical (1990 to 2015) and projected (2020 to 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	2015	2020	2025	2030
Total emissions, million tonnes CO_2 eq.	4.7	4.6	3.9	2.8	2.6	2.1	1.6	1.3	1.1
CH_4	4.6	4.5	3.7	2.7	2.5	2.0	1.5	1.2	1.0
N_2O	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

CH_4 emissions will 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 about two thirds of the 2020 level.

N_2O emissions from biological treatment of waste were 0.04 million tonnes CO_2 eq. and from waste water treatment 0.08 million tonnes CO_2 eq. in 2015. In the WM projection these emissions are expected to remain at approximately the current level up to 2030.

International bunkers

According to the most recent greenhouse gas emission inventory, the fuel consumption for international aviation was 26,818 TJ and for international marine transportation 11,832 TJ in 2015. The annual growth rate by 2030 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 2015 as the basis, the total greenhouse gas emissions from bunker fuels are projected to be 3.3 million tonnes CO_2 eq. in 2020 (1.0 million tonnes CO_2 eq. from marine and 2.3 million tonnes CO_2 eq. from aviation bunkers). The corresponding total estimate for 2030 is 4.3 million tonnes CO_2 eq. (1.2 million tonnes CO_2 eq. from marine and 3.1 million tonnes CO_2 eq. from aviation bunkers).

These 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.

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[64] HWP figure is presented here as according to the Convention reporting.

[65] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste

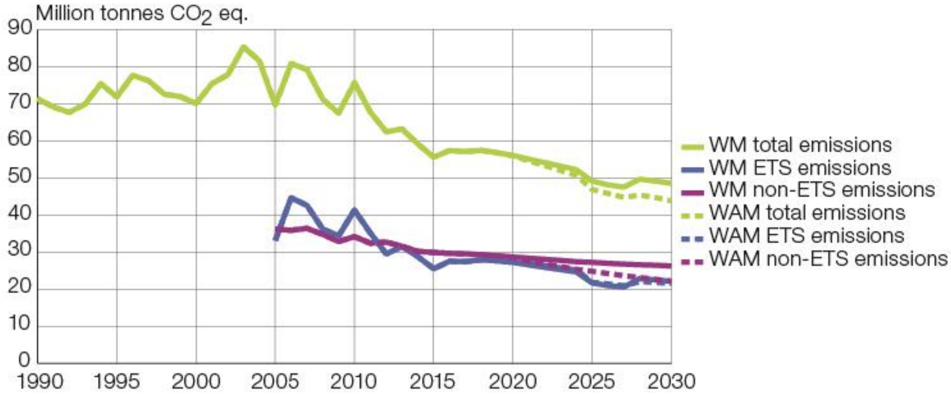
[66] Government Decree on Landfills 331/2013

5.3 'With Additional Measures' projection

With the existing policy measures Finland is on track to meet its 2020 emission reduction and renewable energy targets. The effect of the additional measures is aimed at the 2020s and in full at the year 2030 at the latest. With a few exceptions all the planned measures described in Chapter 4 are included in the WAM projection. Measures for which the impact on the energy balance is not known have not been included in the WAM projection. These are 1) phasing out oil heating in the public sector, 2) reducing emissions from machinery by improving energy efficiency and promoting the use of alternative fuels or power sources, and partly 3) promoting the use of biogas.

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

Figure 5.6 Greenhouse gas emissions in EU ETS and non-ETS sectors in the WAM projection (dashed lines) compared to the WM projection (solid lines) in the years 2016 to 2030 and historical emissions for 1990 to 2015 based on the most recent inventory



The total greenhouse gas emissions in 2030 are estimated to be 48 million tonnes CO_2 eq. in the WM projection and 44 million tonnes CO_2 eq. in the WAM projection. The additional emission reduction measures in the WAM projection will mainly affect the non-ETS sector.

Table 5.10 presents a summary of the WAM projection emissions and the difference between them and the emission levels in the WM projection.

Table 5.10 Greenhouse gas emissions on a gas-by-gas basis for the WAM projection and difference between them and the WM projection in 2020-2030, million tonnes CO_2 eq. (the greenhouse gas emissions in 2010 and 2015 are based on the most recent inventory and shown for comparison)

	Historical		WAM projection		
	2010	**2015**	**2020**	**2025**	**2030**
CO_2	64.1	44.4	45.3	37.2	34.8
CH_4	5.4	4.9	4.5	4.1	3.8
N_2O	4.7	4.7	4.8	4.7	4.7
F-gases	1.5	1.6	1.4	0.9	0.5
Total	**75.7**	**55.6**	**55.9**	**46.8**	**43.8**
difference to WM			-0.1	-2.3	-4.7

In the building sector, additional measures are under preparation. Nearly zero-energy (NZEB) regulations for new buildings will come in force in 2018. According to the National Energy and Climate Strategy for 2030 is an obligation to blend 10 per cent of bioliquids into light fuel oil used for heating of buildings. A decision of the types of policy instruments which are going to be applied to fulfil this PAM have not been made yet and these measures are therefore not yet included in the WAM projection.

In the transport sector, the estimated additional total emission reductions in the WAM projection are 2.8 million tonnes CO_2 in 2030. The potential emission reduction impact of promoting the use of biofuels (additional measure) in the WAM projection is 1.5 million tonnes CO_2 eq. in 2030 compared to the WM projection. The emission reduction effects of improving the energy-efficiency of vehicles (additional measures), should total some 1.0 million tonnes CO_2 eq. in 2030. The potential emission reduction impact of improving the energy-efficiency of the transport system (additional measure) is 0.3 million tonnes CO_2 eq. in 2030.

The WAM projection for F-gases is based on additional measures that are expected to promote the alternative low-GWP non-HFC technologies in the refrigeration and air conditioning equipment sector in addition to the F-gas regulation. These additional measures include criteria for public procurement related to F-gases and information and education campaigns. It is estimated that the emission reductions achieved by these additional measures will be 0.3 million tonnes CO_2 eq. in 2030.

In the waste sector, no significant additional measures are planned. The implementation of the existing measures will push the emissions to a very low level.

In the agricultural sector the estimated additional total emission reductions in the WAM projection are 0.5 million tonnes CO_2 eq. in 2030. The main reductions are based on activities planned to be put into practice on organic soils, for example by intensifying long-term grass cultivation and afforestation. The potential emission reduction impact concerning N_2O emissions is 0.45 million tonnes CO_2 eq. in 2030. Use of biogas produced in the agriculture sector to replace fossil fuels is a new measure which will reduce CH_4 emissions in the agriculture sector in 2030 by 0.05 million tonnes CO_2 eq and in the energy sector in 2030 by 0.3 million tonnes CO_2 eq.

Measures identified to reduce N_2O emissions from organic soils will have effects also on the CO_2 emissions from the LULUCF-sector.

5.4 Total effect of policies and measures

The aggregated estimates for the greenhouse gas reduction impacts of already implemented individual policies and measures presented in Chapter 4 are 12, 20, 34 and 42 million tonnes CO_2 eq. for 2010, 2015, 2020 and 2030 (without LULUCF), respectively. The planned measures will reduce greenhouse gas emissions increasingly in the 2020s reaching an additional annual reduction of 6.3 million tonnes CO_2 eq. in 2030. The total effect of the policies and measures by gas is shown in Table 5.11.

Table 5.11 The total effect of the policies and measures (PaMs) calculated based on estimated impact of PaMs (see Tables 4.3–4.11, excluding Table 4.7 and Table 4.10) for the year 2015, 2020 and 2030 (million tonnes CO_2 eq). The total emissions in 2015 based on the most recent inventory are also given for comparison.

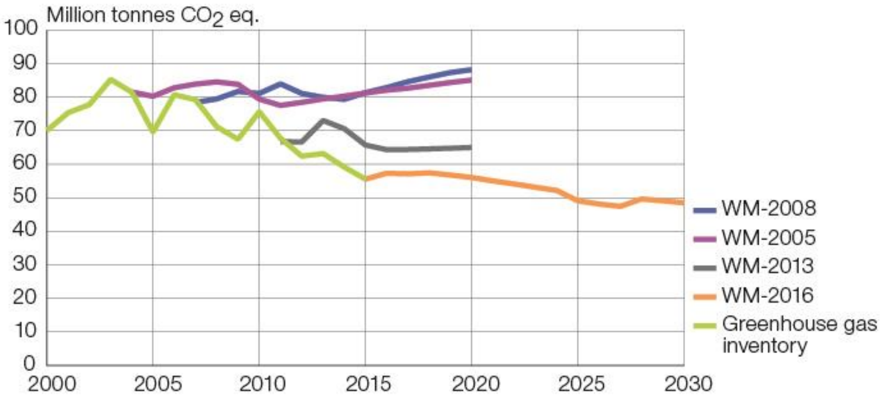
		Implemented measures			Planned measures		
	Total emissions in 2015	Total effect of PaMs in 2015	Total effect of PaMs in 2020	Total effect of PaMs in 2030	Total effect of PaMs in 2015	Total effect of PaMs in 2020	Total effect of PaMs in 2030
CO_2	44.4	18.8	28.9	36.2	0	0	5.5
CH_4	4.9	0	2.9	3.4	0	0	0.05
N_2O	4.7	0	0	0	0	0	0.5
F-gases	1.6	1.4	1.8	2.8	0	0	0.3
Total	55.6	20.2	33.6	42.4	0.0	0.0	6.3

The total effect of policies and measures contains noticeable uncertainties. The impact estimates of individual policies and measures are not fully additive, which may result in an overestimation of the mitigation impact in certain sectors.

The overlapping effect of measures has been paid due attention to for example in the case of simultaneous increase of biofuel content and energy efficiency in the transport sector and in heating. The mitigation impact has, however, not been estimated for all policies and measures. Consequently, the total emission reduction can be larger than the reported total effect.

Figure 5.7 shows Finland's greenhouse gas emissions in the WM projections in the last four national climate and energy strategies, i.e. strategies from the years 2005, 2008, 2013 and 2016. The WM projections in the previous national climate and energy strategies projected significantly higher emissions for 2015 than those reported in the latest greenhouse gas inventory. This suggests that the additional measures implemented in the 2010s have had a substantial impact on the total emissions.

Figure 5.7 Greenhouse gas emissions according to the most recent inventory for 2000 to 2015 and in the WM projections of the climate and energy strategies published in 2005, 2008, 2013 and 2016 up to 2020 and 2030 respectively.



The main difference between the projections shown in Figure 5.7 is that in the newest projection, many measures from previous WAM projections have been implemented and then included in the WM projection. Major additional measures that have been implemented since the Sixth National Communication concern energy efficiency improvements in the existing building stock and reduced deposition of biodegradable waste in landfills. The projections differ mostly compared to the previous National Communication in terms of waste treatment, road transport, space heating of buildings, and electricity supply. In addition, the global recession and the structural adjustment of the Finnish forest industry have been taken into consideration in the 2013 and 2016 strategy but not in the previous ones. Finland is not, according to the energy and climate strategy from 2016, any longer aiming at self-sufficiency of electricity supply as there is no rational for it in a power market that is rapidly integrated regionally as well as on a European-wide level. Part of the condensing power assumed in the projections of earlier years is in reality substituted with electricity import. The current WM and WAM projections try to reflect the international electricity exchange in a realistic manner. Without an aim of self-sufficiency the domestic greenhouse gas emissions in electricity supply are somewhat lower and have smaller yearly variations.

The total effect of implementing additional measures can be seen in the emission development trend after 2015, which has levelled off in the 2013 and 2016 projections, whereas it continued to increase in the projections from 2005 and 2008.

In the current WM projection, the emissions in 2020 are projected to be about 35 per cent below the projected levels in 2005 and 2008 WM projections and 14 per cent below the 2013 WM projection.

5.5 Economic impacts

VTT Technical Research Centre of Finland Ltd has assessed the impacts of the policy measures[67] of the National Energy and Climate Strategy for 2030 on the energy system and national economy.

The impact assessment compares the impacts of the new policy measures of the WAM scenario to the development in the WM scenario. For the economic impact assessment, a dynamic applied general equilibrium model that describes the economy from the perspective of decisions made by households, companies and the public sector is used.

In the WAM scenario, reductions in greenhouse gas emissions will mainly be achieved by means of energy system and non-ETS sector measures. The impacts of emissions trading are already taken into account in the WM scenario. However, the structure of both the production and consumption change in the WAM scenario, which has an impact on the budgetary position of the public sector. In addition, the support required by biorefineries increases public expenditure, while the growing share of biofuels and a slower transport performance reduces the fuel tax accrual. In the modelling, it is assumed that budget neutrality is achieved by a small increase in commodity tax (for example, through value added taxation).

In addition to the impacts associated with central government finances, increasing the share of biofuels by means of the distribution obligation will also push transport costs up, as the price of renewable diesel is higher by some 33 cents/l than the price of fossil fuels. As an estimate, this would mean that with a blending ratio of 30 per cent, diesel users would incur an annual additional cost of EUR 200 million compared to the current prices. Similarly, replacing light fuel oil with bioliquids in heating and machinery will increase the users' costs. A blending ratio of 10 per cent in light fuel oil will increase the fuel oil price by some 6 cents/l, or 8 per cent. If the oil consumption of an oil-heated low-rise building is 3 000 l a year, the annual cost impacts will be approx. EUR 180 million. As regards machinery, the cost increase ensuing from the blending obligation would primarily affect businesses and agriculture. The increase in fuel oil costs will be approx. 8 per cent, or similar to the cost increase of oil heating. The absolute effects will, however, depend on company size and machinery use.

The impact of the WAM measures on the national economy in 2030 is shown in Table 5.12.

Table 5.12 The impact of the WAM measures on the national economy

	Change compared to the WM scenario, per cent	Impact on the domestic product compared to the WM scenario, percentage points
Domestic product	–0.59	
Private consumption	–0.40	–0.23
Investments	–0.85	–0.10
Public consumption	0.00	0.00
Exports	–1.75	–0.76
Imports	–1.33	0.49

The domestic product in 2030 is in the WAM scenario approx. 0.6 per cent smaller than in the WM scenario. This is caused by lower private consumption and investments than in the WM scenario and a slowing down of foreign trade. The decline in exports affects the domestic product most. On the other hand, imports also decline, which increases the domestic product.

While the change in employment in the national economy as a whole is put at -0.15 per cent, it is expected that primary production and energy supply sectors preserve their current employment levels.

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[67] http://tietokayttoon.fi/julkaisu?pubid=16902

More employment is created especially in the production of biofuels and bioenergy. The increase in the biorefining of forest raw materials (300 ktoe) increases employment by 2,000 person-years. In other biorefining sectors, the increase (300 ktoe) is estimated to be 150 person-years. It is expected that the 2 TWh increase in wind power capacity will create 400 person-years' worth of employment.

As coal use is phased out, chip and pellet boilers and heat pumps will replace coal in the heat production. The quantitative impact on employment is, however, difficult to estimate.

5.6 Sensitivity analysis of the projections

Energy use and hence the greenhouse gas emissions are sensitive for the assumptions made on economic growth. Sensitivity analysis has therefore been carried out for the WM projection varying the economic growth of industry and service branches as well as the building sector. No sensitivity analysis on the transport sector was made, but generally, a lower economic growth would have both a reducing and an increasing impact on the energy use for transport. On one hand, the need for transport is likely to be lower, but on the other hand, the renewal of the transport fleet slower. In the sensitivity analysis, the energy use in the transport sector is kept unchanged.

The manufacturing industry uses about 45 per cent of the country's final energy consumption and 47 per cent of the electricity. The forest industry has a significant impact on the energy sector, including renewable energy production, energy consumption and production. Iron and steel production is another energy-intensive branch, the development of which influences the projections noticeably. The energy balances projections of these branches are based on product group specific volume estimates. Both branches develop generally positively in the WM projection, even though some product groups continue to decrease (e.g. manufacturing of paper).

In the sensitivity analysis the annual growth of the volumes in forest industry and metal industry is 1 percentage point less than in the WM scenario from 2017 onwards. This lower growth reduces the energy consumption in the forest and metal industry with 4 TWh in 2020 and 12 TWh in 2030 compared to the WM scenario. Corresponding values for electricity consumption reduction is 1 TWh in 2020 and 3 TWh in 2030. Both branches produce a part of their power themselves, so the net effect on the country's electricity balance is somewhat smaller.

A lower economic growth projection for the building sector has also been formed. The effect of a lower economic growth on construction and on the use of heating sources was assessed. The analysis is presented in a report published by the Finnish Environment Institute. Economic growth has a considerable influence on two factors, namely on renovation of existing buildings and on construction of new buildings. Economic growth affects indirectly also the demolition of buildings. In times with low economic growth there are less energy efficiency improvements done in existing buildings. On the other hand, the total building stock increases slower due to less construction activity, but at the same time fewer old and less energy efficient buildings are replaced. All in all, the energy demand of the building sector decreases slower in the projection with low economic growth than in the WM projection.

In addition to the branches and sectors mentioned above, the development of the other industry and service branches was varied by lowering the annual growths with 1 percentage point from the WM assumptions. No dynamic effects were taken into account. The overall effect of a lower economic growth results in a cease of the final energy consumption increase already after 2018. In 2030 the final energy consumption would be only 290 TWh and the total energy consumption 387 TWh. The greenhouse gas emissions would be 4 Mt CO_2 eq. lower than in the WM projection. Most of the emission reduction would, however, take place in the ETS sector, only 0.4 Mt CO_2 eq. in the non-ETS sector.

The main results of the sensitivity analysis are presented in Table 5.13.

Table 5.13 Main results from the sensitivity analysis on how the economic growth rate affects the overall energy balance and greenhouse gas emission

	2015	2020		2030	
	Historical	WM	Lower growth	WM	Lower growth
Primary energy consumption, TWh	363	407	398	418	387
Final energy consumption, TWh	294	311	303	313	290
Electricity consumption, TWh	82	88	85	91	85
Share of renewables in final energy consumption, %	39.3	43	43	47	47
GHG emissions, million tonnes CO_2 eq.	55.6	56	55	48	44
of which non-ETS emissions, million tonnes CO_2 eq.	29.9	29	29	26	26

5.7 Methodology

5.7.1 Approach and responsibilities

The reported WM and WAM projections are integrated energy and climate projections that were originally compiled in 2016 for the preparation of the National Energy and Climate Strategy for 2030.The preparation of the strategy was coordinated by the Ministry of Economic Affairs and Employment under the Ministerial Working Group on Bioeconomy and Clean Solutions.

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

The sectoral projections and calculations were made by various experts within the contact network set up by the main ministries involved in drafting the climate policy. The ministries have consulted expert organisations for acquiring data, assessments of policies and measures and modeling of sector-specific projections. Following authorities and expert organisations contributed to the reporting in 2017: the Energy Authority, Finnish Environment Institute (SYKE), VTT Technical Research Centre of Finland Ltd, Motiva Ltd, Tampere University of Technology, Natural Resources Institute Finland, Finnish Transport Safety Agency, VATT Institute for Economic Research, Benviroc Ltd and Statistics Finland.

The main models and methods used in the work are briefly described in Section 5.8.3. The Ministry of Economic Affairs and Employment was responsible for the projections regarding the amount of energy used by industry, households and services and for the calculations regarding fuel and carbon dioxide emissions in the energy production sectors as a whole; it was also responsible for coordinating the calculations. The Ministry of the Environment was responsible for the projection regarding space heating, for the analysis of the regional and urban structure, and for emission projections and calculations for waste and machinery. The duty of the Ministry of Transport and Communications included making projections for fuel and electricity usage as well as emissions from the transport sector. The Ministry of Agriculture and Forestry oversaw the calculation of emissions and removals in the agriculture and land use, land-use change and forestry sectors.

5.7.2 Assumptions underlying calculations

A summary of key variables and assumptions is presented in Table 5.14.

Table 5.14 Key variables and assumptions used in the projections analysis for 1990 to 2030

		Historical						Projected		
	Unit	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Population	Million inhabitants	4.99	5.11	5.18	5.25	5.38	5.50	5.63	5.75	5.85
Gross Domestic Product	Million EUR, 2010 prices	126000	123000	158000	180000	187000	187000	201000	229000	260000

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 2.6 million to approximately 3.0 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 the energy demand.

The GDP is assumed to increase in the coming years. In the projections the annual growth during 2016 to 2020 is on average 1.6 per cent. In the 2020s the growth will be higher, 2.6 per cent per annum on average, as the Government's reforms are starting to pay off and the competitiveness of the Finnish economy increases.

The activities that will sustain most growth in production in the 2020s are expected to be machinery and equipment manufacturing, forest industry, and financial and insurance business.

The international fuel price estimates are taken from the IEA's World Energy Outlook publication (IEA 2015). The price of crude oil is assumed to be USD 80/barrel in 2020 and USD 113/barrel in 2030. The price of natural gas is the corresponding years assumed to be USD 27/MWh and USD 38/MWh, respectively. Emission allowance prices are expected to rise in 2020 to EUR 15/ t CO_2 and in 2030 to EUR 30/t CO_2. The primary energy by source, the energy sources for district heat and combined heat and power production, the electricity supply and the energy sources in the transport sector are presented in Tables 5.15–5.18.

Table 5.15 Primary energy by energy source and gross final energy in 2010, 2015 and in the WM projection for 2020 to 2030, TWh

	2010	**2015**	**2020**	**2025**	**2030**
Oil, incl. bio-fraction	97	86	81	78	77
Hard coal	40	17	15	11	7
Coke, blast furnace and coke oven gas	12	11	15	16	17
Natural gas	41	23	27	25	22
Nuclear energy	66	68	106	114	123
Net imports of electricity	11	16	2	2	1
Hydropower	13	17	14	15	15
Wind and solar power	0	2	5	6	7
Peat	27	16	20	17	15
Wood fuels	90	92	104	111	118
Others	10	15	15	16	17
Total energy consumption	407	363	407	411	418
Final energy consumption	319	294	311	312	313

Table 5.16 Energy sources for district heat and combined heat and power production in 2010, 2015 and in the WM projection for 2020 to 2030, TWh

	2010	2015	2020	2025	2030
Hard coal	14	12	10	5	2
Oil	3	1	1	1	1
Natural gas	23	11	12	10	8
Peat	12	9	12	9	8
Wood fuels	12	16	20	25	29
Other renewables	1	2	4	4	4
Other	2	3	3	4	5
Total	66	54	63	59	57

Table 5.17 Electricity supply in 2010, 2015 and in the WM projection for 2020 to 2030, TWh

<table>
<tr><th></th><th>2010</th><th>2015</th><th>2020</th><th>2025</th><th>2030</th></tr>
<tr><td>Hydro power</td><td>13</td><td>17</td><td>14</td><td>15</td><td>15</td></tr>
<tr><td>Wind and solar power</td><td>0</td><td>2</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>Nuclear energy</td><td>22</td><td>22</td><td>35</td><td>43</td><td>40</td></tr>
<tr><td>CHP, district heat</td><td>18</td><td>13</td><td>15</td><td>13</td><td>12</td></tr>
<tr><td>CHP, industry</td><td>10</td><td>8</td><td>11</td><td>12</td><td>12</td></tr>
<tr><td>Condensing power</td><td>14</td><td>4</td><td rowspan="2">tot. 7</td><td rowspan="2">tot. 1</td><td rowspan="2">tot. 6</td></tr>
<tr><td>Net imports</td><td>11</td><td>16</td></tr>
<tr><td>Total supply</td><td>88</td><td>82</td><td>88</td><td>89</td><td>91</td></tr>
</table>

Table 5.18 Energy sources in transport in 2010, 2015 and in the WM projection for 2020 to 2030, TWh

	2010	2015	2020	2025	2030
Motor gasoline, fossil	18	16	14	12	11
Diesel fuel, fossil	27	24	24	24	24
Liquid biofuels	2	6	6	6	5
Electricity	0.7	0.7	0.8	1.0	1.2
Other	4	3	3	3	3
Total	51	49	48	46	45

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. It is estimated that the share of bio-based road transport fuels will increase to 13.5 per cent in 2020 and remain at this level thereafter.

The 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. Several new waste incineration plants have been constructed in recent years and in 2015 the incinerated amount was already more than 900,000 tonnes. The WM projection estimates that from 2020 onwards, the amount of municipal waste incinerated at waste incineration plants will be more than 1,240,000 tonnes per annum. In addition, co-incineration plants are expected to use 420,000 tonnes of waste-based fuels annually. Currently waste co-incineration is included in the emissions trading sector. The transfer of all waste incineration to the emission trading sector will be explored.

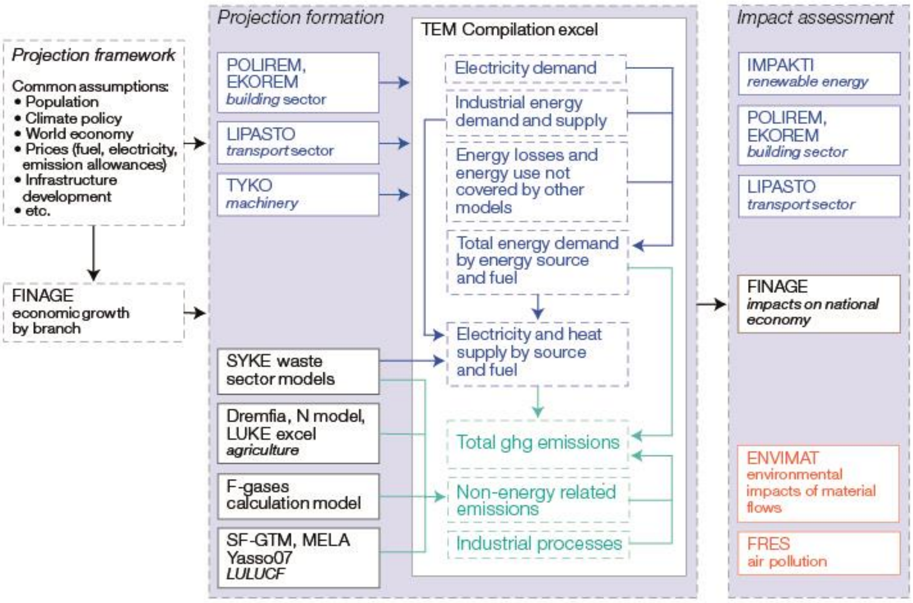
Assumptions and data sources for the different sectors are presented in more detail in the background report that was prepared for the National Energy and Climate Strategy for 2030.

5.8.3 Description of models and methods

A fairly large number of models are applied for the preparation of the greenhouse gas emission projections and for impact assessment of policy measures. Individual models that are central for energy and greenhouse gas emission projections are described in the sections below. The relationship and data flow between the different models is shown in Figure 5.8. Data from sector specific models are compiled by the Ministry of Economic Affairs and Employment in the module named 'TEM Compilation excel' in Figure 5.8. The same excel is used for calculating the projected energy balances and greenhouse gas emissions of the industry and the electricity and district heat production. The methodology for this is presented below under the heading 'Energy demand and production'.

In addition to using advanced sector-specific models, the quality of the projections, including correct treatment of overlapping emission reduction measures, is ensured to the largest possible extent by the methodology used. Firstly, the projection results from all sector specific models are brought together to the TEM compilation excel together with the most recent inventory data which enables direct comparison of historical and projected emissions. Secondly, the energy related CO_2 emissions are not calculated until the final stage in the compilation excel from fuel-specific energy amounts forming the energy balance time series of the whole country. By this, double-counting of emission reductions can be efficiently avoided.

Figure 5.8 Schematic diagram of the relationship and data flow between the different models applied in the projections and impact assessment of policy measures



Buildings

The impacts of policies and measures in the WM projection were estimated using EKOREM and POLIREM models. 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 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. The model is further developed and a calculation and visualization approach for energy use and greenhouse gas emissions is presented.

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[68] 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 uses official energy and building stock statistics of Finland and 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. These two modelling tools have been used for previous National Communications and biennial reports.

Energy demand and production

The Ministry of Economic Affairs and Employment 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 (auto producer plants), as well as on assumptions about electricity net imports. Information on existing and planned power plants and their possible dismantling and construction schedule, respectively, is used. Studies including extensive market simulations performed by Pöyry Management Consulting Oy in 2016 have been used for the projections of electricity and district heat supply.

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 (presented in Chapter 4). 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

[68] U-values (sometimes referred to as heat transfer coefficients or thermal transmittances) are used to measure how effective elements of a buildings fabric are as insulators. That is, how effective they are at preventing heat from transmitting between the inside and the outside of a building

marginal electricity, i.e. electricity produced by condensing power plants using fossil fuels for peat. However, as these marginal production modes may not be in operation at each point of time, it is assumed that the production of electricity using renewables can also replace other electricity generation modes or electricity imports. Therefore, the emission factor used for replaced electricity (600 t CO_2/GWh) is smaller than the emission factor used for electricity production in condensing power plants that use fossil fuels or peat (on average 850 t CO_2/GWh). The emission factor for electricity defined in the IMPAKTI calculation tool (600 t CO_2/GWh) is also used to estimate the mitigation impact of energy efficiency measures presented in Chapter 4.

Transport

The transport sector projections are compiled using the LIPASTO calculation system, which is also used to estimate emissions for the greenhouse gas inventory (see Finland's National Inventory Report for a description of the methodology). The LIPASTO calculation system includes four submodels: LIISA for road transportation, RAILI for railways, MEERI for waterborne transport and ILMI for air traffic. LIPASTO is compiled and updated by VTT Technical Research Centre of Finland. The ILMI submodel is compiled and updated by the Finnish Aviation Administration. Since 2015, the road traffic submodel LIISA includes also a more detailed template for calculating the projections and implications of alternative powertrain and energy options called ALIISA. 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, but re-adjusted by VTT in 2015, as described in Section 4.8. With this re-adjustment, the fuel consumption was assumed to decrease by 3.5 per cent in vehicles using both petrol and diesel yearly. The changes in the vehicle fleet are taken into account based on the estimated annual sales of new vehicles and the scrappage rate, being for cars about 7 per cent of the fleet size and corresponding to an average vehicle age of 11 to 12.5 years. 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.

Machinery

Emissions for machinery are estimated with TYKO-model which is part of the LIPASTO model. TYKO is a deterministic model that gives results of emissions and the amounts of fuels used. The emissions for the following gases are calculated: carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx), Particles (PM), methane (CH_4), nitrous oxide (N_2O), sulphur oxide (SO_2), carbon dioxide (CO_2). The time period of the calculations is 1980-2040 and the model includes 50 types of machinery.

The calculation is based on the following key elements: performance and related emission factors (g/kWh) and fuel usage (g/kWh). The method is widely used, for example, in the Non-Road model used by US EPA (Environmental Protection Agency) and in the CORINAIR Off-Road Vehicle and Machines model. It has been adjusted to Finnish circumstances, e.g. for age and attrition of the machinery. The method is in compliance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories and EMEP/EEA Emission Inventory Guidebook.

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 firefighting systems and semiconductor manufacturing). A completely new calculation model for F gas emissions and emission projections in the refrigeration and air conditioning equipment sector was built during 2016. The model covers the years 1990 to 2050 and is divided into fifteen different subsectors (equipment types). The emissions estimation methodology in the model is the Tier 2 emission factor approach of the 2006 IPCC Guidelines (Volume 3, Section 7.5).

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 model has been frequently used in evaluating impacts of agricultural and agri-environmental policies. For this reason the model has also been continuously updated and re-validated based on available statistical information on, e.g., input and output prices, food consumption, use of inputs, production, land use and productivity in agriculture. Parameters and principles of agricultural policy have been updated annually as well when necessary. The results from Dremfia were fed into the calculation models (Luke excel in Figure 5.8), which are used for the greenhouse gas emission inventory (see the most recent National Inventory Report for details). Dremfia produces most of the input data for the greenhouse gas projections 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 variables (not included as such in the Dremfia model) 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 projections are based on statistics and modelling following IPCC guidelines. The scenario tool is thus primarily an emissions calculation model, which is complemented with expert judgments on how rapidly the measures will affect the waste sector. The same basic modelling tool has been used in previous National Communications.

The projection 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 (landfilling, biological treatment, incineration, recycling). Emissions from wastewater treatment, composting and anaerobic digestion 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.

LULUCF

The development of the tree stock and drain (m^3) for the LULUCF sector projection is estimated using the MELA model[69]. 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 Yasso07 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). Yasso07 model and methods of the greenhouse gas inventory were used to estimate carbon stock changes also for cropland and grassland.

Economic effects

FINAGE is a dynamic, applied general equilibrium (AGE) model of the Finnish economy. FINAGE is based on the MONASH-model developed at the Centre of Policy Studies. MONASH-style models are used in countries ranging from China and South Africa to the United States and Australia. In Europe, models based on MONASH have been developed for Denmark, Finland, and the Netherlands. VATTAGE, a precursor of FINAGE, is described in detail in in Finland's sixth National Communication[70].

Several factors explain the popularity of MONASH. The main ones are the advanced and user-friendly software packages that facilitate data handling and the set-up of complicated policy simulations, and that also allow a very detailed post-simulation analysis of simulation results. MONASH-type models are also very adaptable to analyses of different types of policies and different time frames. In forward-looking policy analysis, MONASH-type models offer a disciplined way to forecast the baseline development of the economy. They also allow the user to replicate and explain the historical development of an economy in great detail, which is not true for most AGE models.

In FINAGE, there are normally three types of inter-temporal links connecting the consecutive periods in the model: (1) accumulation of fixed capital; (2) accumulation of financial claims; and (3) lagged adjustment mechanisms, notably in 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 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.

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[69] 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

[70] http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/fi_nc6[1].pdf

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

The models and methods used for the projections and impact assessment of policies and measures are described in Section 5.3.8. The models and methods are largely the same as those used in preparing the projections for the Sixth National Communication and the Second Biennial Report. Model development and updates, e.g., to ensure consistency with changed inventory methods, have been made. Finland has complemented the methodological descriptions accordingly, also the relationship and data flow between the different models are presented. A brief explanation on how overlaps are avoided has been included. Additional information on the models can be found using the internet links to more detailed descriptions of the models in the References section at the end of this 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 development and poverty eradication are the first and overriding priorities of the developing country Parties. Climate sustainability has been one of the cross-cutting objectives of Finland's development policy and development cooperation since 2012[71]. The latest development policy which has been outlined in the Government Report on Development Policy, published in February 2016[72], takes account among others of the current situation in developing countries, the goals of the UN 2030 Agenda for Sustainable Development and the binding climate convention and the Paris Agreement. Finnish development policy strives to strengthen the rights of the most vulnerable, promote gender equality, and improve climate change preparedness and mitigation. Therefore, besides providing funds to the operating entities of the financial mechanism of the UNFCCC and the 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.

Finland's development aid disbursements were in 2015 EUR 1,161 million which was 0.55 per cent of gross national income (GNI). As part of the general government adjustment measures the government decided in 2015 on substantial cuts on the appropriations for development cooperation starting from 2016. The ODA figures for 2016, which is the final year in this report, amounted to EUR 956 million (0.44 % of GNI). As such the cuts have also some implications to the climate related support provided to developing countries.

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 fast-start finance 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 be higher than in the base year used for fast-start finance. The total allocations were about EUR 115 million in 2015 and EUR 43 million in 2016. The division between mitigation and adaptation support varies according to the year, but it is rather balanced. For example during the reporting period in 2015 about 57 % was allocated to mitigation and about 43 % to adaptation.

According to the new Development Policy Report the Finnish Government considers important that business sector promotes sustainable development in its field, respecting the best practices and obligations of corporate social responsibility. Therefore, particular focus is placed on responsible private sector engagement and mobilizing private sector

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[71] Finland's Development Policy Programme 2012; http://formin.finland.fi/public/default.aspx?contentid=251855&nodeid=15457&contentlan=2&culture=en-US

[72] Government Report on Development Policy 2016; http://formin.finland.fi/public/default.aspx?contentid=341918&nodeid=49540&contentlan=2&culture=en-US

finance and expertise. This tendency is also present in the Paris pledge by Finland[73], stating that "Finland intends to provide over half a billion euros in new investment funding for developing countries over the next four years, a substantial part of which will contribute to climate finance”. The first allocation (EUR 130 million) from this investment package was made in 2016 to Finnfund (Finnish Fund for Industrial Cooperation Ltd.) which is a state-owned development finance institution. Finnfund has a strong mandate to support climate relevant projects (see also Section 7.3.7). Reporting of the resources directed to Finnfund is outflow-based, i.e. the capitalization of Finnfund materializes in the Finnish climate reporting only when Finnfund has invested the funds to developing countries. That will take place in the next few years.

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. 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, totaling 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 usually 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. For the MDBs Finland uses similar approach as done by the OECD when calculating imputed multilateral contributions. 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). Finland's development policy includes both climate change mitigation and adaptation in developing countries. Finland promotes low carbon development and the capacity of its partner countries to adapt to climate change, and it furthers the integration of these goals into partner countries’ own development planning.

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

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[73] UNFCCC; List of Recent Climate Funding Announcements; http://newsroom.unfccc.int/financial-flows/list-of-recent-climate-funding-announcements/

improved energy access and local employment. Finnish-supported EEP programmes have been executed in the Mekong Region, southern and eastern Africa, and the Andean Region.

Finland has also consistently and in the long term worked to reform harmful fossil fuel subsidies for both climate and wider environmental, social and economic reasons. We are part of the Friends of Fossil Fuel Subsidy Reform (FFFSR), playing an active role in all relevant policy arenas on behalf of reform. In addition, in our new action plan on taxation and development[74] we recognize fossil fuel subsidy reform as part of the wise management of public resources. More information on specific activities addressing in particular minimising the adverse impacts of response measures on developing countries is provided in Section 4.Finland's Seventh National Communication and in Chapter 15 of Finland's most recent national inventory report.

6.3.1 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 our Development Policy 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.

6.3.2 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, as stated in our Second Biennial Report a very rough estimation was made in 2013 based on which Finland could mobilize yearly about USD 0.5–1.8 billion private climate finance to developing countries. This should be taken only as a very initial estimation which may not be comparable to other estimations.

Private sector projects in developing countries are being supported, for example, by the Finnish Fund for Industrial Cooperation Ltd. (Finnfund) and Finnpartnership (the Finnish Business Partnership Programme). 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, mezzanine, loans and/or guarantees. It cooperates with Finnish and foreign companies, investors and financiers. Finnpartnership, on the other hand, aims to increase business-to-business cooperation between companies in Finland and in developing countries.

As outlined in previous National Communications both organizations 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, in 2015 Finnfund provided approximately EUR 14 million, which can be included in Finnish public climate funding.

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.

[74] http://formin.finland.fi/public/default.aspx?contentid=350113&nodeid=49150&contentlan=2&culture=en-US

As mentioned in Section 6.1, the Finnish Government considers it important that businesses promote sustainable development in their own fields. In this context the government of Finland has decided to use around 530 million euros during 2016-2019 as investment funding to support programs/projects in line with Finnish development policy, especially to climate funding and creating sustainable jobs and livelihoods in private sector. The first allocation (EUR 130 million) from this package was made in 2016 to Finnfund.

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 programme in Africa, leverage ratio is 1:2.01 and a total of about EUR 114 million was mobilised by December 2016. Furthermore, 30% of supported projects have been scaled up or replicated after EEP engagement.

6.3.3 Multilateral assistance

Finland has supported developing countries' climate actions through multilateral aid, giving core support, for example, to the GEF, LDCF and SCCF (see table 7.). During the reporting Finland announced its aim to support the GCF during the Initial Resource Mobilisation (IRM) period, in total, with EUR 80 million and pledged EUR 34.7 million for 2015.

In 2007, Finland decided to start contributing to the Readiness Fund of the World Bank's Forest Carbon Partnership Facility (FCPF). During the reporting period Finland made additional allocation of EUR 3 million making the total contribution to the Readiness Fund EUR 18 million.

Finland contributed EUR 4.1 million to the World Bank's Partnership for Market Readiness in November 2012. The objective of the Partnership is to develop carbon market capacity in developing countries and countries with economies in transition through developing and piloting carbon market instruments. Finland actively participates in the Partnership Assembly meetings to foster cost-effective climate change mitigation. The first phase of the PMR will end in 2020 and the discussions on the possible second phase have started.

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 was 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.

An example of Finland's effort to promote sustainable use of forest resources and to support development countries' capacity to collect, analyse and use reliable information on their forest resources is FAO's "Sustainable Forest Management in a Changing Climate" programme. The Finnish funded EUR 15.3 million programme (2009-2017) implemented capacity development activities in three continents (Tanzania, Zambia, Vietnam, Peru and Ecuador) and has very strong linkages with the bilateral projects in Zambia and Tanzania. In addition to the direct country support, the programme has established a platform for developing and sharing forest monitoring and assessment related tools and methods. The Open Foris open source tool for forest data collection, analysis and dissemination (www.openforis.org) is used in over 50 countries.

The programme has been implemented in close collaboration with FAO's other forest monitoring related programs, such as Global Forest Resource Assessment (GFRA), United Nation's Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD) and National Forest Monitoring and Assessment program (NFMA). During its duration (2009-2017) the Programme has also engaged a number of international and national institutes, e.g. Natural Resources Institute Finland, USFS, CATIE, JRC, in supporting these capacity building activities.

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.

Finland contributes to the Nordic Development Fund (NDF), which is a multilateral development finance institution established by the five Nordic countries (Denmark, Finland, Iceland, Norway and Sweden). Since 2009, NDF focuses on climate change and development in low-income countries and flexibly uses grants and other innovative forms of support in financing projects. For the period 2013-2016, NDF has approved financing for 47 projects to a total value of EUR 161.5 million. Disbursements totalled EUR 128.9 million.

6.3.4 Bilateral assistance to developing countries

The goal of Finland's development policy is the eradication of poverty and inequality and the promotion of sustainable development. The legally binding obligations that come from the multilateral environmental agreements (MEAs) are taken into account in Finland's development policy. Providing assistance in implementing the MEAs constitutes a long-term investment in building sustainable national development policies and achieving national and international environmental targets. From the standpoint of development cooperation, the implementation of UNFCCC objectives is one of the most important targets.

In long-term partner countries the co-operation is based on country programmes that are prepared in consultation with partners and that build on national development plans. 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, as appropriate. Finland supports projects and programmes that promote environmentally sustainable development in its partner countries and regions. 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. Also, support for forestry projects is substantial.

With regard to adaptation, the most important element has been capacity building 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 Secretariat of the 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 2017; it now covers 14 Pacific island countries.

Besides the examples provided in the report on the climate relevant bilateral cooperation, more examples and information about the projects can be found in the OECD webpages[75].

6.4 Technology development and transfer

Finland has specific programmes and financial arrangements for transferring environmentally sound technology to developing countries. These activities comprise the transfer of both 'soft' technology, such as capacity building, creating information networks and enhancing training and research, and 'hard' technology, that is, technology to control greenhouse gas emissions and for adaptation measures. The differences between these types of technology are not always clear, and some activities have characteristics of both. In developing countries, the private sector and entrepreneurs play a key role in economic development.

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[75] http://stats.oecd.org/Index.aspx?DataSetCode=RIOMARKERS

During the reporting period, Finnfund was a financer of renewable energy production projects in Thailand, Honduras, Sri Lanka, Kenya and Cape Verde and tree-planting projects in Tanzania and Uganda. In addition, Finnfund is an investor in the Central American Renewable Energy and Cleaner Production Facility (CAREC) and the Evolution One Fund, which are investing in renewable and clean technologies in Central America and southern Africa. Finland is also promoting 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 supports multiple programmes and projects related to private sector development (PSD) 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. Regional Energy and Environment Partnership (EEP) programmes with southern & eastern Africa and Mekong countries support various renewable energy and clean energy projects and specifically address technology transfer. Finland also supported PPPs on Combined Heat and Power production in Ukraine with EUR 125.000 in 2016. Finland's 7th National Communication (NC7) provides examples of selected projects supporting transfer of, or access to, environmentally-sound technologies and lists factors contributing to their success (Table 7.6 in NC7).

Concessional credits are used primarily for environmental and infrastructure investments under national development programmes. They have been granted to waste disposal plant with a landfill gas collection system in Vietnam and various renewable energy projects. In Vietnam, Honduras and Kenya projects to improve electricity distribution in order to improve access to energy have been supported.

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 EGTT was first established, 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.

At COP 16 in Cancún, the Technology Mechanism was established. This mechanism consists of two parts: the Technology Executive Committee (TEC), which replaces the EGTT, and the Climate Technology Centre and Network (CTCN). Finland has been a member of the TEC since its establishment. Finland has also been instrumental in decisions leading to the mobilisation of the Climate Technology Centre and Network (CTCN), which will come into operation in 2014. Finland has supported the work of the CTCN with EUR 200 000 in 2015. In addition Finland has supported technology transfer and development through multilateral funds such as the Global Environment Facility (GEF) and the Nordic Development Fund (NDF).

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. During the reporting period, the most important capacity support programmes for hydro-meteorological institutions were going on in the Pacific, Himalayan, Andean and Central Asian regions. Finland also has supported FAO's programme on making agriculture part of the solution to climate change, in which capacity building has a prominent role. Some examples of projects with strong capacity-building components are provided below.

For the past 13 years (since 2004), Finland has funded an international course on environmental law and diplomacy. The support is expected to continue also in the coming years. 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, in 2014 environmental security, in 2015 climate change and in 2016 effectiveness of MEA's. Most courses have included some components related to climate change.

The Southeast Asia Climate Change Network project implemented by UNEP started in 2008. It used 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 supported the sharing of best practices and acceleration of the transfer of climate-friendly technologies. The project assisted countries in negotiations pertaining to agreements and helps them to carry out the practical measures associated with climate change. The goal was to strengthen the countries' potential to respond to the challenges posed by climate change over a wide spectrum. The overall support for the project was EUR 4.3 million for the years 2008–2016.

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. The project that consisted of four phases ended in 2016; the overall support from Finland was 8.9 million euros through 2008-2016. The project focused on advocacy for the establishment and implementation of gender-responsive actions on climate change through a series of activities that included participating in UNFCCC formal meetings, supporting directly the Convention's Secretariat, technical support to Parties and stakeholders, and incorporating gender equality and women's empowerment criteria in climate finance mechanisms. The Women Delegates Fund administered by WEDO supported travel and enhanced leadership and negotiations skills of women delegates. IUCN facilitated development of national climate change and gender action plans (ccGAPs) bringing the total number to 21. UNDP supported mainstreaming gender in national level through e.g. development of guidelines and training programs.

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 of the biennial report, Parties are encouraged to report, to the extent possible, on the domestic arrangements established for the process of the self-assessment of compliance with emission reductions in comparison with emission reduction commitments or the level of emission reduction that is required by science. Parties are also encouraged to report, to the extent possible, on the progress made in the establishment of national rules for taking local action against domestic non-compliance with emission reduction targets.

Finland's Seventh National Communication (Chapters 2 to 6) describes the domestic climate change policy-making process, including legislative and administrative arrangements, plans and strategies to mitigate and adapt to climate change, as well as monitoring and assessment of compliance with Finland's emissions reduction commitments. Information on the policy-making process, including on the process for assessment of progress with the commitments, with focus on changes since previous reporting, is also summarised in Section 4.6 in this report. Information the progress in implementing the emission reductions in comparison with emission reduction commitments is presented in the Section 4.7. Also, interaction between research and policy making, regional and municipal action and initiatives are elaborated in the Seventh National Communication. This information is not repeated here but the information in complemented with descriptions of sectoral programmes.

7.2 Sectoral Programs

7.2.1 Resolution on Energy Saving and Energy Efficiency

Energy intensity of the Finnish economy is relatively high, which leads to relatively high per capita GHG 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, (previous period 2008–2016 and present 2017–2025), and the systematic implementation of energy audits since early 1990's are good examples of successful energy conservation measures.

Energy efficient agreements have been in central role for increasing energy efficiency in industry, private services, municipalities etc. From the agreement period 2008–2016, the annual savings were at the end of 2015 about 10.4 TWh heat and fuels and 3.6 TWh electricity. The savings in energy costs were about EUR 500 million and the CO_2 emissions reduction about 4.3 million tonnes.

Energy Efficiency Directive (EED) made the energy audits compulsory for big companies. This and the whole EED has been implemented mainly with the Energy Efficiency Law that came into force in the beginning of 2015.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 Economic Affairs and Employment (at that time 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.

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.

The climate policy for the transport sector to 2020 and 2030The Climate Policy Programme of the administrative sector of the Ministry of Transport and Communications was completed in March 2009, and 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 2020, greenhouse gas emissions from domestic transport must be no more than about 11.2 million tons. It is noteworthy, that the emissions are already below this target (approx. 11 million tons in 2015). 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 (approx. 49 TWh in 2015).

The Finnish Government approved the National Energy and Climate Strategy for 2030 on 24 November 2016. The strategy sets out concrete actions and targets through which Finland will achieve the EU energy and climate objectives to 2030. Transport plays a key part in achieving Finland's national climate targets, as it produces some 40 % of the Finnish greenhouse gas emissions in the effort-sharing sector. The role of the transport sector in reducing emissions will also be highlighted, as reducing emissions will be even more difficult in other sectors (including agriculture). The transport sector is thus preparing to cut its emissions by up to 50 % by 2030.

The emissions reduction measures will focus especially on road traffic, which presents the greatest potential for emission reductions. The reduction goals for greenhouse gas emissions from international aviation and shipping and the mechanisms for reducing emissions are currently being 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. Emission reduction measures can be divided into three categories: transport system level changes, improvements in vehicle energy efficiency and increased use of renewable fuels. The targets of the transport sector are:

1) Promoting the use of biofuels by replacing oil-based fossil fuels with renewable and/or low emission alternatives. The physical share of biofuel energy content in all fuels sold for road transport will be increased to 30 % by 2030.
2) Improving the energy-efficiency of cars and light commercial vehicles inter alia by developing engine technology, reducing vehicle weights and proceeding to completely new propulsion technologies (including electricity and gas).
3) Improving the energy-efficiency of transport system by promoting the choices of more environmentally friendly mode of transport and curbing the growth of vehicle kilometers.

7.2.2 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 actions were continued 2015–2017. The programme is ongoing and it ends at 2017. For the last year of action, weight is put in spreading good practices and assessing the procedure.

7.2.3 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 on-going. In 2015 a follow up was made. As a result, many effective actions were recognized and the program was estimated to have reached its aims in a good manner. For the following years, focus areas were defined: promoting planned real estate management, improving the cost efficiency and customer-orientation of renovation services and developing skills for repair work and it´s education.

7.2.4 The Climate Policy Programme for Agriculture

The Climate Programme for Agriculture ("Steps towards environmentally-friendly food") was finalized in November 2014 and it is under implementation.

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 climate change.

7.2.5 Society's commitment to Sustainable Development

Finland's national sustainable development work is carried out in line with the policies of the United Nations and the European Union. The sustainable development work in the Arctic Council and the Nordic Council of Ministers complement and support national policies and measures. The Finnish National Commission on Sustainable Development, led by the Prime Minister, is tasked to follow up the implementation of the global 2030 Agenda and its sustainable development goals (SDGs) and advancing the integration of global agenda into Finland's national policies and strategies.

Finland's national strategy for sustainable development 'Society's Commitment to Sustainable Development' was updated in April 2016 in line with the 2030 Agenda for Sustainable Development. The core vision of this national strategy is "A prosperous Finland with global responsibility for sustainability and the carrying capacity of nature".

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 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 Government adopted a national implementation plan for the 2030 Agenda on February 2, 2017. It includes two thematic focus areas: "Carbon-neutral and resource-wise Finland" and "Non-discriminating, equal and competent Finland". These focus areas include numerous concrete measures. Implementation plan defines also policy principles and measures for long-term, coherent and inclusive implementation and establishes a follow-up, review and reporting framework for Finland up until 2030.

7.2.6 The Finnish Bioeconomy Strategy

The Finnish Government continues programs to increase the yield of the bioeconomy from the present € 60 billion to € 100 billion 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, cleantech and cyclic economy.

Attached to the government resolution is the Finnish Bioeconomy Strategy, 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
4) securing the availability of biomass, a functioning market for raw materials, and the sustainability of use.

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