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Finland’s First Biennial Transparency Report

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Figures and tables: Statistics Finland and the ministries, unless otherwise indicated.

Units and abbreviations are listed in Annex 4.

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Foreword

Global warming should be limited to 1.5°C in order to avoid the worst effects of the climate change advises IPCC in its latest mitigation report. Yet global emissions are still increasing and the implementation of nationally determined contributions is lagging behind what is needed to meet the temperature goal of the Paris Agreement. It is therefore essential that all governments and stakeholders step up and strengthen their efforts to combat climate change. Finland remains strongly committed to address climate change at national, EU and international level.

The EU and its Member States are committed to a joint quantified economy-wide emission reduction target. The EU and its Member States have set up comprehensive legislation to implement the EU climate change emission reduction targets. The European Climate law sets the goal to become climate-neutral by 2050 and the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. This 2030 target corresponds to the target of the current Nationally Determined Contribution of the European Union.

To ensure that the EU and its Member States achieve their target, the 2030 Climate and Energy Framework was put in place. The main elements of this framework are the EU Emissions Trading System (EU ETS), the Land Use, Land-Use Change and Forestry (LULUCF) Regulation and the Effort Sharing Regulation (ESR).

Finland is committed to reducing emissions by 50 percent in the sectors covered by the EU Effort Sharing Regulation (ESR) by 2030 compared to the 2005 level. Finland – like all other EU Member States – are subject to gradually decreasing annual emission limits for each year from 2021 to 2030.

Finland has also ambitious national climate targets. According to the national Climate Act, Finland aims to be climate neutral by 2035. A target to strengthen carbon sinks is also included in the Act. The Climate Act specifies three emission reduction targets: the aim is to achieve greenhouse gas emission reductions of 60 per cent by 2030, 80 per cent by 2040 and 90 per cent but aiming for 95 per cent by 2050 compared to the levels in 1990.

Finland's fossil emissions have already fallen by more than 40 per cent since 2005. This fall in fossil emissions continued and even accelerated in 2023. The fall is particularly sharp in power and heat generation and in industry. Emissions from installations covered by the EU Emissions Trading System (EU ETS) declined by one fifth – that is, in a single year by an amount corresponding to 78 per cent of Finnish passenger car emissions in 2022. This reflects the halving of coal combustion in particular, and most of the other half will also be eliminated over the next few years. The downward trend in emissions also continued in transport. Recent scenario calculations by VTT Technical Research Centre of Finland and the Natural Resources Institute Finland indicate that, in terms of total fossil emissions, we will be getting close to the target set by the national Climate Act for 2030 and, as regards 2035, close to the level assumed when enacting the national Climate Act.

We are also able to boost the further decline of fossil emissions. The most important issue is to reach a rapid agreement on the common EU target of a 90 per cent net greenhouse gas (GHG) emissions reduction by 2040. Finland was among the first Member States to take a positive stand on the 2040 target. We require that, at the same time, all clean energy is placed on an equal footing and a revenue model is created for carbon capture. Agreeing on the 2040 package is key to maintaining a rising price level in EU ETS. The tenfold increase in the emission allowance price has been the most important climate action of the century.

Emissions reductions have advanced more rapidly than expected in several sectors, with faster reduction of energy production emissions playing a central role. Our updated sectoral roadmaps show that several industries are transitioning from production processes that traditionally relied on the combustion of fossil fuels to electrification. As Finland’s energy production is increasingly based on clean energy sources, electrification will significantly reduce emissions across various industries. According to the Finnish energy industry roadmap, in an ambitious low-carbon scenario, which contributes to growth of the Finnish economy, emissions from electricity production and district heating will decrease to zero by 2035. In the scenario, emissions will become negative shortly after 2035, thanks to carbon capture, storage and utilization technologies.

Green or clean hydrogen is also expected to play an important role in enabling future emission reductions, but the production of emission-free hydrogen requires a great deal of electricity. Hydrogen is separated from water by electricity in the production of hydrogen. By combining hydrogen with recovered carbon dioxide, synthetic fuels can be produced. Synthetic fuels produced from hydrogen can be used in sites using fossil fuels that are difficult to electrify, for example in logistics. Hydrogen can also be used in the production of emission-free steel.

In Finland, the most important way to accelerate the green transition right now is to ensure an abundant supply of clean electricity at a reasonable price throughout the year. This is the number one condition for heavy industry investments in phasing out combustion. The greatest opportunity in terms of scale is carbon capture from industrial smokestacks, and we are developing incentives for that. A step in this direction is the Government’s intention to introduce a Finnish obligation level that is higher than the EU minimum for synthetic fuels.

Despite all the progress achieved to date, we will need to introduce new policy measures and strengthen existing ones. We have major challenges in the land use, land use change and forestry (LULUCF) sector, where effective measures are needed to enhance the carbon sink. The actions necessary to achieve the 2030 emission reduction targets and the 2035 climate neutrality target are outlined in three plans: the Medium-term Climate Change Policy Plan, National Climate and Energy Strategy and Climate Plan for the Land Use sector submitted to parliament in the summer of 2022. Preparation of new Medium-term Climate Change Policy Plan and Energy and Climate strategy has started and are expected to be completed in the first half of 2025.

Involving stakeholders in policy design is a key element of the Finnish climate policy at both national and international levels. The Green Deal is a voluntary agreement between the government and actors from the private sector. Green deal agreements are used in many fields to find solutions to climate challenges. Also sectoral low-carbon road maps have been drawn up by industries and organisations as a sector-based approach to the national climate neutrality target in 2035.

There has been a growing interest in the interface between science and policy in the field of climate change. Research funding institutions in Finland are developing innovative approaches to strengthen policy relevant research agendas with an active interaction with policymaking. The Finnish Climate Change Panel has a formal role in national climate policy under the Climate Act. The Panel is an independent multidisciplinary actor that produces recommendations and assessments to inform policy-making. In addition Finnish researchers have collaborated actively with the international research community in the form of joint projects and programmes.

Adaptation to climate change is necessary alongside mitigation. The National Climate Change Adaptation Plan was adopted in December 2022 and it is the second national adaptation plan in Finland. The update of the national adaptation plan steer adaptation work until 2030. The Plan, which is to be updated at least every other parliamentary term, is part of Finland’s climate policy planning system as stated in the Climate Act. Research and assessment on climate impacts are instrumental as a basis for adaptation measures. A proper understanding of the risks and vulnerabilities caused by climate change, both domestically and globally, is at the core of climate policy.

Under the Enhanced Transparency Framework, Parties to the Paris Agreement are required to submit Biennial Transparency Reports (BTR) every two years, with the first submission due by 31 December 2024. Finland's first Biennial Transparency Report was prepared in cooperation between several ministries, the Ministry of Economic Affairs and Employment, the Ministry of the Environment, the Ministry for Foreign Affairs, the Ministry of Finance, the Ministry of Agriculture and Forestry, the Ministry of Transport and Communications and Statistics Finland. Statistics Finland coordinated the preparations and compiled the Biennial Transparency Report. In addition, many research centres and expert organisations provided expertise in the preparations, including the Finnish Environment Institute the Natural Resources Institute Finland, the Finnish Meteorological Institute, Finnish Transport and Communications Agency and state owned sustainable development company Motiva Oy.

I would like to thank all the experts for their valuable contributions in preparing this report.

Helsinki, December 2024

Kai Mykkänen

Minister of Climate and the Environment

1 Overview

1.1 National inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

In 2022, Finland’s greenhouse gas emissions totalled 45.7 million tonnes of carbon dioxide equivalent (million tonnes CO_2 eq.) without the land use, land use change and forestry (LULUCF) sector. The total emissions in 2022 were approximately 36 per cent (25.6 million tonnes CO_2 eq.) below the 1990 emissions level. (Table 1.1-1). Compared to 2021, emissions were approximately four per cent, i.e. 1.9 million tonnes, lower.

Finland’s annual greenhouse gas emissions varied considerably from 1990 to 2022 due to changes in electricity imports and the production of fossil-fuel-based condensing power, however since 2010, there has been an overall declining emission trend in the energy sector. 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.

The energy sector is the most significant source of greenhouse gas emissions in Finland and is therefore the key driver behind the trend in emissions. 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 2022, the energy sector accounted for 72 per cent of Finland’s total greenhouse gas emissions. They were 38 per cent lower than in 1990. The important drivers in the energy sector’s emissions trend have been the changes in the amount of imported electricity and in the production of energy with fossil-fuel-based condensing power, as well as the growth in the consumption of renewable energy. The share of transport in energy-related emissions was approximately 30 per cent in 2022. Emissions from transport have decreased by 19 per cent since 1990, mainly due to increased use of biofuels in road transportation.

The second largest source of emissions after the energy sector was the agricultural sector, with a share of approximately 13 per cent of the total emissions. Emissions in the sector decreased by about 17 per cent between 1990 and 2022, mainly due reduced use of synthetic fertilisers. Fluctuations in livestock numbers and in use of lime cause some inter-annual variability in the emissions.

Emissions from industrial processes and product use amounted to approximately 11 per cent of total emissions in 2022. In the beginning of the time-series, emissions increased reaching the highest level in 2008, after that the trend has been decreasing. Reasons for decline have been implementation of N_2O abatement technology and use of alternative low GWP non-HFC refrigerants in many applications. Emissions from industrial processes refer to 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. Since 1990, these emissions have decreased by 67 per cent. A decrease in methane emissions from landfill sites since the adoption of a new waste act in 1994 has been the most significant factor in decline of emissions. The contribution of indirect CO_2 emissions from the atmospheric oxidation of CH_4 and NMVOCs to the greenhouse gas emissions is small – about 0.1 per cent of total greenhouse gas emissions in Finland.

The LULUCF sector in Finland has been a net sink until 2017, after which it has acted as both a net sink and a net source. The net emissions in the sector were 4.4 million tonnes of CO_2 eq. in

2022 which was 28 per cent greater than in the previous year. There are several reasons for the net removals turning into net emissions in the LULUCF sector, of which an increase in commercial fellings is the most important. Compared to the net removals in 1990, the net emissions in 2022 were 119 per cent higher.

Table 1.1-1 Greenhouse gas emissions (+) and removals (–) by sector, 1990, 1995, 2000, 2005, 2010, 2015, 2020 to 2022 (million tonnes CO_2 eq.)

Sector	**Base year**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2021**	**2022**
					million tonnes CO_2 eq.					
Energy	53.4	53.4	55.3	53.7	53.7	60.2	40.7	34.4	34.2	32.9
Industrial processes and product use[1]	5.2	5.2	4.7	5.1	5.4	4.8	4.4	4.1	4.5	4.2
F gases	0.1	0.1	0.2	0.7	1.1	1.3	1.2	0.9	0.9	0.8
Agriculture	7.3	7.3	6.5	6.4	6.2	6.3	6.3	6.3	6.2	6.1
Waste	5.2	5.2	5.1	4.3	3.1	2.8	2.3	1.9	1.8	1.7
Indirect CO_2-emissions[2]	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TOTAL (exl. LULUCF[3])	**71.3**	**71.3**	**71.9**	**70.2**	**69.7**	**75.5**	**55.0**	**47.7**	**47.6**	**45.7**
TOTAL (exl. LULUCF and Indirect CO_2 emissions)	**71.2**	**71.2**	**71.8**	**70.1**	**69.6**	**75.4**	**54.9**	**47.6**	**47.5**	**45.6**
LULUCF[3]	-23.2	-23.2	-22.0	-21.3	-24.9	-22.4	-13.1	-5.4	3.5	4.4

[1] excluding F gases

[2] indirect CO_2 emissions from NMVOC and CH_4 from fugitive emissions, industrial processes and product use

[3] Land use, land-use change and forestry

(Note: Due to rounding, the sum of subtotals does not necessarily equal to total figures.)

According to the Government resolution of 30 January 2003, 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 by the Climate Change Act. Statistics Finland has overall responsibility for compiling and finalising inventory reports and submitting them to the Secretariat of the UNFCCC and the European Commission. It bears the responsibility for the general administration and quality management of the inventory and communicating with the UNFCCC, coordinating participation in the reviews, and publishing and archiving the inventory results. Production of emission and removal estimates and related documentation is carried out by expert organizations, i.e. Statistics Finland, the Finnish Environment Institute (SYKE), Natural Resources Institute Finland (Luke) as well VTT (VTT Technical Research Centre of Finland Ltd).

In Finland, the national inventory arrangements are established on a permanent footing to meet the requirements of the UNFCCC reporting guidelines and in the MPGs referred to in Article 13 of the Paris Agreement. The national inventory arrangements are based on laws and regulations concerning Statistics Finland, including the Climate Act, on agreements between the inventory unit and expert organisations on the production of emission and removal estimates and agreements between the inventory unit and relevant ministries on cooperation and support for the expert organisations participating in Finland's national system.

1.2 Information necessary to track progress made in implementing and achieving nationally determined contributions

1.2.1 National circumstances and institutional arrangements

National circumstances

Finland is a representative democracy. The tasks of the Finnish Parliament include passing laws and approving national budgets. The Government and Parliament make the most important decisions concerning climate policy. In its narrower sense, the Government refers to the Cabinet, which has 18 ministers.

The head of state is the President of the Republic, who directs foreign policy in cooperation with the Government, thus approves Finland's international commitments and decides on their implementation according to the constitution. However, some major decisions also require approval from Parliament. The Government implements parliamentary decisions, presents legislative proposals to Parliament, directs state administrative activities, and represents Finland in the European Union.

The Ministerial Committee on European Union Affairs discusses and decides on Finland's positions on EU and international climate policy issues. Finland participates in the international climate negotiations as part of the European Union. The Ministry of the Environment bears the responsibility for coordinating the preparatory work for the climate negotiations and is the national focal point for the UNFCCC.

Since 2003, every Finnish government has appointed ministerial working groups responsible for energy and climate policy. These ministerial working groups have been responsible for preparing and updating the national strategies on energy and climate policy. Ministry of Economic Affairs and Employment oversees the overall coordination of the strategy work. Institutional arrangements related to climate policy and its implementation are summarized in Figure 1.1-1 below.

Figure 1.1-1 Institutional arrangements related to climate policy and its implementation in Finland

Finland is situated at a latitude between 60 and 70 degrees north, with a quarter of the country extending north of the Arctic Circle. With a total area of 338,400 km^2, it is Europe's seventh largest country. As a result of the country's low population density and geographical extent, the average distances travelled for different purposes can be quite long. The population of Finland was 5.56 million at the end of 2022 and it rose to 5.60 million at the end of 2023. It is estimated that the Finnish population will decline starting from 2033 if fertility rates and amount of net migration remain at the level observed in the autumn of 2023 when the population projection was made.

Boreal coniferous forest zone covers nearly all of Finland. Seventy-two per cent of the total land area is classified as forest land, while only some eight per cent of it is cropland. Peatlands cover almost one third of the total land area in Finland, approximately 9 million hectares. Finland has more than 34,500 km^2 of inland water systems, which is about 10 per cent of its total area.

The mean temperature in Finland is several degrees higher than in most other areas at these latitudes, i.e. Siberia, northern Canada, most of Alaska, and southern Greenland because of the

Baltic Sea, due to the inland waters and above all, as a result of the airflows from the Atlantic Ocean, which are warmed by the North Atlantic Current. There is considerable regional variation in climate: The annual mean temperature is close to 7 °C in the southwestern archipelago, decreasing towards the northeast. The 0 °C mean limit is reached north of the Arctic Circle.

Finland has an open economy with prominent service and manufacturing sectors. The main manufacturing industries include the metal, chemical, manufacture of electrical and electronic products and forest industry. Foreign trade is important, with exports accounting for approximately 40 per cent of the gross domestic product (GDP) in the recent years. In 2022, Finland’s GDP was EUR 268 billion and per capita GDP was EUR 48,200. The cold climate, energy intensive industry structure and long distances have led to a relatively high energy intensity and high per capita greenhouse gas emissions.

Total energy consumption was 1,294 PJ in 2022. Wood fuels accounted for 28 per cent, fossil oil 21 per cent and nuclear energy 20 per cent as sources for the total energy consumption. Starting from the 2010’s, renewable energy has increasingly replaced fossil fuels which is the main reason for the decrease in greenhouse gas emissions, even though energy consumption has grown. In 2022, Finland’s 48 per cent share of renewable energy in gross final energy consumption was the second highest in the EU. Finland’s main domestic energy sources are wood-based fuels, hydropower, wind power, solar power, waste, peat and heat pumps.

Finnish manufacturing industries accounted for 44 per cent of final energy consumption and for 44 per cent of electricity consumption in 2022. The most significant energy source of the final energy consumption by the industrial sector was biomass (40 per cent). Currently, the by-product of chemical pulp production in the forest industries, black liquor, is the most significant renewable energy source in Finland. Other recent trends in Finland’s energy production are the future ban on the use of hard coal, which has had an effect already before, and the steady increase of wind power capacity. The EU Emissions Trading System has become a significant factor in the energy market and in emissions reduction in the EU.

Because of the country’s northern location, a great deal of energy is used for indoor heating. The total area of heated buildings increased by some 50 per cent over the last 25 years. The composition of energy sources used for indoor heating changed significantly between 1990 and 2022. The share of district heating in the heating of indoor spaces as well as the use of electricity and ambient energy in heating increased. The use of heavy and light fuel oil decreased substantially. At the same time, heating obtained from natural gas as well as from small-scale combustion of wood increased.

Transport demand and supply are influenced primarily by developments in the economy, demographic factors, employment patterns and infrastructure provision. Domestic passenger transport, measured in terms of passenger-kilometres, has increased by approximately 15 per cent since 1990. Cars accounted for 83 per cent of the total passenger-kilometres in 2022. The number of electric passenger cars in traffic has increased rapidly in recent years in Finland. Road haulage is the most important form of transport for domestic goods traffic. However, 92 per cent of overseas freight travelled by sea, while four per cent travelled by road and two per cent travelled by rail in 2022.

The main manufacturing industries include the metal, chemical, manufacture of electrical and electronic products and forest industry. The rapid expansion of the metal products industry, especially electronics, has changed the traditional industrial structure starting from the mid-1990s. Because of their high energy demand, energy-intensive industries have worked hard to improve their energy efficiency. For example, between 1990 and 2022 industrial output increased by 59 per cent, while the final consumption of energy rose by only 11 per cent.

In agriculture, climatic conditions are a decisive factor affecting the feasibility of crop production. Cultivation of wheat and oilseed plants is limited to southern Finland, whereas barley, oats, grass and potatoes can be cultivated in most parts of the country. In many parts of Finland, livestock farming, especially dairy farming, is the only profitable form of agricultural production. The number of active farms has decreased considerably during the last thirty years, while the average agricultural area per farm has increased. More than 70 per cent of active farms have crop production as their main line of farming and 20 per cent have livestock as their main line of farming. Agriculture is the most important employer in the countryside.

In the land use, land use change and forestry sector (LULUCF), the forest land forms the greatest carbon sink although its strength was currently considerably lower in 2022 than in 1990. In the national economy, forestry and forest industry are significant. The total volume of Finland's forest stock amounts to 2,530 million m^3 according to the latest national forest inventory. The growing stock volume has been increasing for a long time. In 2020's, the total use of round wood i.e. raw, unmanufactured timber has been in average 81 million cubic meters. The great majority, that is, 84 per cent was used in the forest industry, and 16 percent was used for energy production. Factors affecting production volumes of the forest industry such as economic situation as well as the demand for harvested wood products cause fluctuations in the net removals of the harvested wood products category in time.

Settlements comprise nationally defined built-up land, roads, railroads, gravel collection sites and power lines. Recently, there has been a declining trend in the emissions due to declining annual areas converted to settlements. The greatest source of emissions are the land conversions from forest land to settlements. The high proportion of forest land in the country is the major factor in explaining why land conversions to settlements most often occur on forest land.

In waste sector, the amount of waste deposited in landfill sites has been significantly reduced by effective waste regulation since the early 1990's. In 2022, 113 million tonnes of waste were generated in Finland. The largest quantities of waste came from mining and quarrying (87 million tonnes), construction (11 million tonnes) and manufacturing (10 million tonnes). Households and services generated three million tonnes of waste. The municipal solid waste is responsible for most of the greenhouse gas emissions from the waste sector although it accounted for only 2.6 per cent of the country's total waste.

Institutional arrangements for tracking progress

The EU's Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action ('Governance Regulation') [1] establishes a governance mechanism and specific arrangements to track the progress of the Union and its Member States towards the implementation and achievement of the EU's climate and energy targets and commitments under the UNFCCC and the Paris Agreement. These arrangements include the monitoring of GHG emissions and removals, the reporting of policies and measures, projections of GHG emissions and removals and progress on adaptation to climate change.

Under the Governance Regulation, the EU has established a Union Inventory System to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of the data reported by the EU and its Member States. This inventory system includes a quality assurance and quality control programme, procedures for setting emission estimates, and comprehensive reviews of national inventory data to enable the assessment of compliance towards climate goals. The EU-wide information is summarised annually in the Climate Action Progress Report by the

[1] Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, http://data.europa.eu/eli/reg/2018/1999/oj.

European Commission and in the ‘Trends and projections’ report by the European Environment Agency. Both the Union and the national systems are subject to continuous improvements.

In Finland, the Government and Parliament make all major decisions concerning Finland’s energy and climate policy. Since 2003, the Finnish governments have appointed a ministerial working group on energy and climate policy with representatives from all government parties. The roles and responsibilities of the ministries and other authorities are determined in a Government Resolution on the Obligations of Climate Policy Activities of Government Authorities approved in 2003.

The new Climate Act[2] entered into force on 1 July 2022. The Act sets out several plans that aim to reduce greenhouse gas emissions and adapt to climate change in Finland. It also obliges the central government authorities to monitor the trends in emissions and achievement of climate targets and report on them to Parliament. The Annual Climate Reports to the Parliament are prepared each year under the lead of the Ministry of the Environment. The reports examine the general development of greenhouse gas emissions and the sufficiency of the planned measures in relation to the national climate targets and Finland’s EU obligations.

The Ministry of the Environment is Finland’s focal point to the UNFCCC and Paris Agreement. Statistics Finland is the national entity responsible for compiling the Finnish greenhouse gas inventory. The Energy Authority is the competent authority and the registry administrator for the national emissions trading registry under the EU ETS.

The Ministry of Economic Affairs and Employment is in charge of the overall coordination and compilation of the energy and climate strategy work as well as of the reporting of the policies, measures and projections under the EU’s Regulation on the Governance of the Energy Union and Climate Action. Each sectoral ministry is responsible for the preparation concerning its respective remit.

Institutional arrangements for implementation of the NDC

The EU and its Member State have set up a comprehensive system for the implementation of the EU climate change mitigation targets. The European Climate law[3] sets the goal of climate-neutral by 2050 and the intermediate target of reducing net greenhouse gas emissions by at least 55 per cent by 2030 compared to 1990 levels. These targets cover emissions and removals that are regulated in the Union law.

To ensure that the EU and its Member States achieve their target, the 2030 Climate and Energy Framework was put in place. The main policies of this framework are the EU Emissions Trading System (EU ETS)[4], which caps GHG emissions in energy, industry, aviation and maritime transport; the LULUCF Regulation which includes national net removal targets for the LULUCF sector; and the Effort Sharing Regulation (ESR) which establishes national reduction targets for GHG emissions not covered by the EU ETS or the LULUCF Regulation i.e. domestic transport (excluding aviation), buildings, agriculture, small industry and waste. The implementation of the ESR is supported by additional sectoral policies and. The legislative acts under the 2030 Climate

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[2] 423/2022

[3] Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (‘European Climate Law’), http://data.europa.eu/eli/reg/2021/1119/oj.

[4] This refers to the ETS1, i.e. the Emission Trading System for stationary sources (Chapter III of the ETS Directive) and for aviation and maritime transport (chapter II of the ETS Directive). Note that the ‘Emissions trading system for buildings, road transport and additional sectors’ (ETS2), added in 2023 as Chapter IVa of the ETS Directive, forms an instrument under the Effort Sharing Regulation (ESR).

and Energy Framework require the European Commission and the EU Member States to set up the institutional arrangements for implementing the specific policies and measures.

The revised EU ETS Directive increases the level of ambition in the existing system from 43 per cent to 62 per cent emissions reductions by 2030, compared to 2005 levels and extend the system to also apply to international maritime transport. A separate carbon pricing system will apply to fuel combustion in road transport and buildings and small-emitting sectors (ETS2) with a 42 per cent emission reduction target compared to 2005 across the sectors covered. The amended Effort Sharing Regulation (ESR) increased, for the sectors that it covers, the EU-level GHG emission reduction target from 29 per cent to 40 per cent by 2030, compared to 2005, which translates in updated 2030 targets for each Member State. The new LULUCF Regulation sets an overall EU-level objective of 310 million tonnes CO_2 equivalent of net removals in the LULUCF sector in 2030.

The ESR sets national targets for the reduction of GHG emissions in the Member States by 2030. Member States are also subject to gradually decreasing annual emission limits for each year from 2021 to 2030. The annual progress towards the national targets under the Effort Sharing Legislation is assessed by comparing GHG emission levels from the sectors covered by the ESR with the relevant annual emission allocations under the legislation (AEAs).

Progress in the implementation of these policies and measures is monitored under the Governance Regulation. Relevant information which is reported regularly and archived at the EEA include GHG inventories, approximated GHG inventories for the previous year, information on policies and measures, projections, and progress towards the implementation of integrated National Energy and Climate Plans (NECP). This information helps the EU and its Member State to correct their course if progress towards the targets of the 2030 Climate and Energy Framework is behind schedule.

In the EU Effort Sharing Regulation (ESR), Finland's target for emissions reductions in 2030 compared to the 2005 level is 50 per cent. Finland's new *Climate Act* sets out several plans that aim to reduce greenhouse gas emissions and adapt to climate change in Finland. It also obliges the central government authorities to monitor the trends in emissions and achievement of climate targets and report on them to Parliament. Procedures included in the Climate Act enable annual assessment of the implementation of the EU's NDC regarding Finland's contribution under the EU Effort Sharing Regulation and LULUCF regulation.

The Government regularly prepares strategies and plans for achieving climate targets. The most significant ones are discussed below. In addition, climate policy is increasingly being integrated with the decision-making processes in energy production, transport, agriculture, forestry and land use and other planning in Finland.

National energy and climate strategies have been prepared since 2001 by each Government i.e. the cabinet of ministers and submitted to the Parliament as a Government Reports. The latest strategy, called 'Carbon Neutral Finland 2035 – National Climate and Energy Strategy'[5], in 2022, set out the key starting points and objectives of the Government Programme goals, including the EU 2030 targets. Ministry of Economic Affairs and Employment oversees the overall coordination of the strategy work. The next strategy is under preparation and foreseen to be published in 2025. The relevant ministries are responsible for implementing the measures set out in the National Climate and Energy Strategy and for their monitoring and evaluation.

[5] Carbon Neutral Finland 2035 – National Climate and Energy Strategy, http://urn.fi/URN:ISBN:978-952-327-843-1

The Medium-Term Climate Change Policy Plan is an essential part of the climate policy planning system outlined in the Climate Act. It is adopted by the Government once every government term. It includes an action plan that contains measures for the reduction of anthropogenic greenhouse gas emissions and the mitigation of climate change in the effort sharing sector (sectors outside emissions trading) and projections of greenhouse gas emissions and the effects of policy measures on the emissions.

The second Medium-Term Climate Change Policy Plan was adopted in 2022. It specifies the key measures for achieving the binding emissions reduction targets in the effort sharing sector by 2030. The preparation of the Medium-Term Climate Change Policy Plans is coordinated by the Ministry of the Environment, and all the relevant ministries are involved in the work. The Annual Climate Report, which is submitted to Parliament every year, contains information on the implementation of the policy measures contained in the Medium-Term Climate Change Policy Plan. Preparation for the third Medium-Term Climate Change Policy Plan is ongoing.

The Climate Plan for the Land Use Sector (LULUCF)[6] was prepared from 2021 to 2022 for the first time. It is one of the key elements of the planning system under the revised Climate Act. The purpose of the Plan is to promote the reduction of emissions from land use, forestry, and agriculture, the strengthening of carbon sequestration and carbon storage, and adaptation to climate change in accordance with the Sustainable Development Goals. The first plan was coordinated by a working group, which included members from the Ministry of Agriculture and Forestry and other relevant ministries, as well as two experts from the Finnish Climate Change Panel. The Annual Climate Reports to the Parliament will contain information on the implementation of the policy measures included in the Climate Plan for the Land Use Sector.

The National Climate Change Adaptation Plan[7] was adopted in December 2022 and it is the second national adaptation plan in Finland. The Plan presents a climate change risk and vulnerability assessment and sets out the vision, aims, targets and actions for national adaptation work in Finland. The Plan, which is ought to be updated at least every second parliamentary term, is part of Finland's climate policy planning system as stated by the Climate Act. A preparatory group consisting of representatives of nine ministries was responsible for the preparation of the current Plan. The group was led by the Ministry of Agriculture and Forestry. The implementation of the Plan is reported in the Annual Climate Reports to the Parliament.

[6] Government Report on the Climate Plan for the Land Use Sector, 5 May 2023. Publications of the Ministry of Agriculture and Forestry 2023:12. http://urn.fi/URN:ISBN:978-952-366-592-7

[7] The National Climate Change Adaptation Plan 2030, 2 April 2024. Publications of the Finnish Government 2024:11. http://urn.fi/URN:ISBN:978-952-383-814-7

1.2.2 Description of a Party's nationally determined contribution

Under their updated NDC[8] the EU and its Member States, acting jointly, are committed to a legally binding target of a domestic reduction of net greenhouse gas emissions by at least 55 per cent compared to 1990 by 2030. The term 'domestic' means without the use of international credits.

The NDC consists of a single-year target, and the target type is 'economy-wide absolute emission reduction'. The scope of the NDC covers the 27 Member States of the EU.

Sectors in the NDC are as contained in Annex I to decision 5/CMA.3 under the Paris Agreement: Energy, Industrial processes and product use, Agriculture, Land Use, Land Use Change and Forestry (LULUCF), Waste. Details on the international aviation and maritime navigation can be found in the annex of this report. Greenhouse gases included in the NDC are the following: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3).

1.2.3 Tracking progress: Indicator, definitions, methodologies and progress

For the tracking of progress towards implementing and achieving the NDC of the EU, an indicator is used which has the same unit and metric as the NDC base year and target values. The chosen indicator is 'annual total net GHG emissions consistent with the scope of the NDC in CO_2 eq' Mitigation policies and measures'. The reference level is total net GHG emissions of the EU in the base year (1990).

The EU uses the following accounting approach for tracking progress towards the joint EU NDC: annual GHG data from the national GHG inventory of the EU, complemented for international aviation and navigation with estimations from the Joint Research Centre's Integrated Database of the European Energy System. The total net GHG emissions are provided in the scope of the EU NDC and are compared to the economy-wide absolute emission reduction target as defined in the NDC.

The current status of progress is presented in the textual and tabular parts, i.e. CTF tables of this report and in Table 1.2-1 below. Based on the GHG inventory data and data on international aviation and navigation for 2022, the EU and its Member States reduced net GHG emissions by 31.8 per cent compared to 1990. The EU and its Member States made progress towards implementing and achieving their NDC.

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[8] Submission by Spain and the European Commission on behalf of the European Union and its Member States: The update of the nationally determined contribution of the European Union and its Member States, https://unfccc.int/sites/default/files/NDC/2023-10/ES-2023-10-17%20EU%20submission%20NDC%20update.pdf

Table 1.2-1 Summary of progress towards implementing and achieving the NDC

Indicator	Unit	Base year value	Values in the implementation period			Target level	Target year	Progress made towards the NDC
			2021	2022	2030			
Total net GHG emissions consistent with the scope of the EU NDC	kt CO_2eq	4 699 405	3 272 650	3 205 223	NA	(at least 55% below base year level)	2030	The most recent level of the indicator is 31.8% below the base year level.
NA: Not Applicable.								
Note that an annual emissions balance consistent with chapter III.B (Application of corresponding adjustment) will be provided in a subsequent BTR upon finalisation of relevant further guidance by the CMA, based on the annual information reported under Article 6.2.								
Note: More detailed information can be found in CTF table 4 ('Structured summary: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement'), which has been submitted electronically together with this BTR.								
Source: The indicator values are based on the Annual European Union GHG inventory 1990-2022.								

1.2.4 Mitigation policies and measures

Finland's climate policy is based on international agreements and national targets such as the UNFCCC, the Paris Agreement and the common policies of the European Union. These agreements and targets drive the process of preparing the actual mitigation policies and measures and laying them out in different strategies and plans.

Finnish regulations, policies, and measures are strongly affected by the increasing number of directives, policies, and measures of the EU. A vast majority of the policies and measures reported in this Biennial Transparency Report are already adopted or implemented; they are in other words existing measures. At the time of writing, the Government is planning new policy measures in addition to the adopted and implemented measures.

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 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 Emissions Trading System (EU ETS), energy taxation, other measures to increase the share of renewable energy, and energy conservation measures. The EU ETS is an EU-wide measure, while renewable energy sources are supported by various national measures: investment grants, taxation, support for research, and feed-in tariffs. Energy conservation measures are relevant in all sectors of the economy. Energy efficiency agreements, a voluntary scheme for industries and municipalities, have proved to be efficient measures along with taxes and subsidies. As for both new and existing buildings, building codes and regulations play an important role.

Finland is phasing out coal in the energy sector by prohibiting its use from May 2029. To accelerate the coal phase-out, a special incentive package to support replacement investments was introduced for energy utilities that undertook to give up the use of coal already by 2025. To reduce greenhouse gas emissions from light fuel oil, a distribution obligation of bioliquids was approved in 2019 for oil used for heating and machinery.

The energy sector measures that are estimated to have the largest climate change mitigation impact are promotion of wind power (19.7 million tonnes CO_2 eq. mitigation impact in 2030), ecodesign and energy labelling (9.2 million tonnes CO_2 eq. in 2030), Energy Efficiency Agreements (9.1 million tonnes CO_2 eq. in 2030), promotion of wood chips (8.1 million tonnes CO_2 eq. in 2030) and the building regulations for new buildings (5.8 million tonnes CO_2 eq. in 2030).

For the transport sector the emissions reduction measures fall into three categories: 1) replacing fossil fuels with alternative transport fuels; 2) renewal of the car fleet; and 3) improving the energy efficiency of the transport system. The main transport sector measure is a legally binding yearly target for renewable fuels in road transport. The obligation rises gradually and is 34 per cent of all fuels consumed in road transport in 2030, which equals an emissions reduction of nearly 3 million tonnes of CO_2 eq. Other measures are for example the promotion of alternative fuels infrastructure (electricity, biomethane, hydrogen), taxation of fuels and vehicles, and binding CO_2 threshold values applicable to automotive manufacturers at the EU level. In 2027, a new emissions trading system (ETS2) for road transport, buildings and some additional sectors will start in the EU.

As a member of the European Union, Finland is implementing the EU ETS for aviation and maritime transports. Aviation has been included in the EU ETS since 2012 and covers today all intra-European Economic Area flights. Since 2024, the EU ETS is extended to ships of 5,000 gross tonnage and above calling at European ports, regardless of their flag. Other policies and measures to mitigate emissions from international bunkers include implementing the measures of the International Maritime Organization (IMO) and the International Civil Aviation Organisation (ICAO).

Measures for reducing CO_2 emissions from industrial processes are the EU ETS and investment grants for low-carbon technology. For F-gases, EU regulations constitute the most significant emission reduction measure. In total, the existing measures are estimated to cut F-gas emissions with 3.2 million tonnes CO_2 eq. in 2030.

Within the agricultural sector, the emissions reduction measures are mainly related to the implementation of the EU's Common Agricultural Policy (CAP). The new CAP period from 2023 to 2027 began in January 2023. Since it is neither possible nor appropriate to implement all climate change mitigation or adaptation measures in agriculture through the EU’s Common Agriculture Policy, national measures are required. These measures are identified in the Medium-term Climate Change Policy Plan and in the Climate Plan for the Land Use Sector. Measures in these plans are mainly targeted at agricultural peatlands and enteric fermentation. The Government has also strongly highlighted the role of manure management and nutrient recycling as part of the overall sustainability of agricultural production.

The Climate Plan for the Land Use Sector was prepared in 2022 and it specifies how climate emissions from the land use, land-use change and forestry sector can be reduced, and carbon sinks and reservoirs strengthened. The plan brings together more than 30 different climate measures, such as the updated ownership policies of the State Forests (Metsähallitus) and the ash fertilisation of peatland forests. The plan also outlines additional measures in four categories: resource-efficient land use and land-use change; climate-resilient use of peatlands; other measures to promote carbon sequestration and carbon storage; and crosscutting measures. The aim of the plan is to achieve an annual net impact of at least 3 million tonnes of CO_2 eq. by 2035.

The general reform of waste legislation that was conducted in 2021 provides the basis for more effective waste management with respect to recycling and reuse, enhanced separate collection of waste, reduction of waste generation, and further reduced landfilling of organic waste, all contributing to reduced greenhouse gas emissions. The National Waste Plan for 2027 that was approved in 2022 includes both a plan to reduce the volume and harmfulness of waste and a waste management plan. The estimated total emissions reduction of waste management measures is roughly 4 million tonnes CO_2 eq. per year.

1.2.5 Projections of greenhouse gas emissions and removals

The With Measures (WM) projection presented in this report is an integrated energy and climate projection based on comprehensive modelling and assessments conducted by experts from various research fields. The modelling covers the energy system and all GHG sources and sinks that are included in the GHG inventory. The WM projection includes measures that are adopted or implemented before June 2024. No With Additional Measures (WAM) projection is available for this reporting.

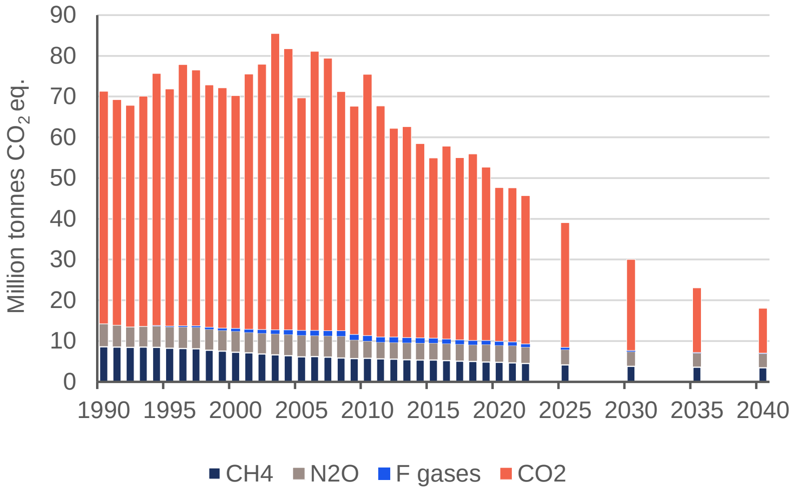
The Covid-19 pandemic and its assumed effects on the economy were considered in the modelling of the WM projection whose starting point is the year 2022. In contrast to Finland's Fifth Biennial Report (BR5), the energy crisis and changed energy scene following Russia's unprovoked and unjustified invasion of Ukraine are now included in the projections. This is especially reflected in cutting off all energy imports from Russia throughout the modelling period. For the LULUCF sector, the most recent results from the national forest inventory on a decline in tree growth now form the base for the projection work.

Most of the measures included in the WAM projection of the Fifth Biennial Report (BR5) have been implemented and are now part of the WM projection, such as improving energy efficiency and promoting alternative fuels in machinery, expansion of the EU Emissions Trading System (ETS2) and energy efficiency measures for transport.

The population growth in the projections is based on the population forecast drawn up by Statistics Finland in 2021. The population will increase only slightly from 5.56 million (end of 2022) to 5.60 million in 2030. In 2033, the population will start to decrease. The current economic growth is modest but it is expected to improve toward the end of the decade. In the WM projection, the annual average increase in the national economic output is 1.3 per cent from 2020 to 2030 and 1.7 per cent from 2030 to 2040.

The WM projection estimates that the total greenhouse gas emissions (without LULUCF) will be 30 and 18 million tonnes of CO_2 eq. in 2030 and 2040, respectively, which equal to reductions of 58 and 75 per cent compared to the 1990 base year. Figure 1.2-1 shows the historical GHG emissions by gas and the development in the WM projection. The development of total emissions regarding the number of inhabitants, primary energy use, and economic development shows a steady downward trend that continues in the WM projection. Today, the emissions are decoupled from both the GDP growth and energy use development and decline steadily.

Figure 1.2-1 Greenhouse gas emissions without LULUCF by gas according to the latest greenhouse gas emission inventory (1990 to 2022) and the WM projection (until 2040), million tonnes CO_2 eq.



1.3 Climate change impacts and adaptation

1.3.1 Climate modelling, projections and scenarios for Finland

Finland’s mean annual temperature is projected to rise by around 2–6 °C by the end of the century, depending on the SSP scenario used. Warming will be stronger in the winter than in the summer. On a timescale of one hundred years, Finland’s mean annual temperature will rise at a rate around 1.6 times the global average.

Climate change is expected to result in increased total precipitation, in particular in the winter; an increase in heavy rains in the summer; an increase in the number of hot days and longer and more intense heatwaves; diminishing cold spells and a shortening snow season; and decreasing duration and depth of soil frost. Changes in mean wind speed and windstorms are expected to be minor.

1.3.2 Vulnerability, risks and climate change impacts

By global comparison, Finland is well-prepared for additional challenges brought about by climate change. Heat waves are currently the biggest health hazard related to climate change in Finland. The ageing population, increasing number of people living alone, low prevalence of air conditioning, and urbanisation further amplify the effect of heat. Other important health harm relates to slip accidents, water-borne epidemics, zoonotic and vector-borne infections, and moisture damage to buildings.

The rising mean temperature and the temporal shift of the seasons have already caused large-scale changes in Finnish natural ecosystems and biodiversity, which are expected to intensify in the future. Climate change also adds to the challenges faced in agricultural production and forestry. Particularly over the long term, climate change may affect Finland’s food supply as well as food and nutrition security. The risk of pests and diseases are increasing in forestry, agriculture, and fisheries. Increasing drought and heatwave periods increase the risk of extensive forest fires.

Climate change can impact the durability and condition of transport systems and infrastructure. Flood risk is projected to decrease slightly over the short term but to double or triple by 2100 if the current flood risk management measures are not continued and implemented as planned. The increase in risk is mainly due to the assumed steady economic growth increasing the value of damaged property. The adverse effects of heatwave periods are also greater in urban environments than in the surrounding areas due to the heat island phenomenon and partly due to the building stock. The impacts of weather and climate on the transport system may cause serious harm or accidents, damage and delay risks that result in costs, value losses and health effects.

The preparation of the current national adaptation plan in 2021 to 2022 included an up-to-date assessment of risks and vulnerabilities from three different perspectives: 1) a national risk and vulnerability assessment focusing on sectorial and cross-sectorial risks and vulnerabilities; 2) regional vulnerabilities; and 3) national and local institutional vulnerabilities.

1.3.3 Domestic adaptation policies and strategies

Finland adopted its current National Adaptation Plan (NAP2030) in 2023, which will steer adaptation work until 2030. Finland's Climate Act, revised in 2022, requires that the National Adaptation Plan will be adopted every other electoral period (essentially every eight years), and that it will be evaluated mid-term. The Ministry of Agriculture and Forestry is responsible for coordinating national adaption overall policy, and each ministry has the responsibility to ensure and monitor its implementation within their own areas of responsibility.

Several administrative branches have developed adaptation action plans. The Ministry of Social Affairs and Health adopted a plan in 2021, the Ministry of Defence in 2023, the Ministry of Agriculture and Forestry revised its plan in 2024, and the Ministry of the Environment has already had several rounds of adaptation planning and is currently updating its plan. Furthermore, adaptation has been integrated into broader climate and environmental policy programmes in certain sectors, including transport and communication.

Several sector-specific plans and legislations have included adaptation considerations recently. Examples include drought risk management, which is gaining importance, and the Ministry of Agriculture and Forestry published national guidelines for drought risk management in 2024. The water management sector is undergoing a National Water Supply and Sewage reform (2020–), which focuses on securing a reliable operation of water supply services and better future risk management, for example, as regards to climate change. In the built environment sector, legislative steering is based on the Construction and Land Use and Building Acts. The new Construction Act, which will enter into force in January 2025, will improve the effectiveness of regulation, in particular to promote mitigation, adaptation and circular economy. Preparations for the reform of the Land use and Building Act continue.

Climate resilience is one of the cross-cutting objectives of Finland's international development policy and development cooperation. The integration of the cross-cutting objectives in all development cooperation activities is a binding obligation, either through mainstreaming or targeted action.

1.3.4 Monitoring and evaluation framework

Several measures for monitoring and developing monitoring have been set in NAP2030. The NAP outlines that by 2026, Finland has set up a monitoring system for climate change adaptation and ensured the conditions for its implementation. The Ministry of Agriculture and Forestry is responsible for the overall operation of the national monitoring system. Adaptation and mitigation actions are reported through the Annual Climate Report, which is part of the Finnish climate policy planning system under the Climate Act. During parliamentary terms when there is no obligation to prepare a national adaptation plan, the Climate Act requires that the current plan’s relevance and the need for new measures be assessed. The implementation of the NAP2030 and the need for additional measures will be assessed in a mid-term review in 2026.

1.3.5 Progress and outcomes of adaptation actions

Awareness of the impacts and risks of climate change and adaptation has strengthened. This is evident, for example, in numerous documents and public discourse referring to adaptation. The revised Climate Act strengthens the overall framework for managing adaptation.

Adaptive capacity has generally increased through the increased awareness of possible climate change impacts. Progress has been made in particular in sectors in which weather and climate fluctuations have long been relevant for normal operations, such as construction, infrastructure maintenance, and water management. Concrete actions have been implemented for example in the built environment both at the level of regulation and in practical measures. However, the sectors have progressed at a different pace in terms of actions and guidelines that will tangibly strengthen the adaptive capacity.

1.4 Financial, technology development and transfer and capacity-building support

Finland's support to developing countries in the context of climate action involves financial, technological, and capacity-building assistance, administered by the Ministry for Foreign Affairs (MFA).

1.4.1 Financial Support

Climate Finance: Finland channels its climate finance as part of its Official Development Assistance (ODA) budget, which is allocated to developing countries' climate change mitigation and adaptation activities.

Multilateral and Bilateral Funding: Most of Finland's climate finance is provided as core contributions to multilateral organizations and funds (e.g. the GCF and the GEF) as core contributions, but all channels of finance are used, including support to civil society organizations (CSO) and investment funding.

2021–2022 Allocations: In 2021, Finland allocated approximately EUR 175 million (ODA), while in 2022 the total was EUR 153 million in ODA and EUR 15 million in Other Official Flows (OOF).

Mitigation and Adaptation: The distribution between mitigation and adaptation support varies yearly, but Finland aims for balance (share of mitigation was 53 per cent in 2021 and 61 per cent in 2022).

1.4.2 Technological Development and Transfer

Technology Transfer: Finland support the transfer of both ‘soft’ technologies (e.g., capacity building, information networks) and ‘hard’ technologies (e.g., technology for greenhouse gas emission control).

Weather Observation: Finland is a leader in weather observation technology and systems, supporting the weather, climate and early warning services in developing countries through bilateral and regional cooperation.

1.4.3 Capacity-Building Support

Capacity Building in Climate Projects: Most Finnish-funded climate projects include a capacity-building component. Multilateral climate funds such as the GCF also have strong capacity-building elements.

Specific Instruments: Finland uses various funding mechanisms to support capacity building, such as the Institutional Cooperation Instrument (ICI) and Higher Education Institutions Cooperation Instrument (HEI ICI). These instruments support government agencies and higher education institutions in developing countries.

National Meteorological Services: Finland is one of the world leaders as a donor in supporting the capacity building of partner countries’ national meteorological and hydrological services (NMHS), with projects implemented in 11 countries during the reporting period (2021–2022).

Gender Equality: Gender equality is integrated into capacity-building efforts, with an emphasis on equal participation and leadership opportunities for women.

2 National inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

Finland’s National Inventory Report containing the national inventory document (NID) and the CRT tables are submitted as a stand-alone report in conjunction with this first biennial report, i.e. the written report and the CTF tables.

3 Information necessary to track progress made in implementing and achieving nationally determined contributions

3.1 National circumstances and institutional arrangements

3.1.1 National circumstances

National circumstances relevant to progress made in implementing and achieving the joint NDC are described in this section, including description how Finland’s national circumstances affect greenhouse gas emissions and removals in different sectors over time. Additional information on the national circumstances is available in Finland’s eight national communication.

3.1.1.1 Government structure

The government structure and climate policymaking process in Finland is briefly described here. More detailed information can be found in Finland’s NC8.

Finland is a representative democracy, with 200 members of Parliament elected every four years. The tasks of the Finnish Parliament include passing laws and approving national budgets. The Government and Parliament make the most important decisions concerning climate policy. In its narrower sense, the Government refers to the Cabinet, which has18 ministers.

The head of state is the President of the Republic, who directs foreign policy in cooperation with the Government, thus approves Finland’s international commitments and decides on their implementation according to the constitution. However, some major decisions also require approval from Parliament. Parliament also actively participates in the debate on how EU decisions are implemented nationally. The Government must enjoy the confidence of Parliament. It implements parliamentary decisions, presents legislative proposals to Parliament, directs state administrative activities, and represents Finland in the European Union.

The Ministerial Committee on European Union Affairs discusses and decides on Finland’s positions on EU and international climate policy issues. Finland participates in the international climate negotiations as part of the European Union and therefore follows the EU’s common positions. The Ministry of the Environment bears the responsibility for coordinating the preparatory work for the climate negotiations and is the national focal point for the UNFCCC. Preparatory work for the climate negotiations is carried out in several ministries.

Since 2003, every Finnish government has appointed ministerial working groups responsible for energy and climate policy, with representatives from all government parties. These ministerial working groups have been responsible for preparing and updating the national strategies on energy and climate policy. The ministerial working group has a network of officials acting as its preparatory body, comprising representatives from seven ministries and the Prime Minister’s office. The network of officials is led by the Ministry of Economic Affairs and Employment, which oversees the overall coordination of the strategy work.

Institutional arrangements related to climate policy and its implementation are summarized in Figure 3.1-1 below. More information can be found in Sections 3.1.2 and 3.1.3/3.1.2.1 and 3.1.2.2 and Finland's eight national communication.

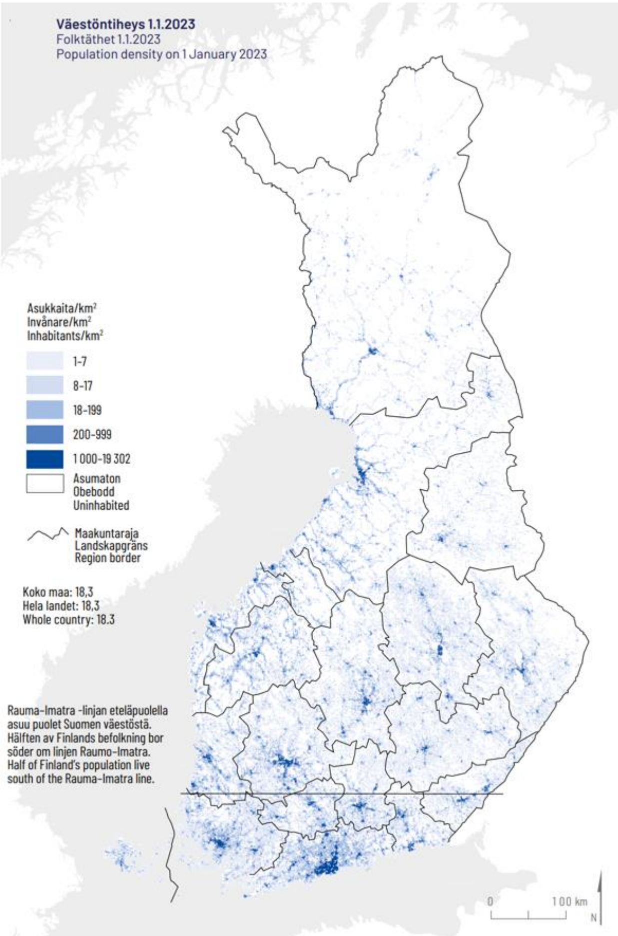
Figure 3.1-1 Institutional arrangements related to climate policy and its implementation in Finland

3.1.1.2 Population profile

The population of Finland was 5.56 million at the end of 2022 and it rose to 5.60 million at the end of 2023. The population growth was 3.5 per cent between 1990 and 1999, 3.3 per cent between 2000 and 2009 and 2.8 per cent between 2010 and 2019. Over the current decade, the population growth has averaged 0.36 per cent per year. At the end of 2023, there were a total of 2.8 million households. The average household size was two persons. The population density averages 18 inhabitants per km² but ranges from two inhabitants per km² in Lapland in northern Finland to 193 inhabitants per km² in the south of the country in the Helsinki-Uusimaa region (Figure 3.1-2). The country's low population density and geographical extent mean long distances can be travelled for different purposes.

The urban population accounted for 73 per cent of the total population in 2022. The corresponding figure in 1990 was 63 per cent of a total population of 5.0 million. Many rural municipalities have a declining population, especially in northern and eastern Finland. Internal migration from rural to urban areas was strong in the mid and late 1990s, when urban municipalities gained more than 10,000 migrants per year. Internal net migration to urban municipalities declined in the early 2000s but has increased steadily since, reaching an annual average of 10,000 internal migrations between 2015 and 2019. However, during the Covid-19 pandemic, the net urban migration gain fell significantly to 5,800 and 1,400 in 2020 and 2021, while the net migration losses of semi-urban and rural municipalities decreased. Recently, the trend of increasing net migration to the urban municipalities has emerged again and the net gain of urban municipalities has increased to 6,400 and 8,400 migrants in 2022 and 2023, respectively.

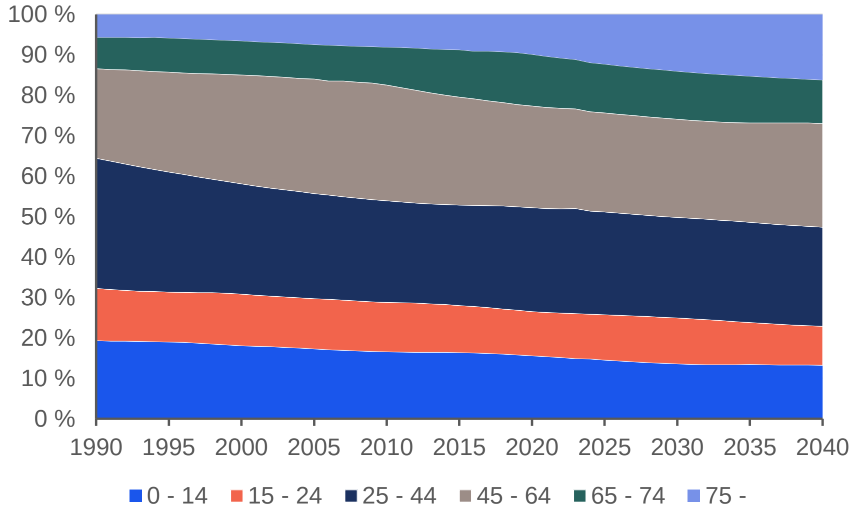
Figure 3.1-2 Population density in Finland, 1 January 2023



Net migration to Finland increased steadily during the late 1990s and the 2000s. In 1994, net migration to Finland was around 3,000; in 2006, it reached more than 10,000 migrations. Net migration to Finland ranged between 12,000 and 18,000 in the 2010s. During the current decade, immigration to Finland has increased, with net immigration reaching 58,000 in 2023.

The population is ageing as the life expectancy has risen rapidly over the last 30 years. Currently, baby girls may expect to reach the age of 83.8, and baby boys the age of 78.6. The proportion of the population aged over 65 has risen from 13.5 per cent in 1990 to 23.3 per cent in 2023. This trend will accelerate in the coming years. Overall, population growth has slowed down, and the natural population growth is expected to decline in the coming decades. According to population projection made by Statistics Finland in the autumn of 2021, it is estimated that the Finnish population will decline starting from 2033 if fertility rates and amount of net migration remain at the level observed at the time when the projection was made. By 2040, it is estimated that more than a quarter of Finland's population will be 65 years old or over (Figure 3.1-3).

Figure 3.1-3 Population profile for 1990 to 2040 (1990 to 2023 actual, 2024 to 2040 projected)



3.1.1.3 Geographical profile

Finland is situated at a latitude between 60 and 70 degrees north, with a quarter of the country extending north of the Arctic Circle. In the west and south, Finland has a long coastline with numerous islands along the Baltic Sea coast. With a total area of 338,400 km^2, it is Europe's seventh largest country.

Finland lies between the Scandinavian mountains and northern Russian plains. The land boundary with Sweden is 614 km long, with Norway 736 km long and with Russia 1,340 km long.

Finland's terrain is a varying mosaic of low hills, broad valleys and flat, low-lying plains, with higher fells in the north. The landscape is a mixture of forests, lakes and mires. Much of the country is a gently undulating plateau of mostly ancient bedrock.

Nearly all of Finland is situated in the boreal coniferous forest zone, and 72 per cent of the total land area is classified as forest land, while only some eight per cent of it is cropland (Table 3.1-1).

Peatlands cover almost one third of the total land area in Finland, approximately 9 million hectares. Regional differences in coverage are considerable. The majority of the peatlands are located in the north. Two-thirds of the peatlands i.e. six million hectares is forest land of which over 70 per cent has been drained. Approximately 0.3 million hectares, corresponding to three per cent of peatland is in agricultural use, i.e. cropland. The area of protected peatlands is approximately 1.3 million hectares, which is 14 per cent of peatlands. Active peat production covered 50,000 ha i.e. less than one per cent of the surface area of peatlands in 2022. More information on peatlands can be found in Chapter 2 in Finland's NC8.

Finland has more than 34,500 km^2 of inland water systems, which is about 10 per cent of its total area. There are some 190,000 lakes and 180,000 islands, with almost half the latter along the Baltic Sea coast. The Baltic Sea is the second largest brackish water basin in the world in terms of water volume. The water of the Baltic Sea is a mixture of ocean water and fresh water brought in by numerous rivers. Eutrophication is a severe problem affecting the Baltic Sea. It is the consequence of more than a century of nutrient loading caused by human activity i.e. settlements, industry, agriculture, and forestry in the Baltic Sea region.

Changes in land use since 1990 are shown in Table 3.1-1. The area of settlements has increased by 24 per cent, and that of grassland has decreased by seven per cent, whereas changes in areas of other land use categories have been small, one and a half per cent or less.

Table 3.1-1 Land use in 1990 and 2022

	1990	2022	Change
Land use classification [1]		km^2	%
Forest land	221 086	218 409	-1.2
Cropland	24 719	25 051	1.3
Grassland	2 663	2 471	-7.2
Wetlands	30 070	29 618	-1.5
Settlements	12 239	15 220	24.4
Other land	13 139	13 101	-0.3
Total	303 916	303 870	0.0
Inland waters	34 518	34 565	0.1
Total with inland waters	338 435	338 435	0.0

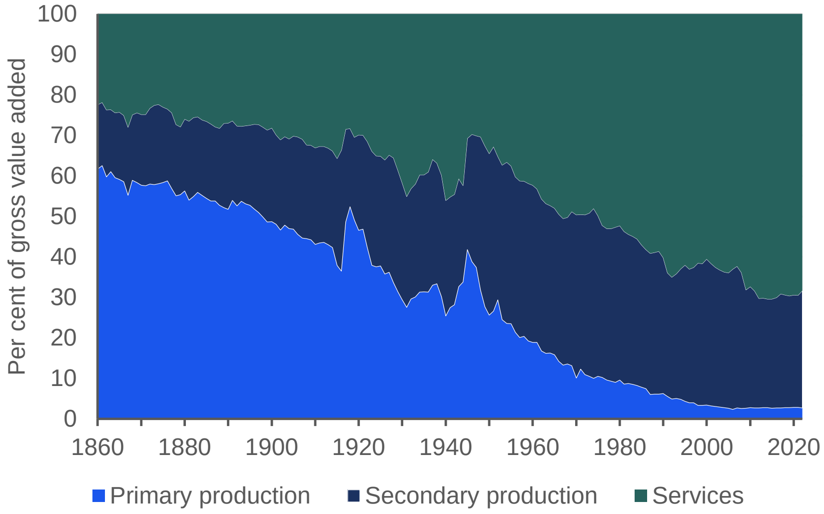
[1] The classification is based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Vol.4. Agriculture, Forestry and Other land Use

Source: National Resources Institute Finland (Luke), Greenhouse Gas Inventory team

3.1.1.4 Economic profile

Finland has an open economy with prominent service and manufacturing sectors (Figure 3.1-4). The main manufacturing industries include the metal, chemical, manufacture of electrical and electronic products and forest industry. Foreign trade is important, with exports accounting for approximately 40 per cent of the gross domestic product (GDP) in the recent years. In 2022, Finland's GDP was EUR 268 billion and per capita GDP was EUR 48,200. The cold climate, energy intensive industry structure and long distances have led to a relatively high energy intensity and high per capita greenhouse gas emissions.

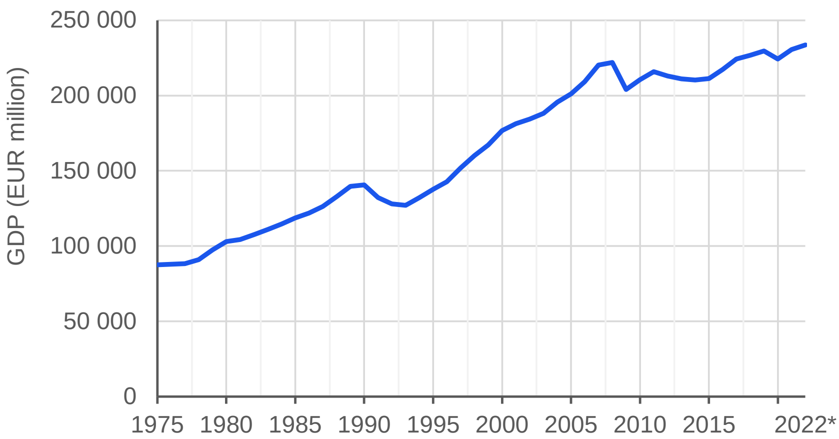
Figure 3.1-4 Structural change in the Finnish economy between 1860 and 2022*



* Preliminary estimate published by the Annual National Accounts at Statistics Finland.

For several decades, the Finnish economy was characterized by rapid growth combined with vulnerability to international cyclical fluctuations (Figure 3.1-5). Finland went through severe economic recessions in the early 1990s but the economy recovered rapidly after it. After the financial crisis of the late 2000s, however, it took nine years for the Finnish economy to reach the same level of real GDP than in 2008 because of the restructuring of the economy in the 2010s. The slow growth was partly due to difficulties in net exports and in the electrical and electronic products industry. After modest economic growth in the late 2010s, the volume of Finland's GDP fell in 2020 by 2.4 per cent as the Covid-19 pandemic prevailed. The economy recovered swiftly from the pandemic and grew by 2.8 per cent in 2021 and by 1.3 per cent in 2022.

Figure 3.1-5 Finland's gross domestic product 1975 to 2022 (at 2015 prices)

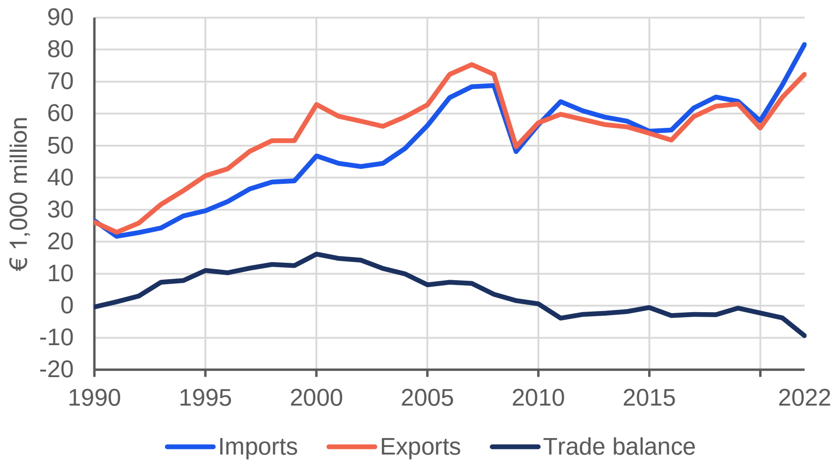


* Preliminary estimate published by the Annual National Accounts at Statistics Finland.

The volume of Finnish exports of goods has remained below the level achieved before the recession that started in 2008 (Figure 3.1-6). However, after the Covid-19 pandemic, the exports increased significantly in 2021 and 2022. The volume of goods exported in 2022 was 48 million tonnes and their total value at current prices was EUR 81.9 billion. More than half of the total value was exported to the EU countries. Paper and paper products, machinery and equipment, basic metals, and electrical equipment have been the most important groups of exported goods in recent years. The degree of refinement in exported goods is higher than in imported goods.

The total value of exports of services at current prices was EUR 33.2 billion in 2022. Telecommunications, computer, and information services are the largest item among exported services. The export of services has shown an increasing trend during the past ten years, with the exception of 2020, when the Covid-19 pandemic reduced exports of travel and transportation services in particular.

Figure 3.1-6 Finnish imports, exports, and trade balance of goods, 1990 to 2022 (at 2015 prices)



Sources: Finnish Customs, Foreign trade of goods,
Statistics Finland, consumer price index

Finland imported almost 54 million tonnes of goods in 2022. The total value of imported goods was EUR 92.5 billion with a significant rise after the Covid-19 pandemic (Figure 3.1-6). Industrial products represented some 80 per cent of the total value, with products of the basic metals, electrical equipment, machinery and equipment, chemicals and chemical products, and motor vehicles being the most significant groups of goods. For imports of services, the most significant important item was other business services, which consisted mainly of R&D services, business and management consulting and public relations services and trade-related services. Imports of services have exceeded the exports of services in recent years; this was also the case in 2022, when the value of imports of services (EUR 39.3 billion) was higher than that of exports (EUR 33.2 billion).

3.1.1.5 Climate profile

The climate of Finland displays features of both maritime and continental climates, depending on the direction of airflow. Considering its northern location, the mean temperature in Finland is several degrees higher than in most other areas at these latitudes, i.e. Siberia, northern Canada, most of Alaska, and southern Greenland. The temperature is higher because of the Baltic Sea, due to the inland waters and above all, as a result of the airflows from the Atlantic Ocean, which are warmed by the North Atlantic Current.

The annual mean temperature is close to 7 °C in the southwestern archipelago of Finland, decreasing towards the northeast. The 0 °C mean limit is reached slightly north of the Arctic Circle. Temperature differences within the country are greatest in January, when it is, on average, by more than 10 °C colder in northern Finland compared to the southwestern archipelago. In June and July, on the other hand, the temperature difference between southern Finland and the northernmost Lapland is close to 5 °C.

Finland enjoys long periods of daylight around midsummer, when the length of the day, including civil twilight, reaches 22 hours even at the latitude of the capital, Helsinki. North of the Arctic Circle (66.5°N), it remains light throughout the night at this time of year, as the sun does not descend below the horizon. In the far north, there is a period around midsummer of more than two months when the sun never sets. Conversely, in winter, the sun does not rise above the horizon in the northernmost region for almost two months.

The Finnish climate is characterised by irregular precipitation, and there are typically rapid changes in the weather. The average annual precipitation level in southern and central Finland ranges mainly between 600 and 750 mm, except near the coast, where it is slightly lower. In northern Finland, the average annual precipitation level varies approximately from 450 to 650 mm.

The seasonal variation in precipitation is quite similar throughout the country, with the driest months being February, March, and April. Precipitation then gradually increases towards summer and July or August is, on average, the rainiest month in the most part of the country. Then, precipitation decreases towards the winter and spring. Daily precipitation of 40 mm occurs in a certain location on average once every five years. In an average year, more than half of the days have some precipitation, except near the coastal regions.

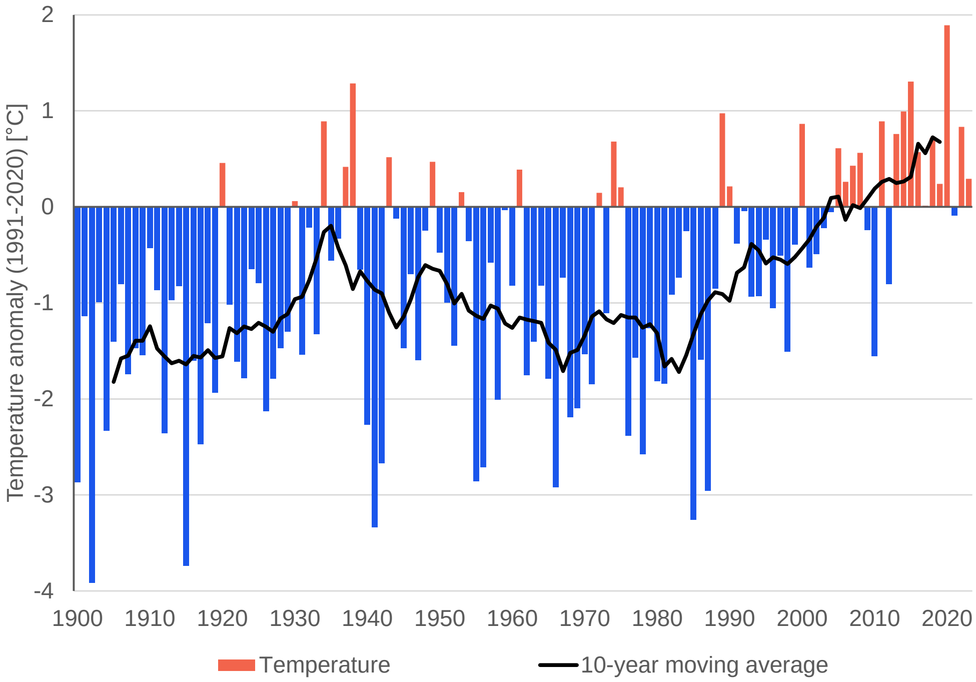
Even in southern Finland, about 20 per cent of annual precipitation falls as snow, which remains on the ground for about three to four months. In Lapland, 35 to 50 per cent of the annual precipitation falls as snow, and snow remains on the ground for six to seven months.

The lakes freeze over in October in Lapland and in early December in southern Finland. During severe winters, the Baltic Sea may freeze over almost completely, but in mild winters, it remains open for the most part, except for the Bothnian Bay and the eastern part of the Gulf of Finland.

The most common wind direction (around 20 per cent) in Finland is from the south or southwest. The average wind speed is three to four m/s inland, slightly higher on the coast, and five to seven m/s in maritime regions. Damage due to storms and strong winds occurs most often during the autumn and winter, but also during the summer in connection with thunderstorms. Cloud cover is especially abundant in the late autumn and winter. The long-term average for the monthly cloud cover ranges from approximately 50 per cent in May to July in the south to more than 80 per cent in many places in November and December.

The annual mean temperature has increased by about two degrees Celsius since the beginning of the 20th century (Figure 3.1-7). The increase has been greatest in the winter and spring, but even in the summer and autumn, the temperature has increased by almost 1.5 °C. Most of the warming has taken place since the 1980s, and the new climatological normal period between 1991 and 2020 was approximately 0.6 °C warmer than the previous period between 1981 and 2010, and almost 1.3 °C warmer than the period from1961 to1990. Nevertheless, considerable temperature fluctuations occur between individual years.

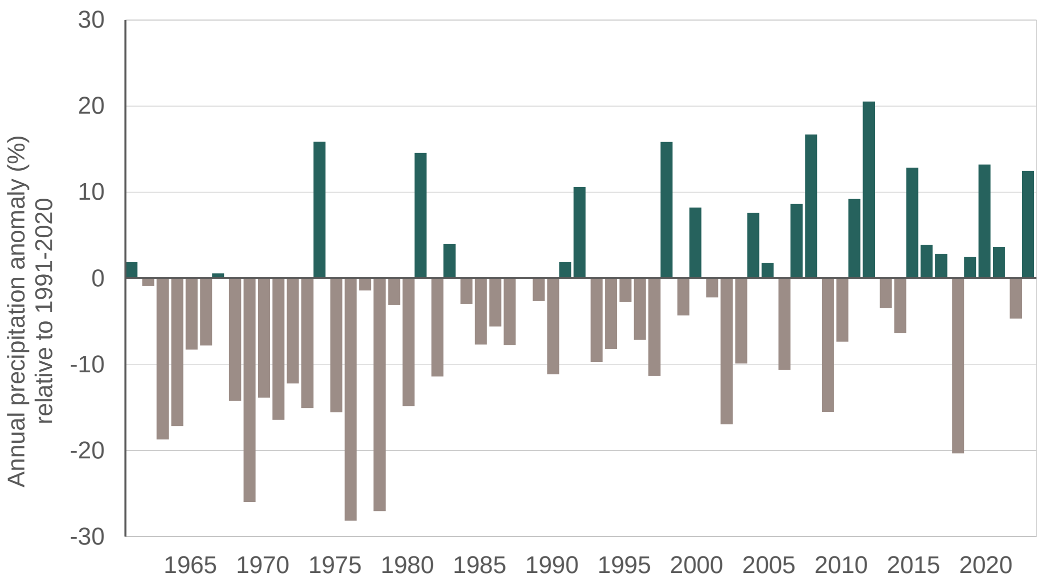
Figure 3.1-7 Annual mean temperature in Finland from 1900 to 2023, presented in anomalies (°C) relative to the reference period 1991–2020. The black line represents the 10-year moving average.



Source: Finnish Meteorological Institute

The average annual precipitation level shows significant variations from year to year (Figure 3.1-8). Long-term changes in the precipitation level are thus mainly obscured by the natural variability, but years with above-normal precipitation levels have recently occurred more often than in the 1960s and 1970s. Moreover, the countrywide average precipitation level was almost 10 per cent higher between 1991 and 2020 than between 1961 and 1990. Precipitation has increased mainly in winter.

Figure 3.1-8 Annual mean precipitation in Finland from 1961 to 2023, presented as anomalies (%) for the reference period 1991–2020 in terms of mean precipitation



Source: Finnish Meteorological Institute

3.1.1.6 Energy, including transport, and industrial processes and product use

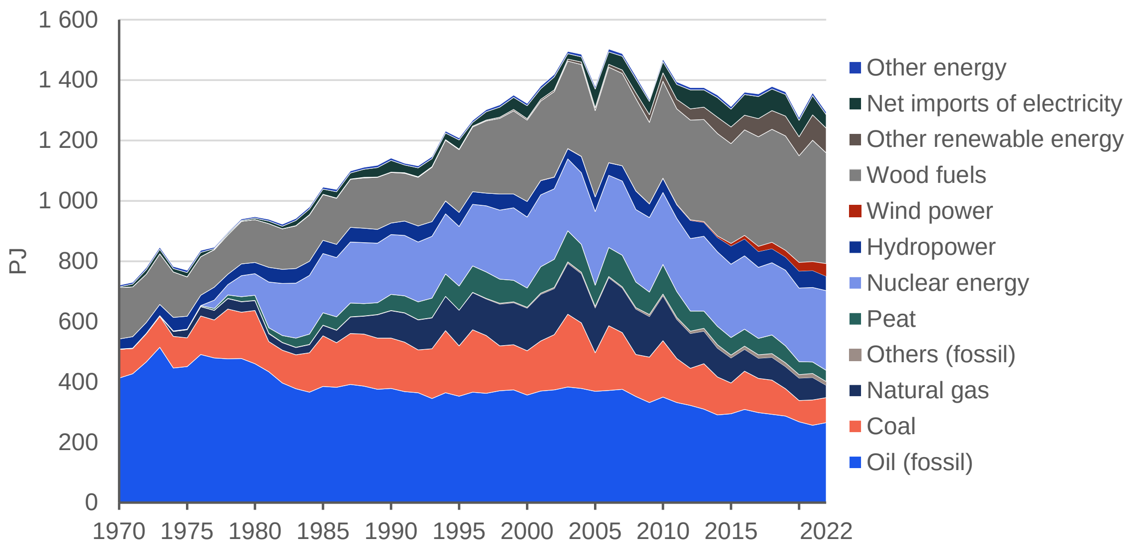
This section covers energy sector, including transport, and industrial processes and product use sector of the greenhouse gas inventory.

Energy supply and consumption

The energy-intensive basic industries, cold climate and long distances underline the importance of energy for the wellbeing of Finland's inhabitants and the country's competitiveness. Until the 1960s, Finland's energy policy relied on the electricity produced by hydropower stations and the extensive use of wood, after which the use of fossil fuels began to increase. The rapid increase levelled off after the energy crises and with the advent of nuclear power. Both total energy consumption and electricity consumption were increasing for several decades, peaking in 2006. Starting from the 2010's, renewable energy has increasingly replaced fossil fuels (Figure 3.1-9).

Total energy consumption was 1,294 PJ in 2022. Wood fuels accounted for 28 per cent, fossil oil 21 per cent and nuclear energy 20 per cent as sources for the total energy consumption (Table 3.1-2). Finland's main domestic energy sources are wood-based fuels, hydropower, wind power, solar power, waste, peat and heat pumps.

Figure 3.1-9 Total energy consumption, 1970 to 2022, PJ



In 1990, the share of renewable energy in total energy consumption was just 18 per cent, after which it has grown steadily and started to increase in particular since 2010 (Figure 3.1-10).

The European Union's Emissions Trading System (EU ETS) was implemented in Finland in 2005. The system incentivises most of the energy sector and industry to cut emissions in the form of an extra cost of CO_2 emissions. In addition, several national measures have been put into action. For example, in 2010, the Government launched an extensive national package of specific targets concerning different renewable energy sources. The package promoted use of forest chips and other wood-based energy, wind power, use of transport biofuels, and increased utilisation of heat pumps. Other recent trends in Finland's energy production are the future ban on the use of hard coal, which has had an effect already before, and the steady increase of wind power capacity.

The rise of the allowance price in the EU ETS is accelerating the replacement of fossil fuels with renewable energy. Finland significantly exceeded the national target of 38 per cent for the share of renewable energy in total final energy consumption by 2020 set in the EU’s Renewable Energy Directive. In 2022, Finland’s 48 per cent share of renewable energy in gross final energy consumption was the second highest in the EU.

Figure 3.1-10 Energy consumption by fuel groups in PJ and share of renewable sources in 1990 to 2022

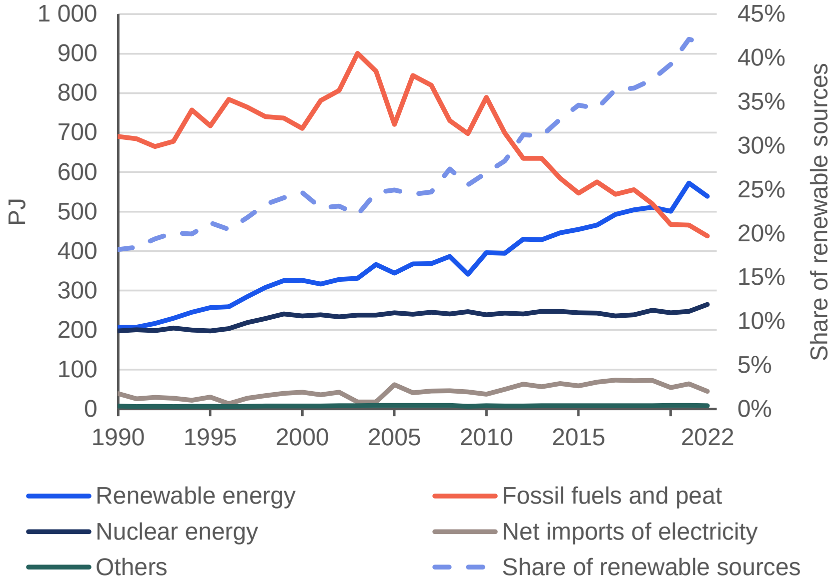


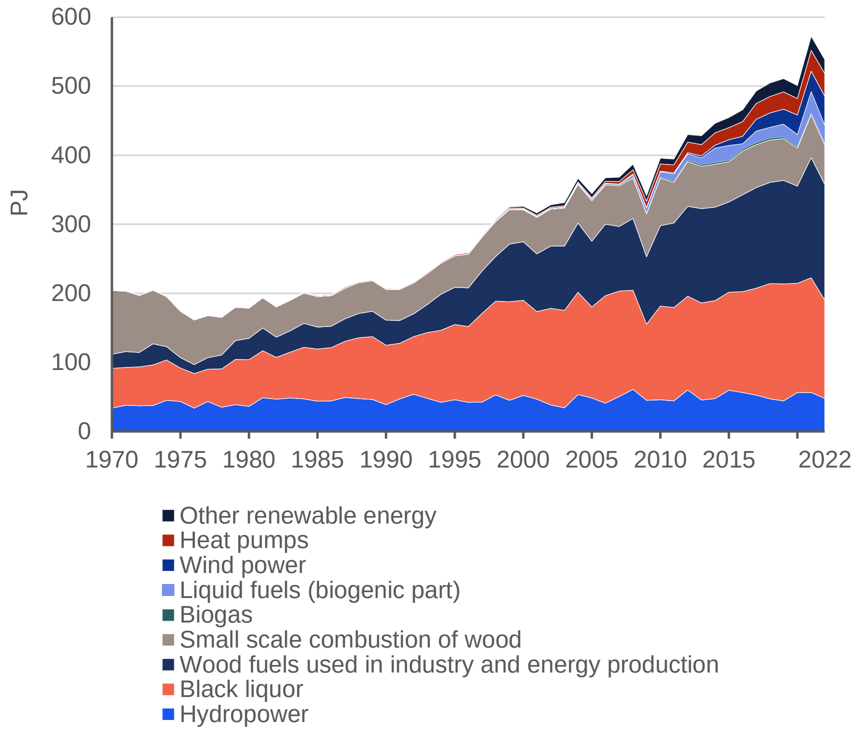
Table 3.1-2 Total energy consumption by sources in 2022, PJ and share of total energy consumption

2022	Quantity (PJ)	Share of total energy consumption (%)
Wood fuels	367	28
Oil (fossil)	265	21
Oil (bio)	26	2.0
Nuclear energy	264	20
Coal	83	6.4
Natural gas	40	3.1
Peat	37	2.8
Net imports of electricity	45	3.5
Hydropower	48	3.7
Wind power	42	3.2
Heat pumps	33	2.6
Other (bio and other renewable)	23	1.8
Others (fossil)	13	1.0
Others	8	0.6
Total	1 294	100

In 2022, wood fuels accounted for 28 per cent of total energy consumption (Table 3.1-2), and they were the most used energy source in Finland from 2012 during the period from 1990 to 2022 (Figure 3.1-11). Majority of wood fuels is derived from the by-products of the forest industry, such as black liquor from the pulp-making process and bark, sawdust, and other industrial wood residues. Logging residues or other low value biomass from silvicultural and harvesting operations are also used for energy production.

Policy measures promoting wind power have been highly successful, resulting in a viable industry and wind power being built in the 2020s fully on a market basis and without economic subsidies. Thanks to investment grants and fiscal support, solar energy has had the fastest relative growth, although the absolute amounts remain modest.

Figure 3.1-11 Total consumption of energy from renewable sources, 1970 to 2022, PJ



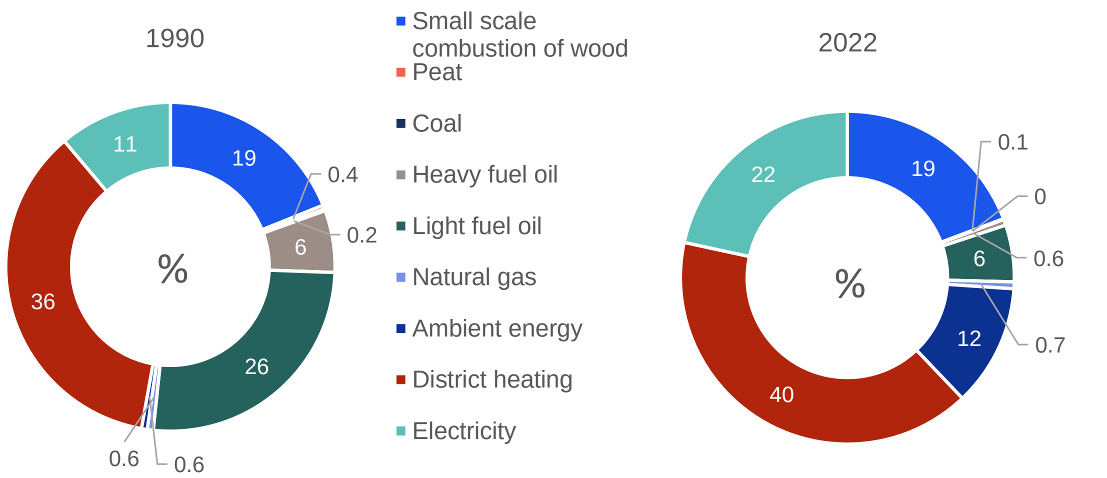
Concerning fossil fuels, Finland depends on imports. Its energy dependence, calculated as the proportion of imported net energy in the total primary energy supply, was 42 per cent in 2022. However, Finland relies more on imports than this energy dependency figure indicates, as the indicator considers nuclear energy to be domestic.

Indoor heating

Because of the country’s northern location, a great deal of energy is used for indoor heating in Finland. The building stock is fairly new, with more than 60 per cent of buildings having been constructed since 1970. The total area of heated buildings increased by some 50 per cent over the last 25 years. The heating of indoor spaces consumes two thirds of the energy consumed in households. It is the biggest source of CO_2 emissions by household, as well as within the public and service sectors.

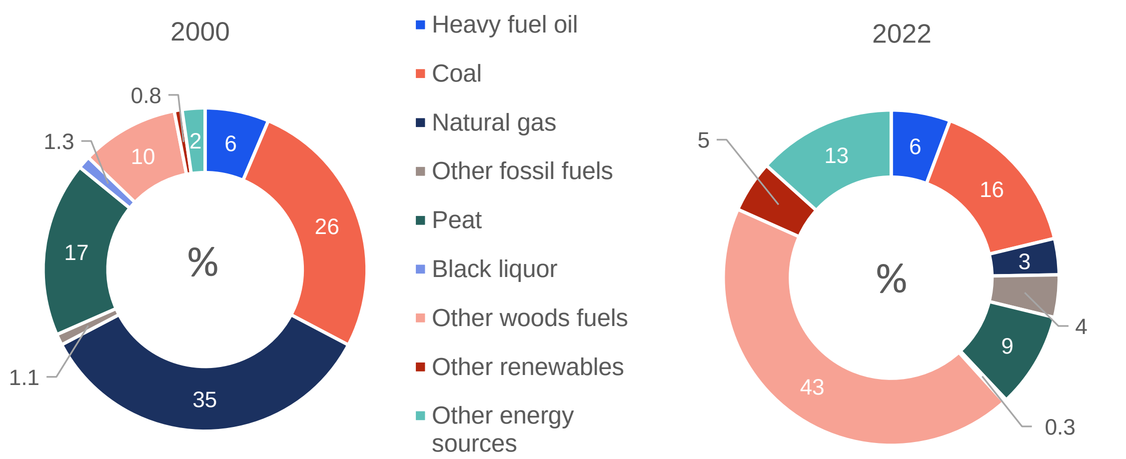
The composition of energy sources used for indoor heating changed significantly between 1990 and 2022 (Figure 3.1-12). The share of district heating in the heating of indoor spaces as well as the use of electricity in heating increased. The use of oil decreased substantially. At the same time, energy obtained from natural gas increased. The use of electricity in heating doubled. The increase in the use of heat pumps is due to economic and environmental reasons, as well as to advances in technology. Small-scale combustion of wood also increased. It is often used as a secondary heating system, but it is also used as the principal heating source in rural areas.

Figure 3.1-12 Energy sources for heating residential, commercial, and public buildings in 1990 and 2022



District heating has increased considerably, by 50 per cent between 1990 and 2022, and its share was 40 per cent of the total heating energy in 2022 (Figure 3.1-12). District heating is the primary heating system in blocks of flats, and half the country's total building stock relies on it. The district heating network now covers most areas with a cost-effective potential i.e. relatively or more densely populated areas. A wide range of fuels is used to produce district heat. The share of renewable energy sources in the production of district heating has increased considerably (Figure 3.1-13). Combined heat and power (CHP) accounted for 51 per cent of the total heat produced in district heating in 2022. CHP improves efficiency, especially compared with separate condensing power production.

Figure 3.1-13 Fuels in district heating production in 2000 and 2022



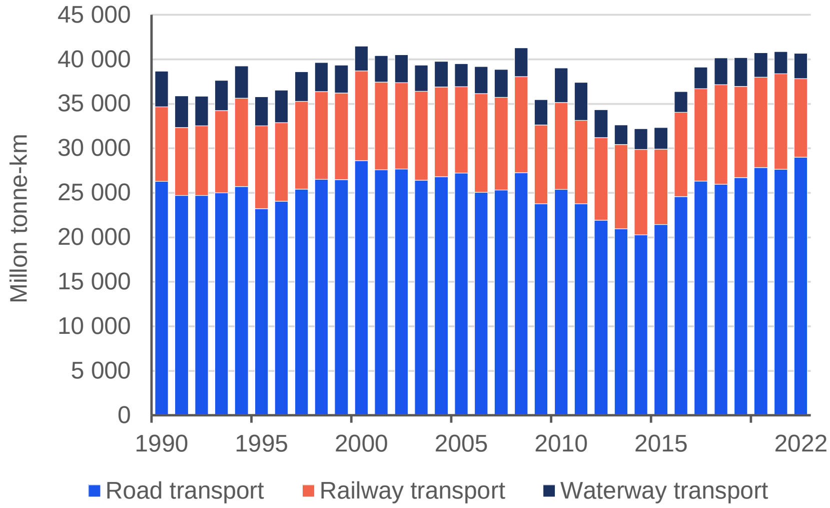
In Finland, the energy efficiency of new buildings has been continuously improved since the energy crises in the 1970s, particularly through building regulations for new construction. Energy conservation in heating has been aided by technical advances in insulation and window designs, as well as by developments in combined heat and power (CHP) production, district heating, heat recovery and air-conditioning and ventilation systems.

Transport

The Finnish transport network consists of roads, rail transport, waterways, and the air traffic infrastructure, the main elements of which form part of the EU’s Trans-European Networks. In 2022, 92 per cent of overseas freight travelled by sea, while four per cent travelled by road and two per cent by rail. Icebreakers play an important role, because the 27 ports and harbours are kept open all year round. Finland has 24 airports, although approximately 95 per cent of the country’s international air traffic operates via Helsinki Vantaa Airport.

The number of freight tonne-kilometres in inland Finland per capita in 2022 was 1.3 times as big as the number of freight tonne-kilometres in the EU, mainly because of the long distances and industrial structure. Heavy industries such as timber, pulp and paper, and metal and engineering have traditionally played a prominent role in the Finnish economy, and these industries all need transport for their raw materials and products. Road haulage is the most important form of transport for domestic goods traffic (Figure 3.1-14).

Figure 3.1-14 Tonne-kilometres in domestic goods transport, 1990 to 2022, million tonne-kilometres

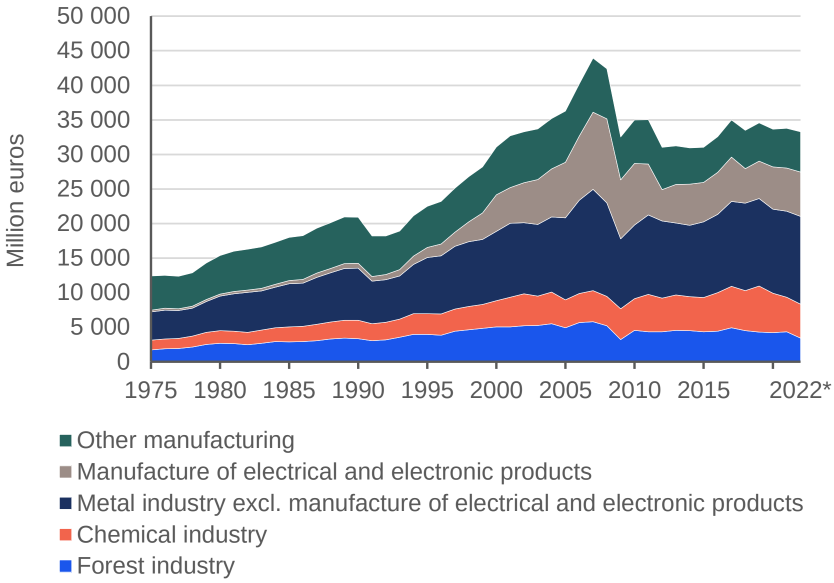


Transport demand and supply are influenced primarily by developments in the economy, demographic factors, employment patterns and infrastructure provision. Domestic passenger transport, measured in terms of passenger-kilometres, has increased by approximately 15 per cent since 1990. Cars accounted for 83 per cent of the total passenger-kilometres in 2022. The number of passenger-kilometres travelled by car was 18 per cent greater, and the number of passenger-kilometres by public transport was one per cent greater compared to 1990. The number of electric passenger cars in traffic has increased rapidly in recent years in Finland.

Manufacturing industry

The main manufacturing industries include the metal, chemical, manufacture of electrical and electronic products and forest industry. The rapid expansion of the metal products industry, especially electronics, has changed the traditional industrial structure starting from the mid-1990s (Figure 3.1-15). The increase in the technology intensity of the country’s manufacturing sector has been strong. The forest industry has undergone structural change as manufacturers have downsized their capacity in certain paper segments. In general, paper production has declined, while paperboard production has shown an opposite trend. The volume of exported pulp has doubled from 2001 to 2022. In the chemical industry, especially in oil refining, the production of renewable fuels is growing.

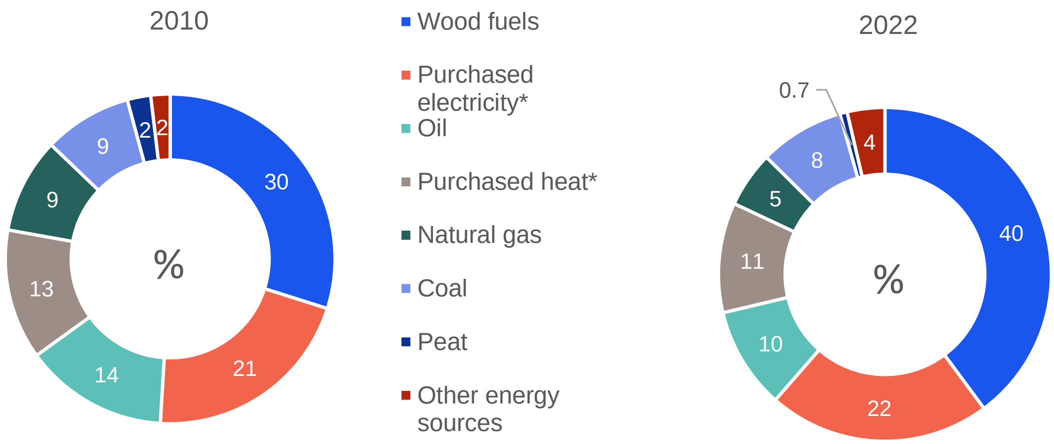
Figure 3.1-15 Output of manufacturing industries by sector, 1975 to 2022 (at 2015 prices), million euros



* Preliminary data

In 2022, Finnish manufacturing industries accounted for 44 per cent of final energy consumption and for 44 per cent of electricity consumption. The most significant energy source of the final energy consumption by the industrial sector was biomass (40 per cent). The share of biomass as an energy source has risen significantly over the last ten years, while the share of oil and heat have decreased (Figure 3.1-16).

Figure 3.1-16 Energy use in manufacturing by source in 2010 and 2022



* Purchased (net), i.e. does not include electricity and heat produced and used by the manufacturing industry

The forest industry uses more energy than any other industrial sub-sector (57 per cent), followed by the chemical industry (16 per cent) and the manufacturing of basic metals (14 per cent). A considerable number of the energy-intensive industries are export oriented. More than 90 per cent of paper and board production is exported and the share of exports is also high in the basic metal industry and in the chemical industry's products.

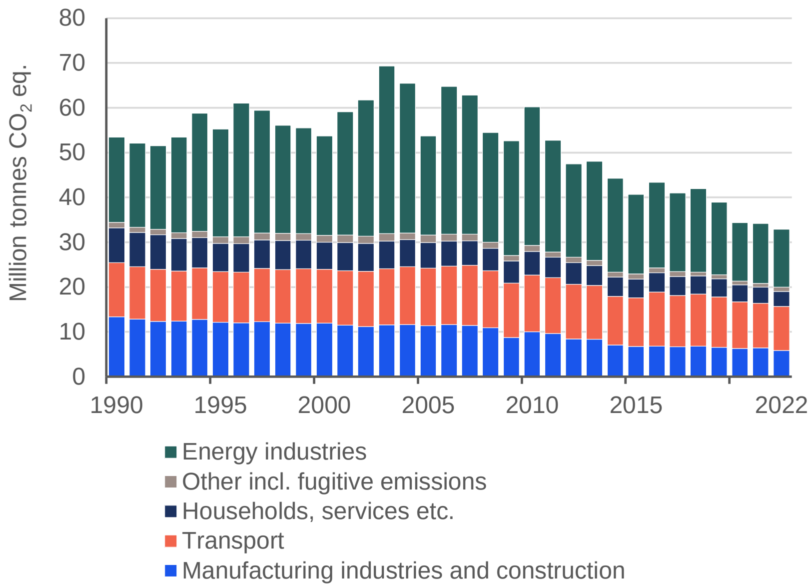
Because of their high energy demand, energy-intensive industries have worked hard to improve their energy efficiency. For example, between 1990 and 2022[9] industrial output increased by 59 per cent (measured in terms of value added in 2015 prices), while the final consumption of energy rose by only 11 per cent. All pulp mills produce energy in excess of their own requirements. Currently, the by-product of chemical pulp production, black liquor, is the most significant renewable energy source in Finland. Forest industry side streams of bark, sawdust and wood chips are also used elsewhere, especially in district heating. At many industrial sites, the heat left over from the pulping process is channeled to the municipal district heating network. Yet, industrial installations have increasingly outsourced their electricity generation to the open electricity market.

Trends in greenhouse gas emissions

Energy

The energy sector is the main source of greenhouse gas emissions in Finland. In 2022, the sector contributed 72 per cent to total national emissions, totalling 32.9 million tonnes CO_2 eq. Most of the emissions originate from fuel combustion, as fugitive emissions make up only 0.3 per cent of the sector's total emissions. Energy-related emissions vary greatly from year to year (Figure 3.1-17), mainly following the economic trend, the structure of the energy supply and climatic conditions. Compared with 1990, the emissions in the energy sector were 38 per cent lower in 2022.

Figure 3.1-17 Greenhouse gas emissions in the energy sector, 1990 to 2022, including transport, million tonnes CO_2 eq.

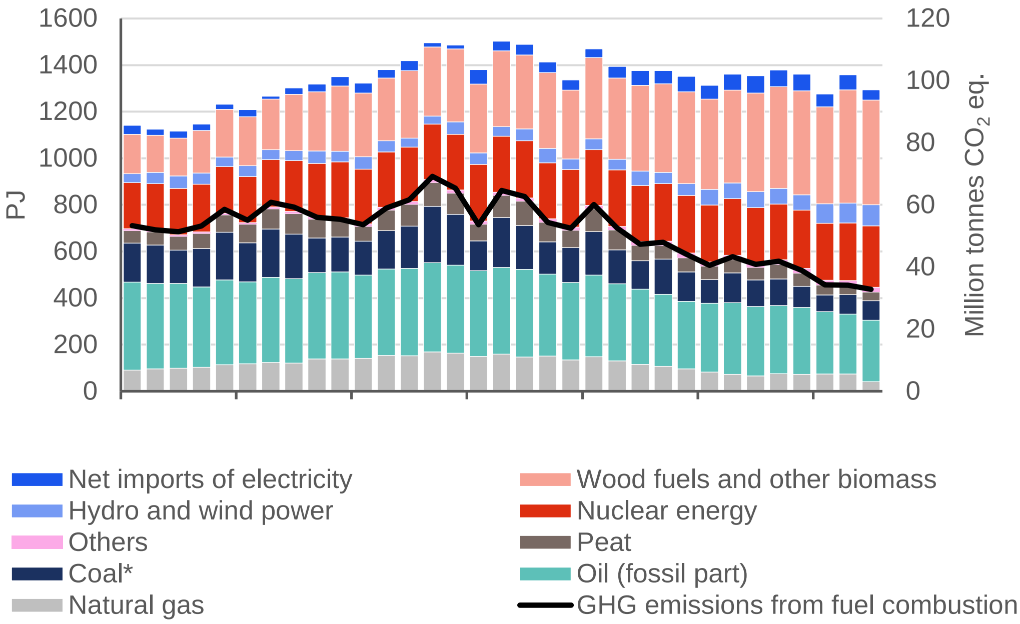


The energy industries, mainly electricity and district heat production, caused 39 per cent (12.9 million tonnes CO_2 eq.) of the total emissions in the energy sector in 2022. Emissions from the energy industries were 32 per cent lower in 2022 than in 1990. Manufacturing industries and construction produce a great deal of energy for their own use. Their share of energy-related emissions was 18 per cent in 2022 (5.9 million tonnes CO_2 eq.). These emissions have declined by 56 per cent since 1990. The main reasons for this trend are the increased use of biofuels, i.e.

[9] Preliminary data

black liquor, in the forest industry and the outsourcing of power plants from the manufacturing industries to energy industries (Figure 3.1-18).

Figure 3.1-18 Development of total energy consumption by energy source and energy sector greenhouse gas emissions in Finland, 1990 to 2022, including transport, PJ and million tonnes CO_2 eq.

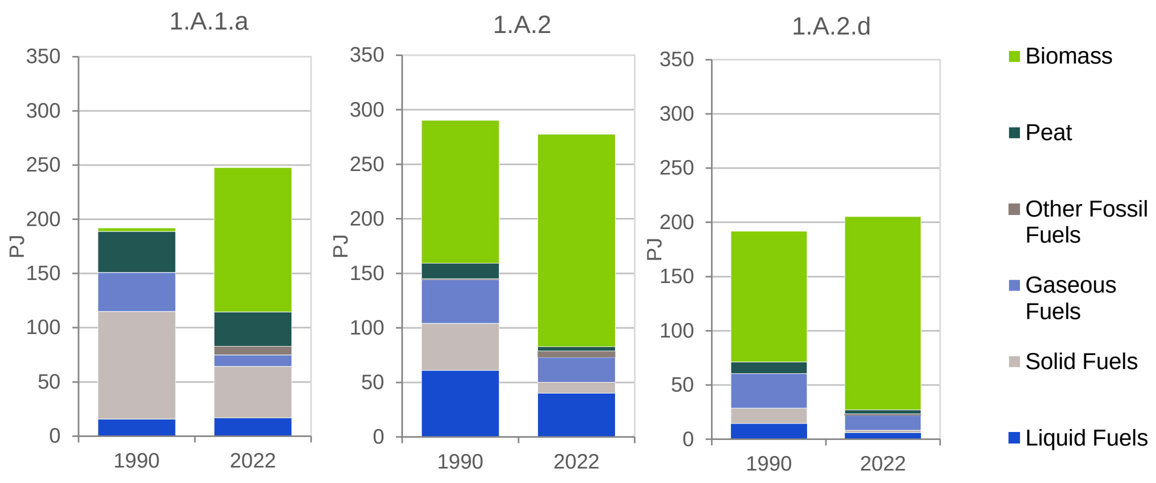


*Coal includes hard coal and coke, blast furnace gas, coke oven gas in manufacturing, and until 1994, town gas.

The important drivers in the energy sector's greenhouse gas emissions trend have been the changes in the amount of imported electricity and in the production of energy with fossil-fuel-based condensing power, as well as the growth in the consumption of renewable energy. The availability of hydropower in the Nordic electricity market has a significant impact on the structure of the electricity supply and therefore on the emissions from fuel combustion during the time series. When the annual precipitation in the Nordic countries is lower than usual, Finland has generated additional electricity using coal- and peat-fired power plants, resulting in the higher CO_2 emissions in the corresponding years. During recent years, the share of conventional condensing power in electricity generation has declined as the share of wind power has grown.

Share of biomass as a source of energy has significantly grown in the public electricity and heat production as well as in manufacturing industries and construction between 1990 and 2022 (Figure 3.1-19). Emissions from the residential sector have decreased by 75 per cent and from commercial sectors by 56 per cent compared with 1990 levels. The decrease is mainly due to the substitution of direct oil heating with district heating and electricity.

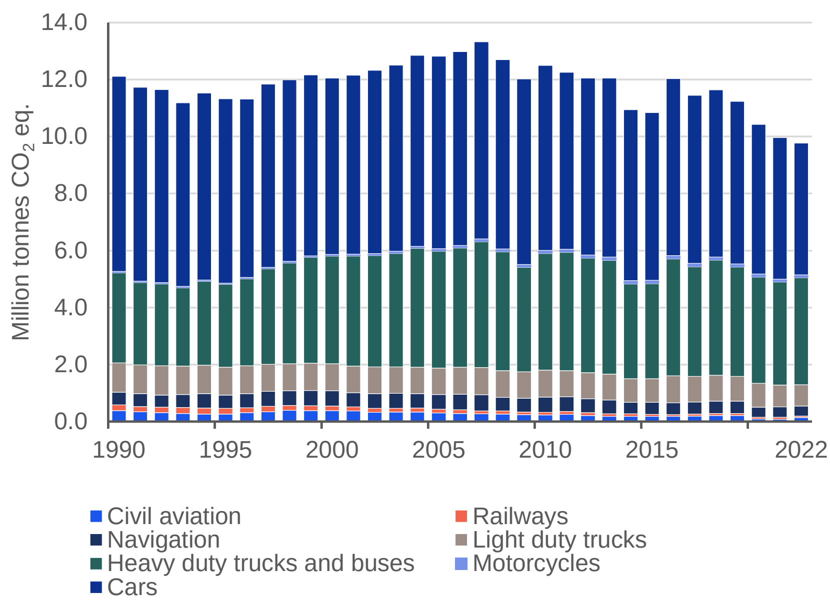
Figure 3.1-19 Fuel combustion in public electricity and heat production (1.A.1.a), manufacturing industries and construction (1.A.2), as well as in its sub-sector of pulp and paper industry (1.A.2.d) in 1990 and 2022, PJ



Transport

In 2022, the greenhouse gas emissions from transport, a category of the energy sector in the greenhouse gas inventory, amounted to 9.8 million tonnes of CO_2 equivalent. The share of the transport in the total greenhouse gas emissions was 17 per cent (12.1 million tonnes CO_2 eq.) in 1990 and 21 per cent (9.8 million tonnes CO_2) in 2022. Road transport is the most important emission source in the transport category (Figure 3.1-20). Road transport emissions were 9.2 million tonnes of CO_2 eq. in 2022; this was 94 per cent of the transport emissions and 20 per cent of the total emissions. The share of emissions from transport in energy-related emissions was 30 per cent in 2022. Emissions from transport have decreased by 19 per cent since 1990.

Figure 3.1-20 Emissions from transport by subcategory, 1990 to 2022, million tonnes CO_2 eq.



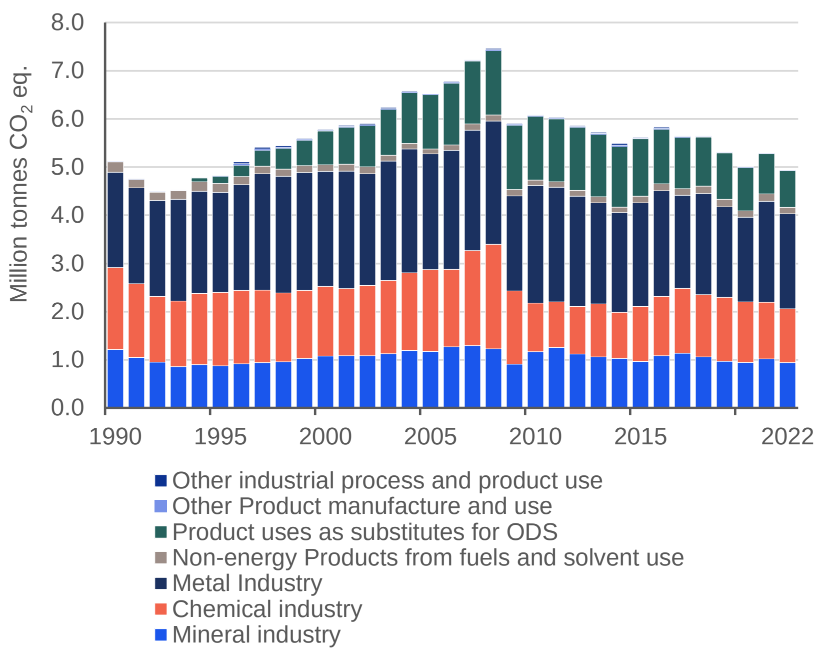
CO_2 emissions from transport decreased considerably in the early 1990s due to the economic depression (Figure 3.1-20). Since 2008, emissions have fluctuated due to many simultaneous different factors, both societal and legislative. In the 2010s, the share of biofuels in diesel oil has varied annually and caused fluctuations in annual emissions. Finland’s biofuel legislation allows the distributors to fulfil the bioshare obligation flexibly in advance. Transport emissions declined substantially in the beginning of the 2020s because of the decreased kilometrage during and after the COVID-19 pandemic.

Industrial processes and product use

In 2022, greenhouse gas emissions from industrial processes and product use sector contributed 11 per cent to the total greenhouse gas emissions in Finland, totalling 5.0 million tonnes CO_2 eq. The most important emission sources of industrial processes and product use were CO_2 emissions from iron and steel, hydrogen and cement production. Fluorinated greenhouse gases, or F gases, are also reported under industrial processes and product use. They are used to replace ozone-depleting substances (ODS) in refrigeration and cooling devices, as well as in air conditioning devices and aerosols, and they accounted for 2 per cent of total national greenhouse gas emissions in 2022.

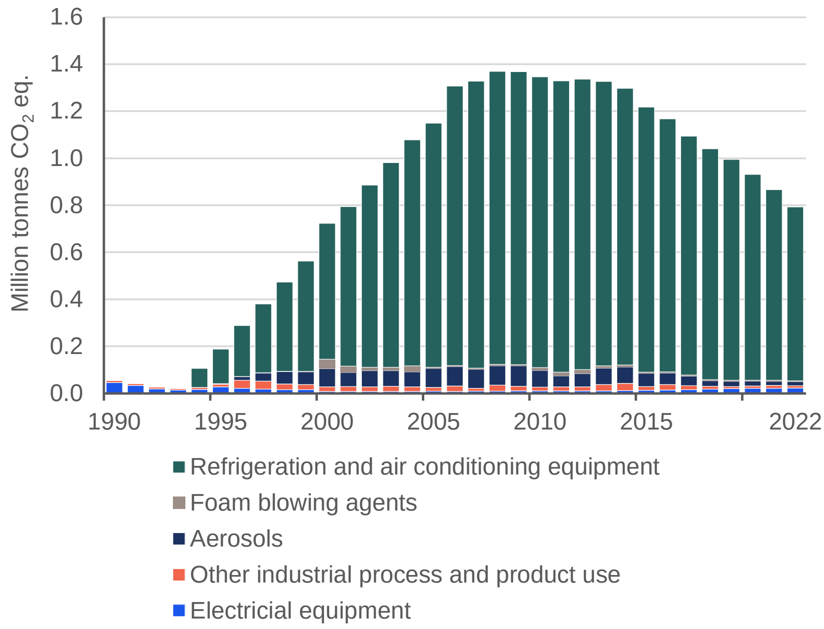
Emissions of industrial processes and product use were 5 per cent smaller in 2022 than in 1990. In the beginning of the 1990s, some production plants were closed down which caused a fast decrease in emissions (Figure 3.1-21). After this, the production outputs and emissions increased and reached the level of 1990 in 1996. Increase of emissions continued until 2009, when emissions decreased fast due to the economic downturn as the demand for industrial products diminished. The implementation of N_2O abatement technology in the nitric acid production happened at the same time, which is why the emissions remained at lower level even when the production started to grow after the economic downturn in 2010. After that, emissions from industrial processes and product use have decreased slowly towards the level of 1990.

Figure 3.1-21 Greenhouse gas emissions from industrial processes, 1990 to 2022, million tonnes CO_2 eq.



In the period from 1990 to 2022, the largest relative change occurred in F gas emissions, which at first increased rapidly but have now begun to decrease (Figure 3.1-22) due to decreased leakage rates and the replacement of high-GWP HFC refrigerants with alternative low-GWP non-HFC refrigerants in many applications.

Figure 3.1-22 F-gas emissions, 1990 to 2022, million tonnes CO_2 eq.



Please see Finland's NID (2024) for further details on trends in emissions in the energy sector, including transport, and in the industrial processes and product use sector and on how national circumstances affect emissions over time. More information on national circumstances can also be found in Finland's 8th national communication (2022).

3.1.1.7 Agriculture

Farming in Finland is possible because of the warming effect of the Gulf Stream, which results in temperatures three to four degrees higher than would otherwise be expected at these latitudes. Climatic conditions are a decisive factor affecting the feasibility of crop production. Cultivation of wheat and oilseed plants is limited to southern Finland, whereas barley, oats, grass and potatoes can be cultivated in most parts of the country. In many parts of Finland, livestock farming, especially dairy farming, is the only profitable form of agricultural production.

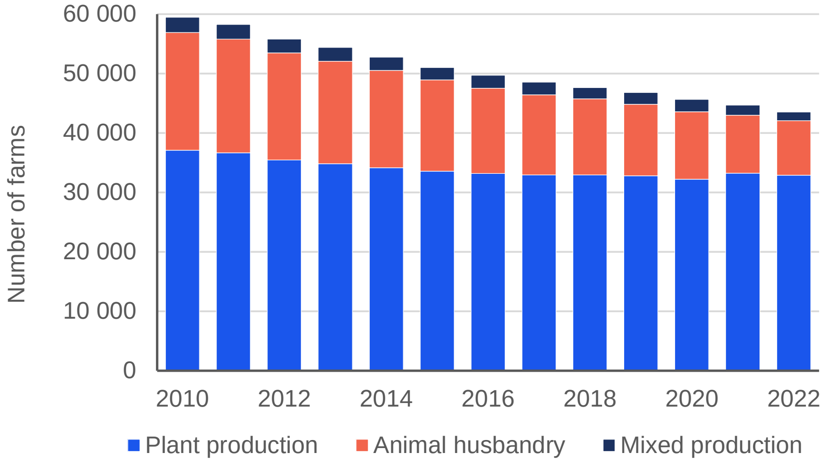
Agriculture, forestry, hunting and fishing together account for 2.6 per cent of Finland's gross domestic product in 2022. The economic importance of the entire food chain is much greater than this percentage alone suggests. Transport and processing increase the role of food materials in the national economy considerably. Agriculture is also the most important employer in the countryside, and alongside forests, is the dominant element of the rural landscape.

As a member of the EU, Finland follows the Common Agricultural Policy (CAP). The CAP is nationally implemented and aims to develop the agricultural production of the European Union in a balanced way, while taking in to account the environment, climate and animal welfare. An important aim of the CAP is also to promote the vitality of rural areas.

As it is neither possible nor appropriate to implement all climate change mitigation or adaptation measures in agriculture through the EU's Common Agriculture Policy, other measures are also required. For example, Nitrates Directive[10] aims to reduce fertilizer and manure use on cropland and improve animal waste management systems. In addition, national Climate Plan for the Land Use Sector also includes policy measures for agriculture, such as climate-resilient use of peatland fields.

Agricultural production has changed significantly from the early 1990s. The number of active farms fell from 130,000 in 1990 to 43,500 in 2022. At the same time, the average utilised agricultural area increased from 17 to 52 hectares. In 2022, more than 70 per cent of active farms have crop production as their main line of farming and only 20 per cent have livestock as their main line of farming (Figure 3.1-23). The total cultivated area has remained at almost the same level since 1990, but the proportions of cultivated crops have varied somewhat over the years. Dairy farming is the main production line of animal husbandry, with over 10 per cent of all farms having it as their main line of farming in 2022.

Figure 3.1-23 Number of farms by production sector, 2010 to 2022



Source: Natural Resources Institute of Finland

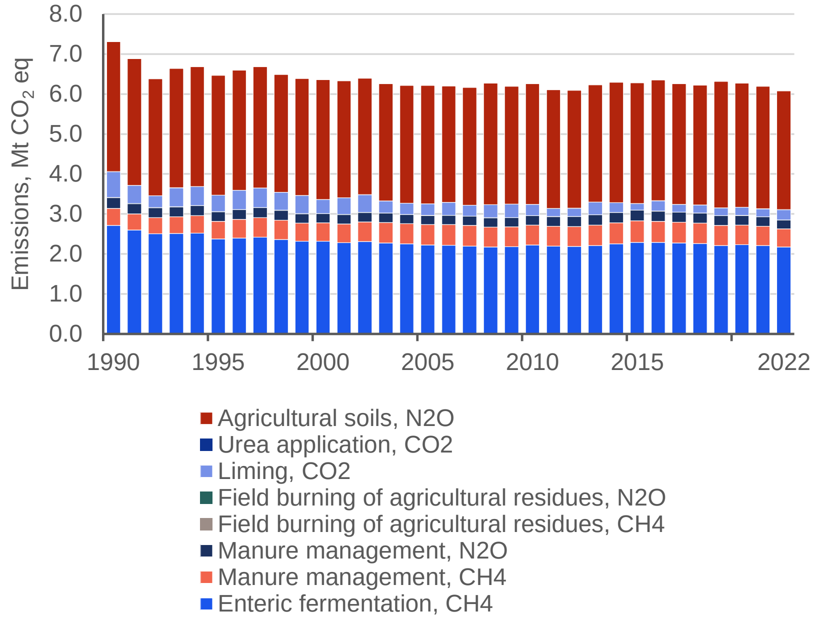
Structural changes in agriculture have, among other things, led to a reduction in greenhouse gas emissions from the agriculture sector in Finland (Figure 3.1-24). Between 1990 and 2022, emissions in the sector decreased by about 17 per cent. Greenhouse gas emissions from the agriculture sector were 6.1 million tonnes CO_2 eq in 2022. The sector accounted for 13 per cent of Finland's total greenhouse gas emissions, making it the second largest source of greenhouse gas emissions after the energy sector.

The use of synthetic fertilisers has notably decreased since 1990, making it the most important factor contributing to the reduction in the sector's emissions. Emissions originating from the use of synthetic fertilisers were 36 to 39 per cent lower in 2020 and 2021 compared to 1990. In 2022, synthetic fertiliser-related emissions were exceptionally low, being 56 per cent lower compared to 1990 due to reduced usage of synthetic fertilisers following a price increase induced by abrupt changes in the global market. The decrease in CO_2 emissions from liming due to the reduced use of lime is also significant. Fluctuations in livestock numbers and in use of lime cause some inter-annual variability in the emissions from the agriculture sector. Emissions from

[10] (1991/676/EEC)

the agricultural activities are also reported in the energy and LULUCF sectors of the greenhouse gas inventory.

Figure 3.1-24 Greenhouse gas emissions from agriculture, 1990 to 2022[11]



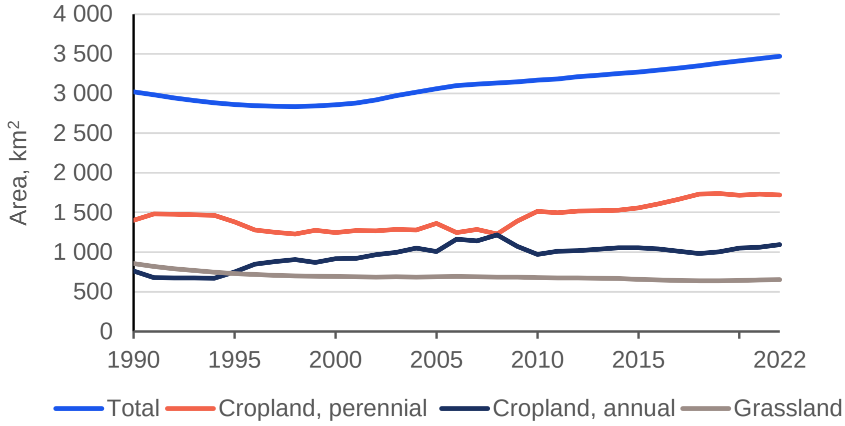
Methane emissions from enteric fermentation accounted for 36 per cent of total emissions in the agriculture sector in 2022. Emissions decreased by 20 per cent from 1990 to 2022, mainly due to a decline in the number of cattle from 1,360,000 to 844,000. The decrease in cattle number over the time series has been counterbalanced by an increase in emission factors due to increased animal weight, size and milk production.

Methane and nitrous oxide emissions from manure management accounted for four and seven per cent, respectively, of total emissions in the agriculture sector in 2022. Total emissions from manure management decreased by two per cent between 1990 and 2022. The fluctuation in the emissions is related to changes in livestock numbers, which are largely dependent on agricultural policies, and changes in the distribution of the manure management systems.

Direct and indirect nitrous oxide emissions from agricultural soils are a significant emission source in Finland, accounting for 49 per cent of total agricultural emissions in 2022. The emissions decreased by nine per cent between 1990 and 2022. The implementation of measures by farmers as part of an agri-environmental programme aimed to minimise nutrient loads into watercourses has led to a decrease in the use of nitrogen fertilisers. Reduced emissions from grazing also have some impact: a lower proportion of animals are kept on pasture, so emissions from pastures have declined. Emissions from cultivated organic soils have increased as a result of the increase in area (Figure 3.1-25).

[11] Field burning of agricultural residues and urea application are not discernible in Figure 3.1-24, because their emissions range from 0.001 to 0.005 million tonnes each. Field burning of agricultural residues has been prohibited since 2021.

Figure 3.1-25 The share of perennial cropland, annual cropland and grassland on agricultural organic soils, 1990 to 2022



Source: Natural Resources Institute of Finland

Carbon dioxide emissions from liming have decreased by 61 per cent from 1990 to 2022 as the use of lime has decreased, most likely because the increased use of soil analysis has reduced excess liming. Urea is applied to agricultural and forest soils on a small scale since Finland has a short growing season and acid soils, which are not well suited for urea fertilisation. The EU's Nitrates Directive has tightened the regulation of emissions from fertilisation since the late 1990s.

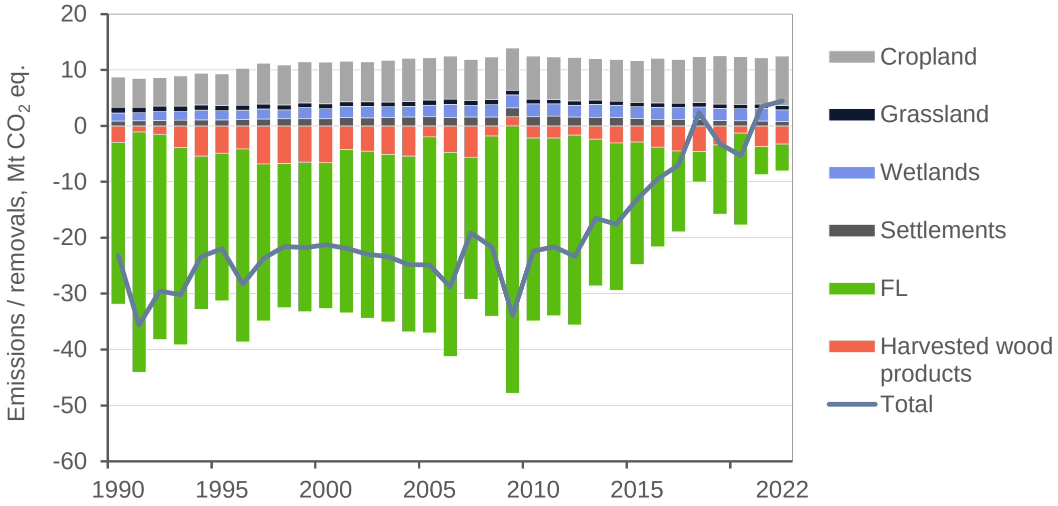
Please see Finland's NID (2024) for further details on trends in emissions in the agriculture sector and on how national circumstances affect emissions and removals over time. More information on national circumstances can also be found in Finland's 8th national communication (2022), including agriculture (Section 2.10) and peatlands (Box 2.1).

3.1.1.8 LULUCF

The land use, land use change and forestry sector consists of six land use categories of forest land, cropland, grassland, wetlands, settlements and other land as well as the category of harvested wood products. Finland does not report emissions or removals in the other land or 'other' categories. The greatest sink of the sector is forest land but also harvested wood products have mostly been a sink of carbon. The large proportion of organic soils in the country (see Geographical profile) results in significant greenhouse gas emissions in forest land, cropland, grassland and wetlands.

The LULUCF sector has been a net sink during the whole time series from 1990 to 2017 (Figure 3.1-26). Starting from 2018, the sector has been either a net sink or a net source of emissions. The decreasing trend in the net removals of forest land has continued for the past decade, so that net removals have been too low in recent years to cover the emissions from other land use categories. The level, trend and the inter-annual variability in the sink or source for the whole LULUCF sector are determined by the forest land sink.

Figure 3.1-26 Net emissions and removals in the LULUCF sector by land-use category and harvested wood products, million tonnes CO_2 eq.



Forest land and harvested wood products

Forest land covers some 72 per cent of the total area without inland waters according to the national greenhouse gas inventory in 2022. Forest industry is one of the five main manufacturing industries in the country (See Economic profile). Its products correspond to some 15 to 20 per cent of the export of goods.

Over a half of forest is owned by private individuals. As a result, some 10 per cent of the Finns own forest land. Roughly a third of forest is owned by the state whereas the rest is owned by private companies and other owners. The average size of a forest holding owned by private individuals is small, approximately 30 hectares.

Sustainable forest management is the basis of Finland's forest policy. The aim is to ensure welfare founded on the use of forests and the diversity of forest nature. Policy measures for sustainable management include the Forest Act[12] and other legislation, Finland's National Forest Strategy 2035 (2023)[13], financing and public forestry extension organisations. According to the Forest Act, measures for the establishment of a new seedling stand must be completed within three years of the end of regeneration felling, for instance, to ensure regeneration and to avoid deforestation. Forest management associations provide forest owners with advisory services in forest management.

The most common species in forests are the Scots pine, Norway spruce and silver and pubescent birches which all are indigenous. About 45 per cent of the forest land area consists of mixed stands. About a fifth of area under regeneration is regenerated naturally, while the rest is regenerated artificially using indigenous tree species with local provenance. One third of forests are situated on organic soils.

In recent decades, forest protection and biodiversity in forests have received special attention. Numerous protection programmes and decisions have contributed to a threefold increase in the area of protected forests since 1970's. Currently, some 13 per cent of forests are protected.

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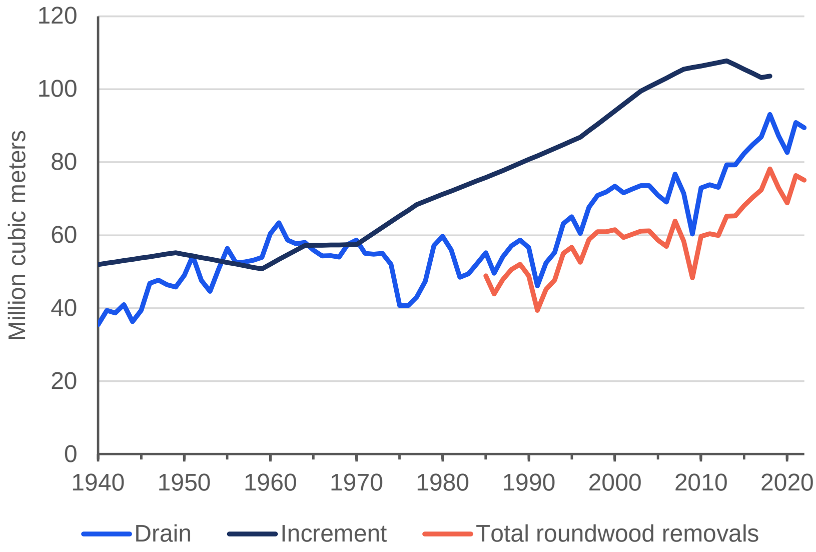
[12] 1093/1996 (amendment 1085/2013)
[13] http://urn.fi/URN:ISBN:978-952-366-748-8

The total volume of Finland's forest stock amounts to 2,530 million m^3 according to the latest national forest inventory. The growing stock volume has been increasing for a long time, mainly because of the active and sustainable management of forests, in which the growth in forest volume has exceeded harvesting volumes and natural drain (Figure 3.1-27).

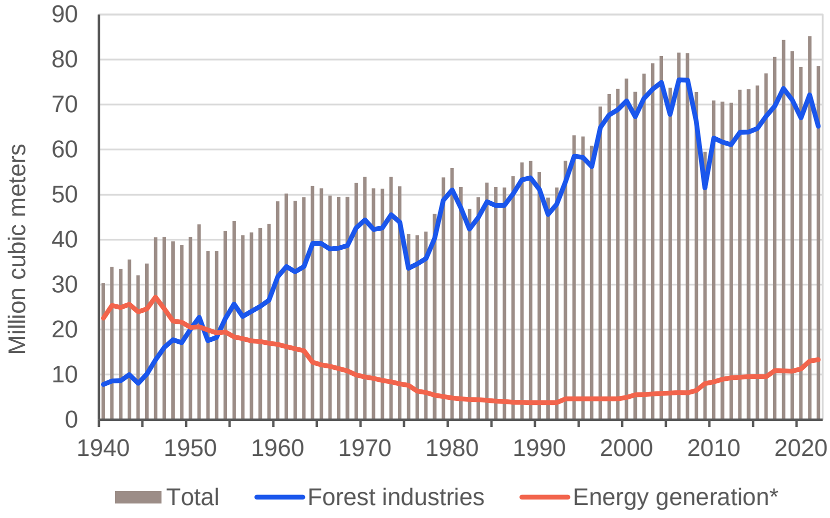
Figure 3.1-27 Total roundwood removals, increment and drain of growing stock 1940–2022



Source: Natural Resources Institute Finland

In 2020's, the total use of round wood i.e. raw, unmanufactured timber has been in average 80.7 million m^3. The great majority, that is, 84 per cent was used in the forest industry, and 16 percent was used for energy production (Figure 3.1-28).

Figure 3.1-28 Total roundwood consumption 1940 to 2022



* includes only roundwood consumption. Energy use of by- and waste products such as sawdust, bark and black liquor is not included.
Source: Natural Resources Institute Finland

The forest land net sink has decreased by 84 per cent from 1990 to 2022. High fluctuation in net removals in forest land during the 1990 to 2022 period is mainly caused by the changes in the international market for forest industry products, which affects the amount of domestic commercial roundwood felling. Roundwood removals have remained at a high level in the recent years compared to the historical levels, reducing the net removals by the biomass (Figure 3.1-27).

The other significant factor affecting the trend in forest land sink is the annual volume increment. Forest growth has increased steadily since 1990 because of factors such as the large proportion of young forest at a strong growth phase and silvicultural measures. However, the annual increment has decreased in the most recent years because of the change in age structure but also other reasons have been identified such as dry years decreasing tree growth.

Living biomass and combined pools of dead organic matter and soil organic matter on mineral soil have been a net sink since 1990, whereas the organic soils have been a net source. The carbon sink in mineral soil and dead organic matter is affected by the litter input patterns following the development of the growing stock and harvests as well as by weather conditions. CO_2 emissions from organic forest soils, i.e. from drained peatland soils, have an increasing trend. The main factor has been the increase in mean air temperature in the snow-free period that has significantly increased emissions in drained peatlands by increasing the decomposition of litter and soil organic matter. The N_2O emissions from drained peatlands have increased but the CH_4 emissions have decreased since the year 1990.

Harvested wood products have been a sink of carbon from 1990 to 2022 except in 2009. The sink was 10 per cent greater in 2022 compared to 1990. Factors affecting production volumes of the forest industry such as economic situation as well as the demand for harvested wood products cause fluctuations in the net removals of this category in time.

Cropland and grassland

For cropland and grassland, carbon stock changes in different carbon pools and N_2O emissions from nitrogen mineralization associated with land conversions to cropland and grassland are reported in the LULUCF sector whereas as other N_2O emissions are reported in the agriculture sector. Description of national circumstances for agriculture can be found in the previous section on the agriculture sector.

Cropland is a source of emissions. The emissions have increased by 64 per cent from 1990 to 2022. Organic soils are the greatest source of emissions. Due to a 30-per cent increase in the area of cropland on organic soil (Figure 3.1-25), the emissions from organic soils have increased by one third from 1990 to 2022. Mineral soils have been a net source of CO_2 for most of the years. Emissions from mineral soils fluctuate according to the annual yields and weather conditions. Emissions from the biomass depend on annual rate of land conversion from forest land to cropland.

The grassland category is also a source, but smaller than the source in cropland. Emissions from organic soils exceed the small removals by mineral soils and living biomass. The area of grassland consists mostly of abandoned fields that are slowly gaining tree biomass and turning into forest land. There are no large grazing land areas or permanent grasslands in Finland.

Emissions from grassland have decreased by 25 per cent from 1990 to 2022. Organic soils are the dominant source of emissions. Emissions from organic soils have decreased over time because of the conversion of grassland to cropland. The trend in biomass has varied depending on the clearance of new grassland from forest land.

Wetlands

Wetlands consist of a diverse group of lands such as open bogs, swamps, peat extraction areas and constructed water bodies. They are characterized by having no biomass cover or low biomass cover. They are a source of CO_2, CH_4 and N_2O emissions. Total emissions have increased by 44 per cent from 1990 to 2022. Peat extraction areas are the most significant source of emissions. As peatlands cover one third of the land area in Finland, peat is a domestic and local energy source but also used in horticulture and as a bedding material for instance. In most recent years, a slight decline in emissions has been seen because the area of peat production sites is currently decreasing.

Settlements

Settlements comprise nationally defined built-up land, roads, railroads, gravel collection sites and power lines. Emissions in the settlements category are 11 per cent lower in 2022 compared to 1990. Recently, there has been a declining trend in the emissions due to declining annual areas converted to settlements. The greatest source of emissions are the land conversions from forest land to settlements. The high proportion of forest land in the country is the major factor in explaining why land conversions to settlements most often occur on forest land. Emissions and removals of settlements remaining settlements are not estimated.

Please see Finland’s NID (2024) for further details on trends in emissions and removals in the LULUCF sector and on how national circumstances affect emissions and removals over time. More information on national circumstances can also be found in Finland’s 8th national communication (2022), including agriculture and forestry (Sections 2.10 and 2.11) and peatlands (Box 2.1).

3.1.1.9 Waste

In 2022, 113 million tonnes of waste were generated in Finland (Table 3.1-3). The largest quantities of waste came from mining and quarrying (87 million tonnes), construction (11 million tonnes) and manufacturing (10 million tonnes). Households and services generated three million tonnes waste. Waste volumes in water supply, sewage, waste management and remediation activities and in electricity, gas, steam and air condition supply were significantly lower than in other industries (both 1 million tonnes).

Mineral waste accounted for 93 per cent of all waste in 2022 (105 million tonnes). The amount of wood waste was 2 million tonnes and chemical waste 0.4 million tonnes. The rest of the total amount of waste includes metallic waste, paper and cardboard, animal and vegetal waste, household and mixed waste, sludges and other waste. In 2022, the total amount of this waste category was 6 million tonnes (Table 3.1-3).

The amount of municipal solid waste was 2.9 million tonnes in 2022. Though accounting for only 2.6 per cent of the country’s total waste, the municipal solid waste is responsible for most of the greenhouse gas emissions from the waste sector. The quantity of municipal solid waste has varied between 2.4 and 3.5 million tonnes per year since 2000. In 2022, total municipal solid waste generation in Finland was 521 kg per capita, close to the EU average of 513 kg.

Table 3.1-3 Waste generation by source and waste category in 2022, 1,000 tonnes

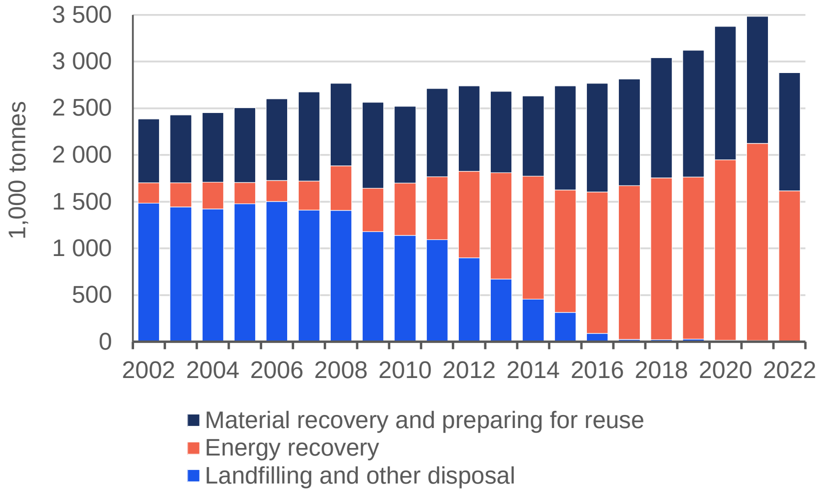
2022	Chemical waste	Wood waste	Mineral waste	Other waste*	Total
	Amount of waste 1000 tonnes				
Mining and quarrying	2	1	86 907	110	87 020
Electricity, gas, steam and air conditioning supply	9	7	905	51	972
Water supply; sewerage, waste management and remediation activities	8	23	676	407	1 114
Construction	0	248	10 261	166	10 675
Manufacturing	341	1 879	6 237	1 944	10 401
Households and services	16	74	11	2 906	3 007
Total	376	2 232	104 997	5 584	113 189

* Excludes gangue and stamp sand used by mines and quarries.
** Includes household and mixed waste (39%), animal and vegetal waste (20%), other waste (14%), sludges (12%), paper and cardboard (9%) and metallic waste (7%). The percentage in brackets is the share of the waste category in the total amount of Other waste category.

The amount of waste deposited in landfill sites has been significantly reduced by effective waste regulation. Finland’s waste policy aims to prevent waste, increase reuse and recycling and reduce landfilling and the environmental impact of various forms of waste management. In 2022, 15.2 million tonnes of waste were recovered as material and 4.7 million tonnes as energy. The latter figure comprises 43 per cent wood waste. Wood waste was especially comprehensively recovered as material in addition to its high recovery rate as energy.

In 2022, 99 per cent of all municipal solid waste was recovered by recycling or through preparation for reuse (44 per cent) or as energy (55 per cent) (Figure 3.1-28). At the end of the 1990s, approximately 65 per cent of all municipal solid waste was disposed of in landfills. The proportion of municipal solid waste sent to landfills has decreased every year since 2002 as a result of the increased waste recovery rate. In 2002, the proportion of municipal solid waste disposed of in landfills was 62 per cent, and in 2015, it amounted to 11 per cent. Due to the landfill prohibition for organic waste that came into force in 2016, biodegradable municipal solid waste has no longer been deposited at landfills. In 2022, less than half per cent of the total amount of municipal solid waste was deposited at landfills.

Figure 3.1-28 Municipal solid waste treatment in Finland, 2002 to 2022, 1,000 tonnes

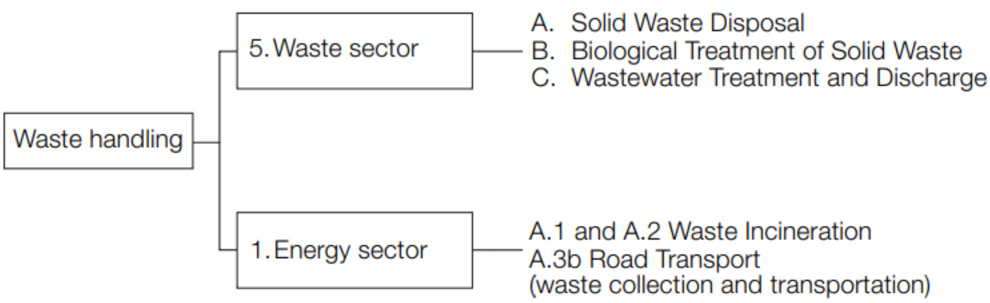


Initially, in the early 1990s, the focus of waste policy was on waste prevention and recycling. Since 2006, waste incineration has started to become more important in municipal waste management, and there have been many investments in waste incineration plants. The amount of incinerated municipal waste has tripled since 2010. A total of twelve waste incineration plants were in operation and 56 per cent of the total amount of municipal waste was incinerated in 2022. All waste incineration plants produce heat and electricity. In addition to waste incineration plans, there are more than 20 co-incineration plants in Finland in which waste is incinerated in addition to other fuels.

Development of greenhouse gas emissions

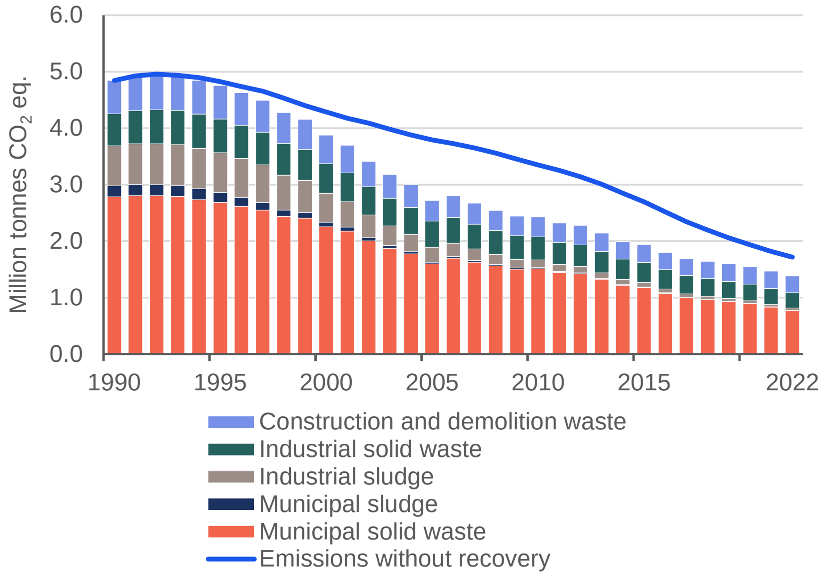
Methane emissions from landfills and methane and nitrous oxide emissions from composting and wastewater treatment are reported under the waste sector (Figure 3.1-29). Greenhouse gas emissions from the waste sector emissions amounted to 1.7 million tonnes CO_2 eq. in 2022, which was four per cent of Finland's total emissions. Solid waste disposal on land accounted for 80 per cent, wastewater treatment for 14 per cent and biological treatment of solid waste for six per cent of the sector's total emissions. Since 1990, these emissions have decreased by 67 per cent. Greenhouse gas emissions from the combustion of waste are reported in the energy sector, as waste incineration without energy recovery is almost non-existent (Figure 3.1-30).

Figure 3.1-29 Reporting categories of emissions from waste handling in the national greenhouse gas inventory



Methane emissions from landfill sites have decreased since the adoption of a new Waste Act[14] in 1994 (Figure 3.1-30). The Act has reduced the volume of waste deposited at landfills by promoting recycling and reuse, as well as the energy use of waste materials. The great increase in the amounts of recovered methane at the beginning of 2000 is a result of the regulations of landfill gas recovery[15]. The amount of recovered methane in recent years has decreased due to the great decrease in the waste amounts to landfills after the ban of organic waste deposits at landfills.[16]

Figure 3.1-30 Methane emissions from solid waste disposal on land, 1990 to 2022, including the amount of methane generated (emission without recovery) at solid waste disposal sites, million tonnes CO_2 eq.



Emissions from wastewater treatment have also been successfully reduced by 26 per cent compared to 1990. The reduction in emissions has been driven by increasingly efficient wastewater treatment, also in sparsely populated areas, as well as a lower nitrogen burden released from industrial wastewaters into waterbodies.

Emissions from composting have more than doubled since 1990, being five per cent of the waste sector's emissions in 2022. This is due to increased composting of waste, especially in semi-urban areas, as a result of separate collection of organic waste. Biowaste recycling doubled between 2006 and 2015, and the amount of separately collected biodegradable waste has increased slightly each year since 2015. In 2016, the landfill prohibition of organic waste came into force. In 2022, 0.4 million tonnes of biodegradable waste were collected. Emissions from anaerobic digestion have also increased significantly in recent years for the same reason as the increase in emissions from composting. Yet, this emission source is very small, accounting for 0.8 per cent of the waste sector's total emissions in 2022.

Please see Finland's NID (2024) for further details on trends in emissions in the waste sector and on how national circumstances affect emissions over time. More information on national circumstances can also be found in Finland's 8th national communication (2022).

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[14] Waste Act 1072/1993
[15] Council of State Decree on Landfills 861/1997
[16] The landfill ban on placing organic waste at landfills came into force in 2016.

3.1.2 Institutional arrangements

3.1.2.1 Institutional arrangements for tracking progress

This section also contains common text for the BTRs of the EU and the Member States.

The EU's Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action ('Governance Regulation') [17] establishes a governance mechanism and specific arrangements to track the progress of the Union and its Member States towards the implementation and achievement of the EU's climate and energy targets and commitments under the UNFCCC and the Paris Agreement. These arrangements include the monitoring of GHG emissions and removals, the reporting of policies and measures, projections of GHG emissions and removals and progress on adaptation to climate change.

Under the Governance Regulation, the EU has established a Union Inventory System to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of the data reported by the EU and its Member States. This inventory system includes a quality assurance and quality control programme, procedures for setting emission estimates, and comprehensive reviews of national inventory data to enable the assessment of compliance towards climate goals.

Each EU Member State compiles its GHG inventory in accordance with the requirements of the Paris Agreement[18] and the relevant Intergovernmental Panel on Climate Change (IPCC) guidelines[19]. Inventory data on GHG emissions and removals, including information on methods, are submitted electronically using a reporting system managed by the European Environment Agency (EEA). The submitted data are subject to quality control procedures and feed into the compilation of the GHG inventory of the EU. Net GHG emissions, calculated from emissions and removals reported in the GHG inventory of the EU, are the key information used for tracking progress towards the EU NDC target of a least −55 per cent net emission reduction by 2030 compared to 1990.

Given the scope of the EU NDC related to international aviation and navigation, a specific share of international aviation and navigation emissions as reported in the GHG inventory data is calculated based on the Joint Research Centre's Integrated Database of the European Energy System (JRC-IDEES)[20] . Details on the methodology applied to identify GHG emissions from international aviation and navigation in the scope of the EU NDC, which are added to the national totals from the EU GHG inventory, are given in Annex 2 to this BTR.

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[17] Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, http://data.europa.eu/eli/reg/2018/1999/oj.

[18] Chapter II of the annex to decision 18/CMA.1, https://unfccc.int/documents/193408; and decision 5/CMA.3, https://unfccc.int/documents/460951.

[19] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, https://www.ipcc-nggip.iges.or.jp/public/2006gl/; and on a voluntary basis: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/.

[20] European Commission, Joint Research Centre, Rózsai, M., Jaxa-Rozen, M., Salvucci, R., Sikora, P., Tattini, J. and Neuwahl, F., JRC-IDEES-2021: the Integrated Database of the European Energy System – Data update and technical documentation, Publications Office of the European Union, Luxembourg, 2024, https://publications.jrc.ec.europa.eu/repository/handle/JRC137809.

Under the Governance Regulation each Member State must report to the Commission biennially on the status of implementation of its integrated national energy and climate plans (NECPs). This process allows the Commission to ensure that the EU and the Member States remain on track to achieve the climate-neutrality objective and progress on adaptation. Under the Governance Regulation, Member States further operate national systems for policies and measures and projections and submit standardised information, which is subject to quality and completeness checks. Based on the submitted data, the EEA compiles projections of GHG emissions and removals for the EU. The EU-wide information is summarised annually in the Climate Action Progress Report[21] by the European Commission and in the 'Trends and projections'[22] report by the EEA. Both the Union and the national systems are subject to continuous improvements.

The national energy and climate plans (NECPs) were introduced by the Governance Regulation. For Member States, the NECP for 2021–2030 play a key role to enabling the tracking of progress towards the 2030 climate and energy targets. The update of the NECPs provides an opportunity for Member States to assess their progress, identify gaps and revise existing measures or plan new ones where needed. Member States were due to submit their final updated NECPs, taking account of the Commission's assessment and recommendations, by 30 June 2024.

In Finland, the new Climate Act[23] entered into force on 1 July 2022. The Act sets out several plans that aim to reduce greenhouse gas emissions and adapt to climate change in Finland. It also obliges the central government authorities to monitor the trends in emissions and achievement of climate targets and report on them to Parliament. The Annual Climate Reports to the Parliament are prepared each year under the lead of the Ministry of the Environment. The reports examine the general development of greenhouse gas emissions and the sufficiency of the planned measures in relation to the national climate targets and Finland's EU obligations.

The Ministry of the Environment is Finland's focal point to the UNFCCC and Paris Agreement. Statistics Finland is the national entity responsible for compiling the Finnish greenhouse gas inventory since the beginning of 2005, enforced in Climate Acts in 2015 and 2022. The national system for the greenhouse gas inventory is described in detail in Finland's National Inventory Document 2024, submitted as a part the first biennial transparency report. 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. National greenhouse gas inventory is submitted to the UNFCCC and European Commission annually – and biannually to the Paris Agreement as a part of the biennial transparency report. The Energy Authority is the competent authority and the registry administrator for the national emissions trading registry under the EU ETS.

Finland's national system for policies and measures and projections is described in detail in compliance with reporting on national systems for policies and measures and projections

[21] Climate Action Progress Report 2024 Climate Action Progress Report 2024, https://climate.ec.europa.eu/document/download/d0671350-37f2-4bc4-88e8-088d0508fb03_en?filename=COM_2024_498_F1_REPORT_FROM_COMMISSION_EN_V4_P1_3729454.PDF

[22] Trends and Projections in Europe 2024, https://www.eea.europa.eu/en/analysis/publications/trends-and-projections-in-europe-2024 ; https://www.eea.europa.eu/en/newsroom/news/eea-trends-and-projections

[23] 423/2022

pursuant to Article 36 of the Commission Implementing Regulation (EU) 2020/1208[24]. Generally, arrangements for preparation of reports and reporting on policies and measures and projections have been stable in Finland for several years.

As previously mentioned, the Government and Parliament make all major decisions concerning Finland's energy and climate policy. Since 2003, the Finnish governments have appointed a ministerial working group on energy and climate policy with representatives from all government parties.

The roles and responsibilities of the ministries and other authorities are determined in a Government Resolution on the Obligations of Climate Policy Activities of Government Authorities approved in 2003. According to the government resolution, the ministerial working group has a network of senior officials acting as its preparatory body. The Ministry of Economic Affairs and Employment chairs the network of senior officials and is in charge of the overall coordination and compilation of the energy and climate strategy work. Each sectoral ministry is responsible for the preparation concerning its respective remit. The network of senior officials comprises representatives from the Ministry of Economic Affairs and Employment, the Ministry of the Environment, the Ministry of Transport and Communications, the Ministry of Agriculture and Forestry, the Ministry of Education and Culture, the Ministry for Foreign Affairs, the Ministry of Finance and the Prime Minister's Office.

In terms of the reporting on policies and measures and projections referred to in Article 18 of the Regulation (EU) 2018/1999, the Ministry of Economic Affairs and Employment is responsible for overall co-ordination, compilation of information and submission it to the European Commission. The sectoral ministries are responsible for policies and measures, the projections and impact assessments concerning their own field. The network of senior officials gives the final approval concerning the information in the reporting tools to be submitted. A specific working group is established for each round of the reporting to carry out the work. The working group consists of experts from the Ministry of Economic Affairs and Employment, Ministry of the Environment, Ministry of Transport and Communications, Ministry of Agriculture and Forestry and Ministry of Finance.

3.1.2.2 Institutional arrangements for implementation of the NDC

This section also contains common text for the BTRs of the EU and the Member States.

The EU and its Member State have set up a comprehensive system for the implementation of the EU climate change mitigation targets. The European Climate law[25] sets the goal of climate-neutral by 2050 and the intermediate target of reducing net greenhouse gas emissions by at least 55 per cent by 2030 compared to 1990 levels. These targets cover emissions and removals that are regulated in the Union law. To ensure that the EU and its Member States achieve their target, the 2030 Climate and Energy Framework was put in place. The main policies of this framework

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[24] European Union, Reportnet 3, GovReg: National systems for policies and measures and projections, https://reportnet.europa.eu/public/dataflow/111

[25] Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'), http://data.europa.eu/eli/reg/2021/1119/oj.

are the EU Emissions Trading System (EU ETS)[26], which caps GHG emissions in energy, industry, aviation and maritime transport; the LULUCF Regulation which includes national net removal targets for the LULUCF sector; and the Effort Sharing Regulation (ESR) which establishes national reduction targets for GHG emissions not covered by the EU ETS or the LULUCF Regulation i.e. domestic transport (excluding aviation), buildings, agriculture, small industry and waste. The implementation of the ESR is supported by additional sectoral policies and measures (details can be found in this BTR and in the EU's first BTR in the chapter on mitigation policies and measures). The legislative acts under the 2030 Climate and Energy Framework require the European Commission and the EU Member States to set up the institutional arrangements for implementing the specific policies and measures.

The revised EU ETS Directive increases the level of ambition in the existing system from 43 per cent to 62 per cent emissions reductions by 2030, compared to 2005 levels and extend the system to also apply to international maritime transport. A separate carbon pricing system will apply to fuel combustion in road transport and buildings and small-emitting sectors (ETS2) with a 42 per cent emission reduction target compared to 2005 across the sectors covered. The amended Effort Sharing Regulation (ESR) increased, for the sectors that it covers, the EU-level GHG emission reduction target from 29 per cent to 40 per cent by 2030, compared to 2005, which translates in updated 2030 targets for each Member State. The new LULUCF Regulation sets an overall EU-level objective of 310 million tonnes of CO_2 equivalent of net removals in the LULUCF sector in 2030.

The ESR sets national targets for the reduction of GHG emissions in the Member States by 2030. Member States are also subject to gradually decreasing annual emission limits for each year from 2021 to 2030. The annual progress towards the national targets under the Effort Sharing Legislation is assessed by comparing GHG emission levels from the sectors covered by the ESR with the relevant annual emission allocations under the legislation (AEAs). To achieve compliance under the ESR, Member States are permitted to use flexibility options to a certain extent.

Progress in the implementation of these policies and measures is monitored under the Governance Regulation. Relevant information which is reported regularly and archived at the EEA include GHG inventories, approximated GHG inventories for the previous year, information on policies and measures, projections, and progress towards the implementation of integrated National Energy and Climate Plans (NECP). This information helps the EU and its Member State to correct their course if progress towards the targets of the 2030 Climate and Energy Framework is behind schedule. As an example, the European Commission assesses the drafts of new or updated NECPs and provides recommendations for improved planning and implementation. In addition, the reported information is subject to quality checks, and the GHG inventories reported by EU Member States are subject to comprehensive reviews in 2025, 2027 and 2032.[27]

All EU legislation, including the legislation under the 2030 Climate and Energy Framework, is subject to a stakeholder engagement process. So-called 'better regulation tools' ensure that

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[26] This refers to the ETS1, i.e. the Emission Trading System for stationary sources (Chapter III of the ETS Directive) and for aviation and maritime transport (chapter II of the ETS Directive). Note that the 'Emissions trading system for buildings, road transport and additional sectors' (ETS2), added in 2023 as Chapter IVa of the ETS Directive, forms an instrument under the Effort Sharing Regulation (ESR).

[27] Consolidated text (2023) of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, https://eur-lex.europa.eu/eli/reg/2018/1999/2023-11-20.

policy is based on evidence and the best available practice[28]. During the preparation of legislative proposals, the European Commission invites citizens, businesses and stakeholder organisations to provide their views on the subject of the new legislation. These comments are documented in a dedicated portal[29], and the European Commission reports on how it takes these comments into account in the development of the legislative proposals. Furthermore, the Governance Regulation sets requirements for Member States to ensure that the public is given early and effective opportunities to participate in the preparation of the NECPs.

In the EU Effort Sharing Regulation (ESR), Finland's target for emissions reductions in 2030 compared to the 2005 level is 50 per cent. Member States are subject to gradually decreasing annual emission limits for each year from 2021 to 2030. Finland's annual emission allocations under the ESR for 2021–2025 are presented in Table 3.3-1 in Section 3.3.3.

Finland's new *Climate Act* sets out several plans that aim to reduce greenhouse gas emissions and adapt to climate change in Finland. It also obliges the central government authorities to monitor the trends in emissions and achievement of climate targets and report on them to Parliament. Procedures included in the Climate Act enable annual assessment of the implementation of the EU's NDC regarding Finland's contribution under the EU Effort Sharing Regulation and LULUCF regulation. Also, the European Commission monitors that the EU Member States, including Finland, are in compliance with their emission reductions targets (see above).

The Government regularly prepares strategies and plans for achieving climate targets. The most significant ones are discussed below. In addition, climate policy is increasingly being integrated with the decision making processes in energy production, transport, agriculture, forestry and land use and other planning in Finland. For example, both the transport sector and the land-use sectors have their own climate policy programmes. Sectoral policies and measures are presented in Section 3.4.

National energy and climate strategies have been prepared since 2001 by each Government i.e. the cabinet of ministers and submitted to the Parliament as a Government Reports. The latest strategy, called 'Carbon Neutral Finland 2035 – National Climate and Energy Strategy'[30], in 2022, set out the key starting points and objectives of the Government Programme goals, including the EU 2030 targets. Ministry of Economic Affairs and Employment oversees the overall coordination of the strategy work. The next strategy is under preparation and foreseen to be published in 2025.

The relevant ministries are responsible for implementing the measures set out in the National Climate and Energy Strategy and for their monitoring and evaluation. In some cases, this responsibility has been delegated to specialised government entities such as Motiva Oy, an entirely state-owned sustainable development company in Finland that promotes the efficient and sustainable use of energy and materials. A sectoral example of monitoring of progress are the summary reports on the impact of energy efficiency agreements published by Motiva Oy.

In reporting on policies and measures, including their implementation and effects on emissions, and projections to the European Commission (see above) and to the UNFCCC and Paris Agreement, the Ministry of Economic Affairs and Employment is responsible or the overall

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[28] Decision-making process, https://ec.europa.eu/info/strategy/decision-making-process/how- decisions-are-made_en
[29] Have your say – Public consultation and feedback, https://ec.europa.eu/info/law/better-regulation/have-your-say_en
[30] Carbon Neutral Finland 2035 – National Climate and Energy Strategy, http://urn.fi/URN:ISBN:978-952-327-843-1

coordination 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 biennial report on policies and measures and projections has been thus compiled in cooperation with the Ministry of Economic Affairs and Employment, the Ministry of the Environment, the Ministry of Transport and Communications, the Ministry of Agriculture and Forestry, the Ministry of Finance, Statistics Finland, the Finnish Environment Institute (Syke), state owned sustainable development company Motiva Oy, and Natural Resources Institute Finland (Luke).

The recent EU regulation on the Governance of the Energy Union and Climate Change Actions requires every EU Member State to regularly prepare *an integrated national energy and climate plan (NECP) and a Long-Term Strategy (LTS)* for low-carbon development. Finland submitted its first NECP to the EU in 2019 and its first LTS[31] in 2020. An update of the NECP was submitted in June 2024.[32] The regulation also includes an obligation to biennially prepare the *national energy and climate plan progress report* (NECPR). The first progress report was submitted in March 2023.

The Climate Act contains a provision on a climate change policy planning system that includes a *Medium-Term Climate Change Policy Plan* adopted by the Government once every government term. The Medium-Term Climate Change Policy Plan includes an action plan that contains measures for the reduction of anthropogenic greenhouse gas emissions and the mitigation of climate change in the effort sharing sector (sectors outside emissions trading) and projections of greenhouse gas emissions and the effects of policy measures on the emissions.

The second Medium-Term Climate Change Policy Plan was adopted in 2022[33]. It specifies the key measures for achieving the binding emissions reduction targets in the effort sharing sector by 2030. The preparation of the Medium-Term Climate Change Policy Plans is coordinated by the Ministry of the Environment, and all the relevant ministries are involved in the work. The Annual Climate Report, which is submitted to Parliament every year, contains information on the implementation of the policy measures contained in the Medium-Term Climate Change Policy Plan. Preparation for the third Medium-Term Climate Change Policy Plan is ongoing.

The Climate Plan for the Land Use Sector (LULUCF)[34] was prepared from 2021 to 2022 for the first time. It is one of the key elements of the planning system under the revised Climate Act. The purpose of the Plan is to promote the reduction of emissions from land use, forestry, and agriculture, the strengthening of carbon sequestration and carbon storage, and adaptation to climate change in accordance with the Sustainable Development Goals. The first plan was coordinated by a working group, which included members from the Ministry of Agriculture and Forestry and other relevant ministries, as well as two experts from the Finnish Climate Change Panel. The Annual Climate Reports to the Parliament will contain information on the implementation of the policy measures included in the Climate Plan for the Land Use Sector.

[31] Finland's long-term strategy to reduce greenhouse gases. Ministry of Economic Affairs and Employment, 1 April 2020. https://tem.fi/eulle-toimitettavat-suunnitelmat-ja-raportit

[32] Finland's Integrated National Energy and Climate Plan Update, 28 June 2024. Publications of the Ministry of Economic Affairs and Employment 2024:30. http://urn.fi/URN:ISBN:978-952-327-527-0

[33] Medium-term Climate Change Policy Plan: Towards a carbon-neutral society, 11 July 2022. Publications of the Ministry of the Environment 2022:20. http://urn.fi/URN:ISBN:978-952-361-417-8

[34] Government Report on the Climate Plan for the Land Use Sector, 5 May 2023. Publications of the Ministry of Agriculture and Forestry 2023:12. http://urn.fi/URN:ISBN:978-952-366-592-7

National Climate Change Adaptation Plan 2030

The National Climate Change Adaptation Plan[35] was adopted in December 2022 and it is the second national adaptation plan in Finland. A preparatory group consisting of representatives of nine ministries was responsible for the preparation of the current Plan. The group was led by the Ministry of Agriculture and Forestry, the ministry coordinating climate change adaptation at the Government level. The preparatory group was supported by an expert secretariat and informed by consultations with a broad range of stakeholder representatives. The Plan presents a climate change risk and vulnerability assessment and sets out the vision, aims, targets and actions for national adaptation work in Finland. The Plan, which is ought to be updated at least every second parliamentary term, is part of Finland's climate policy planning system as stated by the Climate Act. The implementation of the Plan is reported in the Annual Climate Reports to the Parliament.

Stakeholders are engaged in several ways related to the Finland's contribution to the implementation and achievement of the EU's NDC. Preparation of the Government's climate related strategies and plans includes different participatory approaches with various stakeholders - in addition to which stakeholders together with the general public are invited to submit comments before the finalization of the strategies and plans.

Based the Climate Act, the *Finnish Climate Change Panel* acts as an independent body to support climate policy planning and decision making. The Panel's members represent different branches of science from educational to atmospheric sciences. The Panel gives its opinion on climate policy plans and produces reports to support the preparation and implementation of climate policy and legislation in Finland. Panellists have been invited to comment the National Climate and Energy strategy, the Medium-Term Climate Change Policy plan, and the Climate Plan for the Land-Use Sector.

As a recent example of stakeholder engagement, an online Citizens' Jury was convened to deliberate on climate actions planned by the Finnish government to reach its targets in reducing Finland's emissions. The jury was commissioned by the Climate Policy Roundtable with the Ministry of the Environment, and it was implemented by researchers from the University of Turku. The results were used for the preparation of the second Medium-Term Climate Change Policy Plan adopted in 2022. Another example of stakeholder engagement is the implementation of the National Adaptation Plan which is supported by a broadbased Monitoring Group chaired by the Ministry of Agriculture and Forestry. The Monitoring Group brings together representatives of several government ministries, sector agencies, research institutions, local and regional administrations, and other relevant actors (see also Chapter 4) In addition, according to the new Climate Act, the rights of the indigenous Sámi people must be taken into account, and negotiations with the Sámi Parliament must be conducted in the preparation processes of climate policy plans.

More details can be found in Finland's eight national communication.

[35] The National Climate Change Adaptation Plan 2030, 2 April 2024. Publications of the Finnish Government 2024:11. http://urn.fi/URN:ISBN:978-952-383-814-7

3.2 Description of a Party's nationally determined contribution

This section contains common text for the BTRs of the EU and the Member States

Under their updated NDC[36] the EU and its Member States, acting jointly, are committed to a legally binding target of a domestic reduction of net greenhouse gas emissions by at least 55 per cent compared to 1990 by 2030. The term ‘domestic’ means without the use of international credits.

The NDC consists of a single-year target, and the target type is ‘economy-wide absolute emission reduction’. The scope of the NDC covers the 27 Member States of the EU.

The 17 October 2023 updated NDC scope is supplemented by additional information to clarify the precise amount of international aviation and maritime emissions which are covered under the EU NDC. Details on the EU NDC can be found in Table 3.2-1 and in the annex 1.

Table 3.2-1 Description of the NDC of the EU

Information	Description
Target and description	Economy-wide net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990. The term ‘domestic’ means without the use of international credits.
Target type	Economy-wide absolute emission reduction.
Target year	2030 (single-year target)
Base year	1990
Base year value	Net greenhouse gas emissions level in 1990: 4 699 405 kt CO_2 eq.
Implementation period	2021-2030
Geographical scope	EU Member States (Belgium, Bulgaria, Czechia, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, the Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden) including EU outermost regions (Guadeloupe, French Guiana, Martinique, Mayotte, Reunion, Saint Martin (France), Canary Islands (Spain), Azores and Madeira (Portugal)).
Sectors	Sectors as contained in Annex I to decision 5/CMA.3: Energy, Industrial processes and product use, Agriculture, Land Use, Land Use Change and Forestry (LULUCF), Waste. ***International Aviation*:** Emissions from civil aviation activities as set out for 2030 in Annex I to the EU ETS Directive are included only in respect of CO_2 emissions from flights subject to effective carbon pricing through the EU ETS. With respect to the geographical scope of the NDC these comprise emissions in 2024-26 from flights between the EU Member States and departing

[36] Submission by Spain and the European Commission on behalf of the European Union and its Member States: The update of the nationally determined contribution of the European Union and its Member States, https://unfccc.int/sites/default/files/NDC/2023-10/ES-2023-10-17%20EU%20submission%20NDC%20update.pdf

Information	Description
	flights to Norway, Iceland, Switzerland and the United Kingdom. ***International maritime Navigation***: Waterborne navigation is included in respect of CO_2, methane (CH_4) and nitrous oxide (N_2O) emissions from maritime transport voyages between the EU Member States.
Gases	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), nitrogen trifluoride (NF_3)
LULUCF categories and pools	The included LULUCF categories and pools are as defined in decision 5/CMA.3.
Intention to use cooperative approaches	The EU’s at least 55% net reduction target by 2030 is to be achieved through domestic measures only, without contribution from international credits. The EU will account and report for cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA.
Any updates or clarifications of previously reported information, as applicable	The information on the NDC scope contains clarifications/further details compared to the information provided in the updated NDC of the EU.
Note: This table is identical to table ‘Description of a Party’s nationally determined contribution under Article 4 of the Paris Agreement, including updates,’ which has been submitted electronically together with this BTR. This table is also annexed to this BTR.	
Source: Updated NDC of the EU[37]	

3.3 Tracking progress: Indicator, definitions, methodologies and progress

This section contains common text for the BTRs of the EU and the Member States

3.3.1 Indicator

For the tracking of progress towards implementing and achieving the NDC of the EU, an indicator is used which has the same unit and metric as the NDC base year and target values. The chosen indicator is ‘annual total net GHG emissions consistent with the scope of the NDC in CO_2 eq’. Table 3.3-1 provides more information on this indicator.

[37] https://unfccc.int/sites/default/files/NDC/2023-10/ES-2023-10-17%20EU%20submission%20NDC%20update.pdf

Table 3.3-1 Indicator for tracking progress

Information	Description
Selected indicator	Annual total net GHG emissions consistent with the scope of the NDC in CO_2eq.
Reference level and base year	The reference level is total net GHG emissions of the EU in the base year (1990). The reference level value for the EU is 4 699 405 kt CO_2eq.
Updates	This is the first time the reference level is reported, hence there are no updates. The value of the reference level may be updated in the future due to methodological improvements to the EU GHG inventory and to the determination of international aviation and navigation emissions in the NDC scope.
Relation to the NDC	The indicator is defined in the same unit and metric as the target of the NDC. Hence it can be used directly for tracking progress in implementing and achieving the NDC target.
Definitions	Definition of the indicator 'annual total net GHG emissions in CO_2eq': Total net GHG emissions correspond to the annual total of emissions and removals reported in CO_2 equivalents in the latest GHG inventory of the EU. The totals comprise all sectors and gases listed in the table entitled 'Reporting format for the description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates'. Indirect CO_2 emissions are included from those Member States that report these emissions.
Note: The information in this table is identical to the information in Common Tabular Format (CTF) tables 1 ('Description of selected indicators') and 2 ('Definitions needed to understand the NDC'), which were submitted electronically together with this BTR.	
Source: The reference level is based on the Annual European Union GHG inventory 1990-2022	

3.3.2 Methodologies and accounting approach

The EU uses the following accounting approach for tracking progress towards the joint EU NDC: annual GHG data from the national GHG inventory of the EU, complemented for international aviation and navigation with estimations from the Joint Research Centre's Integrated Database of the European Energy System[38] . The total net GHG emissions are provided in the scope of the EU NDC and are compared to the economy-wide absolute emission reduction target as defined in the NDC. The EU will account for its cooperation with other Parties in a manner consistent with guidance adopted by the CMA.

As far as emissions and removals from the LULUCF sector are concerned, net emissions are used for tracking progress towards the 2030 target of the NDC based on all reported emissions and removals.

[38] European Commission, Joint Research Centre, Rózsai, M., Jaxa-Rozen, M., Salvucci, R., Sikora, P., Tattini, J. and Neuwahl, F., JRC-IDEES-2021: the Integrated Database of the European Energy System – Data update and technical documentation, Publications Office of the European Union, Luxembourg, 2024, https://publications.jrc.ec.europa.eu/repository/handle/JRC137809.

Details on methodologies and accounting approaches consistent with the accounting guidance[39] under the Paris Agreement can be found in CTF table 3 ('Methodologies and accounting approaches'), which was submitted electronically together with this BTR.

3.3.3 Structured summary – status of progress

An important purpose of the BTR is to demonstrate where the EU and its Member States stand in implementing their NDC, and which progress they have made towards achieving it. The most recent information on GHG emissions and removals in the scope of the NDC constitutes the key information for tracking this progress. Table 3.3-2 summarises the current status of progress.

Table 3.3-2 Summary of progress towards implementing and achieving the NDC

Indicator	Unit	Base year value	Values in the implementation period			Target level	Target year	Progress made towards the NDC
			2021	2022	2030			
Total net GHG emissions consistent with the scope of the EU NDC	kt CO_2eq	4 699 405	3 272 650	3 205 223	NA	(at least 55% below base year level)	2030	The most recent level of the indicator is 31.8% below the base year level.
NA: Not Applicable.								
Note that an annual emissions balance consistent with chapter III.B (Application of corresponding adjustment) will be provided in a subsequent BTR upon finalisation of relevant further guidance by the CMA, based on the annual information reported under Article 6.2.								
Note: More detailed information can be found in CTF table 4 ('Structured summary: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement'), which has been submitted electronically together with this BTR.								
Source: The indicator values are based on the Annual European Union GHG inventory 1990-2022.								

Based on the GHG inventory data and data on international aviation and navigation for 2022, the EU and its Member States reduced net GHG emissions by 31.8 per cent compared to 1990. The EU and its Member States made progress towards implementing and achieving their NDC. The legal and institutional framework is in place to make further progress in the years ahead and to achieve the NDC target by 2030.

Finland's contribution to the progress towards achieving the joint EU NDC can be illustrated in part by the development of the emissions under the EU Effort Sharing Regulation (ESR) compared to the annual emission allocation that are presented in Table 3.3-3.

[39] Decision 4/CMA.1, Further guidance in relation to the mitigation section of decision 1/CP21, https://unfccc.int/documents/193407.

Table 3.3-3 Finland's annual emissions allocations for the effort sharing sector for 2021–2025, corresponding emissions for 2021 to 2022 and their difference to emissions allocations

	2021	2022	2023	2024	2025
	kilotonnes CO_2 eq.				
Annual emission allocation	28 840	27 970	26 626	25 283	23 939
Effort sharing sector	27 212	26 545			
Difference between AEA allocation and reported total ESR emissions	-1 628	-1 425			

In addition, Finland takes part in the EU Emissions Trading System. Finland also contributes to the overall EU-level objective of 310 million tonnes CO_2 equivalent of net removals in the LULUCF sector in 2030 defined by the LULUCF Regulation.

3.4 Mitigation policies and measures

3.4.1 Introduction

Finland's climate policy is based both on international agreements and national targets such as the UNFCCC, the Paris Agreement and the common policies of the European Union mentioned above. These agreements and targets drive the process of preparing the actual mitigation policies and measures and laying them out in different strategies, which are both described in this chapter.

At the time of writing, the Government, including a ministerial working group, is planning new policy measures in addition to the measures in the WM projection. The process has already commenced but is not yet complete. Therefore, no comprehensive analysis is available of impacts of the planned policies and measures at this point in time. Yet some new measures are described below in the sector-specific chapters.

3.4.2 Strategies and plans

3.4.2.1 National Energy and Climate Strategies

The energy and climate strategy is not part of the planning system of the Climate Act, which lays out the national climate policy goals, for example. However, the strategy is usually prepared once per parliamentary term and its impact assessed in a coordinated manner using data in common with the medium-term climate change policy plan. Being an overarching energy and climate policy planning document that covers the emissions reduction and increasing of carbon sinks, the energy and climate strategy includes other energy policy themes as well: renewable energy, energy efficiency, energy market, energy security and research, innovation and competitiveness.

Finland has prepared six national strategies on energy and climate policy, which were completed and submitted to Parliament as Government Reports in 2001, 2005, 2008, 2013, 2016 and 2022. The focus of the 2008 and 2013 strategies was on policy measures for achieving the EU's 2020 energy and climate targets. The 2016 strategy – National Energy and Climate Strategy for 2030 – outlined the actions enabling Finland to attain the targets specified in the Government Programme of the then Prime Minister Sipilä (May 2015) and in the EU for 2030, and to systematically set the course for achieving an 80 to 95 per cent reduction in greenhouse gas emissions by 2050.

The latest strategy, called ‘Carbon Neutral Finland 2035 – National Climate and Energy Strategy’ and prepared by the previous government in 2022, sets out the key starting points and objectives of the previous Government Programme goals, including the EU 2030 targets and national carbon neutrality target by 2035. It further assesses the adequacy of the previous measures for meeting the targets (the With Existing Measures or WM projection) and (at that time) additional measures by which its targets can be attained (the With Additional Measures or WAM projection). The strategy also refers to the latest Medium-Term Climate Change Policy Plan, which specifies the key measures for achieving the binding emissions reduction targets in the EU’s effort sharing sector by 2030, and to the Climate Change Plan for the Land-Use Sector.

The current Government of Prime Minister Petteri Orpo is preparing a new energy and climate strategy. The preparation started in 2023 with updating the WM projection and estimating potential gaps in the energy and climate targets. As Finland is striving for the goals of the Government Programme for emissions reduction and the Climate Act's 2035 carbon neutrality, new policy measures are being prepared and their impacts modelled in 2024. The energy and climate strategy is expected to be completed in the first half of 2025 and it will include the new policy measures both for reducing emissions and increasing carbon sinks.

3.4.2.2 Long-Term Strategy (LTS)

In 2020, Finland submitted its Long-Term Strategy (LTS) to the UN and EU. It replaces the former Energy and Climate Roadmap 2050, published in 2014. The preparation of an LTS is stipulated in Article 4, Paragraph 19 of the Paris Agreement under the UNFCCC and in Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, also known as the ‘Governance Regulation’. It was the first strategy to take Finland’s carbon neutrality target into account before the latest National Climate and Energy Strategy in 2022.

Finland’s Long-Term Strategy lays out projections and impact assessments concerning the national carbon neutrality target set for 2035 and developments in greenhouse gas emissions and removals by 2050. The strategy explores the following three projections. Alongside the reference projection depicting the development achievable with current policy measures at that time, the strategy presents two alternative low-emission projections, known as the ‘Continuous Growth’ and ‘Savings’ projections. The Continuous Growth and Savings projections describe alternative pathways for achieving the emissions reduction target at that time set by Finland (or by the European Union, if stricter) for 2050. The Long-Term Strategy does not consider the transition to a low-emission society from the perspective of regional or social justice; instead, its underlying calculations are based on the premise that emissions reduction costs will be minimised across the country. Nor does the Long-Term Strategy identify the sectors, to which emissions reductions should be allocated, and the impact assessments derived from the projections do not include any quantitative analysis of the concrete measures or political decisions that would be required to achieve the carbon neutrality target or the 2050 targets considered here.

In the reference projection, carbon neutrality would not be achieved until 2050 – and even then, only with land-use net carbon sinks at about 30 million tonnes of CO_2 eq. per year. Conversely, the Continuous Growth and Savings projections would achieve the carbon neutrality in 2035, but this would require substantial emissions reductions from 2030 to 2035, while also keeping the forest carbon sinks at a high level.

Going forward, Finland will prepare a new complementary national Long-Term Strategy in accordance with the requirements set out in the Climate Act. The new strategy will be submitted to Parliament by the end of 2025 at the latest.

3.4.2.3 Medium-term Climate Policy Plan

The Climate Act (423/2022) contains a provision on a climate change policy planning system that includes a Medium-term Climate Policy Plan adopted by the Government once every government term. The Medium-term Climate Policy Plan will include an action plan that contains measures for the reduction of anthropogenic greenhouse gas emissions and the mitigation of climate change in the effort sharing sector (sectors outside the EU’s emissions trading) and projections of greenhouse gas emissions and the effects of policy measures on the emissions. The preparation of the Plan is coordinated by the Ministry of the Environment, and all the relevant ministries are involved in the work. The Annual Climate report, which is submitted to Parliament every year, contains information on the implementation of the policy measures contained in the Medium-term Climate Policy Plan.

The second Medium-term Climate Policy Plan was finalised during 2022. Alongside the National Climate and Energy Strategy and the Climate Plan for the Land Use Sector, this plan implements the climate policy objectives of the Government Programme. It specifies and complements the emissions reduction measures outlined in the National Climate and Energy Strategy and the Climate Plan for the Land Use Sector. The plan takes into account the energy policy measures included in the strategy and the measures included in the Climate Plan for the Land Use Sector, because they will have an impact on the development of the total emissions and sinks.

The second Medium-Term Climate Policy plan was updated to meet the increasingly stringent EU obligations for 2030 and the Government’s target to achieve carbon neutrality by 2035. The plan sets a target for reducing greenhouse gas (GHG) emissions 50 per cent in the effort sharing sector by 2030 compared to the 2005 level. It also determines the measures for achieving the target. Finland’s target is based on the European Union’s (EU) 2030 overall target of reducing emissions by at least 55 per cent compared with 1990 levels.

A wide range of citizens and stakeholder groups was heard during the preparation of the second Medium-Term Climate Policy Plan. The plan is based on the principle that carbon neutrality should be achieved as cost-effectively and fairly as possible.

The current Government of Prime Minister Petteri Orpo is preparing a new Energy and Climate Strategy and the third Medium-term Climate Policy plan. The Climate Plan for the Land Use Sector will not be updated in this government term. The preparation of these plans started in 2023 with updating the WM projection and estimating potential gaps in energy and climate targets. New policy measures are being assessed and dimensioned in 2024. The energy and climate strategy and the medium-term climate policy plan are expected to be completed in early 2025.

3.4.2.4 Climate Plan for the Land Use Sector

The Climate Plan for the Land Use Sector (LULUCF) was prepared in 2022 for the first time, and it is one of the key elements of the planning system under the revised national Climate Act (423/2022). In line with the UN Framework Convention on Climate Change and the Paris Climate Change Agreement, the land use sector comprises land use, land-use change, and forestry (LULUCF).

The preparation of the Plan was coordinated by a working group, which included members from the Ministry of Agriculture and Forestry and other relevant ministries, as well as two experts from the Finnish Climate Change Panel. The key principle in the preparation was to reach the climate targets as cost-effectively, fairly and justly as possible. The Plan was preceded by an analysis of the most effective climate measures in the LULUCF sector and complemented by an environmental impact assessment, as well as an analysis of the cost-effectiveness of the proposed measures. The Plan was prepared in a participatory manner.

The purpose of the Plan is to promote the reduction of emissions from land use, land use change, forestry and agriculture, strengthen carbon sequestration and carbon storage, and to adapt to climate change in accordance with the Sustainable Development Goals. The annual net impact, i.e. decrease in the emissions and increase in the removals, for which the additional climate measures in the land use sector aim is at least three million tonnes of CO_2 eq. by 2035.

The Climate Plan for the Land Use Sector brings together ongoing measures in the whole land use sector. The measures and their climate impact are presented in detail in chapter 3.4.3.6. The Plan also outlines additional measures in four categories: resource-efficient land use and land-use change; climate-resilient use of peatlands; other measures to promote carbon sequestration and carbon storage; and crosscutting measures. In addition to the ongoing measures, the new measures focus on, for example, actions in peatland fields and forests, the development of carbon markets, swift and timely forest regeneration, increasing the amount of dead wood for climate and biodiversity perspectives, promoting training and expertise, and communication. The most effective measures have been identified in halting deforestation and promoting actions in peatlands. However, currently there is no national funding outside CAP measures for paludiculture / rewetting peatlands. Also, the national funding for fixed-term support for afforestation ended in December 2023. A mid-term assessment of the Climate Plan for the Land Use Sector is planned to start in 2025. Climate Plan for the Land Use Sector will be drawn up every second governmental period.

3.4.2.5 National Forest Legislation and Programmes

The sustainable management of forests in Finland is based on normative steering, high-level scientific knowledge and good practices. The means for steering the use of forests include legislation, Finland's National Forest Strategy 2035, financing, and public forestry extension organisations.

Forest legislation is the most important forest policy means for ensuring sustainable forestry. The key acts include the Forest Act[40] and the Act on Temporary Forestry Incentive Scheme[41]. There is also legislation dealing with the prevention of forest damage and the trade in forest reproductive material, timber measurement, jointly owned forests, and organisations in the forestry sector.

The Forest Act sets requirements for the regeneration and conservation of certain key habitats. For example, a new seedling stand must be established within three years of the end of felling. The Forest Act is complemented by guidelines for good forest management and silviculture, which have been compiled and promoted by public forestry extension organisations. The current law allows for more diversified management methods such as uneven aged forest management. The amendments to the Forest Act increase the freedom of choice of forest owners in managing their own forest property, improve the profitability of forestry and operating conditions of the wood-producing industry, and enhance the biodiversity of forests. Best Practices for Sustainable Forest Management in Finland are continuously updated to reflect the most recent scientific knowledge and societal values among the key stakeholders, as well as the main targets set by the

[40] 1093/1996
[41] 71/2023

Finnish national forest policy. The development work related to the Best Practices is financed by the Ministry of Agriculture and Forestry.

Finland’s new National Forest Strategy (NFS2035) contains the key guidelines of Finland’s forest policy and acts as a statutory forest programme. A new national Forest Strategy 2035 was adopted in December 2022, on which the Government made a resolution in October 2023. The process to reform the strategy was based on the rapid changes in the operating environment, both in Finland and internationally. The new strategy to 2035 considers comprehensive sustainable development in a proactive and timely manner and takes into account the role of forests in climate change mitigation and adaptation by strengthening forests’ climate resilience and controlling the risks of damage. It describes the key objectives and priorities for the development of the forest sector. The revised strategy aims, among other things, to promote active, sustainable and diverse use of forests and to strengthen the vitality, diversity and adaptability of forests. The strategy also has numerous interlinkages to other national and international strategies.

The three key projects to achieve the objectives of the strategy are concerned with increasing forest growth, carbon sequestration and timber output, improving biodiversity in commercial forests, and creating a competitive environment for a responsible forest sector that is capable of renewal. Climate change mitigation and adaptation in forests are supported by diversifying forest management. Forests’ viability, i.e. growth and health, will be maintained and enhanced through active forest management. Over the long term, forest management techniques must be adapted to new and changing climate conditions. Timely and careful forest management can improve both the growth and the resistance of growing stock to damage, while safeguarding the ecosystem services of forests and producing wood biomass sustainably. Forests as a carbon sink have been a significant means of mitigating climate change in Finland.

The NFS2035 is implemented and monitored in broad cooperation between the public and private sectors. The Ministry of Agriculture and Forestry, supported by the Forest Council, has the overall responsibility for the programme. The Forest Council includes representatives from different administrative sectors, industries, NGOs and specialist organisations.

The NFS2035 is also implemented through Regional Forest Programmes, in which the special regional characteristics are duly considered. Regarding the contribution to the conservation of biodiversity and the sustainable use of natural resources, the most important instruments are the Forest Act (on preserving diversity and habitats of special importance) and the policies and measures outlined in the Forest Biodiversity Programme for Southern Finland 2014 to 2025 (the METSO programme), both of which are integral parts of the range of instruments in the NFS to protect biological diversity in the future.

The METSO programme is being implemented jointly by the Ministry of Agriculture and Forestry and the Ministry of the Environment. In southern Finland, 72 per cent of forests are owned by private persons. METSO therefore targets both private and state-owned land. It covers the protection and commercial use of forests. The aim is to halt the decline in forest habitats and species and to establish stable and favourable conditions for forest biodiversity in southern Finland. The programme is being implemented through ecologically efficient, voluntary, and cost-effective means. A Government decision-in-principle sets goals for METSO up to 2025 that 96,000 ha of private and 13,000 ha of state-owned forests will be conserved on a permanent or temporary basis.

The Helmi programme is a key tool for halting biodiversity loss in Finland. The programme (2021 to 2030) is a joint programme of the Ministry of the Environment and the Ministry of Agriculture and Forestry, implemented together by the administrative branches of both ministries and municipal authorities and organisations. Actions are carried out both within and outside protected areas. The participation of landowners is voluntary.

The main objective of the Helmi programme is to take a comprehensive view of habitats and the necessary restoration and management measures in collaboration between numerous stakeholders. Restoration and management actions are targeted at specific areas and sites to maximise their impact on biodiversity.

The SOTKA project of the Ministry of Agriculture and Forestry is part of the Helmi programme. The project was launched in spring 2020 and will continue until the end of 2024. In this project, wetlands and a network of resting areas for birds are built, mires and catchments are restored and small carnivores are captured.

Forestry is a significant income source for forest owners and provides benefits to society at large. Private and public organisations provide guidance and consultation services for forest owners. The provision of these services was liberalised by a new act on forest management associations. A private forest owner may also receive assistance from the State for forest management and improvement work. State support encourages measures with long-term impacts. Managing the natural environment in commercial forests is promoted through environmental support and forest nature management projects. Public funding for forestry is based on the Act on Temporary Forestry Incentive Scheme.

Environmental aid may be granted for additional costs and income losses due to preservation and management of habitats of special value. The State also finances forest nature management projects. The works to be designed and implemented in these projects are defined in further detail in the legislation. Most of the forest nature management projects have special regional importance. Apart from habitats of special value, the projects may concern landscape management, preventing damage to waters and the restoration of drained areas.

3.4.3 Sectoral policies and measures

Finnish regulations, policies, and measures are strongly affected by the increasing number of directives, policies, and measures of the EU. This chapter provides information on the most important policies and measures related to the reduction of greenhouse gas emissions. Both existing and some planned measures are described although no WAM projection is presented. The mitigation actions, or policies and measures, and their effects are described by sector in the sections below and a summary of them is presented in CTF Table 5.

Finland is continuously seeking to improve quality of data on the effects of the policies and measures. Nevertheless, for some individual measures, Finland has been unable to provide quantified estimates of impacts on national emissions. These are marked with the notation key NE (not estimated) in the table. There are various reasons why it has not been possible to obtain estimates, such as complexity and the overlaps with other measures (for example, the EU ETS), the measure is still in a phase in which the details of implementation are unknown (for example, recently decided agricultural measures such as new types of animal feed), the policy or measure targets heterogenous groups and/or many actors with different responses to the measure, or where the quantification of the effect is difficult (for example, measures providing customer advice and information).

For measures targeting F-gas emissions and measures in the waste sector, only aggregate impact estimates of the policies and measures are provided to avoid double counting and improve the accuracy of the estimated effects. The impacts of the individual measures are marked with IE (included elsewhere) in the tables, and the aggregated estimates are provided for the group of measures. The notation ‘Partly IE’, partly included elsewhere, is used in the table for the emissions reduction impact of the investment aid for new energy technology demonstration projects. The emissions reduction has not been estimated separately for this measure because of the wide scope of possible projects being supported. The impact may partly be covered by the emissions reduction figures for the measures promoting different renewable energy sources. In other words, the total emissions reduction figures for the renewable energy measures are presumably somewhat on the low side.

3.4.3.1 Energy

Adopted and implemented policies and measures

The general objective of Finland's energy policy is to ensure cost-competitive energy security with the lowest possible environmental impacts. Finland uses a diversity of energy sources, over 40 per cent of which (including energy for transport) are domestic. The major trend is a steady increase in the use of renewable energy both in absolute and in relative terms. Direct governmental intervention to guide the choice of energy sources is rare in Finland. However, economic instruments, mainly taxation and subsidies, are used to improve energy efficiency and to promote the development of domestic energy sources such as biomass, hydro, wind and solar. For example, new wind power projects established between 2011 and 2017 were eligible for substantial subsidies in the form of a feed-in tariff scheme. The feed-in tariff was also granted to biomass power plants until the end of 2018. The energy market has since and is still undergoing a significant turning point in the investment climate. It is illustrated by the ongoing boom in new wind power projects, which have become profitable without subsidies, for example. In addition to actual energy taxes, the EU ETS acts as one sort of tax on carbon, which directs new investments from fossil fuels to renewables. In addition, the recent disruption to the global energy market because of Russia's attack on Ukraine has accelerated the structural changes even further by underlining the need to advance domestic renewables from the energy security angle.

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 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 Emissions Trading System (ETS), energy taxation, other measures to increase the share of renewable energy, and energy conservation measures.

The EU ETS is an EU-wide measure, while renewable energy sources are supported by various national measures: investment grants, taxation, support for research, and feed-in tariffs. Energy conservation measures are relevant in all sectors of the economy. Energy efficiency agreements, a voluntary scheme for industries and municipalities, have proved to be efficient measures along with taxes and subsidies. As 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 is presented in CTF Table 5. Energy taxation and tax-related subsidies are described in Section 3.4.4.

EU Emissions Trading System

The EU ETS continues to be the most important economic policy instrument for reducing emissions in the EU and its Member States. Under the system, emissions are limited under an EU-wide cap, which sets the maximum amount of emissions for all operators obliged to participate in the system. The system is divided into periods for which the emissions reduction target and the representative cap are established. In addition, more significant rule changes usually take place as the period changes.

The EU ETS covers operators from power production, industrial processes and aviation limited to flights within the European Economic Area (EEA). The coverage was expanded to maritime vessels of or above 5,000 gross tonnage in 2024. The ETS covers 100 per cent of emissions from voyages within the EEA and 50 per cent of emissions from voyages between the EEA and third countries. The covered GHG gases are CO_2 and N_2O and PFC emissions from certain industries. For maritime, also CH_4 emissions will be covered as of 2026.

EU-wide, some 11,000 installations are included in the EU ETS of which over 500 in Finland. At the beginning of 2020, the EU ETS was linked with Switzerland's trading system, allowing more flexibility for the use of allowances for both entities.

Over the years, the EU ETS has undergone several reforms such as increasingly harmonised EU-wide rules, more ambitious emissions reduction targets, the introduction of auctioning as the primary allocation method and the establishment of the Market Stability Reserve (MSR), a mechanism that aims to decrease the allowance surplus in the market and improve its resilience to future recessions.

During Phase 4, that is, between 2021 and 2030, 57 per cent of allowances are allocated in auctions, and the rest is granted directly to installations as free allocation. Most Member States, including Finland, auction their allowance shares in joint auctions organised by the European Energy Exchange (EEX). During Phase 3, Finland's appointed auctioneer, the Energy Authority, accounted for a total EUR 1.10 billion of state revenues.

All sectors except electricity production, maritime and carbon capture, transport, and storage are entitled to apply for a free allocation. Sectors considered to have the highest risk of carbon leakage will continue to receive full free allocation; sectors considered to be less exposed will get 30 per cent compared to their demand. Starting from 2026, free allocation will be gradually phased out for the less exposed sectors, with the exception of district heating. For the aviation sector, free allocation will be removed as of 2026.

In 2027, a new emissions trading system for buildings, road transport and additional sectors (ETS2) will start in the EU. Similar to the current EU ETS, the new ETS2 will be an upstream system where the entity who releases fossil fuels for consumption must hold an emission permit and surrender the allowances covering the CO_2 emissions from the amount of fuel released yearly. For the final consumer of fossil fuel, the system will mean higher fuel prices. The ETS2 is a complementary measure to reduce GHG-emissions in the ESR (Effort Sharing Regulation i.e. outside the current EU ETS) sectors. It is estimated that in Finland the new ETS2 would cover about 50 per cent of the total emissions from the ESR.

The ETS2 will have an emissions reduction target and a cap for emissions as well. The cap will be first set for 2027 in the beginning of the year 2025, and it will be adjusted yearly by a Linear Reduction Factor of 5.1 per cent for the years 2024–2027 and then by 5.38 per cent for the years 2028 onwards. Due to the ETS2 being a European Union wide and market based system, the national reduction of emissions may differ from the union wide reductions that are driven by the cap. According to estimates made in Finland, the new emissions trading system would reduce emissions from the ESR sectors by approximately 0.33 million tonnes of CO_2 eq. in 2030 but could lead to more substantial yearly reductions in later years when the prices for allowances are estimated to be higher.

Unlike the current EU ETS, the new ETS2 will not include free allocation and therefore all the emissions allowances are released to the market by auctioning from the beginning of 2027. The Commission and the Member States will jointly organize a tender for the organisation of the auctions.

The historical division of emissions between the ETS and ESR sectors is presented in Table 3.4-1.

Table 3.4-1 Greenhouse gas emissions in the emissions trading (ETS) sector and non-emissions trading sector in Finland in 2005, 2010, 2015, and 2020–2022, in million tonnes CO_2 eq. The ETS figures do not include emissions from aviation in the EU ETS, as their coverage under the trading system is not consistent with the national greenhouse gas inventory. Total national emissions (also for 1990) without the LULUCF sector and emissions from domestic aviation are also presented.

	1990	2005	2010	2015	2020	2021	2022
	million tonnes CO_2 eq.						
ETS	NA	35.30	41.85	25.35	19.58	20.31	19.02
of which energy	NA	30.46	37.69	21.52	16.03	16.39	15.36
industrial processes	NA	4.89	4.19	3.87	3.54	3.92	3.69
Non-ETS	NA	34.11	33.39	29.44	27.99	27.21	26.55
CO_2 emissions from domestic civil aviation	NA	0.30	0.23	0.18	0.09	0.08	0.14
Total	71.33	69.71	75.47	54.96	47.65	47.60	45.70

Due to a statistical difference between the greenhouse gas inventory and ETS data, sums may not add up.
Scope of the EU ETS in trading period from 2013 to 2020 has been used.

Phasing out coal

Finland has committed to phasing out coal in the energy sector. Achieving this consists of two measures. One is setting a legally-binding deadline; the other is an additional financial incentive to act sooner.

In 2019, an act prohibiting the use of coal in energy production from 1 May 2029 was enforced. The prohibition was estimated to reduce the use of coal by 3 TWh compared to market-based development without the prohibition. The avoided greenhouse gas emissions equal 0.65 million tonnes of CO_2 eq.

To accelerate the coal phase-out, a special incentive package to support replacement investments was introduced for those energy utilities that undertook to give up the use of coal already by 2025.

Therefore, the Ministry of Economic Affairs and Employment opened a call for investment subsidies for projects accelerating the replacement of coal in energy production. In 2021, almost EUR 23 million was granted for this purpose in the energy aid mandate. The aid was granted to projects that promoted production or use of renewable energy, energy saving, or more efficient generation and energy use. Priority was given to projects based on technologies other than combustion. After these projects, the priority was given to combined heat and power production before separate heat production. Novelty and demonstration potential of the projects were also considered. After these projects are completed by 2025 at the latest, coal will be almost completely removed from the fuel mix in the energy sector.

Low-carbon roadmaps

In 2020, 14 Finnish sectors produced their own sectoral roadmaps, or pathways for the sector's decarbonization. This work was updated in 2024, according to the statement of Government Programme of Prime Minister Orpo, which outlined that the sector specific low carbon roadmaps will be updated. All 14 sectors committed to updating their roadmaps. The Ministry of Economic Affairs and Employment supported the sectors by coordinating the whole project, offering guidance, and arranging regular discussions. All sectors prepared the updated 2024 roadmaps on a voluntary basis and were responsible for funding the work themselves. Typically, sectors used consultants as support in the scenario work. The roadmaps include a comprehensive description of the current situation, an evaluation of emissions reducing technologies and measures, and an estimate of achievable reductions. The roadmaps also use scenario analysis to assess coming developments. The scenarios include a baseline that depicts the effect of the current operating environment, and nearly all roadmaps included one or two low-carbon scenarios.

Low-carbon road maps were prepared for the following sectors:

- Agriculture
- Bioenergy industry
- Chemical industry
- Commerce
- Construction industry
- Energy industry
- Food industry
- Forest industry
- Hospitality industry
- Property owners and developers
- Sawmill industry
- Service sector
- Technology industries
- Textile industry

The roadmaps show that the changes in the operating environment in the past four years have been fast and surprising and underline the central role of clean energy in all roadmaps. In addition, they showcase that Finland’s electricity demand will rise significantly compared to the 2020 roadmaps with speedy electrification of different processes. Furthermore, the need for skilled labour has emerged as an interesting theme underlining that there will be a significant need for educated workforce to go ahead with the green transition. The results of the roadmap project will be used as direct input for the government's climate and energy strategy, which is currently being prepared under the Ministry of Economic Affairs and Employment as well as the preparation of the industrial policy strategy equally being prepared by the ministry.

In Finland, engaging the sectors in the work on a voluntary basis has produced proven results. In particular, for smaller sectors, it has been important to keep the threshold to participation quite low. It has been important to have different sectors of different size involved. This has contributed to mutual knowledge sharing and further understanding of the linkage between the low emission pathways of sectors. Roadmaps increase the commitment of sectors to emission reduction efforts and offers to the Finnish government valuable assessments of the opportunities, development and potential actions for emissions reductions.

The Ministry of Economic Affairs and Employment published a summary of the findings in October 2024[42]. More information on the roadmaps can be found in the webpages of the Ministry of Economic Affairs and Employment[43].

Energy efficiency

The Finnish economy is relatively energy-intensive, which has led to fairly high per capita greenhouse gas emissions. 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 shifted significantly towards less energy-intensive industries, Finland still has a considerable number of energy-intensive industries.

The need for space heating, measured by average heating degree-days, is one of the largest in the world. In addition, the relatively large geographical area and sparse population are factors that increase energy intensity.

In terms of the efficiency of energy use and improving energy efficiency, Finland is among the world's leading countries. Co-generation of heat and electricity, long history of building codes and regulations, the broad coverage of energy efficiency agreements (the first agreement period started as early as 1997; the third period, 2017 to 2025, is currently ongoing), and the systematic implementation of energy audits since the early 1990s are good examples of successful energy efficiency measures. Ecodesign requirements and energy labelling of products are efficient EU-wide measures.

Energy Efficiency Directive

The EU's Energy Efficiency Directive[44] (EED) has been implemented mainly with the Energy Efficiency Law, which entered into force at the beginning of 2015. In addition to the comprehensive voluntary Energy Efficiency Agreement scheme, most 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 competences, whereas fiscal solutions emphasise motivating energy savings while ensuring the conditions needed for industry to operate solidly.

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

The EU's Energy Efficiency Directive made the energy audits mandatory for large companies. Thus, for the subsidised energy audit programme, which started in the 1990's, the realised annual CO_2 emissions reductions have been declining and are estimated to be 0.15 million tonnes in 2025, and 0.09 million tonnes in 2040. Correspondingly the realised annual CO_2 emissions reductions related to mandatory energy audits are estimated to be 0.13 million tonnes in 2025 and 0.2 million tonnes in 2040. The great majority of the emissions reductions, around

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[42] Summary of Sectoral Low-Carbon Roadmaps 2024, 30.10.2024. Publications of the Ministry of Economic Affairs and Employment 2024:46. http://urn.fi/URN:ISBN:978-952-327-845-5

[43] https://tem.fi/en/low-carbon-roadmaps-2035

[44] (EU) 2018/2002

95 per cent, is estimated to occur in the emissions trading sector due to the large share of electricity and district heat in energy savings. Buildings' energy use is discussed below in a separate section of this chapter.

The Energy Efficiency Directive (EED) Recast[45] (2023) has entered into force and national efforts are being carefully assessed to define and specify the policies and measures needed for the period 2021–2030. This work is being carried out by the Energy Efficiency Working Group 2023, appointed by the Ministry of Economic Affairs and Employment in May 2023. The group consists of representatives from different ministries with the support of a large group of sectoral experts. While the need for new measures is being assessed, the systematic work and effort to promote energy efficiency continues in Finland. Finland's next energy and climate strategy will be completed in spring 2025.

Voluntary Energy Efficiency Agreements

Voluntary Energy Efficiency Agreements have played a central role since 1997 in increasing energy efficiency in Finnish energy policy. They cover industries, private services, and municipalities, as well as oil-heated buildings, well over 60 per cent of the total energy consumption in Finland. The agreements have played a central role in implementing both national energy policy and EU energy efficiency obligations. The role of the agreements has been especially important in achieving Finland's binding cumulative energy savings target under EED 2018/2002 Article 7. They will continue to have a significant role in the implementation of EED recast[46] (2023) and in meeting the new binding cumulative energy saving targets in its Article 8.

The estimated annual CO_2 emissions reductions achieved by the Energy Efficiency Agreement is 8.1 million tonnes in 2025, and 9.6 million tonnes in 2040. Most of the emissions reductions, well over 95 per cent, are expected to occur in the emissions trading sector due to the large share of electricity and district heat in energy savings. The estimates reported for 2040 are calculated based on assumptions that the current agreement period from 2017 to 2025 will continue.

Negotiations on a new agreement period of 2026–2035 have already started, aiming to seamlessly continue a new agreement period at the beginning of 2026.

Ecodesign and energy labelling

The EU Ecodesign Regulation[47] provides consistent EU-wide rules for improving the environmental performance of physical goods through ecological design. It imposes requirements on products and components to improve their energy efficiency and reduce their environmental impact. If a product does not meet the applicable ecological design requirements, it cannot be marketed or used within the EU.

The EU Energy Labelling Regulation[48] lays down a framework that applies to energy-related products. It provides for the labelling of products and the provision of standard product information regarding energy efficiency, the consumption of energy and of other resources, thereby enabling consumers to choose appliances on the basis of their energy efficiency.

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[45] (EU) 2023/1791

[46] (EU) 2023/1791

[47] Ecodesign Regulation (EU) 2024/1781, https://eur-lex.europa.eu/eli/reg/2024/1781/oj
[48] Energy Labelling Regulation (EU) 2017/1369, https://eur-lex.europa.eu/eli/reg/2017/1369/oj

The ecodesign requirements for energy efficiency of energy using products are estimated to lead to 22.7 TWh annual saving of energy in 2030 corresponding to CO_2 emission reductions of 9.2 million tonnes of CO_2 eq. The estimation is based on the results from the Nordcrawl calculation tool[49] that has been developed for calculation of energy savings of ecodesign and energy labelling policies in the Nordic countries. Energy labelling has not been evaluated.

Renewable energy

Finland is one of the world's leading users of renewable energy sources. The recent development in the renewable energy sector has been very good and the trend is expected to continue. Finland has been able to increase its renewable energy target for 2030 significantly recently. The most important renewable energy sources include bioenergy – wood and wood-based fuels and especially the side-products of the forest industry – hydropower, wind power, ground and air heat pump energy and solar energy. In 2022, the share of renewable energy sources increased to 48 per cent of final energy consumption. The growth of the share of renewable energy in recent years is mainly due to growth of onshore wind capacity. The capacity of onshore wind power has grown rapidly, from 2600 MW in 2020 to 7300 MW in June 2024. The number of wind power (both onshore and offshore) and solar PV[50] projects at different planning stages is high.

The most significant part of the renewable energy supply comes from biomass, especially from the side-products of the forest industry. The remainder of the renewable energy supply comes mainly from hydro and wind power. The new capacity of onshore wind power is built market based. Solar PV is rapidly becoming market based. Offshore wind power is still facing some challenges with economic feasibility of the projects, but project developers show high interest towards offshore wind in Finnish sea areas. Finland has set a target of 62 per cent for the share of renewable energy (gross final consumption) in 2030, in compliance with the Renewable Energy Directive.

Policies and measures in the field of renewable energy focus on promoting new energy technology demonstration projects and promoting renewable energy production from various renewable sources (e.g. wind power, wood chips, solar, biogas and bioliquids). However, the objective is that the majority of the renewable energy investments in Finland are funded without state aid. Due to high EU ETS prices and high energy taxes for fossil fuels, new investments in renewables are, in most cases, more competitive than investments in new fossil fuel plants. For example, the majority of the new electricity capacity is wind power, which is being built in Finland without state aid. Therefore, Finland has been able to phase out operating aid schemes and is not planning for new state aid auctions or other operating aid schemes.

Renewable energy is promoted through the Energy Aid Scheme which is an investment subsidy[51]. It is primarily targeted at the commercialisation of new technologies and for the non-ETS sector. The aid is paid at up to 30 per cent for mature technologies and up to 40 per cent for new technology projects. However, aid levels are typically much lower, especially for mature technologies. The objective is that the aid for a given technology will be phased out as the technology develops, the costs decrease and competitiveness improves. The annual budget will be EUR 14.1 million for small-scale projects. Finland is currently phasing out a separate funding for large-scale demonstration projects. However, decisions concerning the state budget are made annually.

Finland also allocated EUR 537.17 million of European Union Recovery and Resilience Funds to renewable energy, energy infrastructure and electrification projects. The sliding feed-in tariff

[49] 2024 Nordcrawl report (to be published) https://www.norden.org/en
[50] photovoltaic system
[51] Government Decree 262/2023

system for the production of electricity from renewable energy sources came into force in Finland on 25 March 2011. The aid scheme concerns government support for electricity production based on wind power, biogas and small-scale CHP (wood fuels). The aid scheme has been phased out. It was closed for new wind power plants from 1 November 2017 and for new biogas and small-scale CHP plants from 1 January 2019. However, the plants under the scheme will receive the aid for up to 12 years from the start of production.

In May 2018, Parliament approved the Act on the Amendment of the Act on Production Aid for Electricity from Renewable Energy Sources[52], which lays down provisions on the premium system. The premium system was based on a competitive tendering process in which renewable energy technologies competed with each other on the basis of cost-effectiveness. The only auction was held in 2018 and the decisions were made in March 2019. The aid was granted for seven projects within total of 1.4 TWh worth of annual electricity production.

Finland introduced an operating aid for electricity generation from forest chips in combined heat and power generation (CHP) in 2011. The aid is to compensate for the higher production costs of generating electricity from forest chips compared to using fossil fuels. The maximum aid for electricity produced from forest chips has been EUR 18/MWh. However, the aid depends on the price of the EU ETS emissions allowance and has thus been in decline since the beginning of 2018. When the price of the allowance is above EUR 23.7/CO_2 tonne, no aid is paid, which has recently been the case. The aid scheme was closed for new power plants in March 2021. The aid is paid for up to 12 years from the start of production.

Other measures that have been implemented to promote renewable energy include an electricity tax exemption for small-scale production, information measures, and in terms of wind power, the development of land use planning.

The effect of promoting wind power and solar PV on emissions has been estimated based on the assumption that wind power and solar PV reduce 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 emissions reduction impacts of renewables, see Annex 3). Using a marginal emission coefficient of 600 t CO_2/GWh, the promotion of wind power and solar PV will reduce the emissions in 2030 by 19.7 million tonnes CO_2 and 3.3 million tonnes CO_2, respectively. The reduction will occur entirely in the ETS sector. The estimate includes the impact of all policies and measures promoting wind power and solar PV (including the impact of the feed-in tariff).

The production of renewable energy is generally promoted by streamlining the permit granting processes and speeding up the appeal proceedings. The historic use of and WM projection for renewable energy in Finland is shown in Figure 3.4-1 and Table 3.4-2.

[52] Government Decree 441/2018

Figure 3.4-1 Historic development and WM projection for renewable energy, TWh

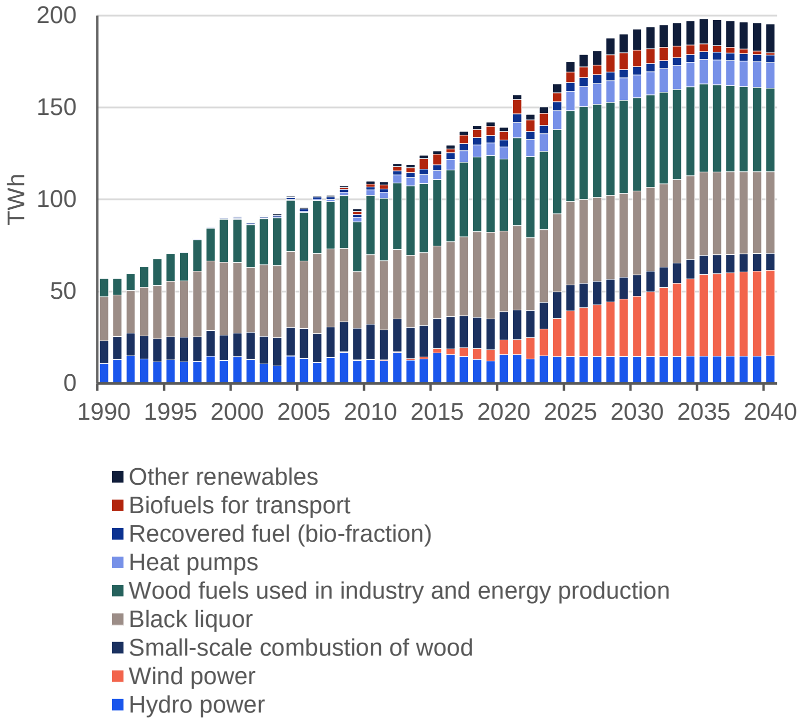


Table 3.4-2 Historic development and WM projection for renewable energy, TWh

	Historical				WM Projection			
	2010	2015	2020	2022	2025	2030	2035	2040
	TWh				TWh			
Black liquor	37.7	39.5	43.9	39.6	45.5	45.5	45.3	44.3
Wood fuels used in industry and energy production	32.3	36.2	39.1	44.2	49.3	50.8	47.9	45.4
Small-scale combustion of wood	19.2	16.2	15.3	14.8	14.0	11.5	10.5	9.3
Hydro power	12.7	16.6	15.7	13.3	14.6	14.7	14.8	14.9
Heat pumps	2.9	4.8	6.6	9.2	10.5	12.4	13.4	13.9
Wind power	0.3	2.3	7.9	11.6	24.9	32.8	44.3	46.5
Biofuels for transport	1.6	5.8	4.7	6.3	5.7	8.9	4.4	1.3
Recovered fuel (bio-fraction)	1.7	3.2	3.8	4.4	4.9	4.6	4.1	4.0
Other renewables	1.5	1.6	2.2	3.0	5.6	11.4	13.6	15.6
Total	109.9	126.3	139.2	146.3	174.9	192.6	198.3	195.4

Energy use in residential and other buildings

Policies and measures for buildings and housing aim to improve energy efficiency, make energy use in buildings smarter, reduce ETS and non-ETS emissions, and increase use of renewable energy sources. Policy measures include standard-setting, economic instruments, dissemination of information, and education and research. Measures are targeted both at new buildings and the existing building stock, including use and maintenance of the building stock. In addition to policy measures in the building sector, energy use is affected by the EU emissions trading system ETS via changes in the prices of heat and electricity.

CO_2 emissions from the use of energy in buildings are mainly covered by the EU ETS. District heating is the source of almost half of all space heating in Finland. Most district heating production falls within the sphere of the EU ETS. The total space heating energy used in residential, commercial and public buildings was 75 TWh in 2022 (27 per cent of the total end use of energy in Finland). Approximately 28 TWh of the space heating belonged to the non-ETS sector in 2022.

Finland has some specific conditions in the heating and cooling of buildings. The most common heating source in Finland in 2022 was district heating (40 per cent of heat energy use). The second most common heating source in Finland in 2022 was electricity (22 per cent). The share of small-scale combustion of wood in heating energy consumption was 19 per cent. The number of heat pumps is increasing rapidly, especially in detached housing, and their share of heat energy use was 12 per cent in 2022. The use of natural gas in building-level heating systems is practically non-existent in Finland, but oil boilers were still quite common in 2022 (7 per cent). Demand for cooling remains low in Finland, but it is expected to increase due to climate change.

In addition to the national standards, the EU's Directive on the Energy Performance of Buildings (EPBD) 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
- The Ministry of the Environment Decree on Energy Certification of Buildings
- Act on inspection of air conditioning systems
- Amendments to the Land Use and Building Act, which was expanded to cover energy efficiency requirements and details on how energy efficiency should be calculated.

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. The building regulation came into force in July 2012, and it is based on the overall energy consumption, which considers, among other things, air conditioning, cooling, lighting and heating, washing water, and heating energy. The regulation favors the utilisation of district heating and renewable energy in defining the overall energy performance of a building. In addition, energy regulations were again revised in 2017, and nearly zero-energy regulations for new buildings were given, and new regulations entered into force, on 1 January 2018.

The Ministry of the Environment is responsible for legislation and guidelines for energy performance certificates, energy performance certificate templates, and other instructions concerning the issuance of certificates. All new buildings need an energy certificate when applying for a building permit. For existing buildings, the energy performance certificates are needed when the building (or part of it, for example, an apartment) is sold or rented. The Housing Finance and Development Centre of Finland (ARA) is the administrative authority ensuring the quality of certificates and the qualified experts, and the appropriate preparation and use of the certificates.

The regulation for the energy performance of new buildings entails about 6.3 million tonnes of annual emissions reductions of CO_2 eq. by 2030. Almost all the emissions reduction will take place in the EU ETS sector through the reduced use of electricity and district heat.

Based on the amendment to the decree of the national building code for sewage and freshwater 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 to heat it. The water measurement instruments provide information on the use of water in each apartment and ensure invoicing is done according to 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. Currently, activities exist for giving internet-based informational guidance, e.g. in repair, energy efficiency, and building maintenance issues.

Finland submitted its Long-Term Renovation Strategy (LTRS) to the EU in 2020. It follows the EPBD 2018/844/EU revision and covers the 2020 existing building stock. The main goals of the strategy are to decrease the energy use of the existing building stock by 51 per cent by 2050 and the related CO_2 emissions by 92 per cent by 2050. The factors affecting the decrease in energy use and emissions are climate change, removals of buildings from the building stock, retrofitting and building maintenance, the change of heating sources in buildings, and decreasing the emission intensity of electricity and heating production. The improvements of energy performance in renovations and alterations, the phase-out of oil use in heating and related policies, as well as retrofitting subsidies are policy measures supporting the Finnish LTRS.

Figure 3.4-2 Heating and cooling use of buildings by building type (TWh)

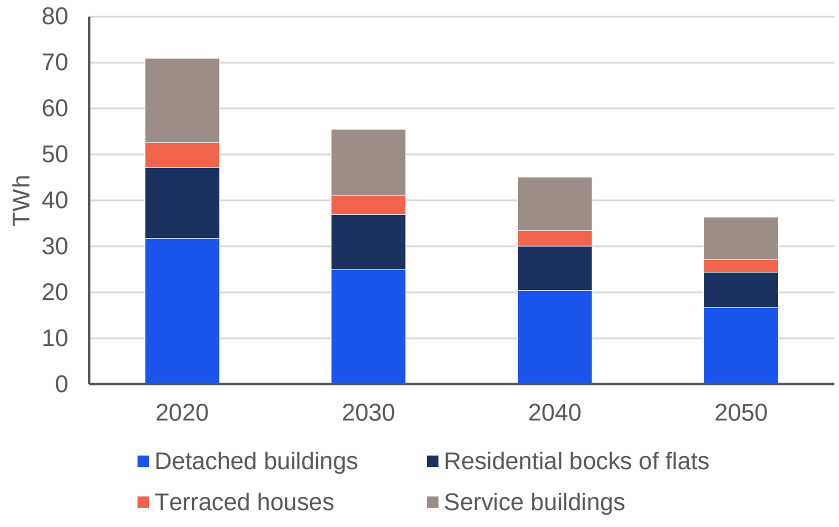
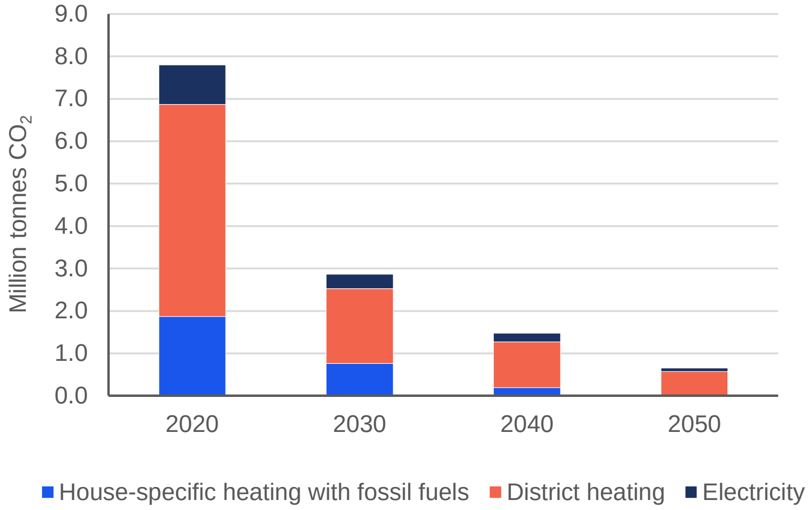


Figure 3.4-3 Heating and cooling energy use emissions (million tonnes CO_2)



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 emissions reductions due to improvements in energy performance in renovations and alterations will be 1.1 million tonnes of CO_2 annually in 2030. Most of the emissions reductions will take place in the EU ETS sector. However, there are expected non-ETS emissions reductions from oil fuel boiler replacements, especially in detached houses.

Emissions from building-specific heating have been declining in recent years, but annual variation occurs due to heating needs, for example. The main reasons for the declining trend in emissions from separate heating are the decrease in oil heating and improvements in the energy efficiency of buildings. The majority of emissions from separate heating results from oil heating. In 2022, emissions from separate heating amounted to 1.9 million tonnes of CO_2 eq. In 2022, residential buildings accounted for 36 per cent of emissions from building-specific heating, commercial and service buildings for 42 per cent and agricultural buildings for 22 per cent. Emissions from building-specific heating have decreased by 55 per cent from the 2005 level.

Emissions are expected to decrease further as a result of gradual renewal of the building stock, renovations and changes in heating systems. The obligation to distribute biofuel oil and the replacement of fossil oil heating with other forms of heating will have a significant impact on reducing emissions.

The phasing out of oil in residential properties has been promoted with subsidies for detached houses, which may be granted for costs arising from the removal and modification of the oil heating system and replacement with other heating systems. In summer 2022, the subsidy system for detached houses was extended to apply to phasing out natural gas heating, although its role is almost insignificant.

The subsidy for phasing out oil heating has significantly activated the replacement of heating systems. By August 2024, a total of 33,770 owners of detached houses had applied for aid for switching away from oil heating, of which more than 28,350 had received a favourable decision. A total of 1182 owners of detached houses had applied for grants for phasing out gas heating, of which 1083 had received a favourable decision. So far, when those who have received a favourable decision implement a heating method change, the estimated impact on annual emissions is approximately 0.19 million tonnes of CO_2 eq.

An alternative form of support for owners of detached houses to renew their heating system is income tax credit for household expenses, including the labour costs of phasing out oil heating. Since 2022, the credit has been up to EUR 3,500 per person per year, or EUR 7,000 per household with two adults.

The phasing out of oil heating in municipality-owned buildings and the transition to other forms of heating have been accelerated with grants since October 2020. Around 9,300 oil-heated buildings are owned by municipalities and municipal enterprises in Finland, of which around 4,300 are in use and around 5,000 are empty. However, even empty buildings often have to be heated. The grant accounts for 30 per cent of the costs approved and incurred in the grant decision. The grant will be increased by 5 percentage points if the municipality has acceded to a Voluntary Energy Efficiency Agreement.

Finland has decided to take measures of advice as an alternative to obligatory inspections of heating and air conditioning systems laid down in articles 14 and 15 of the EPBD. The coordinating advice programme (advice forum) covers almost all buildings and gather actors in energy efficiency agreements in the building sector. The annual impact is estimated to be 0.015 million tonnes of CO_2. This measure is however not included in the WM projection, as there is no detailed information on the impact of the measure on the energy balance. The latest EPBD recast has entered into force, so the previously mentioned decrees will soon be reviewed.

Machinery

Emissions from machinery can be reduced by increasing the energy efficiency of machinery or by switching to alternative fuels or power sources. An act to promote the use of biofuel in heating, machinery and stationary engines entered into force on 1 April 2019[53]. The act sets an obligation to supply light fuel oil with bioliquids so that the share of biofuels will increase from 3 per cent in 2021 towards 10 per cent in 2028.

The Ministry of the Environment and the Association of Finnish Technical Traders have a Green Deal for 2019–2025 on non-road mobile machinery to increase the share of fully electric and low-emission machinery. Through voluntary commitments made under this agreement, those operating in the sector will aim to increase the supply of fully electric and other low-emission non-road mobile machinery and encourage its wider use. The Ministry of the Environment, Senate Properties and the Cities of Espoo, Helsinki, Turku, and Vantaa have a voluntary Green Deal for 2020–2030 to reduce emissions at construction sites. As part of the implementation of the voluntary Green Deals in 2021, Motiva Oy, a hundred per cent state-owned sustainable development company in Finland, created a training package for non-road mobile machinery with funding and coordination from the Ministry of the Environment. The training package is freely available for operators in the non-road mobile machinery sector and it was further developed and updated in 2022–2023.

The conversion of tractors to use biogas is supported as an environmental investment through agricultural investment subsidies. Subsidies are available for modifications to enable biogas use and for the equipment involved, but not for purchasing the tractor itself. Modifications of diesel engines and accessory purchases to convert tractors and other agricultural machinery to biogas are eligible for a subsidy. The subsidy covers 35 per cent of eligible costs, including the cost of purchasing and installing new equipment.

[53] Government Decree 418/2019

There are also continuous efforts to improve the knowledge base of emissions calculations from non-road mobile machinery. With funding from the Ministry of Transport and Communications, the Ministry of the Environment and the Ministry of Finance, Statistics Finland is developing a new transport and construction machinery emission calculation system LIIKE. The purpose of the accounting system is to respond to growing reporting needs and to support decision-making related to climate action. The LIIKE calculation system with its models is planned to be completed by the end of 2024.

Customer energy advice

One main aim of the Action Plan for Energy Services in the Energy Efficiency Agreement scheme and Energy Efficiency Agreement for oil-heated buildings is to enhance their customer energy use. Energy advice actions have been running since the first agreement period starting in 1997. Customer energy advice is also one of the policy measures notified for Energy Efficiency Directive (EED, (EU) 2018/2002) article 7 implementation in Finland. When calculating energy savings for these behavioural measures based on advice services, only conservative one-year energy savings lifetime has been considered. Annual estimated energy savings are constantly around one terawatt hour per year, and the CO_2 emissions reduction is about 0.35 million tonnes per year.

Extensive energy advisory service, sharing information and best practices and training services are the means of information guidance to promote energy efficiency, to save energy, to increase the use of renewable energy, to promote demand response and to promote energy communities. Government-funded national energy advising network is the core of energy advisory services in Finland. Practically it is a one-shop-stop service. It is coordinated and led by Motiva and Energy Authority of Finland. The steering group covers the ministries in fields of energy, transport, environment, buildings, construction, agriculture, and finance. Municipalities and energy companies have an active role in the national energy advice network. The service of this network offers free guidance to all Finns. Consumers, companies and housing associations can contact either national energy advising or regional energy advisors.

The advising activities are versatile, including e.g., web services, active information and knowledge sharing, webinars, workplace activities, newsletters, online courses, information campaigns, announcements, media cooperation, podcasts, videos, and social media utilization.

Active sharing of best practices and updated information on improving energy efficiency in companies and municipalities is done in a network that covers all parties of energy efficiency agreements. Additional targeted advice (partly financed by certain trade unions) of improving energy efficiency is given to small and medium size companies that have signed the energy efficiency agreement.

Special attention in energy advising is also given to vulnerable consumers and consumers who are at risk of falling into energy poverty by e.g., active collaboration between regional energy advisors and social workers and with pensioner organizations. Special counsel by regional energy advice is targeted at municipalities, for example, on information of energy performance contracting, energy efficiency first principle and funding of energy efficiency investments.

National energy advisory service is complemented by online courses that contain learning materials of, for example, energy efficient construction, housing, and procurement, and by online services, that contain the whole recent comprehensive information and different web pages about national energy advisory service. The most essential are listed below.

- Energy Advice for Consumers – Motiva
  https://www.motiva.fi/en/home_and_household/energy_advice_for_consumers

- Regional energy councelling | Energy Authority
  https://energiavirasto.fi/en/regional-energy-councelling
- Kuluttajien energianeuvonta – Motiva
  https://www.motiva.fi/koti_ja_asuminen/asiaa_energiasta_-_kuluttajien_energianeuvonta
- Motivan muut verkkopalvelut
  https://www.motiva.fi/motiva/motivan_muut_verkkopalvelut
- Motivan verkkokurssit
  https://motiva-verkkokurssit.fi/

Planned policies and measures

The government is planning on a new subsidy for investments that contribute to the green transition. Each firm (including subsidiaries) could deduct taxes up to 20 per cent or EUR 150 million of an investment or investments that exceed EUR 50 million. At the time of writing, it is estimated that the subsidy would come into force in 2028 and last for 20 years. Preliminarily, almost all projects that cut greenhouse gases would be eligible except for electricity production but the exact criteria would be determined later according to the EU's state aid framework.

Summary of policies and measures

A summary of the policies and measures in the energy sector is presented in CTF Table 5.

3.4.3.2 Transport

Adopted and implemented policies and measures

This chapter focuses on measures related to road transport, although the biofuels distribution obligation also slightly reduces emissions from recreational boats. Measures related to shipping and air transport are described in Chapter 3.4.3.3, as they mainly concern international transport and bunker fuel emissions. In the projections, the maritime and aviation emissions are, nonetheless, reported in accordance with the CRF-classification of the greenhouse gas inventory.

In the effort sharing sector, transport offers the greatest potential for reducing emissions. The objectives and measures to reduce transport emissions in Finland are included in the Roadmap to Fossil-Free Transport (2021), the Medium-term Climate Change Policy Plan (2022) and National Climate and Energy Strategy (2022). The Medium-term Climate Change Policy Plan and the Roadmap to Fossil-Free Transport set a target to reduce transport emissions by at least half by 2030 compared to 2005 levels. The Roadmap to Fossil-Free Transport is also one of the reforms included in the Finnish Recovery and Resilience Plan (the original plan and the revised plan). Milestones and targets have been set for this reform in the plan and their achievement is linked to the payments from the RRF[54] instrument.

The emissions reduction measures fall into three categories:

1) Replacing fossil fuels with alternative transport fuels

The main measure in this category is the biofuel distribution obligation The current legally binding target is for renewable fuels to account for 34 per cent of all fuels consumed in road transport in 2030 and beyond. This would help avoid around 3 million tonnes of CO_2 emissions

[54] Recovery and Resilience Facility

in 2030. However, Finland has revised the gradually rising distribution obligation several times. For 2024, the target is 13.5 per cent instead of 28 per cent as stipulated by the legislation previously in force. A bill enabling inclusion of renewable electricity delivered at public charging stations in the distribution obligation is to be submitted to the Parliament in the autumn of 2024. The bill also proposes reduced distribution obligation shares for the years 2025–2027, as well as an adjustment of the required shares of advanced biofuels and new minimum shares for renewable fuels of non-biological origin. In addition to reducing fossil fuel consumption and emissions in transport, the distribution obligation can also increase fuel prices and thus further reduce transport emissions. When the distribution obligation is reduced during this government term, this emission reduction effect will temporarily decrease.

Other measures included in this category are the promotion of the infrastructure for electricity and biogas used in transport. In February 2024, the Ministry of Transport and Communications launched work to prepare a national programme for alternative transport fuels distribution infrastructure. The programme contains an updated assessment of the development of distribution infrastructure and market for fuels other than fossil fuels in road, rail, maritime and air transport. The programme sets objectives and presents measures that will promote the achievement of the objectives. The programme will promote the implementation of the AFIR Regulation[55] and be the basis for monitoring required by the Regulation. The programme[56] was published in November 2024.

Regarding the support mechanisms in place, there is a state-funded infrastructure support programme for alternative fuels infrastructure (electricity, biomethane, hydrogen). A total of approximately EUR 35 million was allocated to subsidies for 2022–2023. A total of EUR 10 million has been reserved for 2024. Decisions on further continuation of the programme have not yet been made.

In Finland, the construction of electric car charging points in housing associations has also been supported since 2018. From the beginning of 2022, subsidies began to be granted not only to housing associations, but also for electric car charging devices installed at workplaces. A total of EUR 32.5 million was allocated to charging subsidies for housing associations and workplaces for 2022–2023. There is no allocation for 2024 for this purpose. VTT Technical Research Centre of Finland (2020) estimates that in 2030, public charging infrastructure subsidies could reduce emissions by approximately 0.01–0.02 million tonnes of CO_2 eq. and recharging grants for housing companies and workplaces by approximately 0.02–0.1 million tonnes of CO_2 eq.

2) Renewal of the car fleet

According to the latest WM projection, there will be a total of approximately 925,000 electric cars (BEV[57] + PHEV[58]) and 2,400 electric trucks in Finland in 2030 and their number will continue to strongly increase towards 2040. The main measure in this category is the binding CO_2 threshold values applicable to automotive manufacturers at the EU level. The regulation strengthening the CO_2 standards for cars and vans was adopted in 2023 and the regulation strengthening the CO_2 standards for heavy-duty vehicles (HDVs) in 2024.

[55] Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU

[56] National programme for alternative transport fuels distribution infrastructure; Publications of the Ministry of Transport and Communications 2024:10; https://urn.fi/URN:ISBN:978-952-243-747-1

[57] a battery electric vehicle

[58] a plug-in hybrid electric vehicle

According to an estimate by VTT Technical Research Centre of Finland, the updated regulation on CO_2 emission performance standards for cars and vans will reduce the greenhouse gas emissions from transport by approximately 0.21 million tonnes of CO_2 eq. in 2030 and 1.0 million tonnes of CO_2 eq. in 2040 compared to the previous WM projection. The updated regulation on CO_2 emission performance standards for heavy-duty vehicles will reduce emissions by approximately 0.13 million tonnes of CO_2 eq. in 2030 compared to the previous WM projection.

In 2018, Finland introduced a purchase subsidy for battery electric vehicles and a conversion subsidy for converting an old car into an ethanol- or gas-powered car. The purchase subsidy for a battery electric car was EUR 2,000. The conversion subsidy for a gas-powered car was EUR 1,000 and the subsidy for an ethanol-powered car was EUR 200. These subsidies expired at the end of 2022. During the period 2018–2022, a total of EUR 37 million was directed to purchase (around EUR 35 million) and conversion (around EUR 2 million) subsidies in Finland. In 2024, the Ministry of Transport and Communications prepared a bill according to which it is still possible to apply for conversion subsidies during 2024.

A subsidy for purchasing gas-powered trucks was introduced in December 2020, and one for purchasing electric trucks and electric and gas-powered vans from the beginning of 2022. The purchase subsidy for a gas-powered truck is EUR 2,000–14,000 per vehicle and a subsidy for an electric truck is EUR 6,000-50,000 per vehicle. The subsidy for electric van is EUR 2,000–6,000 per vehicle and the subsidy for a gas-powered van is EUR 2,000 per vehicle. From the beginning of 2024, it is also possible to apply for a purchase subsidy (EUR 6,000–50,000 per vehicle) for hydrogen-powered trucks. During the period 2022–2024, a total of EUR 12 million have been directed to these subsidies.

According to an estimate by VTT Technical Research Centre of Finland, the subsidy for purchasing electric cars will reduce greenhouse gas emissions from transport by approximately 0.019 million tonnes of CO_2 eq. in 2030 and 0.011 million tonnes of CO_2 eq. in 2040. Purchase subsidies for electric and gas-powered trucks and vans would reduce emissions by around 0.009 million tonnes of CO_2 eq. in 2030 and 0.002 million tonnes of CO_2 eq. in 2040.

Finland also supports the electrification of transport through tax changes. The taxable value of zero-emission and low-emission company cars has been temporarily reduced until the end of 2025. In the spring of 2024, the Government decided to extend this reduction for zero-emission vehicles benefit into 2026–2029 while increasing the daily vehicle tax of battery electric vehicles and plug-in hybrids. The car registration tax on battery electric vehicles was abolished as of 1 January 2022, and this was compensated for by increasing the daily vehicle tax for battery electric vehicles. The total net effect of these tax changes on emissions is probably modest.

In 2027, a new Emissions Trading System for distributors (ETS2) will start in the EU. According to estimates made in Finland, the ETS2 will reduce traffic emissions by approximately 0.04–0.4 million tonnes of CO_2 eq. in 2030.

3) Improving the energy efficiency of the transport system

This category includes participation in the coordination of transport and land use in urban regions, as well as participation in transport system plannings through, for example, agreements on land use, housing and transport (MAL agreements). Other measures to improve the energy efficiency of the transport system include the investment programme for walking and cycling, discretionary government grants for public transport, making use of longer, heavier vehicle combinations (HCT, High Capacity Transport), and comprehensive EU-level emissions trading for road transport (ETS2).

During 2018–2023, a total of EUR 86.5 million have been directed to 248 projects in municipalities of different sizes from the investment programme for walking and cycling. During 2018–2023, a total of EUR 429.4 million have been granted as state grants to public transport authorities. The grants were allocated for the procurement of transportation services and include COVID-19 subsidies for the years 2020–2022. According to an estimate by the Finnish Transport and Communications Agency (2020), the investment programme for walking and cycling could reduce emissions by around 0.004 million tonnes/year and government grants for public transport by around 0.008 million tonnes/year. There is no separate assessment of the emissions reduction impacts of the MAL agreements. In addition, some changes were implemented in the taxation of fringe benefits from the beginning of 2021. Employer-subsidised commuter tickets are tax-free up to EUR 3,400 of the taxable value per year, and employer-provided bicycles are tax-free up to EUR 1,200 of taxable value per year.

The regulation related to the HCT vehicle combinations for road transport[59] was amended and entered into force in 2019 increasing the maximum length of combination to 34.5 metres. This will decrease kilometres driven when the same amount of goods can be transported with fewer vehicle combinations. HCT transport could reduce emissions by 0.06 million tonnes of CO_2 eq. in 2030 and 0.05 million tonnes of CO_2 eq. in 2040. In addition, the new emissions trading system (ETS2) will probably affect the number of kilometres driven and thereby reduce emissions.

The update of the National Transport System Plan (Traffic 12 plan) was launched in 2023. The Traffic 12 plan is a strategic plan for the development of Finland's transport system for 12 years according to the Act on the Transport System and Roads[60]. The plan includes an assessment of the current state of the transport system and changes in the operating environment, goals for the national transport system, and measures to achieve the goals of the programme. In addition, the plan includes a state funding programme and an impact assessment of the plan. The updated objectives are functionality, safety and sustainability. The action plan is currently under preparation and the agreements on land use, housing and transport are being negotiated. In the national transport system plan, sustainability will most probably be promoted by maintaining existing structures and networks and making their use more efficient.

Summary of policies and measures

A summary of the policies and measures in the transport sector is presented in CTF Table 5.

3.4.3.3 International bunkers

Adopted and implemented policies and measures

Finland has actively participated in the International Maritime Organization's (IMO) and International Civil Aviation Organisation's (ICAO) work to limit emissions from international transport.

Shipping

Related to maritime transport, the IMO adopted an Initial Strategy on the reduction of Greenhouse Gas (GHG) emissions from ships in 2018 and the 2023 IMO Strategy on Reduction of GHG Emissions from Ships in 2023. The main level of ambition of the 2023 IMO Strategy is that the GHG emissions from international shipping should peak as soon as possible and reach

[59] 729/2018
[60] 503/2005

net-zero GHG emissions by or around, i.e. close to, 2050. In addition, the 2023 strategy includes levels of ambitions that address the carbon intensity of international shipping and the uptake of zero and near-zero GHG technologies by 2030. In order to reach the levels of ambitions, the IMO is currently developing so-called mid-term measures comprising a goal-based marine fuel standard and a maritime GHG emissions pricing mechanism that will enter into force in 2027 according to the 2023 IMO strategy.

The EU MRV Regulation on monitoring, reporting and verification of carbon dioxide emissions from maritime transport entered into force in 2015 and was amended in 2023. Since 2018, the regulation has applied to ships greater than 5000 gross tonnage, irrespective of their flag, undertaking following voyages in EU and EFTA regions. It requires ships to monitor and report their CO_2 emissions, fuel consumption, transport work and average energy efficiency. Starting from 2025, the regulation covers also methane and nitrous oxide emissions from shipping, smaller general cargo ships, and offshore ships as a new ship type. In 2016, the IMO approved amendments to the Annex VI on Data Collection System (DCS) for the fuel oil consumption of ships of the International Convention for the Prevention of Pollution from Ships (MARPOL). Under the amendments, ships of 5,000 gross tonnage and above are required to collect consumption data for each type of fuel oil they use, as well as other additionally specified data including proxies for transport work. The aggregated data are reported annually to the flag State, which issues a Statement of Compliance to the ship. Flag States are required to subsequently transfer this data to an IMO Ship Fuel Oil Consumption Database. The IMO is required to produce an annual report for the MEPC, summarising the collected data. These measures were implemented in Finland's national legislation in 2021.

In 2021, the IMO adopted amendments to MARPOL Annex VI, which requires ships to reduce their GHG emissions. These amendments combine technical and operational approaches to improve the energy efficiency of ships, also providing important building blocks for future GHG reduction measures. The measures require all ships to calculate their Energy Efficiency Existing Ship Index (EEXI) by following technical means to improve their energy efficiency and establish their annual operational carbon intensity indicator (CII) and CII rating. Carbon intensity links GHG emissions to the amount of cargo carried over the travelled distance. Ships are rated for their carbon intensity (A, B, C, D, E – where A is the best). A ship rated D for three consecutive years, or E, is required to submit a corrective action plan to show how the required index (C or above) would be achieved. The new regulations on EEXI and CII are foreseen to be implemented in Finland's national legislation as of 2024.

Since 2024, the EU Emission Trading System is extended to ships of 5000 gross tonnage and above calling at European ports, regardless of their flag. The emissions from shipping will be phased in gradually. The shipping companies will have to surrender allowances for 40 per cent of their emissions reported for year 2024, for 70 per cent for year 2025 and 100 per cent from 2026 onwards.

Starting from 2025, the FuelEU Maritime regulation[61] sets maximum limits for the yearly average GHG intensity of the energy used by ships above 5000 gross tonnage calling at European ports, regardless of their flag. The level of required reduction will increase gradually reaching up to 80 per cent reduction by 2050 compared to the reference value of 91.16 grams of CO_2 equivalent per MJ. In addition, starting from 2030, container and passenger ships moored at the quayside in an EU port should use on-shore power supply or zero-emission technologies

[61] Regulation (EU) 2023/1805 of the European Parliament and of the Council of 13 September 2023 on the use of renewable and low-carbon fuels in maritime transport

which comply with the requirements provided for in the regulation, for all their electrical power demand at berth.

Aviation

The 2010 ICAO Assembly adopted the existing global aspirational goals for the international aviation sector of 2 per cent annual fuel efficiency improvements and carbon neutral growth from 2020. At the ICAO Assembly in 2016, a global Carbon-Offsetting and Reduction Scheme for International Aviation, CORSIA, was adopted. With this decision, aviation became the first industrial sector to have a global market-based measure scheme in place. Under CORSIA, all operators conducting international flights are required to monitor and verify the CO_2 emissions from these flights, and to report the related information to their State of registration. Aircraft operators offset the growth of emissions in international civil aviation by purchasing CORSIA's approved emission units, mainly originating from emission reduction projects in other fields, on the carbon market. The compensation obligation is calculated annually by comparing the emissions generated on the routes between CORSIA member states to the baseline, which is 85 per cent of 2019 emissions during 2024–2035 and by reducing the potential use of CORSIA-eligible fuels.

The 41st ICAO Assembly in 2022 adopted a long-term global aspirational goal (LTAG) for international aviation of net-zero carbon emissions by 2050 in support of the UNFCCC Paris Agreement's temperature goal. In order to advance towards carbon-neutrality, the ICAO Conference on Aviation and Alternative Fuels (CAAF/3) in 2023 agreed on increasing sustainable aviation fuels, low-carbon aviation fuels and other cleaner energy sources so that carbon dioxide emissions will decrease by five per cent by 2030. This is compared to a situation where these types of fuels are not used. The target is global and non-binding. Member states submit every three years state action plans on reduction of CO_2 emissions from international aviation. Finland's 5th Action Plan to Reduce CO_2 Emissions from Aviation was submitted to the ICAO in 2021 and the updated Action Plan will be completed by the end of 2024.

The EU Emissions Trading System (EU ETS) currently applies to aviation and covers all intra-European Economic Area flights. As a member of the European Union, Finland has participated in the EU ETS from its out-set. The EU Emissions Trading System has generally been seen as a cost-effective way to reduce emissions from the activities it covers, as it provides a better incentive to reduce emissions and improve energy efficiency than through air passenger taxes, for example. On the other hand, the system enables additional purchases of emissions rights if it will be very expensive or impossible to reduce emissions by means of new technology, for example. The Commission has estimated that the EU ETS has reduced aviation CO_2 emissions in total by more than 17 million tonnes per year.

The EU Emissions Trading System (EU ETS) Directive was revised in 2023, with a goal of resulting in an overall emissions reduction of 62 per cent in the sectors concerned by 2030 compared to 2005. Several key provisions of the Directive were strengthened and the scope of the scheme extended. Aviation has been included in the EU ETS since 2012, and it applies to flights between airports in the European Economic Area. During aviation's third emissions trading period's first years in 2021–2023, the total number of emissions allowances was reduced annually with a linear reduction factor of 2.2 per cent. Starting from 2024, the linear reduction factor tightened to 4.3 per cent and for the years 2028–2030 it will be 4.4 per cent. CORSIA will be integrated into the EU ETS and will be implemented in it. For the aviation sector[62], free allocation of emission allowances will be removed as of 2026.

[62] https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-aviation_en

The ReFuelEU Aviation Regulation[63] aims to ramp up the production and deployment of renewable and low-carbon fuels. The ReFuelEU Aviation regulation includes a blending obligation for sustainable aviation fuel (SAF) and a sub mandate for synthetic aviation fuel beginning 1 January 2025. Aviation fuel suppliers at EU airports will gradually increase the share of SAF blended with conventional aviation fuel. Aircraft operators departing from EU airports must refuel with the aviation fuel necessary to operate the flight. This avoids the excessive emissions related to extra weight and minimises the risks of carbon leakage caused by so-called 'tankering' practices. EU airports must facilitate access to the necessary infrastructure to deliver, store and refuel aircraft with SAF.

According to the AFIR Regulation[64], all airports of the TEN-T[65] core network and TEN-T comprehensive network shall ensure the provision of electricity supply to stationary aircraft by 31 December 2024 at all aircraft contact stands and by 31 December 2029 at all aircraft remote stands used for commercial air transport operations. By 2030 Member States shall ensure that the electricity supplied originates from the electricity grid or is generated on site without using fossil fuels. Member States may exempt airports of the TEN-T network with fewer than 10,000 commercial flight movements per year, averaged over the last three years, from the obligation to supply electricity to stationary aircraft at all aircraft remote stands.

Planned policies and measures

The Black Carbon (BC) emissions also have a large impact on climate change, especially in the polar regions, and Finland is committed to decreasing black carbon emissions. Accordingly, the Finnish Transport and Communications Agency Traficom with the Finnish Meteorological Institute (FMI), and VTT Technical Research Centre of Finland Ltd have been conducting studies to test the candidate measuring methods and collect data on black carbon emissions from shipping. The results of these studies have been introduced at the IMO. In 2021, the IMO adopted a resolution urging Member States and ship operators to voluntarily use distillate or other cleaner alternative fuels or methods of propulsion safe for ships and could contribute to the reduction of black carbon emissions when operating in or near the Arctic and report on measures and best practices to reduce black carbon emissions from shipping. In February 2024 the PPR[66] 11 Meeting of IMO prepared draft Guidance on best practice on recommendatory goal-based control measures to reduce the impact on the Arctic of Black Carbon emissions from international shipping and the associated draft MEPC[67] resolution, with a view to adoption at the MEPC 82 Meeting in October 2024. The PPR 11 Meeting also developed draft Guidelines on recommendatory Black Carbon emission measurement, monitoring and reporting and the associated draft MEPC resolution, with a view to adoption at the MEPC 82 Meeting.

Within the EU ETS for aviation, a MRV (monitoring, reporting and verification) system for non-CO_2 aviation effects will apply from 1 January 2025, calculating CO_2 equivalent per flight. By the end of 2027, the Commission will deliver a report on the results and if appropriate, will make a legislative proposal to address non-CO_2 effects of aviation.

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[63] Regulation (EU) 2023/2405 of the European Parliament and of the Council of 18 October 2023 on ensuring a level playing field for sustainable air transport (ReFuelEU Aviation)

[64] Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure

[65] the trans-European transport network

[66] Sub-Committee on Pollution Prevention and Response

[67] Marine Environment Protection Committee

In February 2024, the Ministry of Transport and Communications launched work to prepare a national programme for alternative transport fuels distribution infrastructure. The programme contains an updated assessment of the development of distribution infrastructure and market for fuels other than fossil fuels in maritime and air transport. The programme sets objectives and presents measures that will promote the achievement of the objectives. The programme will promote the implementation of the AFIR Regulation and be the basis for monitoring required by the Regulation. The programme will be completed by the end of 2024.

Summary of policies and measures

A summary of the policies and measures for the international bunkers is presented in CTF Table 5.

3.4.3.4 Industrial processes and product use

Adopted and implemented policies and measures

The most important greenhouse gas emissions from industrial processes are CO_2 emissions from iron and steel, hydrogen and cement production. The main factors affecting the development of these emissions have until now mainly included changes in industrial production activity. However, one can observe a clear change today, in which the manufacturing industry is actively seeking low-carbon technology alternatives and has significantly reduced the process emissions. This is typically not the result of a single measure but several measures strengthening the overall feasibility of new technology investments.

In the WM projection, the growth of industrial production increases emissions, while technology changes reduce them. Most of the industrial process emissions reported in this sector are part of the EU ETS, which is also the main measure for reducing process emissions. The steep rise in EU ETS prices with lower electricity tax, new investment grants and increased climate awareness are motivating manufacturing industry to reduce the process emissions. The measures are the same as those for reducing the energy-sector emissions and a description of them can be found in Section 3.4.3.1. No additional measures targeting CO_2 emissions from industrial processes are planned.

The policies and measures described in this chapter therefore only address measures related to F-gases.

F-gases

The share of F-gas emissions (HFCs, PFCs and SF_6) was two per cent of the total greenhouse gas emissions in 2022. Emissions of NF_3 are not occurring in Finland. F-gases are emitted from various applications that use these industrial gases, which are highly harmful to the climate. More than 90 per cent of the emissions originate from the use of F-gases as refrigerants in refrigeration and air-conditioning equipment. Most of the emissions are HFC emissions and they increased heavily from the early and mid-1990s when they were introduced as substitutes for ozone-depleting substances in many applications. From the peak year 2008, emissions have by now decreased by more than 40 per cent. PFC emissions are very low, and they have decreased significantly from the peak level in late 1990s. SF_6 emissions are also low (four per cent of the total F-gas emissions in 2022) and the peak level of SF_6 emissions occurred in the early and mid-1990s. The level of emissions has since decreased mostly due to electricity distribution industries' voluntary actions. However, there is fluctuation in the total annual emissions level due to the use of SF_6 in specific applications in which the consumed amount of SF_6 varies year-on-year. F-gases are not produced in Finland.

The existing measures will reduce HFC emissions, and therefore the total F-gas emissions, efficiently. The most important legislation affecting the use and emissions of these gases is the EU F-gas regulation[68]. In addition, the so-called EU MAC Directive (Mobile Air-Conditioning Directive[69]) prohibits the use of HFCs with a GWP higher than 150 in air conditioning systems in passenger cars and light commercial vehicles. Technical development has also affected the development of emissions. The main features of the F-gas regulation in cutting F-gas emissions are a phase-down of F-gases that can be placed on the EU market, bans on the use of F-gases in certain applications and obligations related to leak checking and repairs, F-gas recovery and technician training. These measures will lead to a replacement of F-gases with natural and other low GWP alternatives in most applications.

A slight increase is expected in SF_6 emissions until 2035 due to the increased use of SF_6 in electricity distribution equipment. However, the restrictions introduced in the EU F-gas regulation[70] for the use of SF_6 in electricity distribution equipment will stop the increase of emissions after 2035.

Planned policies and measures

F-gases

As additional measures to little speed up the emissions reductions, accelerated transition to natural refrigerants and the lifecycle management of refrigerants will be promoted through information and regulatory policies. The measures will include updating the criteria for public green procurement, promoting the harmonisation of norms and standards related to building services and building regulations in a direction that enables natural refrigerants. In addition, a report for a national plan for the lifecycle management of refrigerants will be prepared and opportunities to promote producer responsibility and systemic promotion of the circular economy will be explored.

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 5.

3.4.3.5 Agriculture

Adopted and implemented policies and measures

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 to have profitable domestic production and make agriculture sustainable and multifunctional. The objectives of sustainable and multi-functional agriculture include taking greenhouse gas emissions, the possible need for adaptation measures, and other environmental and socioeconomic aspects into account. These objectives can be reached through the Common Agricultural Policy (CAP) of the EU, as well as through national measures. According to conclusions of the European Council, agricultural production should continue in all areas of the Community.

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[68] 573/2024
[69] 2006/40/EC
[70] (573/2024)

The starting point of agriculture emissions projection is that domestic food production will be secured and maintained at the current level, and mitigation policies will be implemented where the most cost-effective reduction potential exists. Some of the effective climate policy measures may conflict with other agricultural policy objectives and measures such as securing the availability of food, animal welfare, and the biodiversity of rural areas. 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.

Agricultural greenhouse gas emissions come from dispersed biological emission sources, which makes reducing them more complicated than in many other sectors. It is worth noting, though, that agricultural land is not just a source of greenhouse gas emissions but may also sequester atmospheric carbon into soil. Favourable cultivation practices, such as plant cover in winter, perennial grassland and reduced soil tilling, can make this possible.

The current measures in the agricultural sector are mainly related to the implementation of the EU's Common Agricultural Policy (CAP). The new CAP period from 2023 to 2027 began in January 2023. The main tasks of Finland's CAP Strategic Plan (CSP) include safeguarding active food production, climate and environmental sustainability in agriculture and strengthen the vitality of regenerating rural areas. However, in its CAP strategic plan, each EU country is obliged to display a higher ambition on environment and climate action compared to the previous programming period. Each country is also required to update the plan when climate and environmental legislation is modified. The aim is that 40 per cent of the total EU funding for CAP measures will be allocated to climate measures at the EU level. Member States are obliged to allocate 35 per cent of the rural development funds to environmental and climate measures at the national level. In addition to this, at least 25 per cent of the budget for direct payments is allocated to eco-schemes, providing stronger incentives for climate- and environment-friendly farming practices and approaches.

Hence, compared to the previous programming period, the Finnish CAP Strategic Plan has increased the environmental and climate ambition. According to the environmental impact assessment of Finland’s current CSP, greenhouse gas emissions from agriculture would decrease by around 0.8 million tonnes CO_2 eq. per year compared to the previous CAP funding period.

Finland's CAP Strategic Plan includes measures that, in addition to their impacts on water bodies, also contribute to increasing and preserving carbon in soil. The emission reduction impact will affect both the land use sector and the agricultural sector. These measures include turning cleared areas permanently into grassland, catch crops, soil improvers and renovation plants, subsidies for grasslands and fallows (including grasses on peat fields), investments in controlled subsurface drainage and their management, and establishing and managing wetlands (including managed climate wetlands). An investment subsidy is also available for more efficient storage, treatment and use of manure and for investments in energy efficiency and sustainable energy, such as biogas plants. The advisory services in the programme offer advice on energy efficiency and issues related to the mitigation of and adaptation to climate change.

Since it is neither possible nor appropriate to implement all climate change mitigation or adaptation measures in agriculture through the EU’s Common Agriculture Policy, national measures are also required. These measures are identified in the Medium-term Climate Change Policy Plan and in the Climate Plan for the Land Use Sector. The Medium-term Climate Change Policy Plan is currently under revision and the new version will be published in 2025. The emissions reduction measures proposed in the current Medium-term Climate Change Policy Plan related to land use change include restricting the clearing of fields, restricting the transfer of previous peat production areas into agricultural use, the afforestation of wasteland and the conversion of agricultural land into climate wetlands. Measures related to arable land use include the cultivation of wet peatlands (paludiculture), adding carbon to fields by cultivating grass instead of annual crops, and introducing precision farming methods. In addition, efforts are made to reduce methane emissions from dairy cows through feeding methods.

The Medium-term Climate Change Policy Plan has also highlighted a number of measures that are likely to reduce greenhouse gas emissions from agriculture in the future but for which the emission impact cannot be calculated at the moment. Such measures include improving the real estate composition of fields, changes in the age structure of cattle, increasing use of gender-selected semen, improving carbon sequestration with various soil improvers, increasing compliance with nutrition recommendations, reducing food waste, developing public procurements, promoting carbon markets, and deepening cooperation between stakeholders in the food system.

The Climate Plan for the Land Use Sector complements the climate measures targeted at agricultural peatlands. Alternative measures include raising the groundwater level on peaty arable land to prevent peat decomposition, the promotion of perennial grasslands without tilling and converting agricultural land into managed wetlands (when the area would no longer be used for agricultural production). These measures targeted at agricultural soils also reduce CO_2 emissions in the land use, land-use change and forestry (LULUCF) sector. The EU Restoration Law and the upcoming national restoration plan will also set new targets and requirements for peatlands in the coming years. The concrete policy measures will be identified at the national restoration plan during 2024–2026.

Finland does not have a separate strategy for reducing methane emissions but addresses them as part of the sectoral strategies. Agriculture is the biggest source of methane emissions in Finland (in 2023, approximately 49 per cent of CH_4 emissions in Finland originated from agriculture, including enteric fermentation and manure management). In the agriculture sector, methane emissions mostly depend on the number of domestic animals. The expected reduction in the number of bovine animals also reduces the methane emissions from their digestion. In addition, the reduction in the number of bovine animals and pigs will reduce the emissions from manure processing.

Enteric methane emissions from ruminants can be reduced by changing the feeding practices for dairy cows. Using rapeseed cake in the feeding of dairy cows can reduce methane emissions by approximately 10 per cent per litre of milk if the cows are fed predominantly roughage, i.e. grass. However, as more than 40 per cent of the feed of dairy cows is concentrated feed, rapeseed cake would mostly replace the currently widely used rapeseed meal, and the actual reduction in methane emissions would probably be 3–5 per cent per cow.

Of the feed additives that reduce enteric methane production, research has advanced furthest with regard to 3-NOP (3-nitrooxypropanol), which has been approved in the EU as a feed additive for dairy cows and cows for reproduction. In the best-case scenario, this additive may reduce methane emissions from dairy cows by up to 25 per cent, but at the same time, it entails a permanent cost to farmers.

The Ministry of Agriculture and Forestry is funding studies and projects to develop feeding solutions applicable for Finnish grass roughage based feeding that reduce greenhouse gas emissions from the enteric digestion of bovines. The projects aim to find solutions for reducing greenhouse gas emissions related to cattle feeding in Finnish feeding systems and, in particular, enteric methane emissions produced in rumen fermentation. The projects also aim to enhance knowledge about the means for reducing emissions that are already available or will be introduced within the next 5–10 years, as well as incentives and steering instruments through which the introduction and use of such means can be promoted. The projects started in autumn 2022.

The Government has strongly highlighted the role of manure management and nutrient recycling as part of the overall sustainability of agricultural production. Various incentive schemes are available for research, experiments, advice and investments and operating in streamlining manure management and nutrient recycling. The purpose is to create the conditions for an organic fertiliser market that functions well and thereby to ensure efficient recycling and use of nutrients. An experimental nutrient recirculation programme has run since 2016. The support scheme for biogas investments and new manure processing techniques was launched in December 2020. Another subsidy scheme (operating aid for nutrient recycling) for the production of biogas based on nutrient cycles was launched in April 2024.

Ammonia is to some extent involved in greenhouse gas emissions because part of the ammonium nitrogen landing on the ground is transformed into nitrous oxide. International treaties and EU legislation oblige Finland to reduce its ammonia emissions into the air. Approximately 90 per cent of Finland's ammonia emissions originate from agricultural sources. The most effective measures for reducing ammonia emissions from agriculture involve manure, its storage and its application. Ammonia emissions can also be reduced by measures involving the feeding of domestic animals, but these measures are more difficult to regulate, and their impact more difficult to assess, than measures related to the management of manure.

In addition to the measures referred to above, many other factors may help reduce greenhouse gas emissions from agriculture by 2035. However, the magnitude remains difficult to estimate. For example, gender-selected semen is a relatively new technology. The goal is to reduce the number of male dairy calves and increase the share of faster-growing dairy-beef crossbreed calves among dairy cattle. More research is needed on the use and effects of gender-selected semen, but the method is already rapidly gaining popularity.

The Medium-term Climate Change Policy Plan highlights the reduction of edible food waste and promotion of eating in accordance with nutrition recommendations as measures related to food consumption. Finland's National Waste Plan sets the target of halving food waste by 2030. The Finnish Waste Act[71] and the Government Decree on Waste[72] lay down further provisions on how food sector actors must keep records of the amount and treatment of food waste generated in their activities.

New Nordic nutrition recommendations were published in 2023. For the first time, the Nordic nutrition recommendations contained scientific recommendations on a healthy and ecological diet. The recommendations emphasise a more plant-based diet, increasing fish consumption and reducing meat consumption. The Finnish nutrition recommendations are based on the Nordic nutrition recommendations. The national nutrition recommendations are currently being updated and will be published in November 2024.

A shift towards more plant-based consumer diet will change agricultural production and land-use in a direction with lower emissions, but the concrete climate impact is difficult to estimate. Despite the national dietary change, the reduction of greenhouse gas emissions may be slow if exports of dairy products increase due to strong global demand and prices. Then structural development and productivity will progress, and the change in production and land use will remain small. Whether consumers reduce their consumption of meat and dairy products as assumed in the scenario depends on the development of consumers' taste and eating habits. When implemented, a more plant-based diet will significantly reduce emissions from livestock production and, together with land use measures, it will also give the opportunity to reduce emissions from cropland, which are currently around 75 per cent of total agricultural emissions.

[71] 646/2011
[72] 978/2021

As part of Prime Minister Petteri Orpo's Government Programme, the Ministry of Agriculture and Forestry is currently preparing a long-term strategy for Finnish food production. The strategy work will create a vision of what kind of food system Finland will have in 2040, which measures are needed to achieve the vision, and what kind of agricultural changes Finland should be prepared for. The strategy will also take into account perspectives related to climate change. The Finnish Government is committed to improving the sustainability of the Finnish food system and doubling food exports by 2031. To strengthen the national vision and enhance the appreciation of agricultural producers, the long-term strategy for domestic food production will be drawn up in parliamentary cooperation.

Summary of policies and measures

A summary of the policies and measures in the agriculture sector is presented in CTF Table 5.

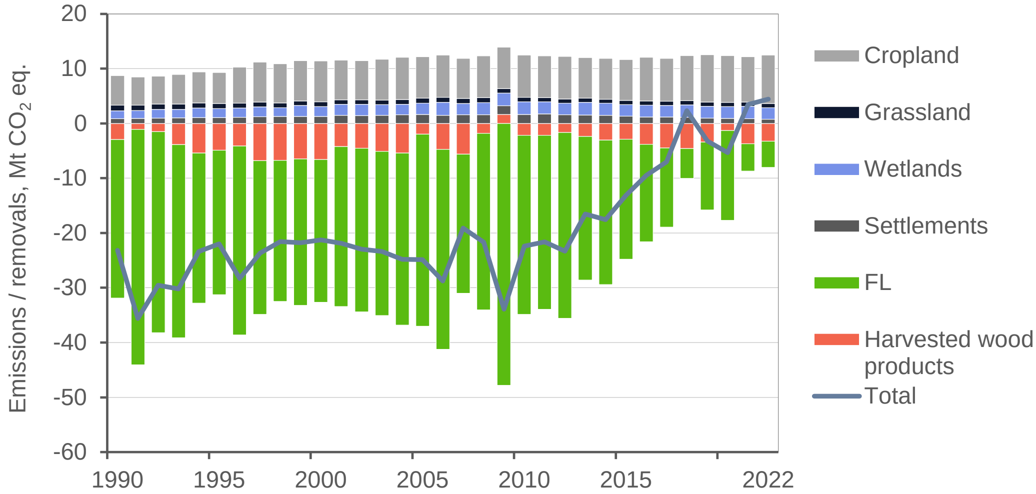
3.4.3.6 Land use, land use change and forestry

Adopted and implemented policies and measures

Forests are Finland’s largest carbon sink. Forest stand biomass growth binds more carbon than is released into the atmosphere as a consequence of felling and natural drain. The size of the net sink of forests varies from year to year, particularly due to felling, whereas factors that influence felling volumes include the market situation of forest industry products, and demand for energy wood. The highest emissions come from the soil of drained peatlands in forests and on cropland. In addition, smaller emissions are generated by treated wetlands, including peat production areas or unsuccessfully drained forest areas or drained forest areas without drainage repair that have transformed into wetlands again. Forest fires, prescribed burning and restoration burning as well as nitrogen fertilisation of forests, generate minimal emissions.

The overall LULUCF sector has for many years been a net sink in Finland because its emissions have been smaller than the removals. However, this net sink from the LULUCF sector can significantly vary year to year. The first indicators regarding the LULUCF sector turning into a source of emissions instead of a net sink were seen in the Statistics Finland’s preliminary data in spring 2022. In December 2023, the national inventory data revealed that the LULUCF sector had been a source of emissions for the first time already in 2018 (Figure 3.4-4). These changes in the net sink level compared to previous estimates of the level of emissions and removals in the LULUCF sector can be explained by the improvement of GHG inventory calculation methods, and by the decreased growth of forests and changes in logging volume. Ending wood imports from Russia has also increased the demand for domestic raw wood.

Figure 3.4-4 Historical (1990 to 2022) greenhouse gas emissions and removals in the LULUCF sector



The Climate Plan for the Land Use Sector was prepared in 2022 and it specifies how climate emissions from the land use, land-use change and forestry sector can be reduced, and carbon sinks and reservoirs strengthened. The aim of the plan is to achieve an annual net impact of at least 3 million tonnes of CO_2 eq. by 2035. To ensure that this target is achieved, the Natural Resources Institute Finland Luke was commissioned to produce a new estimation with updated inventory numbers at the beginning of 2024, which indicated that the target of three million tonnes would be achieved.[73] This will also contribute to Finland's EU LULUCF target for 2030. A monitoring system for the Climate Plan for the Land Use Sector is currently under preparation and will be introduced by the end of 2024. The aim of this monitoring system is to measure and identify the concrete amount of emission reduction achieved per year under the Climate Plan for the Land Use Sector. The monitoring systems also tries to capture those small-scale climate measures that aren't visible in the national GHG inventory.

The Climate Plan for the Land Use Sector brings together more than 30 different climate measures, such as the updated ownership policies of the State Forests (Metsähallitus), the ash fertilisation of peatland forests, and the Act on Fixed Term Support for Afforestation, the latter having ended in December 2023. It also outlines measures in following categories: resource-efficient land use and land-use change; climate-resilient use of peatlands; other measures to promote carbon sequestration and carbon storage; and crosscutting measures. In addition to the measures presented above, the measures focus on, for example, actions in peatland fields and forests, the development of carbon markets, swift and timely forest regeneration, increasing the amount of dead wood for climate and biodiversity perspectives, promoting training and expertise, and communication. The most effective measures have been identified in halting deforestation and promoting actions in peatlands. Preliminary climate impacts of the measures listed in the Plan are presented below in Table 3.4-3. However, it should be noted that currently there is no national funding outside CAP measures for paludiculture/rewetting peatlands. Also,

[73] Natural Resources Institute Finland (LUKE) 2024: http://urn.fi/URN:ISBN:978-952-380-869-0

the national funding for fixed-term support for afforestation ended in December 2023. A mid-term assessment of the Climate Plan for the Land Use Sector is planned to start in 2025.

Table 3.4-3 Preliminary climate impacts in 2030 and 2035 of the measures presented in the Land Use Sector Climate Plan, in million tonnes of CO_2 eq.

Measure	Area	Climate impact in 2030	Climate impact in 2035
New ownership policy decisions concerning Metsähallitus		0.4 Mt CO_2 eq.	0.7–0.9 Mt CO_2 eq.
Preventing the conversion of forests into fields	About 1,700–1,900 ha per year		0.5 Mt CO_2 eq.
Act on fixed-term support for afforestation	3,000 ha per year, of which 40% in peat production areas	0.09 Mt CO_2 eq.	0.11 Mt CO_2 eq.
Afforestation of low-yield arable land	9,000 ha in 2024–2028	0.08 Mt CO_2 eq.	0.09 Mt CO_2 eq.
Raising the groundwater level in peaty agricultural lands (cropland on grass) −30 cm	2030: 20,000 ha 2035: 32,500 ha	0.132 Mt CO_2 eq.	0.215 Mt CO_2 eq.
Paludiculture, groundwater level −30 cm	2030: 5,000 ha 2035: 10,000 ha	0.046 Mt CO_2 eq.	0.093 Mt CO_2 eq.
Paludiculture, groundwater level −5 – −10 cm	2030: 2,500 ha 2035: 5,000 ha	0.052 Mt CO_2 eq.	0.105 Mt CO_2 eq.
Managed wetlands (no longer in agricultural use)	2030: 4,000 ha 2035: 7,500 ha	0.081 Mt CO_2 eq.	0.151 Mt CO_2 eq.
Perennial cropland on grass without tilling	2030: 40,000 ha 2035: 40,000 ha	0.081 Mt CO_2 eq.	0.081 Mt CO_2 eq.
Rewetting of low-yield, thick peaty arable land into wetlands	2030: 10,000 ha 2035: 10,000 ha	0.202 Mt CO_2 eq.	0.202 Mt CO_2 eq.
Comprehensive planning of peatland forest management (avoidance of remedial ditching)	-	-	-
Comprehensive planning of peatland forest management (continuous cover forestry)	6,000 ha per year	0.21 Mt CO_2 eq.	0.21 Mt CO_2 eq.

Measure	Area	Climate impact in 2030	Climate impact in 2035
Ash fertilization of peatland forests	26,000 ha per year	0.18 Mt CO_2 eq.	0.40 Mt CO_2 eq.
Promotion of forest fertilization on mineral soils	25,000 ha per year	0.46 Mt CO_2 eq.	0.28 Mt CO_2 eq.
Increasing carbon stocks of decaying wood in commercially utilised forests by leaving trees for biodiversity and climate reasons	-	-	-
Total		**2.01 Mt CO_2 eq.**	**3.14–3.34 Mt CO_2 eq.**
Source: Natural Resources Institute Finland 2022			

In July 2022 the Finnish Government approved the first Climate Plan for the Land Use Sector and as a result of the changed situational picture of the Finnish LULUCF sector, the following additional actions were decided upon:

- Start legislative work to prepare for a land use change fee. However, the preparation couldn’t be completed before the parliamentary elections in spring 2023. Impact assessment was carried out in autumn 2023.
- Set as one of the objectives of the National Forestry Strategy 2035 the maintenance and increase of the carbon sink. Also set as an objective the promotion of the achievement of the carbon sink and emission targets of the Climate Act and the EU's LULUCF targets.
- Implement the METKA (Act on Temporary Forestry Incentive Scheme) scheme, which supports climate-friendly forest management. The act came into force at the beginning of 2024.
- Carry out a climate assessment study of the Forest Act and identify measures in the Forest Act that could promote sink growth in the short and long term.
- Analyse the reasons why the land use sector has become a net source of emissions and what this means in terms of meeting the 2021–2025 EU LULUCF target.

In line with Prime Minister Petteri Orpo’s Government Programme, a package of forestry measures (‘First Aid Kit for Forest Growth’) will be prepared during 2024 by the Ministry of Agriculture and Forestry to strengthen the growth of forests and carbon sequestration. The aim of the package is to gather and define actions that have already been initiated and that are to be initiated by industry and government actors, as well as to propose new measures. The goal is to find possible and acceptable additional measures, so that the goals of Finland’s Climate Act and the LULUCF obligations can be achieved, and so that the conditions for the sustainable use of forests can be ensured. In addition, the package includes an assessment of the cost-effectiveness and climate effectiveness of the measures in different time spans to the extent possible. No quantitative goal has been set for the package.

Organic soils are the main source of CO_2 emissions in the LULUCF sector. The CAP Strategic Plan for 2023–2027 and the Climate Plan for the Land Use Sector both include measures for climate-resilient use of peatland fields, such as raising the ground water level in peatland fields to prevent the decomposition of peat, establishing managed climate wetlands and perennial grassland on peatland. One of the policy measures in the Climate Plan for the Land Use Sector is the preparation of a roadmap for the use of peatland fields. The roadmap is currently under preparation and it will be published by the end of 2024. In addition to these measures, the Ministry of Agriculture and Forestry is currently piloting market-based competitive tendering for rewetting peatlands and performance-based funding models for carbon sequestration. These new measures are part of Finland's increased contribution to meet the EU's climate targets.

The size of the managed forests sink depends mainly on the forest growth and harvesting rates, which result from the global demand for housing and packaging, for example. The National Forest Strategy[74] was revised in 2022 and implementation of it began at the beginning of 2023. The National Forest Strategy 2035 is a coordinating strategy for the whole sector that brings together people, the environment and the economy. The strategy takes into account the principle of comprehensive sustainable development and the important role of forests in climate change mitigation and adaptation. The objectives of forest use have been reconciled in the National Forest Strategy 2035. Active forest management and use will maintain the forests' health and ability to grow, which is a basic requisite for their capacity to bind carbon. The current National Climate and Energy Strategy also emphasises the importance of enhancing the implementation of the National Forest Strategy, especially of maintaining good forest health and strengthening the growth and carbon capture capacity of the forests in the long term.

A significant source of emissions in the land use sector is the clearance of forest for other land use purposes, mainly as a result of civil engineering, construction and clearing land for agricultural use. Finland is the most forested country in the EU, and estimates indicate that the potential for reforestation is limited. Act on fixed-term support for afforestation was in force in 2021–2023. The objective of the Act was to increase the forest area and carbon sinks by supporting afforestation and to reduce greenhouse gas emissions on sites to be afforested without weakening biodiversity. The EU Deforestation Regulation entered into force in June 2023. The regulation will most likely decrease deforestation caused by agriculture in the coming years, especially as it hinders the clearing of forest for grazing. Public financing for private forest owners has in previous years been around EUR 48–60 million euros annually. Financing instruments until the end of 2023 were Act on the Financing of Sustainable Forestry[75] and Act on fixed-term support for afforestation. From 2024 onwards the Act on Temporary Forestry Incentive Scheme has been in force. Also, the management fees for afforestation made between 2021–2023 will continue until 2033. The general objectives of forestry financing is to increase the growth of forests, maintain road networks for forestry purposes, secure forest biodiversity and promote the adaptation of forests to climate change. Nature management in commercial forests is promoted through environmental support and forest nature management projects. Private forest owners themselves invested around 200 million euros in 2022 for forest management and improvement work.

To tackle the challenging ongoing situation in the LULUCF sector, the Prime Minister Petteri Orpo's Government carried out an impact assessment of a proposal for a fee for land use change in 2023. According to the assessment, a potential fee for land use changes could decrease land clearing by around 2,000 hectares in agriculture and 1,000 hectares in the built environment. The potential emissions reduction by 2030 would be 0.59 million tonnes of CO_2 eq. and 0.74 million tonnes of CO_2 eq. by 2035. However, no political decision has been made on implementation or on continuation of the preparation.

The Catch the Carbon government programme is a concreate example of an innovative policy instrument advancing climate measures in the LULUCF sector since its launch in 2020. The programme is due to close by the end of 2024. Close to 200 individual research, development

[74] The National Forest Strategy 2035. http://urn.fi/URN:ISBN:978-952-366-748-8

[75] 34/2015

and innovation projects have been funded under this programme. The aim of the overall programme has been to reduce greenhouse gas emissions both in the LULUCF sector and in agriculture and also to enhance carbon sinks and reservoirs. The final climate impact of these projects is difficult to assess. The project results and lessons learnt will be a large input into Finland's future policy preparation concerning agriculture, forestry and land use changes. The Ministry of Agriculture and Forestry is currently also funding a few separate projects that aim to improve the national greenhouse gas inventory.

Summary of policies and measures

A summary of the policies and measures in the land use, land use and forestry sector is presented in CTF Table 5.

3.4.3.7 Waste management

Adopted and implemented policies and measures

Emissions from waste management originate from landfill, composting, digestion, the treatment of wastewater and the incineration of waste. Emissions from waste treatment have decreased steadily since the 1990s. Since 2005, emissions have decreased around 45 per cent most of which is attributed to landfills. The placement of organic waste in landfills is restricted and in practice all mixed municipal waste is incinerated. The recovery of landfill gas has also reduced emissions. On the other hand, carbon dioxide emissions from waste incineration are growing because of increased incineration capacity. National measures to reduce emissions from waste incineration have not been implemented. Instead, it seems likely that the sector will be included in the EU's emissions trading scheme in the coming years. The following presents various policies of reducing emissions in the waste sector.

The Waste Tax Act[76] (1126/2010) entered into force at the beginning of 2011. The purpose of the Waste Tax Act is to collect tax from those waste fractions which could be technically and environmentally recovered, but which are disposed of in landfill sites. The industrial land-fills are also under taxation. The waste tax has been EUR 80 per tonne since 2023.

The National Waste Plan for 2027 was approved by the Government in March 2022. The National Waste Plan includes both a plan to reduce the volume and harmfulness of waste and a waste management plan. The vision of the plan is e.g. to reduce the generation of waste and increase recycling, while reducing greenhouse gas emissions. The Waste Plan proposes measures to achieve the vision and objectives.

The general reform of waste legislation has been conducted in 2021. For example, the following legislation has been amended: the Waste Act; the Decree on Waste; the Government Decree on Landfills; and the Government Decree on Packaging and Packaging Waste. For example, the reform provides the basis for more effective waste management with respect to recycling and reuse, enhanced separate collection of waste, reduction of waste generation, and further reduced landfilling of organic waste, all contributing to reduced greenhouse gas emissions. It applies to all forms of waste production and waste management. Enforcement of the amended Waste Act and the Decree on Waste will increase recycling and recovery. Landfilling has been reduced, and

[76] 1126/2010

greenhouse gas emissions of the waste sector have diminished. The Decree on Packaging and Packaging Waste is also intended to increase recycling.

The restrictions on the landfilling of biodegradable municipal solid and other organic wastes have been made stricter. From 2016 the Decree on Landfills has restricted the amount of biodegradable and other organic waste to less than 10 per cent of total organic carbon or loss on ignition. These restrictions increased the incineration of waste and decreased landfilling.

The estimated total emissions reduction of waste management measures is roughly 4 million tonnes of CO_2 eq. per year in 2025–2035.

Summary of policies and measures

A summary of the policies and measures in the waste sector is presented in CTF Table 5.

3.4.3.8 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 the cutting of emissions in the urban structure are associated with sustainable urban development: the urban structure and effective functioning of urban subregions; the coordination of land use and transport; the creation of preconditions for renewable energy production; and enabling a low-emission lifestyle. In urban subregions, the pre-conditions 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 to 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.

The preconditions for increasing wind power production include the coordination of wind power construction with land use in the surrounding areas, giving sufficient consideration for negative impacts and ensuring local acceptability. To promote planning, the Land-Use and Building Act contains specific provisions on local master plans that directly apply to wind power construction. 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 (2017) for the installation and construction of solar panels and solar collectors harmonises and streamlines the permit procedure so that permit consideration will only be required for solar panels or collectors that have significant impacts on the townscape or the environment.

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

Nearly all the regions in Finland and many individual municipalities have prepared their own climate strategies. However, it is difficult to provide quantitative emissions reduction potentials for the policies and measures concerning land-use planning and the urban structure. For example, the urban form influences emissions mainly in the energy sector through its effects on transport and the heating of buildings. Emissions from daily mobility especially may be many times higher in car-oriented zones than in 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 with 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 thus depend not only on the urban structure but on complex processes that include lifestyle changes, as well as economic conditions and development.

The land-use planning measures are included in the energy and transport measures in CTF Table 5.

3.4.4 Energy taxation and related measures

Energy taxation

Energy taxation is a key instrument of the Government's climate and energy policy. Energy taxes are levied on electricity, coal, natural gas, peat, tall oil and liquid fuels. The energy taxation of fuels is based on the energy content, life cycle carbon dioxide emissions and local emissions of fuels. The energy content component is levied on both fossil fuels and biofuels, based on their volumetric energy content. The CO_2 component is based on the lifetime CO_2 emissions of the fuel in question, and biofuels are therefore 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. In connection with the excise duties on electricity, coal, natural gas and liquid fuels, the Government also collects a strategic stockpile fee, which is transferred to the National Emergency Supply Agency.

The current energy tax structure for energy used in transportation is illustrated in Figure 3.4-5.

The energy content tax for gasoline is approximately EUR 60.5 per MWh (the benchmark rate) and the carbon dioxide tax for life-cycle emissions is EUR 62 per tCO_2.[77] For gas oil, the energy content tax is reduced by EUR 25.95 per MWh compared to the benchmark rate. Tax rates for gaseous fuels used in transportation are also lower than the benchmark rates for transport use, as gaseous fuels are taxed with benchmark rates of heating use. Also, the energy tax rate of electricity used in road transportation is lower. For passenger cars, lower taxation of diesel, gaseous fuels and electricity is compensated for by an annual propelling force tax, which is part of the vehicle tax, so that lower taxation effectively applies mostly to commercial vehicles. According to the General Government Fiscal plan, the taxation of liquid fuels used for transportation will be reduced by a total of EUR 100 million by 2027.

The energy tax structure for fuel used for heating and mobile machinery and for electricity is illustrated in Figure 3.4-5.

The energy content tax for separate heating and mobile machinery is EUR 10.33 per MWh and the carbon dioxide tax is EUR 53 per CO_2. Energy content tax rates for fuels used in combined heat and power production are reduced by EUR 7.63 per MWh (see Figure 3.4-6).

The energy content tax for oil products used in professional agriculture (excluding transport use) is rebated. The tax rebate for fuels used by energy intensive businesses in manufacturing, mining and greenhouse cultivation will be phased out by the end of 2024. The energy tax on electricity for manufacturing, mining, certain data centres and certain heat pumps and agriculture is at the EU minimum level, EUR 0.5 per MWh (class II). For households, services etc. the energy tax of electricity is EUR 22.4 per MWh. Small-scale production of electricity for own use is exempt.

[77] This equals approximately a tax rate of EUR 74–75 per tCO_2 applied to emissions of fuel combusted. The carbon dioxide was reduced from EUR 77 to EUR 62 per tCO_2 from the beginning of 2024.

Figure 3.4-5 Current energy tax structure and rates for energy used in transportation

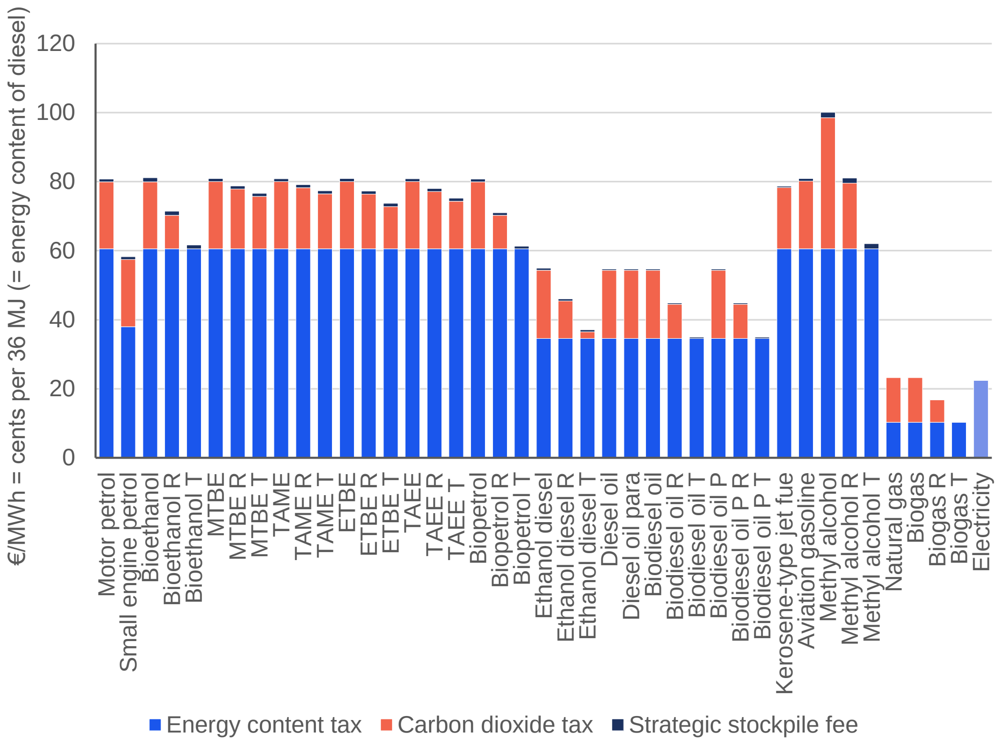
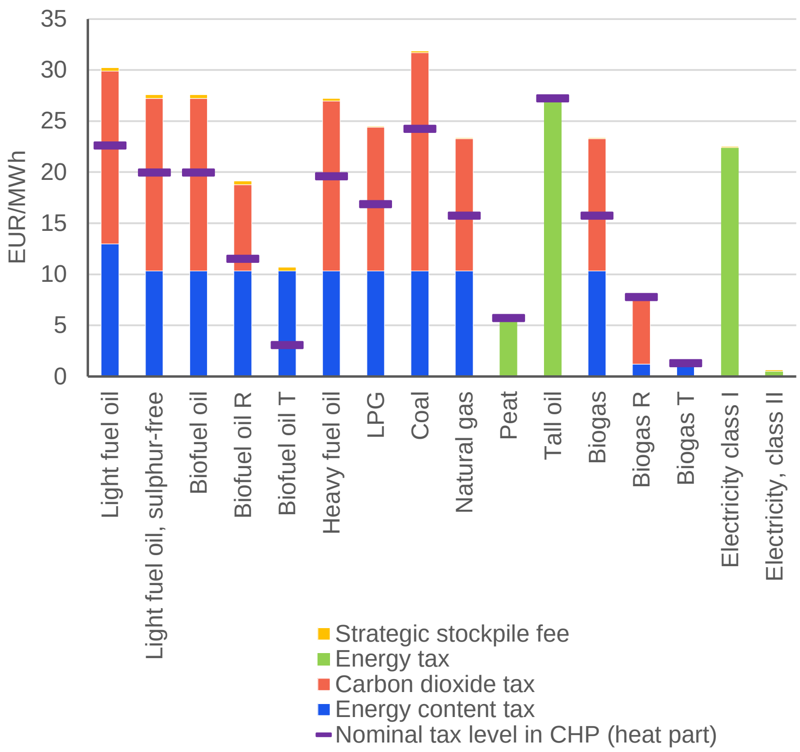


Figure 3.4-6 Tax rates for fuels used in heating and mobile machinery, EUR/MWh



Government expenditure on energy and climate policy

The Finnish government supports the transformation to a greener economy with a variety of different subsidies. The total Government expenditures on energy and climate policy have increased significantly in recent years, with the budget for 2022 being EUR 2,554 million. This expenditure covers a wide range of sectors, and the largest outlays are in subsidies given to energy and agriculture.

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 the public economy’s other expenditure needs.

One of the main ways in which the Government supports the transition to greener energy production is a direct subsidy for projects that aim to cut emissions at the firm or municipality level (‘Energy Subsidy’). The current total level of this subsidy is EUR 230 million for 2022 (including RRF funding), which is substantially higher than just a few years ago, when it was around EUR 50 million.

In addition, there have been separate fixed-term aid schemes for renewable energy and additional budget authorities for different large demonstration projects. As renewable energy has become more profitable, direct subsidies for renewable production have decreased. These energy-related measures include the Government’s key projects related to energy (in total, EUR 100 million between 2016 and 2018), energy projects replacing coal (in total, EUR 90 million between 2020 and 2021), and current Recovery and Resilience Facility (RRF) energy projects (around EUR 500 million between 2022 and 2023) and large demonstration projects. Initially, a total of EUR 200 million was earmarked for large demonstration projects in the period from 2019 to 2022. The Ministerial Working Group on Preparedness decided to increase the budget authority for the energy aid item for the period from 2022 to 2023 by a total of EUR 150 million. At the same time, an additional budget authority was decided for hydrogen projects (EUR 150 million) and battery ecosystem projects (EUR 50 million). The development is partly based on the policies of the previous climate and energy strategy on shifting the focus of renewable energy subsidies from production subsidy type aid schemes to supporting new technologies. In addition, the number of projects has increased significantly and national targets have become stricter.

On top of these subsidies, the Government also actively provides support for R&D projects and rail projects and funding for private sector projects that aim to cut emissions. While this support is divided over several smaller measures, they amount to a total of several hundred million euros annually.

A compilation of funding related to the energy and climate policy from 2018 to 2022 under the General Government Fiscal Plan is presented in Table 3.4-4.

Table 3.4-4 Funding under the current General Government Fiscal Plan

Appropriation	2018	2019	2020	2021	2022
			EUR million		
MINISTRY OF ECONOMIC AFFAIRS AND EMPLOYMENT					
Energy aid	58	47	61	101	231
Investment and operating subsidies for renewable energy and new energy technologies	354	215	337	294	135
Subsidies for green R&D and innovation	120	121	130	143	176
Other measures	189	146	155	180	190
MINISTRY OF AGRICULTURE AND FORESTRY					
Agri-environment payment measures	218	218	185	236	263
Other measures	313	313	398	353	413
MINISTRY OF TRANSPORT AND COMMUNICATIONS					
Investment in rail infrastructure	0	0	8	26	123
Other measures	150	127	521	267	281
MINISTRY OF THE ENVIRONMENT					
Investment subsidies for lower emission heating systems	65	70	306	261	323
Other measures	85	86	116	105	105
MINISTRY FOR FOREIGN AFFAIRS					
Development aid for environmental, water and energy related projects	144	159	199	266	283
Other measures	65	70	236	186	184
TOTAL appropriations	1 761	1 573	2 651	2 418	2 706

3.4.5 Effect of policies and measures on longer-term trends

Finland has a long tradition of assessing longer-term energy and climate development. The Government's Foresight Report on Long-Term Climate and Energy Policy (published in 2009) highlighted possible paths to a low-carbon Finland. Moreover, 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 projections on alternative development paths for a low-carbon society until 2050 made by the Low Carbon Finland 2050 platform research project. Finland's target of carbon neutrality by 2035 was officially laid out as part of the Government Programme in 2019. The target is also reflected in the latest Long-Term Strategy (LTS), which was submitted to the UN and EU in 2020 and contains updated possible projections for how to achieve the target. The latest Climate and Energy Strategy prepared in 2022 is also closely tied to the carbon neutrality target and assesses if the target can be achieved with the policy measures at the time. The most recent projections were completed in the first half of 2024 which form the baseline for this report and the next LTS in 2025.

A large proportion of the current Finnish climate and energy policies already 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, the regulations for improving energy efficiency of new and existing buildings will have long-lasting impacts due to long lifetimes.

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

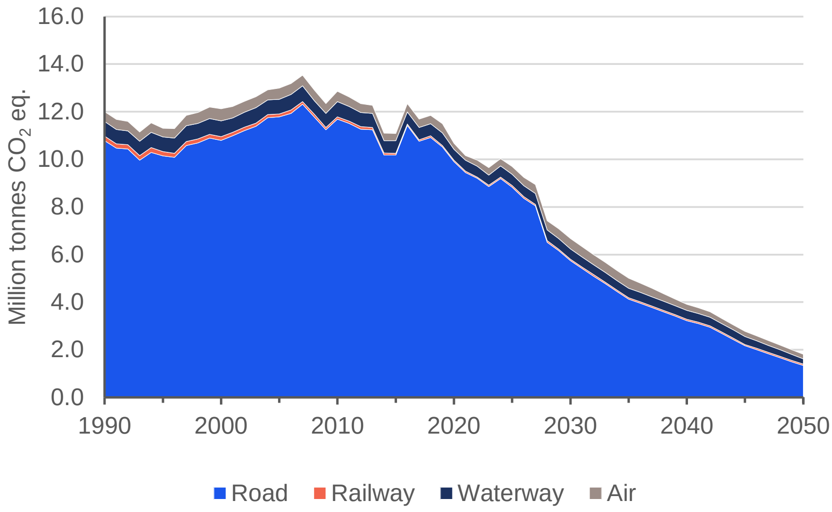
Investments in the energy infrastructure have long lifetimes as well. Measures that promote investment in renewable energy and improve competitiveness of renewable energy sources will therefore reduce greenhouse gas emissions in the longer term. Measures that would in principle directly contribute to emissions reductions only if the measure is ongoing, such as feed-in tariffs for renewable energy, also have long-term emissions reduction effects, provided the measure has triggered new investments. This is exactly what has happened in the case of Finland’s feed-in tariff for wind power.

Prohibiting use of certain F-gases and the replacement of F-gases with low GWP alternatives or halting disposal of biodegradable waste on landfills can be expected to lead to permanent changes in current practices, and therefore to yield permanent emissions reductions.

Since 2022, the impact of policies and measures on the longer-term trend in greenhouse gas emissions from road transport have been calculated using a new standalone model called ELIISA, which is an upgraded version of its predecessor ALIISA. ELIISA computes the development of the vehicle fleet, kilometrage, consumption and greenhouse gas emissions (including CO_2, CH_4 and N_2O) until 2050. ELIISA considers all possible powertrain options for vehicles in Finland. The changes in the vehicle fleet are based on the estimated annual sales of new vehicles and imported vehicles and the vehicle scrappage rate. Fuel and energy consumption estimates are based on actual fuel sales.

According to the projections, transport volumes continue to grow over the forecast period, whereas the GHG emissions start to decline (see Figure 3.4-7). The main reasons for emissions reductions are replacement of fossil fuels with alternative transport fuels and improving the energy efficiency of the vehicles and the transport system.

Figure 3.4-7 Projection of the longer-term trend in greenhouse gas emissions in transport



3.4.6 Assessment of economic and social impacts of response measures

Economic impacts

Most of the effects of the WM projection on the economy stem from the need to invest in new carbon-free and energy-efficient technologies in the energy, industry, and the transport sectors. These large investments will probably dominate economic activity for most of the next two decades and entail account deficits, but once completed, they will facilitate a structural shift towards an energy- and material-efficient low-carbon economy, in which many of the current industries will become newly competitive and create export growth.

Economic growth and changes in the structure of the economy also 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 indefinitely. However, in the short and medium term, factors affecting labour input growth also matter because changes in labour input directly affect the economy's potential output. In Finland, the ageing population is the most significant single factor in terms of its effect on labour input and thus the 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 above new investments will result in both increased costs and changes to economic consumption and production structures. At the microeconomic level, the WM projection assumes that businesses make mostly profitable investments. Nevertheless, less profitable investments (such as carbon capture technologies) may also be necessary to meet the strict emission targets. Such investments usually require subsidies or investment aid from the Government, which contributes to households being susceptible to a decline in their purchasing power. For example, if the government implements a costly investment aid scheme to reduce emissions, it is likely that part of the funding will need to come from tax increases or spending reductions which also affects households.

Increase in energy prices due to emission trading or renewable fuel mandates reduces the purchasing power of households. In absolute terms, the impact is most significant on households that consume the most energy and energy-intensive commodities and services, i.e. middle- and high-income households. Yet in relative terms, the impact may be even more significant on lower-income households, because to some extent energy is a necessity in modern societies.

At the macroeconomic level, the new structures are expected to lead to improved economic efficiency, including labour productivity and new business opportunities especially adding value to exports. Structural changes in the economy will also have impacts on employment. The total employment rate is expected to grow slightly thanks to new investments by large and medium-sized enterprises, especially in the energy sector. However, as is often the case, some sectors will benefit more than others. It is expected that industrial and construction sectors, including expert work, product development, installation work and production of renewable materials, will receive most of the benefits, whereas especially agriculture and services will add fewer jobs.

The Confederation of Finnish Industries maintains information on green and clean transition investments[78] in Finland. The data window puts the overall estimate of cumulative investments by 2030 at EUR 268 billion (June 2024 data). The largest estimated investments would be made in wind power (both offshore and onshore), clean hydrogen production and battery materials production, to name a few.

Social impacts and just transition

The general principle of planning and preparing new policies and measures is that emissions reductions should be implemented in a way that is as socially and regionally fair as possible and in consultation with many sectors of society.

Although Finland has top expertise in various sectors, competence is not entirely crosscutting in the labour market but, on the other hand, skills gaps have already been identified. The demand for specialist work and other occupations requiring a high level of competence will increase. The labour market and occupations have a good opportunity to adapt to the green transition, but targeted support measures related to job seeking and employment may be needed locally. It is likely that the adaptation will eventually affect a wide range of professions, as well as citizens' experience of societal development. Responding to these developments will require strengthening sustainability skills at all levels of education, in all forms and programmes. In particular, there is a need to emphasise the role of transformative learning, challenging current practices, skills and structures, as part of building a knowledge base for the green transition. Therefore, workplace learning will play a key role in green transition as well.

The EU Just Transition Fund (JTF) is one example of a direct policy instrument implemented in Finland. The JTF aims to halve the energy use of peat by 2030 and to mitigate the adverse socioeconomic impacts. There are 14 different regional plans on implementing the JTF. It provides support for diversification of livelihoods, revitalising economic structures and boosting employment by reskilling and upskilling the workforce in peat extraction and related sectors, especially young people. Furthermore, peat fields will be restored back to carbon sinks where possible. Finland's EU funding from the JTF is approximately EUR 466 million. Public national funding, including some EUR 665 million, can be allocated to projects during the 2021–2027 programme period.

[78] https://ek.fi/en/green-investments-in-finland/

In addition, Finland has prepared an equality assessment in connection with the Medium-term Climate Change Plan and justice assessment, human rights assessment and gender impact assessments in connection with the latest energy and climate strategy published in 2022 (the new strategy is currently being prepared). For example, the gender impact assessment covered six sectors: energy production, construction and buildings, transport, industry, the service sector and agriculture. The research showed that the climate policy measures mostly concern male-dominated sectors. It suggests that male-dominated jobs related to fossil fuels will disappear to some extent, but at the same time the overall impact on economic activity and employment would still be positive in male-dominated sectors. The research also found that women and young people are more prepared to make and support climate-friendly decisions. Therefore, the proposed measures emphasise men's inclusion in climate policy and influencing their consumer habits.

Since the Social Climate Fund (SCF) regulation came into force in the summer of 2023, Finland has actively sought to strengthen the knowledge base on the definitions on energy and transport poverty, and to identify (through numbers, regional distribution and type) the households, transport users and microenterprises impacted by expanding the EU ETS. This is done via several avenues, both EU-related projects and national efforts. The scope and spread of energy poverty in Finland have been clarified in studies conducted by Gaia Consulting[79] and VATT Institute for Economic Research's Data room[80].

In addition, Finland is preparing the Social Climate Plan (SCP). The process is underway to use all available information to gather an evidence base for the most appropriate measures to be included in the SCP. The main focus is on the vulnerable groups and how to address both decarbonisation and energy efficiency most effectively, mainly through structural changes.

3.5 Summary of greenhouse gas emissions and removals

Summary of the greenhouse gas emissions and removals is presented in the CTF Table 6 of this report and in Table 1.1-1 of this report. Further information is provided in the CRT tables and in the national inventory document (NID) submitted as a stand-alone national inventory report (NIR) in conjunction with this report.

3.6 Projections of greenhouse gas emissions and removals

3.6.1 Overview of projections

The projections presented in this chapter are integrated energy and climate projections based on comprehensive modelling and assessments conducted by experts from various research fields. The projections were modelled in an extensive project 'Baseline scenarios for energy and

[79] https://energiavirasto.fi/-/uusi-selvitys-avaa-nakyman-energiakoyhyyden-ehkaisemiseen-suomessa
[80] https://vatt.fi/en/data-room

climate policy package towards zero emissions' (PEIKKO)[81] financed by the Government's analysis, assessment and research activities. The modelling covers the energy system and all GHG sources and sinks that are included in the GHG inventory. Methodology is described in Annex 3. The projections of the PEIKKO project include those policy measures that have been implemented by the previous Government or earlier than that, i.e. before 1 April 2023. For this report, the projections of the PEIKKO project have been updated with information and data on a few recently adopted or implemented policy measures. The resulting projection is called the WM projection.

At the time of writing, the Government, including a ministerial working group, is planning new policy measures compared to the measures in the WM projection. These measures will be assessed and, whenever feasible, included in a new WAM (With Additional Measures) projection. The modelling process has already commenced but is not yet complete. Therefore, no WAM projection is available for this report.

A pure 'Without Measures Projection' (WOM) is not applicable to Finland's national circumstances and has therefore not been provided either. Some essential mitigation policies and measures (such as measures related to energy efficiency improvements and use of renewable energy) have been implemented since the 1970s. The creation of a WOM projection omitting all measures of previous climate and energy strategies (e.g. 2022, 2016, 2013, 2008, or 2005) would be very complicated and require significant effort, particularly in predicting the industrial structure. The technology development outlook in the energy sector would also be quite different without the current emissions trading system and binding renewable energy targets set by the EU. In other words, the outcome would be quite an arbitrary WOM projection. In Finland's case, a more reliable and suitable approach is to compare the current projection with previous WM projections, which is done in Section 3.6.4.

The Covid-19 pandemic and its assumed effects on the economy were considered in the modelling of the WM projection whose starting point is the year 2022. In contrast to Finland's Fifth Biennial Report (BR5), the energy crisis and changed energy scene following Russia's unprovoked and unjustified invasion of Ukraine are now included in the projections. This is especially reflected in cutting off all energy imports from Russia throughout the modelling period. For the LULUCF sector, the most recent results from the national forest inventory on a decline in tree growth now form the base for the projection work. Most of the measures included in the WAM projection of the Fifth Biennial Report (BR5) have been implemented and are now part of the WM projection, such as improving energy efficiency and promoting alternative fuels in machinery, expansion of the EU Emissions Trading System (so called ETS2) and energy efficiency measures for transport.

The population growth in the projections is based on the population forecast drawn up by Statistics Finland in 2021. The population will increase only slightly from 5.56 million (end of 2022) to 5.60 million in 2030. In 2033, the population will start to decrease. The population's age structure will significantly change over the next couple of decades as the proportion of older age groups increases.

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 macro-economic study for the ministries by Merit Economics. The current economic growth is modest but it is expected to improve toward the end

[81] Baseline scenarios for energy and climate policy package towards zero emissions (PEIKKO), https://julkaisut.valtioneuvosto.fi/handle/10024/165717

of the decade. In the WM projection, the annual average increase in the national economic output is 1.3 per cent from 2020 to 2030 and 1.7 per cent from 2030 to 2040.

Regarding the forest industry, the basis for the WM projection is the same as in the BR5 but the latest market development, including some production capacity closures, has been taken into account. As a result, compared to the BR5, the total growth is more modest as the production volumes of pulp, cardboard and sawmill increase less and the volumes of other products, especially paper, continue to decline.

The key assumptions are summarized in Table 3.6-1.

Table 3.6-1 Assumption of the WM projection

Parameter	Trend 2020 to 2035
GDP growth	1.4 per cent annually
Structure of economy	Increasing share of services
Structure of industry	Less capital and energy intensive
Population growth	Increases by 1.2 per cent from 2020 to 2035 after which slowly decreases
Population structure	Ageing
Technology development	Gradual introduction of improved and more energy efficient technology, increased electrification

Projection of the key indicator, annual total net GHG emissions of the EU and its member states, consistent with the scope of the EU’s NDC, is presented in the EU’s BTR1 and its CTF Table 10 to determine progress towards EU’s NDC. The key indicator in question is the same for the EU and its member states because they are committed together to a legally binding, joint emission reduction target described in their NDC.

3.6.2 'With Measures' projection

3.6.2.1 Total effects

Total emissions in the WM projection for 1990 to 2040 are shown in Figure 3.6-1 (total emissions without the LULUCF sector) and Table 3.6-2 (without and with the LULUCF sector). Compared with the 1990 base year, the total greenhouse gas emissions without LULUCF are projected to be 58 per cent lower in 2030, and 75 per cent lower in 2040. The corresponding figures for CO_2 emissions are 61 and 81 per cent. CH_4 emissions are expected to continue to decline steadily, being 55 per cent lower in 2030 and 59 per cent lower in 2040 than in 1990. N_2O emissions are projected to decrease the least, but still being 36 per cent lower in 2030 and 39 per cent lower in 2040 than in 1990. The amount of emissions from F-gases is small and expected to decrease in the coming years.

Figure 3.6-1 Greenhouse gas emissions without LULUCF by gas according to the latest greenhouse gas emission inventory (1990 to 2022) and the WM projection (until 2040), million tonnes CO_2 eq.

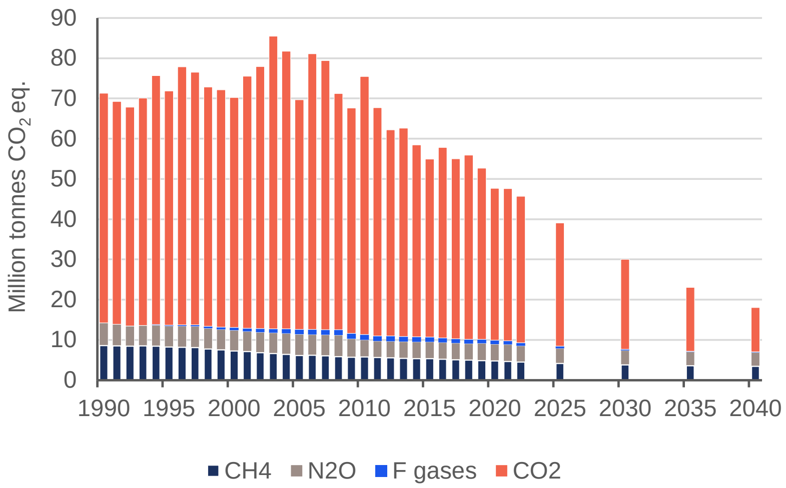


Table 3.6-2 Greenhouse gas emissions according to the most recent inventory data (1990 to 2022) and the WM projection (2025 to 2040)

	GHG emissions and removals (kilotonnes CO_2 eq.)											
	1990	1995	2000	2005	2010	2015	2020	2022	2025	2030	2035	2040
Sector												
1. Energy[1]	41 329	43 945	41 612	40 851	47 532	29 833	23 922	23 091	17 304	11 771	7 760	5 100
2. Transport	12 091	11 312	12 071	12 870	12 668	10 845	10 437	9 777	9 563	6 524	4 849	3 743
3. Industrial processes and product use	5 223	4 908	5 823	6 569	6 108	5 635	5 038	4 979	4 928	4 805	3 842	2 662
4. Agriculture	7 315	6 469	6 356	6 217	6 255	6 282	6 276	6 075	5 753	5 612	5 516	5 551
5. Land use, land-use change and forestry	-23 175	-22 000	-21 258	-24 850	-22 378	-13 131	-5 354	4 443	-3 018	-6 415	-2 831	-3 467
6. Waste	5 208	5 125	4 251	3 119	2 837	2 310	1 914	1 727	1 503	1 250	1 067	929
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Indirect CO_2	165	131	107	87	68	56	67	51	42	31	24	19
Total (with LULUCF, with indirect)	48 156	49 889	48 962	44 863	53 090	41 830	42 299	50 143	36 075	23 577	20 227	14 538
Gas												
CO_2 emissions without net CO_2 from LULUCF[2]	57 086	58 253	57 124	57 151	64 160	44 248	37 767	36 418	30 686	22 363	15 862	11 001
CO_2 emissions with net CO_2 from LULUCF[2]	30 720	33 017	32 572	29 092	38 822	28 432	29 764	38 254	24 430	12 576	9 656	4 270
CH_4 emissions without CH_4 from LULUCF	8 624	8 293	7 310	6 156	5 839	5 372	4 822	4 554	4 170	3 847	3 643	3 510
CH_4 emissions with CH_4 from LULUCF	10 317	9 917	8 817	7 505	6 930	6 263	5 676	5 402	5 876	5 522	5 207	4 913
N_2O emissions without N_2O from LULUCF	5 567	5 155	5 063	5 257	4 124	4 124	4 133	3 935	3 715	3 551	3 411	3 388
N_2O emissions with N_2O from LULUCF	7 065	6 767	6 851	7 116	5 992	5 918	5 927	5 694	5 247	5 248	5 222	5 249
HFCs	0	149	693	1 123	1 321	1 193	904	763	490	199	109	73
PFCs	0	2	3	4	3	1	1	2	1	1	1	1
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	54	38	27	23	22	23	26	28	30	32	33	31
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	71 166	71 759	70 113	69 626	75 400	54 905	47 587	45 649	39 051	29 961	23 034	17 986
Total (with LULUCF)	47 991	49 758	48 855	44 776	53 022	41 774	42 232	50 092	36 033	23 545	20 203	14 519
Total (without LULUCF, with indirect)	71 331	71 890	70 220	69 713	75 468	54 961	47 654	45 700	39 093	29 992	23 059	18 005
Total (with LULUCF, with indirect)	48 156	49 889	48 962	44 863	53 090	41 830	42 299	50 143	36 075	23 577	20 227	14 538

NO = not occurring 1) without transport 2) including indirect CO_2 emissions

The split of greenhouse gas emissions between the EU ETS sector and the non-ETS sector is illustrated in Figure 3.6-2 and Table 3.6-3. The historical ETS emissions correspond to the EU ETS scope of the emissions trading period from 2013 to 2020. The emissions in the EU ETS sector reached their peak in the mid-2000s and have declined since. In 2020, emissions in the EU ETS sector accounted for 41 per cent of the total greenhouse gas emissions, whereas the non-ETS sector accounted for 59 per cent. The ETS emissions are expected to decrease further in the future being 70 per cent lower than the 2005 level in 2030 and 91 per cent lower in 2040.

The emissions from the non-ETS sector have decreased steadily since 2005, and the decrease is expected to continue. In the WM projection, the emissions from the non-ETS sector in 2030 are 44 per cent, and in 2040, 57 below the 2005 level when using the 2013–2020 scope for the EU ETS. Approximately 2.4 million tonnes of CO_2 eq. non-ETS emissions in 2005 originate from sources that have since been moved to the ETS sector.

Figure 3.6-2 The split of greenhouse gas emissions between the EU ETS sector and the non-ETS sector (2005 to 2022) based on the latest greenhouse gas inventory and the WM projection (until 2040). The development of the total emissions without the LULUCF sector is also presented.

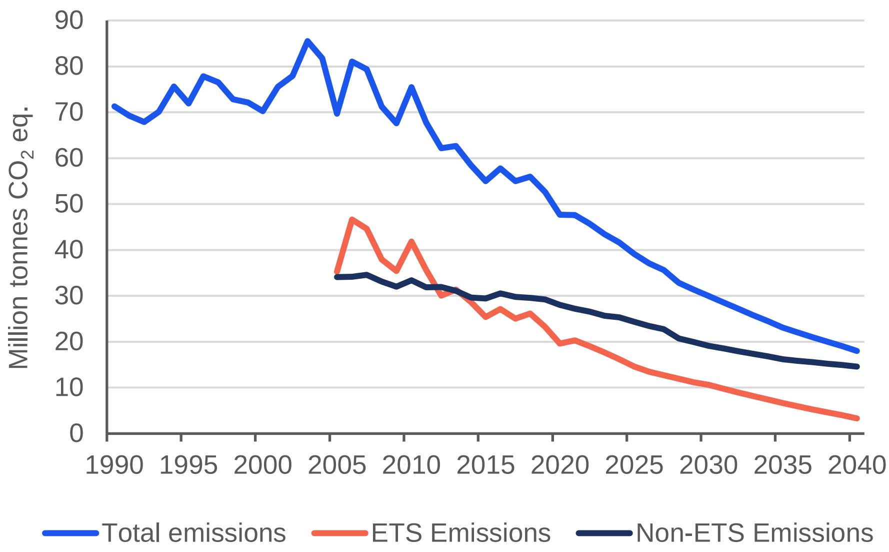


Table 3.6-3 Historical (2005 to 2020) and projected (2025 to 2040) greenhouse gas emissions in the Non-ETS and ETS sector and civil aviation based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical					WM Projection			
	2005	2010	2020	2021	2022	2025	2030	2035	2040
	million tonnes CO_2 eq.					million tonnes CO_2 eq.			
Non-ETS	34.114	33.388	27.986	27.212	26.545	24.350	19.124	16.161	14.582
ETS	35.297	41.853	19.580	20.312	19.020	14.554	10.577	6.615	3.310
Civil aviation, CO_2	0.302	0.228	0.088	0.079	0.135	0.189	0.292	0.282	0.113
Total emissions	69.713	75.468	47.654	47.604	45.700	39.093	29.992	23.059	18.005

The development of total emissions regarding the number of inhabitants, primary energy use, and economic development is presented in Table 3.6-4. All indicators show a steady downward trend that continues in the WM projection. Today, the emissions are decoupled from both the GDP growth and energy use development and decline steadily.

Table 3.6-4 Greenhouse gas emission intensity based on the latest greenhouse gas inventory for 2010-2022 and the WM projection for 2025–2040

	Historical				WM projection			
	2010	2015	2020	2022	2025	2030	2035	2040
Emissions per capita, tonnes CO_2 eq. /capita	14.04	9.53	8.61	8.16	7.02	5.36	4.11	3.21
Emissions per GDP, kg CO_2 eq./EUR	0.30	0.19	0.18	0.15	0.14	0.10	0.07	0.05
Emissions per primary energy, tonnes CO_2 eq./MWh	0.18	0.14	0.13	0.13	0.10	0.08	0.07	0.05

3.6.2.2 Sectoral emissions

Energy

The energy sector is strongly affected by policy measures to reduce the emissions, enhance energy efficiency and increase the share of renewable energy sources. Both the supply and demand sides have faced significant changes in the last decade: part of the changes results from policy measures; part from technological development and the development of the energy and fuel markets. However, the transition is only half completed, and the emissions will decline further in the energy sector. As many of the changes involve or concern investments like power generation capacity, the effects are robust and enduring.

The supply and demand situation in the Nordic-Baltic regional electricity market to which Finland belongs was a very important factor affecting the Finnish power supply's greenhouse gas emissions in the past. However, over 90 per cent of the Finnish electricity production is emissions-free today and the positive development is expected to continue further, resulting in lower and less varying total greenhouse gas emissions for Finland.

In the WM projection, the most significant recent change in electricity production is the start-up of a new 1,600 MW nuclear power plant unit in 2022. Going forward, a significant increase is expected in use of renewable energy sources and waste heat both in electricity and heat production. Use of coal for energy will be banned from May 2029, and use of peat will rapidly decrease already in the 2020s due to high EU ETS prices. All these changes reduce emissions.

Factors affecting the future energy demand are primarily energy efficiency measures, as well as the economic development and structural and technology changes within the industry. According to the WM projection, energy used to heat residential and service sector buildings will decrease, even though the volume of buildings is expected to increase continuously. The emissions from space heating are decreasing even faster than energy demand due to the increased use of renewable energy. District heat production from heat-only plants is expected to slightly increase its share at the expense of combined heat and power production, which has been struggling with feasibility. Low electricity prices in the 2010s and rising prices of emission allowances and fuel prices in the 2020s have challenged combustion-based heat and power production.

District heating, power generation, and industrial energy use are strongly affected by the EU ETS price, which makes use of fossil fuel increasingly infeasible and with energy taxation, efficiently cuts emissions in these sectors. This trend will lead to increased electricity demand replacing some fossil fuel consumption, which is also reflected in the low-carbon roadmaps prepared by all major industries and sectors. In power generation, the emphasis is shifting from fossil fuels (especially coal and natural gas) and peat to renewables and nuclear power. In district heating and industry, fossil fuels are increasingly being replaced with renewables and waste heat recovery. Electrification is a major trend in the industrial sector and in heating and cooling, resulting in more electric boilers, heat pumps and electricity-based industrial processes.

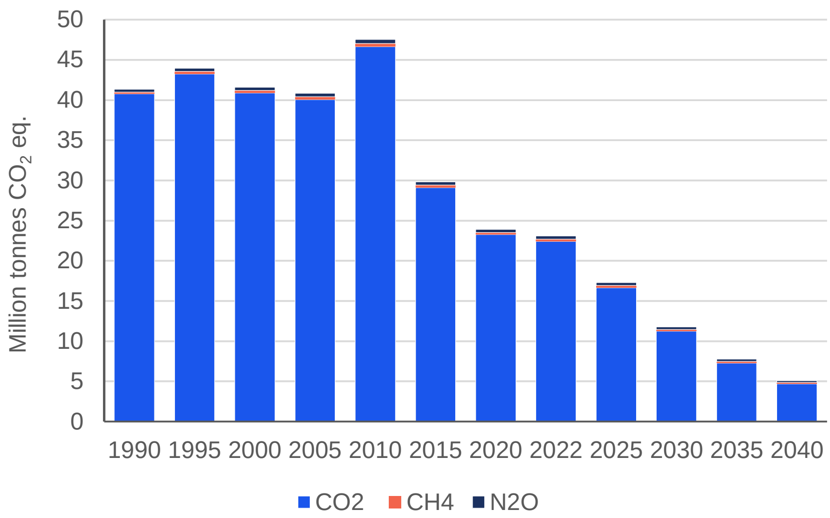
In specific industrial sectors, electrolysis-based hydrogen production is also expected to take off, although the exact timing is difficult to predict. Carbon Capture in its various forms (such as CCS, CCSU, BECCS) could reduce emissions even further, but its timing is equally difficult to estimate, and it has therefore been omitted from the WM projection. Electrification is also true of other sectors like transport, due to which (with Finland's biofuel and other policies) the refining volumes of fossil oil are also decreasing.

The historical and projected emissions from the energy sector (excluding transport) in the WM projection are presented in Table 3.6-5 and Figure 3.6-3. The emissions in the energy sector are mainly CO_2 emissions from combustion of fossil fuels and peat. Most of the energy production, as well as industrial energy use, is subject to the EU Emissions Trading System.

Table 3.6-5 Historical (1990 to 2022) and projected (2025 to 2040) 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	2022	2025	2030	2035	2040
	million tonnes CO_2 eq.								million tonnes CO_2 eq.			
Total emissions	41.33	43.94	41.61	40.85	47.53	29.83	23.92	23.09	17.30	11.77	7.76	5.10
CO_2	40.76	43.23	40.89	40.05	46.65	29.11	23.26	22.40	16.66	11.23	7.28	4.68
CH_4	0.23	0.33	0.31	0.36	0.37	0.32	0.27	0.28	0.28	0.23	0.20	0.17
N_2O	0.34	0.38	0.41	0.44	0.51	0.41	0.39	0.41	0.36	0.32	0.28	0.25

Figure 3.6-3 Historical (1990 to 2022) and projected (2025 to 2040) greenhouse gas emissions from the energy sector (excluding transport) based on the latest greenhouse gas inventory and the WM projection, respectively



Historically, emissions from space heating on site, as well as district heating, have varied according to heating demand (cold or warm winters). Likewise, emissions from condensing power have varied strongly, depending on the hydro situation in the Nordic-Baltic electricity market. In the projections, future years are assumed to be standard years (i.e. the long-term average plus the impact of climate change) with respect to heating demand and hydro levels. Consequently, the energy sector emissions are smoother in the future years (i.e. they have less interannual variability) of the WM projection than in the historical years.

The impact of CH_4 and N_2O emissions within the energy sector is 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 low.

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 decrease from the recent 1.3 to 2 million tonnes of CO_2 eq. to 0.2 million tonnes of CO_2 eq. in 2030 and close to zero in 2040. The emissions from machinery are expected to decrease from their current level, i.e. 2.4 million tonnes of CO_2 eq. to 2.2 million tonnes by 2030 and 1.6million tonnes by 2040. The reasons for this favourable development are more efficient equipment (including some electric machinery) and a more efficient use of the equipment. The emissions from non-ETS industrial energy use remain at around the current level of 0.6 million tonnes of CO_2 eq. in the WM projection at first and slightly decrease later, despite an increase in activity. The energy-related emissions from agriculture and forestry are 1.3–1.4 million tonnes of CO_2 eq. today, of which 0.6 million tonnes of CO_2 eq. comes from machinery. By 2030 and 2040, the energy-related emissions in agriculture and forestry are expected to decrease to 1.1 and 0.8 million tonnes of CO_2 eq., respectively.

Transport

Greenhouse gas emissions from domestic transport (without domestic aviation) totalled 9.6 million tonnes of CO_2 eq. in 2022. Transport emissions account for approximately a fifth of Finland's total greenhouse gas emissions and some 36 per cent of the emissions in the effort sharing sector. Greenhouse gas emissions from domestic transport have mainly been decreasing since 2008. From 2005 to 2022, greenhouse gas emissions from transport (without domestic aviation) dropped by some 2.9 million tonnes in total, or by 23 per cent.

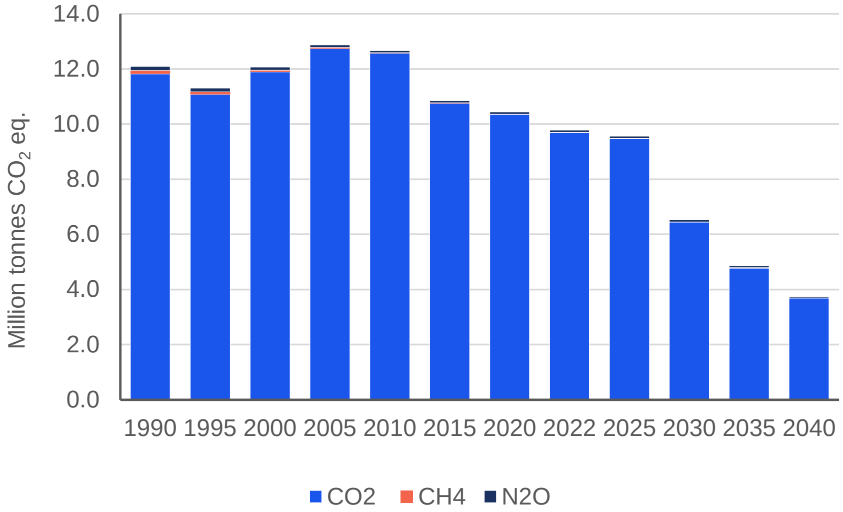
The new WM projection of greenhouse gas emissions from transport was completed at the end of 2023 and published in 2024. Table 3.6-6 and Figure 3.6-4 present the historical and projected greenhouse gas emissions. The WM projection for transport is based on the traffic performance projected until 2030 by the Finnish Transport and Communications Agency Traficom. In road transport, the transport performance of passenger cars is increasing as a result of the strong increase in the number of electric cars. This is due to the reduction in the marginal cost of driving. By 2030, it is estimated that passenger car performance will grow by 6.3 per cent from 2021. Truck performance is estimated to grow by 8.3 per cent in the same time. Other key assumptions in the WM projection are the replacement rate of cars and technologies and the average CO_2 emissions of new vehicles, which are projected by VTT Technical Research Centre of Finland Ltd. In the WM projection, the annual replacement rate of cars is estimated at approximately 5 per cent. In 2030, the specific emissions of new cars would be close to the limit that the EU has established for car manufacturers, and in 2035, sales of combustion engine cars will stop completely. The third factor having a substantial impact on transport greenhouse gas emissions in the WM projection is the share of biofuels in the total consumption of fuel in road transport. The distribution obligation for 2024 has already been lowered by the current Government from what the previous Government decided. It is also very likely that further reductions in the share of biofuels will take place. Therefore, the WM projection of greenhouse gases was revised to include these reductions according to the latest Government Programme, which results in an increase of the emissions from transport until 2027.

Most of the measures will be focused on road transport where, with existing measures (WM), emissions could be reduced by approximately 51 per cent, or 6.0 million tonnes of CO_2 eq., by 2030 and by approximately 72 per cent, or 8.5 million tonnes of CO_2 eq., by 2040 compared to 2005. In the period 2005–2022, the emissions fell by approximately 2.7 million tonnes.

Table 3.6-6 Historical (1990 to 2022) and projected (2025 to 2040) 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	2022	2025	2030	2035	2040
	million tonnes CO_2 eq.								million tonnes CO_2 eq.			
Total emissions	12.09	11.31	12.07	12.87	12.67	10.85	10.44	9.78	9.56	6.52	4.85	3.74
CO_2	11.82	11.08	11.89	12.74	12.57	10.75	10.35	9.69	9.47	6.43	4.77	3.68
CH_4	0.13	0.10	0.07	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
N_2O	0.14	0.14	0.11	0.09	0.07	0.07	0.08	0.07	0.08	0.08	0.07	0.05

Figure 3.6-4 Historical (1990 to 2022) and projected (2025 to 2040) greenhouse gas emissions from transport based on the latest greenhouse gas inventory and the WM projection, respectively



International bunkers

According to the most recent GHG emission inventory, the total fuel consumption of international bunkers for international marine transport was 13,909 TJ in 2022, which is similar to the amount (13,522 TJ) prior to the pandemic in 2019. In contrast, the pandemic affected international aviation, as according to the most recent GHG emission inventory, the fuel consumption for international aviation was 22,261 TJ in 2022 and the corresponding fuel consumption prior to the pandemic in 2019 was 35,166 TJ.

According to the latest EUROCONTROL base scenario, the annual flight growth rate for Finland between 2024 and 2030 will be an average of 2.6 per cent[82]. This forecast is subject to various uncertainties, such as the possibility of deterioration/unforeseen geopolitical events, economic shocks, and ongoing challenges in the aviation industry. Although air traffic is

[82] EUROCONTROL Seven-Year Forecast 2024-2030 - Spring 2024 Update; https://www.eurocontrol.int/sites/default/files/2024-02/eurocontrol-seven-year-forecast-2024-2030-february-2024.pdf

predicted to grow, the various measures and especially alternative fuels will reduce the emissions. The impact of policies and measures described in chapter 3.4.3.3 have not been estimated and thus there is no WM/WAM projection. In the case of marine bunkers, the emissions are estimated to decrease in the future. The annual average decrease of emissions by 2030 is estimated to be about one per cent.

Industrial processes and other product use

The most important greenhouse gas emission sources in this sector are iron and steel, hydrogen, and cement production. The main factors affecting the development of emissions include changes in industrial production volumes and technology. In the WM projection, the growth of the industrial production volumes increases these emissions. Most of the emissions other than F-gases in this sector are part of the EU ETS, which is also the main measure for reducing process emissions. Other measures driving low-carbon technology investments in the manufacturing industry are increased funds for new technology investments and the reduction of the electricity tax.

In the WM projection, it is assumed that the industrial use of fossil fuels decreases thanks to the above measures. It is expected that use of peat will be replaced with biomass almost completely in every sector. In carbon steel production, Finland's largest steel mill has disclosed plans to replace the existing two blast furnaces with electric arc furnaces and the use of carbon-free direct reduced iron (or sponge iron), which would be produced with hydrogen either in Finland or Sweden. However, the exact timing of this shift is still a significant uncertainty. The assumption in the WM projection for the first blast furnace is by 2035 and for the second one by 2040. In the chemical industry, the share of fossil fuels will probably decrease due to the largest plastic producer's plans to replace the existing chemical cracking furnace with an electric cracking process. In the WM projection, the replacement will be implemented by 2030. In hydrogen production, use of natural gas as raw material will be partially replaced with electrolysis. The low-carbon roadmaps prepared by different industries also include additional but more high-level measures that are not yet finally decided but are expected to decrease industrial emissions further in the future.

In 2022, F-gas emissions totalled 0.8 million tonnes of CO_2 eq., which currently equals approximately three per cent of emissions in the effort sharing sector and two per cent of the national total greenhouse gas emissions. The emissions peaked in 2008 at approximately 1.4 million tonnes of CO_2 eq. Since then, emissions have decreased by more than 40 per cent. More than 90 per cent of the emissions originate from the use of F-gases as refrigerants in refrigeration and air-conditioning equipment. The WM projection for F-gases includes the impacts of the EU F-gas Regulation[83] (2024) and the so-called EU MAC Directive (Mobile Air-Conditioning Directive) that prohibits the use of HFCs with a GWP higher than 150 in air-conditioning systems in passenger cars and light commercial vehicles. The main features of the F-gas regulation in cutting F-gas emissions are a phase out of HFCs that can be placed on the EU market by 2050, bans on the use of F-gases in certain applications and obligations related to leak checking and repairs, F-gas recovery and technician training. As a result, F-gases will be replaced with natural and other low GWP alternatives in most applications. The existing measures are estimated to reduce F-gas emissions to 0. 23 million tonnes of CO_2 eq. by 2030 and further to 0. 11 million tonnes of CO_2 eq. by 2040.

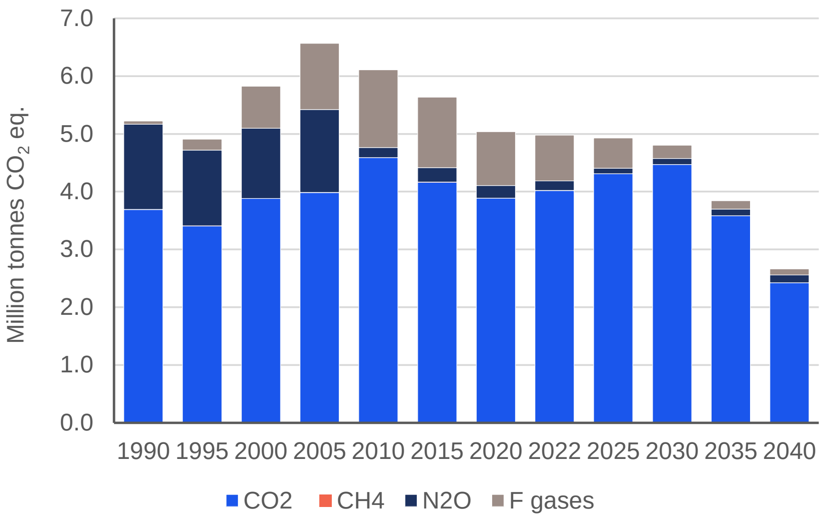
[83] 573/2024

Emissions from solvent and other product use are expected to remain at their present level in the WM projection. Historical and projected greenhouse gas emissions from industrial processes and other product use are presented by gas in Table 3.6-7 and Figure 3.6-5.

Table 3.6-7 Historical (1990 to 2022) and projected (2025 to 2040) greenhouse gas emissions from the industrial processes and other product use sector based on the latest greenhouse gas inventory and the WM projection respectively

	Historical								WM Projection			
	1990	1995	2000	2005	2010	2015	2020	2022	2025	2030	2035	2040
	million tonnes CO_2 eq.								million tonnes CO_2 eq.			
Total emissions	5.22	4.91	5.82	6.57	6.11	5.63	5.04	4.98	4.93	4.80	3.84	2.66
CO_2	3.69	3.40	3.88	3.98	4.59	4.16	3.89	4.02	4.31	4.47	3.58	2.43
CH_4	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_2O	1.47	1.31	1.22	1.43	0.17	0.25	0.22	0.17	0.09	0.10	0.12	0.13
F gases	0.05	0.19	0.72	1.15	1.35	1.22	0.93	0.79	0.52	0.23	0.14	0.11

Figure 3.6-5 Historical (1990 to 2022) and projected (2025 to 2040) greenhouse gas emissions from the industrial processes and other product use sector based on the latest greenhouse gas inventory and the WM projection, respectively



Agriculture

In recent years, changes in the emissions from agriculture have been small. The emissions reported by Finland in the agricultural sector in 2022 totalled about 6.1 million tonnes of CO_2 eq. Agricultural sector is the second most significant source of greenhouse gas emissions in Finland, accounting for approximately 13 per cent of Finland's total emissions and approximately 23 per cent of emissions from the effort sharing sector. Emissions from the agricultural sector have remained approximately at the same level between 2005 and 2022 (Table 3.6-8). Agriculture WM projections were updated in spring 2024 (Table 3.6-8, Table 3.6-9 and Figure 3.6-6). In the WM projection, the total emissions from the agricultural sector are expected to decrease by around 0.5 million tonnes of CO_2 eq. by 2030 compared to the 2022 level. After this, the emissions from agriculture are expected to remain between 5.8 and 5.5 million tonnes of CO_2 eq./year until 2040. This is because the number of animals will remain more or less at the 2025 level or decrease very slowly, and the effect of the measures targeted at peatlands will abate after 2035. The minor decrease in livestock numbers will reduce emissions from manure processing and manure application by around 0.13 million tonnes of CO_2 eq. by 2040. The N_2O emissions from agricultural soils are expected to decrease by around 0.3 million tonnes of CO_2 eq. by 2035 and remain around at that level until 2040. Energy-related emissions related to agriculture are reported in the energy sector and not included in Tables 3.6-8 and 3.6-9.

Table 3.6-8 Historical (1990 to 2022) and projected (2025 to 2040) greenhouse gas emissions from the agriculture sector based on the latest greenhouse gas inventory and the WM projection, respectively

	Historical								WM Projection			
	1990	1995	2000	2005	2010	2015	2020	2022	2025	2030	2035	2040
	million tonnes CO_2 eq.								million tonnes CO_2 eq.			
Total emissions	7.32	6.47	6.36	6.22	6.25	6.28	6.28	6.07	5.75	5.61	5.52	5.55
CO_2	0.65	0.41	0.35	0.29	0.28	0.17	0.20	0.26	0.20	0.20	0.20	0.20
CH_4	3.14	2.82	2.78	2.74	2.72	2.83	2.72	2.63	2.47	2.45	2.46	2.49
N_2O	3.53	3.24	3.23	3.19	3.26	3.28	3.35	3.19	3.08	2.96	2.86	2.86

Figure 3.6-6 Historical (1990 to 2022) and projected (2025 to 2040) greenhouse gas emissions from agriculture based on the latest greenhouse gas inventory and the WM projection, respectively

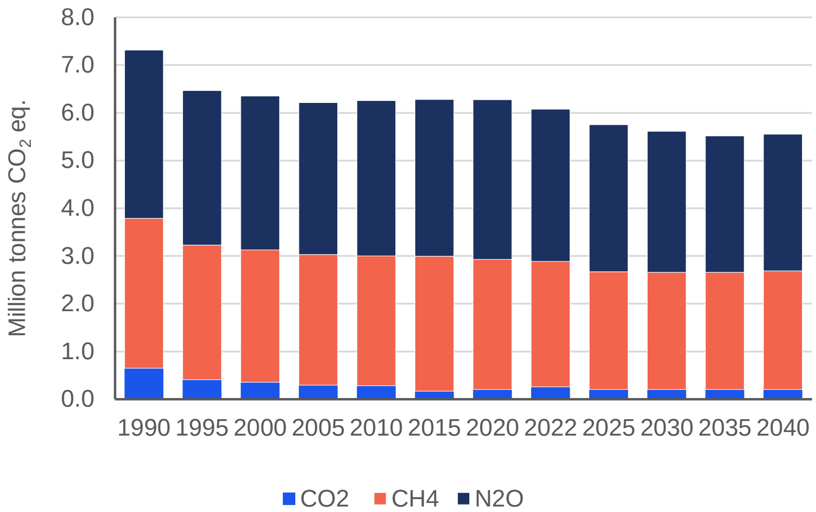


Table 3.6-9 Projected greenhouse gas emissions for 2025 to 2040 by categories and the emissions in 2022[84]

	Historical	Projected			
	2022	2025	2030	2035	2040
	million tonnes CO_2 eq.				
WM - total	6.07	5.75	5.61	5.52	5.55
Enteric fermentation, CH_4	2.18	2.04	2.04	2.07	2.12
Manure management, CH_4	0.45	0.43	0.42	0.38	0.37
Manure management, N_2O	0.22	0.21	0.20	0.18	0.17
Agricultural soils, N_2O	2.97	2.87	2.76	2.68	2.69
Liming and urea application, CO_2	0.26	0.20	0.20	0.20	0.20

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 from 2025 onwards (Table 3.6-10 and Table 3.6-11 and Figure 3.6-7).

In 2022, the LULUCF sector as a whole acted as a source of 4.4 million tonnes of CO_2 eq. because the total removals resulting from the sector were smaller than the total emissions. The net emissions in 2022 were 10 per cent of the total national emissions, which did not include the LULUCF sector. The change to the 2022 net emissions from the 1990 net removals was 119 per cent and from the 2021 net emissions 28 per cent.

The LULUCF sector was a net sink from 1990 to 2017. Starting from 2018, the sector has been either a net sink or a net source of emissions. Forest land has been a net sink during the whole time series, whereas the other land-use categories have been net sources. Harvested Wood Products have overall been a net sink, except for the year 2009. The low levels of roundwood fellings at the beginning of the 1990s and mid-2000s, and again after the financial crisis in 2008/2009, are the cause of the high removals of the LULUCF sector during those periods of time. There are several reasons why the sector has moved from being a net sink to becoming a net source. The main reasons are that commercial fellings have increased, and at the same time, the tree volume increment has decreased according to the National Forest Inventory. Since 2007, wood export duties from Russia have gradually increased and the imports into Finland were completely cut off in 2022. This has put pressure on domestic wood harvests in Finland. Also, the emissions from organic soils have increased considerably, but the carbon sink of mineral soils has decreased. This meant that the forest land net sink has decreased so that the sum of emissions from the other land categories is larger than the forest land net sink.

For forest land, the largest sink was tree biomass, with −12.6 million tonnes of CO_2 of net removals in 2022. Harvested wood products were a net sink of −3.25 million tonnes of CO_2 eq. Mineral soils on forest land were a sink of −4.8 million tonnes of CO_2, whereas organic forest soils were a source of 10.1 million tonnes of CO_2. Other emission sources in the forest land category are methane and nitrogen oxide emission from drained organic forest lands (2.43 million tonnes CO_2 eq.), and minor emissions from nitrogen fertilisation (0.005 million tonnes of CO_2 eq. in 2022) and biomass burning in forest fires and in controlled burning (0.001 million tonnes of CO_2 eq. in 2022). Croplands were also a source of emissions in the LULUCF sector

[84] Baseline scenarios for energy and climate package towards zero emissions (in Finnish). http://urn.fi/URN:ISBN:978-952-383-219-0

with 8.83 million tonnes of CO_2 eq. in 2022. Other emission sources in the LULUCF sector include grasslands (0.77 million tonnes CO_2 eq. in 2022) and wetlands (2.09 million tonnes CO_2 eq. in 2022), of which peat production areas accounted for 1.82 million tonnes of CO_2 eq. in 2022.

The LULUCF WM projection was updated as a part of the PEIKKO projection work in spring 2024. The LULUCF sector as a whole is projected to be a net sink in the WM projection from 2025 onwards. In 2025, the net sink is estimated to be −3.02 million tonnes of CO_2 eq. and −2.83 in 2035. After this, the LULUCF net sink is expected to increase to the level of −3.47 million tonnes of CO_2 eq., by 2040.

Table 3.6-10 Historical (1990 to 2022) and projected (2025 to 2040) greenhouse gas emissions from the LULUCF sector based on the latest greenhouse gas inventory and the WM projection, respectively

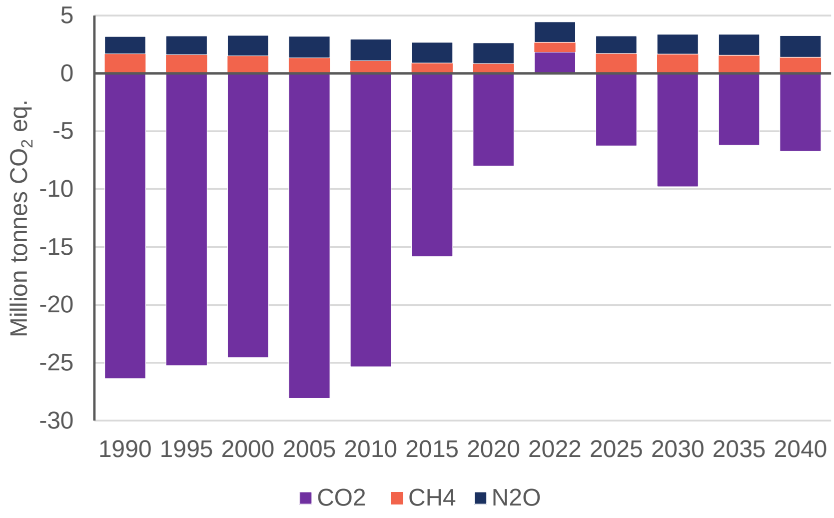
	Historical								WM Projection			
	1990	1995	2000	2005	2010	2015	2020	2022	2025	2030	2035	2040
	million tonnes CO_2 eq.								million tonnes CO_2 eq.			
Total emissions	-23.17	-22.00	-21.26	-24.85	-22.38	-13.13	-5.35	4.44	-3.02	-6.42	-2.83	-3.47
CO_2	-26.37	-25.24	-24.55	-28.06	-25.34	-15.82	-8.00	1.84	-6.26	-9.79	-6.21	-6.73
CH_4	1.69	1.62	1.51	1.35	1.09	0.89	0.85	0.85	1.71	1.67	1.56	1.40
N_2O	1.50	1.61	1.79	1.86	1.87	1.79	1.79	1.76	1.53	1.70	1.81	1.86

Table 3.6-11 Projected greenhouse gas emissions for 2025 to 2040 by categories and the emissions in 2022[85]

	Historical	Projected			
	2022	2025	2030	2035	2040
	million tonnes CO_2 eq.				
WM - total	4.44	-3.02	-6.42	-2.83	-3.47
Forest land	-4.77	-8.52	-11.11	-8.28	-9.17
Cropland	8.83	6.38	5.75	6.03	6.49
Grasslands	0.77	0.75	0.72	0.71	0.70
Wetlands	2.09	1.84	1.59	1.18	1.03
Settlements	0.78	1.26	1.20	1.01	0.80
HWP	-3.25	-4.72	-4.57	-3.48	-3.31

[85] Baseline scenarios for energy and climate policy package towards zero emissions. Publications of the Government's analysis, assessment and research activities 2024:26. Prime Minister's Office. https://urn.fi/URN:ISBN:978-952-383-219-0

Figure 3.6-7 Historical (1990 to 2022) and projected (2025 to 2040) greenhouse gas emissions and removals from the LULUCF sector based on the latest greenhouse gas inventory and the WM projection, respectively



Forest land remains as a net sink in the WM projection; the net sink of forest land is projected to increase from −4.77 million tonnes of CO_2 eq. in 2022 to −8.28 million tonnes of CO_2 eq. in 2035 and −9.17 million tonnes of CO_2 in 2040. In the WM projection, the surface area of forest land decreases by only around 5,000 ha until 2055. In 2023–2055, the area of deforestation will be around 300,000 hectares, slightly more than the afforestation area. Deforestation is mainly caused by construction. Most of the new forest land comes from grassland (around 105,000 hectares), but also from other land use categories, such as peat production areas (53,000 hectares) and cropland (24,000 hectares). The area to be cleared as arable land from forest land is relatively small, totalling approximately about 26,000 hectares over the period 2023–2055.

In the WM projection, the estimate of annual roundwood removals is 77.3 million cubic metres in 2019–2028. In 2029–2038, the estimated roundwood removals will average 81.9 million cubic metres per year, which will slightly decrease, reaching a level of 81.1–81.4 million cubic metres in 2049–2058.

Cropland and grassland are a net source of greenhouse gas emissions in Finland. The CO_2 emissions in 2022 have been 8.83 million tonnes of CO_2 eq. for cropland and 0.77 million tonnes of CO_2 eq. for grasslands. In the WM projection, the emissions are projected to decline to 6.03 million tonnes of CO_2 eq. for cropland and 0.71 million tonnes of CO_2 eq. for grasslands by 2035. The WM projection estimates that the area of arable land will decrease by approximately 80,000 hectares by 2055.

The Harvested Wood Products (HWP) pool was a net sink of 3.25 million tonnes of CO_2 in 2022. HWP was a net sink over the period 1990–2020, except in 2009. The annual fluctuations in the time series are generally due to changes in the economic situation and the demand for wood products. In the WM projection, the sink of HWP decreases over time during the reference period. As the production increases, the sink also grows, but as production remains at the same level, the removal of the old carbon stock starts to reduce the sink. As the lifetime of paper and paperboard is considerably shorter than that of solid wood products, the category is more sensitive to changes in production and produces net emission in some years.

The total emissions from wetlands were 2.09 million tonnes of CO_2 eq. for 2022. The emissions have increased by 0.64 million tonnes CO_2 eq. compared to 1990, when they were 1.45 million tonnes of CO_2 eq. In the WM projection, the emissions from wetlands are expected to decrease

1.03 million tonnes of CO_2 eq. by 2040. The most significant source of emissions are the peat extraction areas. The decreasing trend in emissions from wetlands is due to the decreasing energy use of peat, resulting in a smaller area being needed for peat extraction.

Waste / Waste management

Greenhouse gas emissions from waste management (excluding incineration) totalled 1.7 million tonnes of CO_2 eq. in 2022, or 6 per cent of Finnish emissions in the effort sharing sector. The most significant greenhouse gas produced in waste management is methane emitted from landfills. Waste management emissions in the effort sharing sector also include the greenhouse gases produced in the biological treatment of waste and in the disposal and treatment of wastewater: CO_2, methane and nitrous oxide. These emission sources are of limited importance and their emission volumes are stable. Greenhouse gas emissions from waste management have reduced by approximately 45 per cent from 2005 to 2022. The greatest reductions have been achieved in methane emissions from landfills following a decrease in the landfilling of organic waste. The increased use of digestion in the biological treatment of waste has slightly reduced CO_2 emissions from biological treatment. However, CO_2 is still being emitted from the digestion residue that will be composted and the remaining compost windrows. According to the WM projection, emissions from the waste management sector will decrease by around 60 per cent by 2030 compared to the 2005 levels.

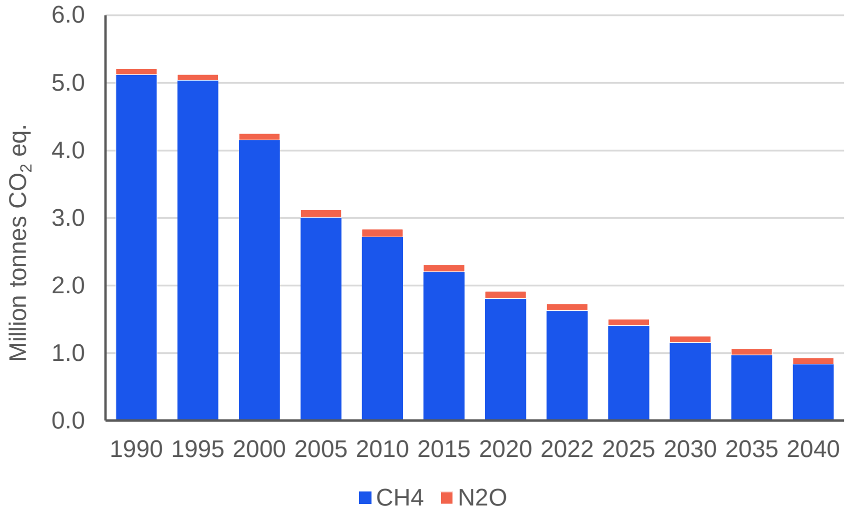
Emissions from facilities that burn municipal waste are mainly included in the effort sharing sector, while emissions from co-incineration plants belong to the EU ETS. The waste incineration emissions of the effort sharing sector have increased significantly since 2005. The increase in emissions is due to the increase in the energy utilisation of municipal waste. About 55 per cent of the municipal waste generated in 2022 was used as energy, while in 2008 only about 17 per cent of the municipal waste was incinerated. In 2008, emissions from municipal waste incineration were lower than 0.1 million tonnes of CO_2 eq. and, in 2022, 0.7 million tonnes of CO_2 eq. Emissions from waste incineration are still expected to increase slightly in the next few years, but level off after that.

Historical and projected greenhouse gas emissions from the waste sector are presented by gas in Table 3.6-12 and Figure 3.6-8.

Table 3.6-12 Historical (1990 to 2022) and projected (2025 to 2040) greenhouse gas emissions from the waste sector based on the latest greenhouse gas inventory and the WM projection, respectively (waste incineration not included)

	Historical								WM Projection			
	1990	1995	2000	2005	2010	2015	2020	2022	2025	2030	2035	2040
	million tonnes CO_2 eq.								million tonnes CO_2 eq.			
Total emissions	5.21	5.12	4.25	3.12	2.84	2.31	1.91	1.73	1.50	1.25	1.07	0.93
CH_4	5.12	5.04	4.16	3.01	2.72	2.20	1.81	1.63	1.41	1.15	0.97	0.84
N_2O	0.08	0.09	0.09	0.11	0.12	0.11	0.11	0.10	0.10	0.09	0.09	0.09

Figure 3.6-8 Historical (1990 to 2025) and projected (2025 to 2040) greenhouse gas emissions from the waste sector based on the latest greenhouse gas inventory and the WM projection, respectively (waste incineration not included)



3.6.3 'With Additional Measures' projection

At the time of writing, the Government, including a ministerial working group, is planning new policy measures compared to the measures in the WM projection. These measures will be assessed and, whenever feasible, included in a new WAM (With Additional Measures) projection. The modelling process has already commenced but is not yet complete. Therefore, no WAM projection is available for this report.

3.6.4 Assessment of aggregate effect of policies and measures

The aggregated estimates for the greenhouse gas reduction impacts of the individual implemented policies and measures presented in Section 3.4 are 57 and 72 million tonnes CO_2 eq. for 2025 and 2030 (without LULUCF), respectively. The estimate of the planned measures is 0.3 million tonnes CO_2 eq. for 2030. The addition of the planned measures is modest, because most of the planned measures have not yet been decided on. Table 3.6-13 presents the total effect of the current policies and measures which has been calculated with a bottom-up approach.

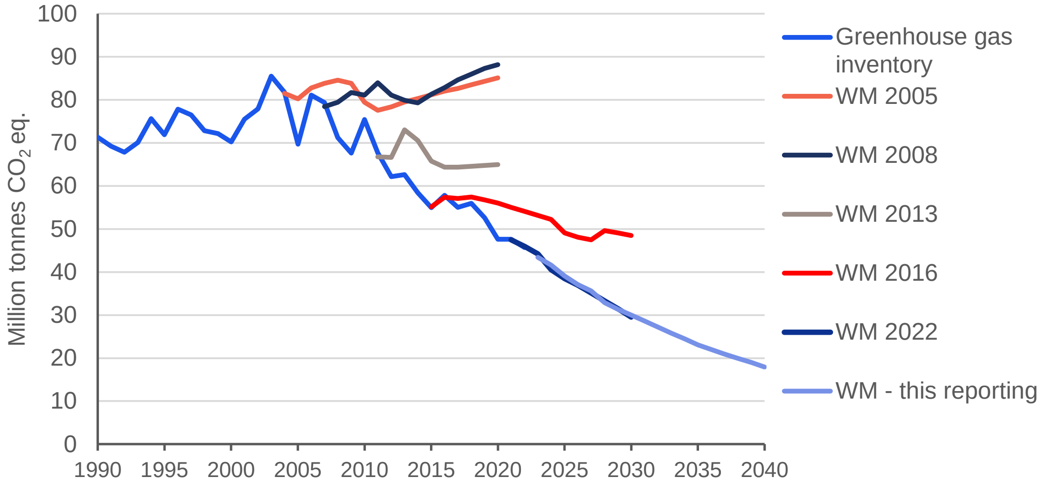
Table 3.6-13 The total effect of the policies and measures (PaMs) calculated based on estimated impact of PaMs for the years 2025, 2030, 2035 and 2040 (million tonnes CO_2 eq). The total emissions in 2022 based on the most recent inventory are also given as a comparison

	Total emission 2022	Total effects of PaMs 2025	2030	2035	2040
		million tonnes CO_2 eq.			
Without LULUCF					
Implemented measures	45.7	57.4	71.6	80.5	67.9
Planned measures		0.0	0.3	0.1	0.1
With LULUCF					
Implemented measures	50.1	57.4	73.0	82.9	67.9
Planned measures		0.0	0.3	0.1	0.1

The estimated total effect of policies and measures contains noticeable uncertainties. The mitigation impact has not been estimated for all policies and measures. Furthermore, the impact estimates of individual policies and measures are not always 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 in the case of the simultaneous increase of biofuel content and energy efficiency in machinery, the transport sector, and heating, for example. Altogether, the total emissions reduction is probably larger than the reported total effect.

A top-down assessment of the overall effect of mitigation policies and measures is possible by comparing the greenhouse gas emissions of this reporting with WM projections from earlier reporting rounds. Figure 3.6-9 shows Finland's greenhouse gas emissions in the WM projections in the last four national climate and energy strategies, i.e. strategies from 2005, 2008, 2013, 2016 and 2022, as well as in this reporting. The WM projections in the national climate and energy strategies projected significantly higher emissions for 2020 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 total emissions.

Figure 3.6-9 Greenhouse gas emissions according to the most recent inventory for 1990 to 2022 and in the WM projections of the climate and energy strategies published in 2005, 2008, 2013, 2016 and 2022 up to 2020 and 2030, and the WM projection of this reporting



The main difference between the projections shown in Figure 3.6-9 is that most measures from the previous WAM projections have been implemented since the previous reporting and are therefore included in the following WM projections. The biofuel distribution obligation in road transport is one of the measures with the greatest impact. Another significant difference since the WM projections of 2013 and earlier years is the result of domestic conventional condensing power capacity being shut down almost entirely. Furthermore, combined heat and power plants are struggling with feasibility and are being shut down ahead of time due to market circumstances and the prohibition of coal energy use. Electrification of society and introduction of new emissions-free technology in all sectors are advancing earlier and faster than previously expected.

The total effect of implementing additional measures can be seen in the emission development trend after 2015, which levelled off in the 2013 and 2016 projections, but was even upwards in the projections from 2005 and 2008. In turn, the WM projection of this reporting and the one published in 2022 are clearly in decline.

For comparison purposes, the WM projections from 2005 and 2008 can be considered reasonable WOM (Without Measures) projection substitutes, even though they already include some mitigation measures. The gap between the projections for 2005 to 2008 and the projection of this reporting is up to 40 million tonnes of CO_2 eq. in 2020. By 2030 the gap would presumably increase to over 60 million tonnes of CO_2 eq. if the old projections would have extended that far into the future. This is relatively well in line with the bottom-up estimation of the total effect of policies which gives 72 million tonnes of CO_2 eq. emissions reduction in 2030.

3.6.5 Sensitivity analysis of the projections

Energy use and hence greenhouse gas emissions are sensitive to the assumptions made for economic growth. Two sensitivity analyses have therefore been carried out for the WM projection, varying the economic growth of industry and service branches. No sensitivity analysis of the transport sector was made, but lower economic growth could generally have both a reducing and an increasing impact on energy use and greenhouse gas emissions for transport. On the one hand, the need for transport is likely to be lower; on the other, the renewal of the transport fleet will be slower. The situation is similar for buildings in which lower economic growth results in slower growth of the building volume, but also in less investment in energy efficiency. In the sensitivity analyses, energy uses in the transport sector and buildings remain unchanged.

The manufacturing industry uses about 45 per cent of both the Finland's final energy and electricity. The forest industry has a significant impact on the energy sector, including renewable energy production, energy consumption, and electricity generation. Iron and steel production is another energy-intensive branch, the development of which significantly influences the projections. The energy balance projections for these branches are based on product-group-specific volume estimates. Both branches develop generally positively in the WM projection, even though some product groups already decrease (e.g. paper manufacturing) in the base case WM. In the sensitivity analyses, the annual growth of the product volumes in the forest and metal industries varies by 1 percentage point in both directions from 2020 compared to the WM projection.

In addition to the branches and sectors mentioned above, the annual growth rate of the other industry and service branches was varied by plus and minus 1 percentage point from the WM assumptions. No dynamic effects were considered.

The results of the sensitivity analyses are presented in Table 3.6-14 below. The overall effect of a lower economic growth (WM−) results in a steadily decreasing final energy consumption in contrast to a higher economic growth (WM+), which somewhat increases the energy use in the period from 2022 to 2030. In turn, in the base case WM projection, the final energy consumption decreases only slightly.

In 2030, the final energy consumption would be only 272 TWh in the low growth case, but 288 TWh in the high growth case compared to 280 TWh in the base case WM. The corresponding figures for primary energy consumption are 359 TWh (WM−), 377 TWh (WM+), and 368 TWh (base case WM). The relative impact of economic growth is therefore slightly stronger on final energy consumption than on primary energy. The greenhouse gas emissions in 2030 differ in both cases in total by about 0.8 million tonnes of CO_2 eq. from the emissions in the base case WM projection.

Most of the emission increase and reduction would take place in the ETS sector, with only a 0.1 to 0.2 million tonnes of CO_2 eq. reduction in the non-ETS sector.

Table 3.6-14 Main results for the sensitivity analysis on how the economic growth rate affects the overall energy balance and GHG emissions

			2030			2035			2040		
GHG emissions	Unit	2022	WM	WM +	WM -	WM	WM +	WM -	WM	WM +	WM -
Total excluding LULUCF	Mt CO_2 eq.	45.70	30.00	30.80	29.20	23.10	24.00	22.20	18.00	18.80	17.40
Total ETS	Mt CO_2 eq.	19.02	10.60	11.30	9.90	6.60	7.40	5.90	3.30	3.90	2.80
Total non-ETS	Mt CO_2 eq.	26.55	19.10	19.30	19.00	16.20	16.30	16.00	14.60	14.80	14.40
Primary energy consumption	TWh	359.51	367.89	376.87	359.44	353.93	369.43	340.01	344.75	366.59	326.07
Gross final energy consumption	TWh	288.14	279.80	287.65	272.40	265.80	279.40	253.60	257.40	276.70	240.90

WM +, projection with higher economic growth than the WM projection

WM -, projection with lower economic growth than the WM projection

Source for historical data: Energy Statistics and Finnish Energy

3.7 Other information

According to paragraph 103 of the annex to decision 18/CMA.1, 'each Party may provide any other information relevant to tracking progress made in implementing and achieving its NDC under Article 4 of the Paris Agreement'. All relevant information can be found in sections 3.1 to 3.6, above. Hence, no additional information is provided here.

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4 Climate change impacts and adaptation

4.1 National circumstances, institutional arrangements and legal frameworks

4.1.1 Biogeophysical characteristics relevant to adaptation actions

A more thorough description of biophysical and geographic factors can be found in the Progress chapter. Finland is situated at a latitude between 60 and 70 degrees north, with a quarter of the country extending north of the Arctic Circle. With a total area of 338,400 km^2, it is Europe’s seventh largest country. Finland lies between the Scandinavian mountains and northern Russian plains. The land boundary with Sweden is 614 km, with Norway 736 km and with Russia 1,340 km long. Its terrain is a varying mosaic of low hills, broad valleys and flat, low-lying plains, with higher fells in the north. The landscape is a mixture of forests, lakes and mires. Nearly all of Finland is situated in the boreal coniferous forest zone.

About 10 per cent of Finland’s total area is inland waters. There are some 190,000 lakes and 180,000 islands, with almost half of the latter along the Baltic Sea coast.

The Baltic Sea is the second largest brackish water basin in the world in terms of water volume. Its water is a mixture of ocean water and fresh water brought in by numerous rivers. The Baltic Sea has a severe eutrophication problem, which is the consequence of more than a century of nutrient loading caused by human activity (settlements, industry, agriculture, and forestry) in the Baltic Sea region.

Finland's climate displays features of both maritime and continental climates. The annual mean temperature is several degrees higher than in most land areas at the same latitudes. The mean annual temperature is approximately 7 °C in south-western Finland, and decreases towards the north. The 0°C limit is near the Arctic Circle. The most common wind direction (around 20 per cent) in Finland is from the south or southwest.

The Finnish climate is characterised by irregular precipitation, and there are typically rapid changes in the weather. The mean annual precipitation in southern and central Finland is usually between 600 and 750 mm, slightly lower near the coast. In northern Finland, the annual precipitation is 450 to 650 mm. The seasonal variation is similar throughout the country, with the driest months being February, March and April. Precipitation then gradually increases towards summer and July or August is, on average, the rainiest month in the most part of the country. Then, precipitation decreases towards the winter and spring. Daily precipitation of 40 mm occurs in a certain location on average once every five years. In an average year, more than half of the days have some precipitation, except near the coastal regions.

Even in southern Finland, about 20 per cent of annual precipitation falls as snow, which remains on the ground for about three to four months. In Lapland, 35 to 50 per cent of the annual precipitation falls as snow, and snow remains on the ground for six to seven months.

4.1.2 Demographic situation relevant to adaptation actions

The demographic situation in Finland is also described in the Progress chapter. The population of Finland was 5.56 million at the end of 2022 and it rose to 5.60 million at the end of 2023. The population growth was 3.5 per cent between 1990 and 1999, 3.3 per cent between 2000 and 2009 and 2.8 per cent between 2010 and 2019. Over the current decade, the population growth has averaged 0.36 per cent per year.

The urban population accounted for 73 per cent of the total population in 2022. The corresponding figure in 1990 was 63 per cent of a total population of 5.0 million. Many rural municipalities have a declining population, especially in northern and eastern Finland. Internal migration from rural to urban areas was strong in the mid and late 1990s, when urban municipalities gained more than 10,000 migrants per year.

Net migration to Finland increased steadily during the late 1990s and the 2000s. In 1994, net migration to Finland was around 3,000; in 2006, it reached more than 10,000 migrations. Net migration to Finland ranged between 12,000 and 18,000 in the 2010s. During the current decade, immigration to Finland has increased, with net immigration reaching 58,000 in 2023.

The population is ageing as the life expectancy has risen rapidly over the last 30 years. Currently, baby girls may expect to reach the age of 83.8, and baby boys the age of 78.6. The proportion of the population aged over 65 has risen from 13.5 per cent in 1990 to 23.3 per cent in 2023. This trend will accelerate in the coming years. Overall, population growth has slowed down, and the natural population growth is expected to decline in the coming decades. According to population projection made by Statistics Finland in the autumn of 2021, it is estimated that the Finnish population will decline starting from 2033 if fertility rates and amount of net migration remain at the level observed at the time when the projection was made. By 2040, it is estimated that more than a quarter of Finland's population will be 65 years old or over.

Finland has a population of approximately 10,000 indigenous Sámi people. More than 60 per cent of them now live outside the Sámi Homeland. The Sámi culture has its own unique challenges from adaptation perspective, particularly due to the strong dependency of the traditional Sami livelihoods, such as reindeer herding and fishing, to the environment.

4.1.3 Economic and infrastructural situation relevant to adaptation actions

The Finnish economy and infrastructure are also described in the Progress chapter.

Finland has an open economy with prominent service and manufacturing sectors. The main manufacturing industries include the metal, chemical, manufacture of electrical and electronic products and forest industry. Foreign trade is important, with exports accounting for approximately 40 per cent of the gross domestic product (GDP) in the recent years. In 2022, Finland's GDP was EUR 268 billion and per capita GDP was EUR 48,200. The cold climate, energy intensive industry structure and long distances have led to a relatively high energy intensity and high per capita greenhouse gas emissions.

After modest economic growth in the late 2010s, the volume of Finland's GDP fell in 2020 by 2.4 per cent as the Covid-19 pandemic prevailed. The economy recovered swiftly from the pandemic and grew by 2.8 per cent in 2021 and by 1.3 per cent in 2022.

Industry

The main manufacturing industries include the metal, chemical, manufacture of electrical and electronic products and forest industry. The rapid expansion of the metal products industry, especially electronics, has changed the traditional industrial structure starting from the mid-1990s. The increase in the technology intensity of the country's manufacturing sector has been strong. The forest industry has undergone structural change as manufacturers have downsized their capacity in certain paper segments. In general, paper production has declined, while paperboard production has shown an opposite trend. The volume of exported pulp has doubled from 2001 to 2022. In the chemical industry, especially in oil refining, the production of renewable fuels is growing.

Agriculture

Climatic conditions in Finland are a decisive factor affecting the feasibility of crop production. The growing season is too short for many cultivars grown elsewhere, and, therefore, frost-resistant varieties have been developed. Because of the short growing season, the yield levels of the field crop species are considerably lower in Finland than in central Europe. The harsh winters also reduce productivity, as they restrict the cultivation of winter cereals. In many parts of Finland, livestock farming, especially dairy farming, is the only profitable form of agricultural production.

Agricultural production has changed significantly from the early 1990s. The number of active farms fell from 130,000 in 1990 to 43,500 in 2022. At the same time, the average utilised agricultural area increased from 17 to 52 hectares.

Water services

Water services in Finland are mostly provided professionally, and service reliability is high. The public sector plays a key role in safeguarding sustainable water services. Municipalities are currently responsible for organising water services, and municipalities are the most important owner group for water utilities. By law, municipalities must develop water services in their territory and, where necessary, take measures to secure access to water services.

Water utilities as service providers are responsible for water abstraction, supply of water for household use, and wastewater sewerage and purification. The main networks of water utilities cover more than 90 per cent and wastewater sewer networks about 85 per cent of Finnish households. Beyond networks in sparsely populated areas, the access to water for household use is based on private wells. Of the water supplied by water utilities, 65 per cent is groundwater or artificial groundwater.

The built environment

There are 712 built-up areas covering approximately 2.3 per cent of the land area in 2021. In 2000, the corresponding proportion was 1.8 per cent. The population density in these built-up areas was 683 inhabitants per km² in 2021. Density has declined by 70 inhabitants per km² since 2000 as the lower density fringes of these built-up areas have grown. However, in some of the biggest urban regions, the density has started to rise slightly in the main urban area particularly after 2010. Approximately 65 per cent of the inhabitants of all urban areas live in neighbourhoods with a population density of more than 20 inhabitants per hectare. Often there is no distinct boundary between urban and rural areas, as in many cases there are some tight restrictions on construction close to urban areas. This has led to a dispersed and fragmented urban structure. In Finland, the starting point for construction planning is a healthy and safe building that is fit for purpose.

Energy and electricity

The energy-intensive basic industries, cold climate and long distances underline the significance of energy for the wellbeing of Finland’s inhabitants and the country’s competitiveness.

In 2022, total energy consumption was 1,294 PJ. Industry is the largest energy consuming sector, with a 44 per cent share of final energy consumption.

Wood fuels is the biggest energy source covering 28.4 per cent of the energy supply. Oil and nuclear energy are second and third with 20.5 and 20.4 per cent, respectively. Finland’s domestic energy sources are wood-based fuels, hydropower, wind power, waste, peat and ground and air heat-pump energy.

Policy measures promoting wind power have been highly successful, resulting in a viable industry and wind power being built in the 2020s fully on a market basis and without economic subsidies. Thanks to investment grants and fiscal support, the fastest relative growth can be seen in solar energy, even though the absolute amounts remain modest. Hydropower plays a central role as a regulating power source. Finland's fifth nuclear power unit started its regular electricity production in 2023.

The Finnish electricity wholesale market is part of the Nordic and Baltic power market. The Nordic and Baltic power market is price coupled with the continental electricity markets. Physical day-ahead and intra-day trading takes place in the power exchange Nord Pool. Finland has strong power connections with neighbouring countries allowing fluent functioning of the electricity wholesale market. Scandinavian precipitation largely determines the electricity price on the Nordic power exchange.

The system operator, Fingrid, is responsible for managing the national power balance and ensuring that the transmission system is maintained and used in a technically appropriate manner. The total length of the Fingrid’s main transmission network in Finland is 14,500 km. Weatherproofing the power lines has substantially advanced in recent years owing to the Electricity Market Act[86] which entered into force in 2013.

Transport and communications infrastructure

The entire length of the Finnish road network is about 454,000 kilometres. Of this, private and forest roads account for about 350,000 kilometres and municipal street networks for 26,000 kilometres. There is a total of 78,000 kilometres of state roads which are maintained and developed by the Finnish Transport Infrastructure Agency, together with the regional Centres for Economic Development, Transport and the Environment (ELY Centres). Municipalities and cities are responsible for the street network and its condition in their own area. The maintenance of private roads is usually the responsibility of road municipalities, private landowners, communities or companies.

[86] 386/1995

The length of the Finnish rail network is slightly less than 6,000 km, of which almost 3,300 km are electrified. There are a total of about 16,300 km of waterways, of which almost 4,000 km are merchant shipping lanes. There are just under 8,300 km of coastal waterways and 8,000 km of inland waterways.

There are up to 20 airports in Finland having scheduled or seasonal commercial passenger air transport. Eighteen of those are run by the national airport company Finavia Corporation and two are municipal ones. The total runway length is up to around 60 km. Airports operate in varying climatic environments from the northernmost part of Finland to the island of Åland.

Finland has multiple privately owned telecommunication operators that provide nationwide mobile and fixed network services with their own infrastructure, and a large number of smaller companies providing for example fiber connections on a limited geographical area. A minimum of 100 Mbit/s mobile or fixed broadband connection is available to about 95 per cent of all households. All telecommunication service providers are subject to regulation and are required to prepare for outages and ensure that their activities will continue with minimal disruption even in disruptive situations. Climate change may increase the risk of disruptions to the communications infrastructure due to incidents such as floods or electrical power outages. Preparedness for these, however, has been maintained in Finland for a long time. It is important to actively monitor their impacts and, where necessary, limit the risks with regulation concerning the reliability of communications networks.

4.1.4 Institutional arrangements and governance

The institutional set up for assessing climate vulnerability and risks is based on work by research institutes and universities that carry out research on climate change impacts and adaptation. Vulnerabilities have been assessed in the preparation of national and sector-specific adaptation plans as well as in regional and local level adaptation planning. *The Government's analysis, assessment and research activities* is a funding instrument supporting policy relevant analyses that has funded focused projects exploring aspect of climate change and assessments of vulnerability and risks. In addition, the Strategic Research Council and the Research Council of Finland have funded several projects exploring adaptation to climate change.

The monitoring of climate change risks and impacts is integrated into the monitoring activities of research institutes. Cuts in the resources available for monitoring of e.g. natural resources and biodiversity have created challenges[87]. The monitoring of risks and hazards is described in more detail in section 3.2. The Finnish Meteorological Institute (FMI) has a weather and climate impact database which contains eight different impact data sources (air traffic, maritime and land area rescue missions, traffic accidents etc.). The Finnish Environment Institute (Syke) collects flood damage information annually from the largest insurance companies. Previously this information was given at a detailed level allowing identification of damages caused by specific flood situations, but currently all damages are reported as total annual damages without information on location, date or flood type. The Natural Resources Institute Finland (Luke) is responsible for a large repertoire of monitoring and inventories including those targeted to either utilised habitats or species. The Finnish Institute for Health and Welfare (THL) is responsible of monitoring of multiple health effects linked to climate change, e.g. infectious diseases, waterborne outbreaks and promoting adaptation to health effects of heat waves.

[87] Peltonen-Sainio et al. 2018

The national climate panel has been established based on the Climate Act. It is an expert panel that brings together high-level researchers on climate change, and it also has some resources to carry out synthesis work. In addition, the Sámi Climate Council was established by the Climate Act[88]. The task of the Council is to give statements on climate policy plans and strengthen the knowledge base in support of climate policy preparation from the perspective of promoting the Sámi culture. The Council consists of researchers and holders of traditional knowledge. The researchers represent diverse expertise in different scientific fields, including climatology and meteorology, study of indigenous peoples, ecology and environmental economics. The holders of traditional knowledge, in turn, have expertise in matters such as reindeer herding, handicraft, surveys and inventories related to climate change, fishing and collection of traditional knowledge. They also represent the Sámi homeland as a whole, both geographically and with respect to languages.

A National Monitoring Group of the National Adaptation Plan to 2022 was appointed in 2015, and in 2019 and 2020 the group was reappointed with an updated mandate and broadening membership. The group was responsible for steering implementation, monitoring and communication relating to the NAP. The group was chaired by the Ministry of Agriculture and Forestry and its members represented relevant ministries, national agencies, research institutes and regional and local actors. In total more than 20 key stakeholders are represented in the group that met 4-5 times each year. The current National Adaptation Plan to 2030, sets a target of systematic adaptation monitoring that supports the development of activities. Measures include further development of institutional arrangements relating to monitoring of adaptation policies at national and regional levels.

4.1.5 Legal and policy frameworks and regulations

National adaptation planning is stipulated in Finland's Climate Act[89] (423/2022). Finland’s National Climate Change Adaptation Plan is part of the climate policy planning system under the Climate Act. Under the Climate Act, the Government adopts a National Climate Change Adaptation Plan at least every second parliamentary term. In addition, during the parliamentary terms when there is no obligation to prepare a plan, the up-to-dateness of the plan in force and the need for new measures must be assessed. The current national adaptation policy framework is described in the Government Report on Finland’s National Climate Change Adaptation Plan until 2030 (NAP2030).

In publishing its first National Strategy for Adaptation to Climate Change in 2005, Finland was among the first countries in the world to produce such a strategy. The first National climate change adaptation plan was published in 2014. Adaptation has also been recognised in the National Energy and Climate Strategies (2005, 2008, 2013, 2016, 2022).

Legislation related to climate change adaptation is also described in the below sections describing the implementation, planning and updating of plans, measures and regulations.

[88] 423/2022

[89] 423/2022

4.2 Impacts, risks and vulnerabilities

Under the Finnish Climate Act[90], the objectives and measures concerning climate change adaptation must be based on scientific evidence so that the progress of climate change, its probable impacts and their associated hazards, risks and opportunities, and the capabilities to prevent disasters, limit the most adverse effects or exploit benefits are taken into account.

The most recent weather and climate change risk and vulnerability assessment was compiled in 2021-2022 to support the development of the current national climate change adaptation plan 2030. It contains a description of the observed and future evolution of various climatological variables and hazards, and a sectorial and cross-sectorial impact and risk assessment. Simultaneously, a separate regional status and vulnerability assessment was conducted. The reports were published in 2023.

In 2021, the Finnish Climate Panel published an extensive report, where the panel collected information on the temporal and local impacts of climate change, and compiled extensive tables on changes in weather, climate and marine factors for each of Finland's current regions, the autonomous Åland Islands and five sea areas.

National level, sectorial weather and climate change risk and vulnerability assessments have a long history in Finland. A general assessment of vulnerability and adaptation preparedness across sectors (FINADAPT) was the basis for the original National Adaptation Strategy 2005. For the first National Adaptation Plan published in 2014, a national adaptation research programme (ISTO) was concluded in 2012 and a study of the impact of the climate change and vulnerability of sectors was conducted in 2013. In 2018, a comprehensive national weather and climate risk assessment collated new and recent knowledge of risks and vulnerabilities generated in sectorial assessments (SIETO Project).

4.2.1 Climate monitoring, modelling, projections and scenarios

The Government research institutes, in particular the Finnish Meteorological Institute (FMI), the Finnish Environment Institute (Syke), the Natural Resources Institute Finland (Luke) and the Finnish Institute for Health and Welfare (THL) all have activities linked to climate monitoring and modelling. FMI is the main institute for physical climate variables as well as impacts on future weather risks, Syke on hydrology, floods and water management as well as impacts on ecosystems, Luke focuses on effects related to renewable natural resources, and THL on human health. The Finnish Museum of Natural History (Luomus) has a particular role in monitoring change in species and biodiversity, and many research activities are conducted in collaboration with university research departments.

In Finland, the prime source of atmospheric observations relevant to climate is the routine surface and upper air weather observations undertaken by FMI. Arrangements and conditions for data provision are consistent with WMO Resolution 40 (Cg-XII) on policy and practice for the exchange of meteorological and related data and products.

FMI makes observations of the atmosphere, Baltic Sea and space at over 400 observation stations around Finland, and using remote sensing instruments such as radars and satellites. In addition to weather observations, FMI monitors e.g. air quality, radioactivity and properties of

[90] 423/2022

the upper atmosphere. The most common methods of observation, observation stations and observed parameters are introduced in the following.

Meteorological observations have been made at several stations in Finland for more than a hundred years. In December 2022, the observation network consists of 185 automatic stations, 82 precipitation stations, 24 aviation stations, 2 sounding stations, 11 radar stations, 3 mast stations, 14 marine stations and 14 buoy stations. FMI is building an extension for urban measurement network to Helsinki, Tampere, Oulu and Rovaniemi to improve monitoring of urban heat island risks. Long climatological time series form a necessary basis not only for climatological research itself but also for estimating impacts of climate change.

FMI maintains a network of measurement stations for sea level, sea state, hydrography and currents in the northern part of the Baltic Sea. FMI operates 14 tide gauges on the Finnish coast. Thirteen of them were established between 1887–1933 and have been operating since then. Since the late 1990s sea surface temperature has also been measured at the tide gauges.

FMI measures the state of the sea at four locations in the northern part of the Baltic Sea using Directional Waverider buoys. Together with the city of Helsinki, FMI also measures waves in Helsinki's coastal area. Four wave buoys are in operation, excluding the ice season: for the Northern Baltic Proper (since 1996), Helsinki (since 2000), the Bothnian Sea (since 2011) and the Bothnian Bay (since 2012).

Baltic Sea monitoring is conducted by Syke using research vessel Aranda, which gives the widest 3D overview of the physical state and nutrients in the open sea. The measurements provide accurate information on the water column including the near bottom layer. The parameters measured include dissolved oxygen, which is measured by probes at 1m interval resolution.

There are also two additional types of monitoring stations: those used for intensive monitoring near the coast and open sea stations. During the ice-free season, measurements are conducted at intensive stations one to three times a month and at open sea stations twice a year. In 2013, FMI also established one fully automated measurement station on the island of Utö located in the outer Archipelago Sea.

The Centres for Economic Development, Transport and Environment (ELY Centres) perform coastal monitoring of intensive sites in their river basin districts. Vertical samples cover the basic hydrographical variables such as temperature, salinity, pH and oxygen concentrations. The results are reported annually to a HELCOM database.

FMI uses multisensor satellite data in maritime and sea ice services, and for research purposes. Syke uses satellite images to retrieve information about sea surface temperature, turbidity, algal blooms and a-chlorophyll in the Baltic Sea. Syke also maintains automatic measurement equipment on Ships-of-Opportunity (Algaline). Measurements include temperature, salinity, chlorophyll-a and nutrients.

FMI uses satellite synthetic aperture radar (SAR) imagery, supplemented with optical imagery, for operational monitoring of Baltic Sea ice. The SAR imagery is the main data source for the daily ice chart prepared manually. FMI uses also satellite data for developing new remote sensing methods for monitoring sea ice conditions in the Baltic Sea, Arctic and Antarctic.

The Maritime Service of FMI uses data from US National Oceanic and Atmospheric Administration (NOAA) satellites to provide information about ocean surface temperatures. Other information about the sea state (surface floating algal blooms, water turbidity etc.) is provided with the help of satellite images by the Finnish Environment Institute (Syke). For example MODIS-Aqua data is used for Baltic Sea chlorophyll-a and turbidity research, though it is planned to use data on these variables from Sentinel satellites (Sentinel 2 and Sentinel 3A) in the future.

Flood forecasting at the Finnish Environment Institute (Syke) is based on the Watershed Simulation and Forecasting System (WSFS). Its main component is a hydrological model representing the circulation of water in a catchment. WSFS covers 100 per cent of Finland and is used for forecasting over 85 per cent of the total area of the country. The forecasts are made daily for 800 water level and discharge observation points. The WSFS is used for a number of purposes, including studies on climate change. Syke is also the national centre for monitoring the physical, chemical and biological state of inland waters in Finland.

In 2013, FMI adopted an open data policy, which led to a vast amount of forecast and observational data becoming freely available to the public; with more being added continuously. The open data policy has emphasized the importance of digitizing past observations as well as further improving the quality control of observations. In addition, it has widened the use of systematic observations both in scientific as well as commercial use. Updated observations have been resubmitted, for example for various reanalysis projects.

FMI's Arctic Space Centre (ARC) operates Sodankylä National Satellite Data Centre (NSDC). NSDC has four satellite receiving systems that are used to receive satellite data for operational and research purposes.

Scenarios are used to project future conditions that are too uncertain to provide confident predictions. Examples of scenario-related activities supporting climate change analysis include the following:

- FMI has constructed projections of future climate at various temporal resolutions based on global (CMIP5 and CMIP6[91]) and regional (EURO-CORDEX) climate model ensemble simulations. These are conditional on the future composition of the atmosphere (i.e. greenhouse gases and aerosols that affect the climate), which is influenced by human activities.
- Syke has carried out joint work with other research institutes (Luke, FMI, THL) on the application for Finland of the SSP-based global framework of socioeconomic scenarios, focusing on specific sectors[92] and regions (ongoing research).
- THL has participated in joint work carried out by Syke on the application of the SSP framework for the health sector.

4.2.2 Methodologies and tools, and associated uncertainties and challenge

Between 2021 and 2022, climate projections for Finland were updated to correspond to the Shared Socioeconomic Pathway (SSP)-based atmospheric composition scenarios, considering nearly 30 global climate models (GCMs) that participated in Phase 6 of the Coupled Model Intercomparison Project (CMIP6). Projections are provided for three future 30-year periods and

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[91] Phases 5 and 6 of the Coupled Model Intercomparison Project

[92] e.g. Lehtonen et al. 2021 for agriculture

four of the five SSP scenarios from which enough GCM[93] data were available[94]. In 2022, projections of temperature and precipitation from the CMIP6 climate models were used to analyse anticipated declines in the sum of winter frost and increases in frequency of precipitation falling as rain in mid-winter.

There has been less attention paid to uncertainties in modelling impacts of climate change than in modelling the climate changes themselves. There are alternative approaches for combining these sources of uncertainty. One approach for obtaining ensemble impact estimates is to combine multiple climate projections with multiple impact model projections, as has been demonstrated for Finnish crop yields[95] for instance. Challenges associated with this approach include the possibility that the wide range produced with an ensemble of scenarios may make decision making based on the results more difficult. Another approach combines sensitivity to climate change (e.g. using impact response surfaces for one or more impact models[96]) with probabilistic climate projections[97] to estimate the likelihood of exceeding critical thresholds of impact[98]. A third approach, for more robust estimates of future risks of rare events such as drought, is to emulate observed weather time series using weather generators that can produce much longer series that can then be subjected to more robust statistical analysis in search of win-win solutions for adaptation[99].

The basis of recent scenario development work has been the global SSP framework. For climate projections SSPs (used in CMIP6) have superseded Representative Concentration Pathways (RCPs - used in the earlier CMIP5), though both sets strive to span a representative range of future uncertainties in atmospheric composition and are readily comparable. Work is proceeding to downscale some of these climate projections to a finer spatial resolution.

The socioeconomic drivers described by global SSPs, as well as influencing atmospheric composition are also important for describing alternative future trends in society that affect risks of climate change. For example, trends in population, economic development, societal preferences, and technology can affect exposure and vulnerability to future climate. Recent participatory research in Finland has focused on co-developing regional and sector-based SSP narratives that interpret these global trends in a Finnish context. National SSP-based narratives are already available for the agriculture and food and social welfare and health sectors. Co-creation of sub-national, system-level SSP-based scenarios and narratives is in its early stages.

4.2.3 Current and projected climate trends and hazards

Finland’s annual mean temperature has already risen by about 2 °C compared with the mid-1800s. The increase has been greatest in the winter and spring, but even in the summer and autumn, the temperature has increased by almost 1.5 °C. Over the most recent 30-year period, i.e., the standard normal period 1991–2020, the mean temperature was 0.6 °C higher than the mean temperature of the previous reference period of 1981–2010. The biggest change has been seen for December and the smallest for June and October. Compared with 1961–1990, the mean

[93] Global Climate Models

[94] Ruosteenoja & Jylhä, 2022

[95] Tao et al. 2018

[96] Pirttioja et al., 2015

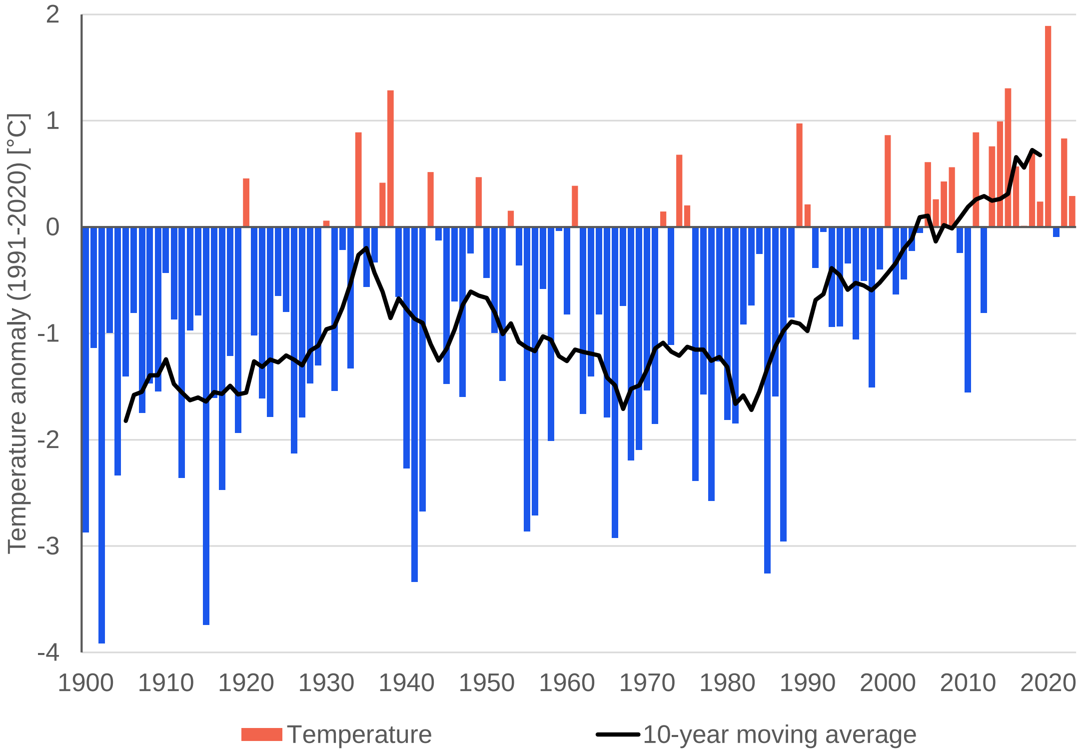
[97] e.g. Ruokolainen & Räisänen, 2006

[98] e.g. Pirttioja et al., 2019; Fronzek et al., 2022; Carter & Fronzek, 2022

[99] e.g. Ahopelto et al. 2020

temperature has risen by around 1.3 °C. Nevertheless, considerable temperature fluctuations occur between individual years.

Figure 4.2-1 Annual mean temperature in Finland from 1900 to 2023, presented in anomalies (°C) relative to the reference period 1991–2020. The black line represents the 10-year moving average



Climate change has, above all, affected winter conditions in Finland. Shorter winters have resulted in reduced snow cover in the south. Permanent snow cover, that is, the longest uninterrupted winter period with snow cover, has become 1–2 weeks shorter in southern and central parts of Finland compared with the 1981–2010 reference period. The change is even greater when compared with 1961–1990: the duration of permanent snow cover on the southern and western coast is now more than a month shorter.

An increase in the number and intensity of heatwaves has been observed in recent decades. Warm weather and long uninterrupted heatwaves also cause local droughts. With the climate warming, the thermal growing season (the period when snow has melted from open areas and the mean daily temperature exceeds +5 °C) has also become longer and the temperature sum has increased.

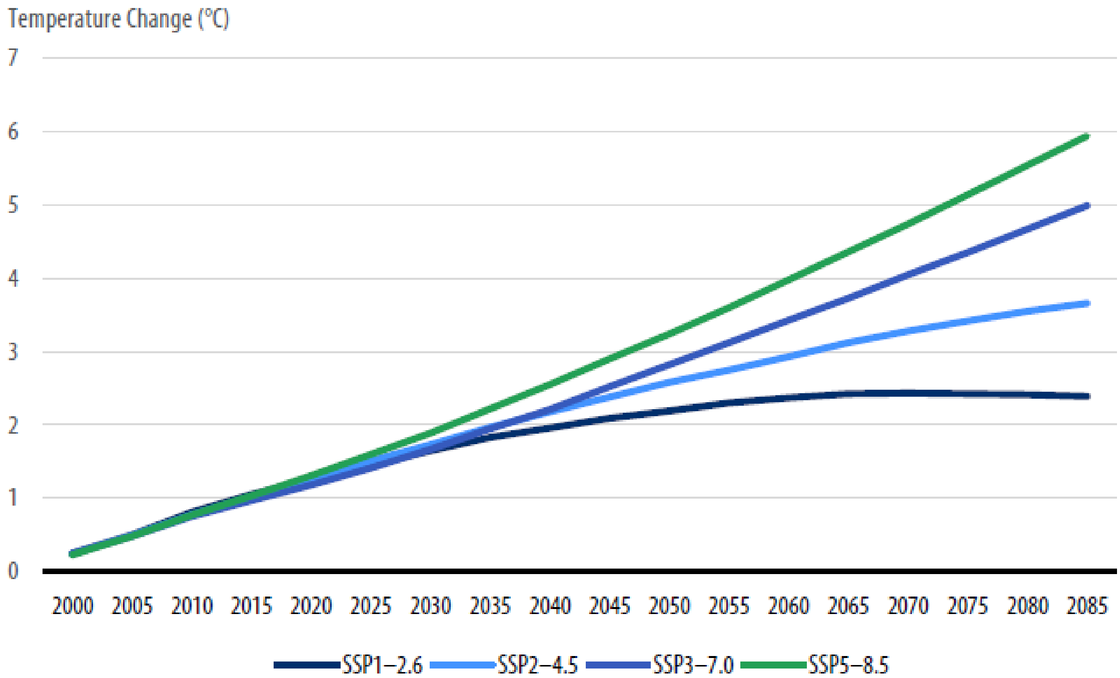
The average annual precipitation level shows significant variations from year to year (Figure 4.2-2). Long-term changes in the precipitation level are thus mainly obscured by the natural variability, but years with above-normal precipitation levels have recently occurred more often than in the 1960s and 1970s. Moreover, the countrywide average precipitation level was almost 10 per cent higher between 1991 and 2020 than between 1961 and 1990. Precipitation has increased mainly in winter. Drought is a relatively rare phenomenon in Finland, with no increase in drought periods observed yet. There is no comprehensive research on the topic, however.

Finland's wind and storm climate is characterised by major variation between years and decades. Based on weather observations, the average annual wind speeds have fallen slightly in recent decades. No statistically significant long-term trends can be observed in the number of windstorms. By contrast, an increase can be seen in conditions facilitating the occurrence of thunderstorms, but there is uncertainty as regards how this is reflected in changes in gusty winds.

Impacts of climate change are studied using climate scenarios based on climate models produced by the Intergovernmental Panel on Climate Change (IPCC), with a number of different emissions scenarios underlying these. In 2021, the IPCC published a new framework for emissions scenarios, seeking to provide narratives for climate futures and socioeconomic futures, these being to some extent interlinked. There are four of these global Shared Socioeconomic Pathways (SSP). SSP1–2.6 represents the lowest, SSP2–4.5 intermediate, SSP3–7.0 high and SSP5–8.5 very high greenhouse gas (GHG) emissions.

Finland's climate scenarios regarding temperature and precipitation were updated in 2021 based on the latest IPCC scenarios. As regards temperature, the results of the latest climate scenarios are similar to those based on earlier scenarios. Figure 4.2-2 shows that Finland's mean annual temperature is projected to rise by around 2–6 °C by the end of the century, depending on the SSP scenario used. The most substantial change in the results of the new scenarios is that the warming of Finnish summers is projected to exceed the projections based on earlier scenarios. However, in the future, warming will still be stronger in the winter than in the summer. On a timescale of one hundred years, Finland's mean annual temperature will rise at a rate around 1.6 times the global average.

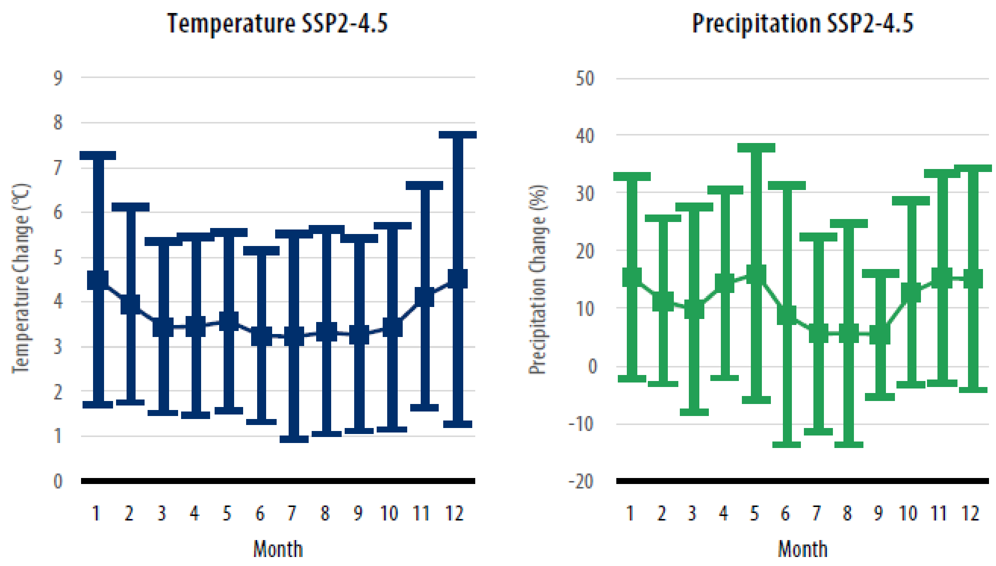
Figure 4.2-2 Temporal evolution of annual mean temperature in Finland in 2000–2085 compared with 1981–2010. Responses to the four different climate scenarios are based on the outputs of 28 global climate models



Total precipitation is projected to increase as the climate changes. The increase will be higher in the winter than in the summer, although in southern Finland the change may turn out to be very minor. Heavy rains in the summer are expected to intensify. In addition, the amount of incoming solar radiation may decrease due to increased cloudiness.

Figure 4.2-3 shows the projected change in mean temperature and precipitation by month when moving from 1981–2010 to 2070–2099. The calculations for the figure are based on the 'interim' GHG scenario of SSP2–4.5, the materialisation of which would mean the global mean temperature in 2081–2100 being an estimated 2.7 °C above the pre-industrial level.

Figure 4.2-3 Changes in Finland's (a) monthly mean temperatures (°C) and (b) precipitation (%) from 1981–2010 to 2070–2099. The curves represent the averages of the changes projected by the climate models and the vertical line segments denote the 90% confidence interval in accordance with the IPCC's SSP2–4.5 scenario



The number of hot days (with temperatures exceeding 25 °C) in summer are expected to increase and heatwaves are anticipated to become longer and more intense. Regardless of increases in precipitation, the scenarios also project the increased prevalence of periods of drought due to the increased occurrence of severe weather events and the increased evapotranspiration caused by rising temperatures.

The warming of the climate will also lengthen the thermal growing season, and the effective temperature sum of the season will increase. On the other hand, the winter frost sum and temperature fluctuations will decrease, as the temperature change is proportionally greater with regard to the lowest sub-zero temperatures. The depth of soil frost will decrease and the soil frost period will shorten. This is expected to increase windfalls of trees during as well decrease soil bearing capacity during winter season.

With the winters becoming milder, a greater share of winter precipitation will fall as rain. This will affect flow rates of rivers and streams and the occurrence of fluvial floods, mainly in the form of spring floods becoming reduced but winter floods becoming more common. The direction of change in fluvial floods varies from increase to decrease depending on location, the period examined and the characteristics of the river basin. The flood risk is projected to increase particularly in the large water bodies of southern and central Finland as precipitation increases. The increased the risk of pluvial flooding, due to the projected increase in heavy precipitation events, needs to be taken account in management of water resources, especially in design of drainage systems. By contrast, the changes seen in the near future in more northern parts of the country may be quite small and the direction of change is uncertain, depending on whether the increasing precipitation will be snow and whether the snow will melt all at once or gradually over the winter. The seasonal variation and increased intensity of floods will challenge the performance of current risk management methods.

The rise in sea level varies on the Finnish coast depending on the location. In eastern Gulf of Finland, the interim scenario shows an upturn in sea level, resulting in a 20–30 cm rise by the end of the century. If the highest scenario materialises, the sea level may rise by 70–80 cm from the current level in eastern Gulf of Finland by 2100. By contrast, in the Bothnian Bay, the rate of land uplift is high enough to counteract the rise in sea level at least until the 2040s or even until 2100, depending on the scenario used.

All in all, Finland's flood risk is projected to decrease slightly over the short term but to double or triple by 2100 if the current flood risk management measures are not continued and implemented as planned. The increase in risk is mainly due to the assumed steady economic growth increasing the value of damaged property. Over the short term, the risk is reduced in particular by climate change, as the flood risk may decrease in many river basins and the rise in sea level will not yet significantly increase the coastal flood risk over the short term. Over the long term, the mean sea level rise will clearly increase the probability of coastal floods too, particularly on Finland's southern coast.

The period of Baltic Sea ice cover will become shorter, but ice conditions may be challenging in the decades ahead, too. Cold and mild periods shifting back and forth create ice conditions that hinder shipping. The role played by changing sea ice conditions is greater in the northern part of the Baltic Sea, especially as regards shipping.

Windstorms have caused significant impacts, including electrical power outages, in recent years. No major changes are projected on the basis of climate scenarios in windstorms, however. Changes in mean wind speeds are also anticipated to be minor. There are, however, several uncertainties involved in the assessment of future changes in storm occurrence. The total number and intensity of strong windstorms are projected to decline in the North Atlantic Ocean.

In the light of current knowledge, phenomena related to thunderstorms, such as lightning, downbursts and tornadoes, are not anticipated to change in the next few decades. There are, however, major uncertainties involved in long-term scenarios in particular. Major variation between years and randomness are still emphasised in the occurrence of phenomena, particularly as regards the strongest phenomena. It should, however, be noted that, if global warming takes place according to the most pessimistic IPCC emissions scenario, there will be a considerable increase in thunderstorms specifically in Northern Europe.

4.2.4 Current and projected trends affecting exposure and vulnerability to changing climate

The risks associated with climate hazards also depend on non-climatic risk drivers as much as on the climate hazards themselves. In addition to the changing climate, risks in Finland are affected by current and future societal and economic developments. The risks vary greatly from one part of the country to another and depend on specific regional characteristics. Regional livelihoods, nature and other elements of society have adapted to the current climate, but climate change will result in risks growing around Finland, including the Arctic and Baltic Sea Regions.

The population is ageing throughout Finland. This trend is also described in the section on the demographic situation in Finland. The decline in the working age population is a major challenge for the dependency ratios and employment in many regions. In rural areas, the challenge is compounded by the migration of young people to urban areas, which is expected to continue. Some health challenges related to climate change will particularly affect the elderly, with the ageing of the population will increase the prevalence of these problems. Population is concentrating in the major cities and even outside the major cities there is a trend of migration from rural to urban areas.

Climate change affects the whole built environment. The age of the building stock and changing weather conditions throughout Finland are increasing the need for large-scale renovation. In sparsely populated areas, the building stock is underused, making maintenance and repair investments difficult. New construction is concentrated in growing urban areas. Challenges here relate to the resilience of buildings and ensuring healthy living and working conditions, e.g. during heat waves. The importance of stormwater management will also increase significantly.

Functioning logistics, the condition of the transport network and the water and energy supply infrastructure play an important role in the basic functions of society. Infrastructure across the whole country is in need of repairs, and the risks are increasing as a result of, for example, less frost and more frequent periods of rainfall and drought. From a water supply perspective, areas that rely heavily on surface water abstraction are the most vulnerable to the impacts of climate change. All over Finland, especially in small water utilities, human resources are scarce, which creates challenges for operations.

The economic structure of the regions will influence the impacts of climate change. In regions where industry is economically important, the risks are likely to be indirect and will materialise as a result of weather events elsewhere in the world. Livelihoods reliant on natural resources will experience direct impacts as seasons and typical weather conditions change. Such livelihoods include agriculture, forestry, reindeer husbandry and tourism.

4.2.5 Observed and potential impacts of climate change

By international comparison, the impacts of climate change seen in Finland appear to be rather small, particularly during the decade ahead. By global comparison, Finland is well-prepared for additional challenges brought about by climate change. Finland's stable society, well-maintained infrastructure, well-functioning government and administration, high level of education, gender equality and societal service system improve the country's opportunities to prepare for and adapt to a rapidly changing climate. A more thorough description of the risks to different sectors in Finland can be found in Finland's 8th National Communication under the United Nations Framework Convention on Climate Change.

In the European climate risk assessment published in 2024, it was identified that an increase in mean temperatures, total precipitation, and heavy precipitation has already been observed in Northern Europe. These trends are expected to continue in the future along with an increase in heatwave days. The European climate risk assessment expected droughts to decrease in Northern Europe in the future, however the Finnish climate risk and vulnerability assessment conducted in 2023 expects droughts to keep becoming more frequent, especially in areas that are more vulnerable to drought, although there are many uncertainties associated with this.

Climate change is anticipated to accelerate biodiversity loss, and biodiversity loss in turn can intensify climate change. Impacts on biodiversity differ depending on local conditions, species and habitats. The rising mean temperature, fewer periods with considerable sub-zero temperatures and the temporal shift of the seasons have already caused large-scale changes in Finnish natural ecosystems and biodiversity. Increasing land use pressures from e.g. forestry and mining along with climate change can be expected to contribute to a change in vegetation from lichens towards shrubs. Land use change can also be a contributor to conditions that benefit new pests and more damage done by insects.

The temporal and spatial distribution of species has already changed. As the climate changes, conditions suitable for species shift in space and many species follow this shift, often resulting in a northward or north-eastward shift in species distribution. The situation is particularly challenging for species adapted to the Arctic conditions of Lapland, as they are unable to move any further north. Changes in the distribution range of species have also taken place in protected areas, and climate change may result in species moving outside protected areas, too.

The impact of alien species on native species is currently most significant in southern Finland. It has, however, been anticipated that impacts will be more broadly visible by the end of the century. As the climate changes and, especially as winters become milder, many alien species that so far have shown low reproductive and dispersal rates may increase in abundance and become invasive alien species. Alien species may already today displace indigenous species in various habitats, and the impact is expected to increase in the future.

Climate change adds to the challenges faced in agricultural production, as production risks increase because of increasing weather variability. This might cause fluctuations in crop yields and declines in crop quality. Arable farming will most likely face challenges caused by increasing plant pest and disease pressure, increasing heavy rains and excessively wet fields, southern Finland’s shorter or absent ground frost periods and, in particular, coinciding high temperatures and drought and, consequently, increasing evapotranspiration during the growing season. The negative impacts of climate change on the operating conditions, profitability and competitiveness of agriculture may increase in the future. Particularly over the long term, climate change may affect Finland’s food supply as well as food and nutrition security, both via national and transboundary climate change effects.

Increasing drought and heatwave periods increase the risk of extensive forest fires. Forest fires are a natural part of the life cycle of forests, but they cause financial losses to forest owners and potential hazards to humans and require significant resources for rescue services. So far, extensive forest fires have been successfully controlled by efficient fire protection and detection systems, dense forest road network and silvicultural measures. The structure of Finland’s forests is effective in reducing the risk of forest fires, as forest compartments are small, especially in southern Finland. Human activity in forests is a significant factor for the emergence of the forest fire risk. It should also be noted that the reduction in forest fires starting from the 1960s has resulted in a decline in many species and ecosystems that are dependent on forest fires.

Reindeer husbandry is a livelihood that is sensitive to the negative impacts of climate change. Climate change and changing weather conditions have direct effects on the food access, health and wellbeing of reindeer and on practical reindeer husbandry work. In addition, climate change has indirect impacts though changes in the grazing environment. Reindeer husbandry is an inseparable part of the indigenous Sámi culture, which means climate change also has major sociocultural impacts.

The most important health harm caused by climate change in Finland were assessed as harms related to increased heat, slip accidents, water-borne epidemics, zoonotic and vector-borne infections, and moisture damage to buildings. In addition, new species with allergenic potential spread to new areas in Finland, strong winds bring allergenic species to new areas, and the growing season becomes longer, that increase the prevalence and incidence of allergenic symptoms. The darkening of winters can lead to increase in the prevalence of mental health symptoms. Heat waves are currently the biggest health hazard related to climate change in Finland. Prolonged heat waves lasting 3-4 weeks have been estimated to have led to 200-400 extra deaths per year in the 21st century.

In the worst cases, large-scale stormwater floods may cause significant incidents and have adverse effects on the performance of duties such as prehospital emergency medical services. The adverse effects of heatwave periods are also greater in urban environments than in the surrounding areas due to the heat island phenomenon and partly due to the building stock. The mobility of people using assistive devices may be further restricted during extreme weather events.

Climate change poses a threat to cultural heritage and cultural environments through factors including extreme weather events, increasing floods and rising sea level. Climate change has already had significant impacts on, for example, the environment, livelihoods, culture and cultural heritage of the Sámi.

Extreme weather events, rising temperature, increasing floods and rising sea level challenge transport sector and infrastructure. Compound hazards, such as wind blowing snow and other material on the rails and roads, as well as melting and thawing processes leading to increased road surface erosion, can impact traffic and transport. Heavy winds have caused trees falling on railway tracks. Rigid ice conditions can increase ice breaker need for marine transport. Especially winter conditions cause challenges to management and operations of airports in Finland, which reflects into fluency and safety of air traffic. For example, icy conditions on runways, flooding, and fluctuating temperatures cause extra work.

Extreme weather events and climate change affect the durability and condition of transport systems, transport development outlooks, railway and road structures, maintenance and, consequently, adaptation needs. The impacts of weather and climate on the transport system may cause serious harm or accidents, damage and delay risks that result in costs, value losses and health effects. Climate change may cause increasing disturbances relating to critical elements of the transport infrastructure, increase operating costs, reduce the infrastructure service level, exacerbate the infrastructure funding gap and cause major spill-over effects on society and the economy. The weather and climate risks facing transport chains have been identified and reduced by means of several measures relating to aspects including drainage, flood risk management, winter maintenance, design and dimensioning of transport routes and improvements to the reliability of safety devices and systems. However, the vulnerabilities of the transport infrastructure are not yet sufficiently known and identifying adaptation-related information needs and compiling information have been identified as essential in the planning and targeting of adaptation measures.

4.3 Adaptation priorities and barriers

4.3.1 Domestic adaptation priorities

The objective of the Finnish Climate Act[100] and the climate policy planning system based on the Act is to ensure that national measures are taken to adapt to climate change by promoting climate change resilience and the management of climate risks.

The vision of the Finnish national adaptation activities is formulated in the NAP2030 adopted in 2022: wellbeing, safety and security in a changing climate. Three overarching goals have been derived from the vision adopted for NAP2030. The goals specify in more detail the adaptation objectives included in the Climate Act (423/2022) with regard to strengthening climate change resilience and the management of climate risks. The goals are:

1. Societal actors have a strong will to adapt to climate change.
2. Societal actors have access to efficient means to assess, prevent and manage the climate change-related risks to nature and society.

[100] 423/2022

3. Societal actors have the capacity to prevent, prepare for and manage the climate change-related risks to nature and society.

To meet these goals, actions are prescribed in ten main themes:
Theme 1 National-level strategic planning and foresight
Theme 2 Comprehensive security and general security of supply
Theme 3 Food and nutrition security
Theme 4 Infrastructure and the built environment
Theme 5 Use and management of renewable natural resources, biodiversity, nature-based solutions and drought risk management
Theme 6 Health protection and promotion
Theme 7 Cultural heritage and the cultural environment
Theme 8 Climate risk management at the regional and municipal levels
Theme 9 International cooperation
Theme 10 Knowledge base, communication and monitoring

The themes were selected by the preparatory group that led the formulation of the NAP2030. The preparatory group was chaired by the Ministry of Agriculture and Forestry and consisted of representatives from nine ministries. In the selection of themes and subsequent targets and actions, priority was given to cross-sectoral themes that engage multiple sectors as well as selected sectoral priorities for adaptation action. The NAP2030 is complemented by sectoral adaptation plans and action programmes, which define further targets and adaptation actions in various sectors.

Furthermore, the NAP2030 includes actions for the coordination, monitoring and evaluation of its implementation. The Plan describes the actors responsible for the actions and their implementation, along with timeframes, resources when they are known, or if additional resources are needed.

4.3.2 Progress towards adaptation priorities

The assessment of the progress of the previous NAP and the comprehensive assessment of Finnish adaptation policy described below were used to inform formulation of the current NAP. The NAP2030 will be evaluated in 2026.

The long-term aim of the previous NAP2022 was to ensure that Finnish society has the capacity to manage the risks associated with climate change and adapt to changes in the climate
The following objectives set the priorities:

A. Adaptation has been integrated into the planning and activities of both the societal sectors and their actors.
B. The actors have access to the necessary climate change assessment and management methods.
C. Research and development work, communication and education and training have enhanced the adaptive capacity of society, developed innovative solutions and improved citizens' awareness on climate change adaptation.

The comprehensive evaluation of Finnish adaptation policy concluded in 2022 that

- The general awareness of the impacts and risks of climate change and the need to adapt has strengthened and is at a comparatively good level in Finland. Climate change has been widely recognised as an issue in legislation and other guidance.
- Regional analyses of adaptation across sectors have become more common due to the activities of Regional Councils and Centres for Economic Development, Transport and Environment (ELY Centres). Regional analyses can support the implementation of adaptation measures also in those municipalities that do not have sufficient resources of their own to plan adaptation activities.
- The need to plan adaptation measures has been identified, especially in cities with more than 50,000 inhabitants. Cities also use their networks to share good practices and develop ideas.
- The adaptive capacity has strengthened in many administrative sectors with actions that generally improve preparedness for risks and various extreme conditions, although they are not always recognised as adaptation to climate change.
- R&D activities have supported the development of adaptation activities, increased understanding of the challenges ahead and enabled the provision of climate services. For example, the Climateguide.fi portal and operation of the flood center (vesi.fi) offer versatile information for adaptation and preparedness. In addition, guidelines and guides have been prepared, for example, to assess the climate impacts of projects and legislation.

4.3.3 Adaptation challenges and gaps, and barriers to adaptation

Finland is experiencing greater than average warming due to its northern location. Until now, climate extremes and weather have not, however, been disastrous, and some areas have also benefited. As a consequence, climate change induced risks and adaptation needs have not been recognized in all sectors.

Based on the 2022 adaptation policy evaluation, some of the main challenges related to adaptation are:

- Coordinated and comprehensive preparation of and decision-making on adaptation action based on continuous monitoring and impact assessment are still in the process of taking shape.
- Statutory obligations and concrete adaptation targets are absent from many sectors: therefore, authorities are only able to encourage actors to adapt.
- Labour shortage in the healthcare and social welfare sector and rescue services as well as the maintenance backlog of infrastructure, such as the road network and water services.
- The shortage of human and budget resources allocated to implementation makes it difficult in many sectors to develop and implement new adaptation measures.
- The development of actual adaptation action has been largely based on individual projects and low resources. The lack of permanent staff knowledgeable about climate change adaptation is reflected in short-termism in activities.
- Many sectors have targets and measures that are not recognised as adaptation. This causes difficulties in monitoring adaptation activity and measuring performance. The fragmentation of adaptation action hampers learning, which results in inefficiency.
- Responsibilities and chains of actions relating to adaptation are in part complex, which is something that municipalities and regional authorities in particular have regarded as a challenge.
- General climate change data is abundantly available, but local, sector-specific and solution-oriented applied knowledge or expertise is not available in all respects.
- The lack of systematic monitoring data on adaptation activities makes it difficult to assess the impacts and effectiveness of adaptation measures.

4.4 Adaptation strategies, policies, plans, goals and actions to integrate adaptation into national policies and strategies

Finland’s National Climate Change Adaptation Plan is part of the climate policy planning system under the Climate Act. Under the new Climate Act[101], the Government adopts a National Climate Change Adaptation Plan at least every second parliamentary term. The revised Act specifies that the following shall be presented in the adaptation plan: 1) up-to-date assessment of risks and vulnerabilities; 2) assessment of the adaptation in individual administrative branches, across the boundaries of administrative branches and on a regional basis as considered necessary; 3) measures to achieve the adaptation targets and estimate of their effectiveness.

The ten themes of the National Adaptation Plan are presented in section 3.3.1. Under these themes, 24 targets are prioritized and presented in the NAP:

Theme 1 National-level strategic planning and foresight

- Target 1: Adaptation is integrated into the Government’s and ministries’ strategic planning and foresight by 2030
- Target 2: Sectoral adaptation is done in a structured manner and means for implementation are secured by 2030

Theme 2 Comprehensive security and general security of supply

- Target 3: The consequences of climate change and the adaptation needs are identified as part of comprehensive security and integrated into the comprehensive security model and the objectives of security of supply by 2026

Theme 3 Food and nutrition security

- Target 4: The operating conditions of agriculture to adapt to climate change are enhanced by 2030
- Target 5: Climate-resilient food production and consumption maintain food and nutrition security throughout the NAP2030 period

Theme 4 Infrastructure and the built environment

- Target 6: The preparedness of water services for climate change impacts is improved by 2026
- Target 7: The vulnerabilities of the transport and communications infrastructure are identified by 2026 and climate resilience is improved by 2030
- Target 8: The built environment sector has the capacity to manage climate change-related risks and to adapt to foreseen changes in climate by 2030
- Target 9: In the energy and industrial sectors and business activities, awareness of climate change impacts, risk management and the innovation environment will have been strengthened by 2030

[101] 423/2022

Theme 5 Use and management of renewable natural resources, biodiversity, nature-based solutions and drought risk management

- Target 10: Climate change adaptation is promoted in the use of renewable resources by 2030
- Target 11: Adaptation to climate change and halting biodiversity loss are tackled together by 2030
- Target 12: Nature-based solutions are established and have increased society's preparedness for climate risks, improved water protection and increased biodiversity by 2030
- Target 13: Drought risk management has developed by 2030

Theme 6 Health protection and promotion

- Target 14: Negative health impacts of heat are recognised and adaptation and monitoring have progressed on various levels by 2030

Theme 7 Cultural heritage and the cultural environment

- Target 15: The protection of cultural heritage and the cultural environment against the impacts of climate change has improved, these are better taken into account in climate change adaptation policy and the utilisation of knowledge carried by cultural heritage and the cultural environments in climate change adaptation has progressed by 2030

Theme 8 Climate risk management at the regional and municipal levels

- Target 16: Regional and municipal actors have access to guidelines for managing climate risks as well as the competence to make use of them in planning on various sectors by 2030
- Target 17: The guidance of adaptation for regional and municipal level is consistent and appropriate by 2030
- Target 18: Funding opportunities encourage regional and municipal actors to strengthen adaptation, and monitoring of the allocation of funding is made possible by 2030

Theme 9 International cooperation

- Target 19: Adaptation, particularly the capacities of the most vulnerable countries to adapt, is increasingly promoted in international cooperation
- Target 20: The capacities and capabilities of developing countries to plan and implement adaptation measures and to develop in a climate-resilient way are promoted as part of international cooperation
- Target 21: Promoting climate change adaptation appropriately as part of international cooperation, strengthening Finland's adaptive capacity and the broadening of the knowledge base

Theme 10 Knowledge base, communication and monitoring

- Target 22: The knowledge base related to weather and climate change risks and adaptation is strengthened in a practical manner, and the availability of research data to end users is ensured by 2027
- Target 23: Awareness among society's actors of risks and adaptation measures related to climate change is strengthened through communication
- Target 24: Adaptation monitoring is systematic and supports the development of activities

4.4.1 National level adaptation plans and actions

The starting point of Finland’s adaptation policy has been that adaptation is integrated into the normal planning and activities of administrative branches and sectors. Consequently, in addition to the national adaptation plan, adaptation is strengthened and implemented under several administrative branch-specific plans and sector-specific regulation. Adaptation plans and actions are also undertaken at the regional level and at the municipal level.

The sectoral adaptation (action) plans that detail more specific actions in different sectors include:

- Action Plan for the Adaptation to Climate Change of the Environmental Administration 2022 (revision adopted in 2016). The action plan is to be updated in 2024–2025.
- Ministry of Agriculture and Forestry adaptation plan (revision adopted in 2024)
- Ministry of Social Affairs and Health (adopted in 2021)
- Ministry of Defence (adopted in 2023)

Furthermore, adaptation has been integrated into broader climate/environmental policy programmes in other sectors, including transport and communications.

Altogether, there are over 700 adaptation measures and actions described in the plans. Many actors also undertake autonomous adaptation actions that are not described in formal plans. Due to the large number of measures, examples have been selected below to show the types of measures being implemented in Table 4.4-1. The examples have been categorised into the seven thematic targets identified in the UAE Framework for Global Climate Resilience that highlight global priorities for adaptation.

Table 4.4-1 Examples of identified climate risks and related adaptation measures in national level plans

Sector	**Examples of climate risks and related adaptation measures**		**Plan/study the measures/ risks feature in**
Water	**Risk**	Drought can cause problems with water sufficiency and decreased groundwater levels can cause problems with water quality.	Risks and Vulnerabilities Related to Climate Change in Finland
	Measure	Instructing utilities supplying household water to take account of climate change as part of their risk assessment concerning household water production and the quality and quantity of raw water	NAP2030
		Creating a national drought risk management process that also includes regional aspects of risk management	NAP2030
Food and agriculture	**Risk**	Increased challenges of agricultural production, as production risks increase with the increasing variability of weather conditions	Risks and Vulnerabilities Related to Climate Change in Finland
		Possible decrease in global food availability, as well as an increase in prices and, in the long term, a price crisis, which can affect Finland's food supply and food and nutrition security, which will impact Finnish food security	Risks and Vulnerabilities Related to Climate Change in Finland

Sector	Examples of climate risks and related adaptation measures		Plan/study the measures/ risks feature in
	Measure	Continuing the emergency stockpiling of certain production inputs that are important for food security	NAP2030
Health	**Risk**	Climate change can impact health through the impacts caused by increasing temperatures, increasing extreme weather events and the mental health impacts caused by the changing climate and decreasing snow cover.	Risks and Vulnerabilities Related to Climate Change in Finland
		Climate change creates new possibilities for vectorborne disases.	Possible arrival of new vector-borne diseases in Finland as a result of climate change and human mobility - report
	Measure	Setting up a monitoring mechanism for heat-related mortality, to monitor heat-related deaths on a weekly basis during the summer period	NAP2030
		Increasing operational capabilities to treat trauma-related psychological crises and stress disorders caused by possible extreme weather events, intensifying treatment to prevent the disease burden increased by hot summer periods, and increasing the use of timed light to prevent the harm caused by the darkening of winter days.	Ministry of Social Affairs and Health's Climate Change Adaptation Plan (2021–2031)
Ecosystems and biodiversity	**Risk**	Climate change can impact the functioning of the ecological connection network, i.e. the interaction relationships of species.	Risks and Vulnerabilities Related to Climate Change in Finland
		The effects of climate change on natural habitats are primarily qualitative. Habitat types can also disappear as a result of climate change.	Risks and Vulnerabilities Related to Climate Change in Finland
	Measure	Developing the protected area network and its management on the basis of research data	NAP2030
		Restoring and managing degraded habitats to improve nature's adaptive capacity	NAP2030
Poverty and livelihoods	**Risk**	Companies will experience financial losses, but the change in investments is more difficult to anticipate, as damage increases the need to rebuild production capacity.	Risks and Vulnerabilities Related to Climate Change in Finland
	Measure	Assessing the existing funding opportunities for developing and introducing adaptation innovations for businesses	NAP2030
Infrastructure	**Risk**	The effects related to extreme weather phenomena and climate change impact the maintenance and service level of highways, external services for transport networks, traffic control organisation, and the management of an operational road network.	Risks and Vulnerabilities Related to Climate Change in Finland

Sector	Examples of climate risks and related adaptation measures		Plan/study the measures/ risks feature in
		Changes in the thaw-freeze cycle and the amount of slanting rain increase the risk of frost corrosion in buildings.	Risks and Vulnerabilities Related to Climate Change in Finland
		Spring floods are expected to decrease and winter floods become more common	Risks and Vulnerabilities Related to Climate Change in Finland
	Measure	Assessing the state of private roads and bridges and consequently encouraging road maintenance associations to carry out needed improvements and maintenance work of the private road network.	NAP2030
		Encouraging the voluntary preparedness measures of real estate and construction actors and raising the actors' awareness of adaptation	Finland's environmental administration adaptation programme
		Flood risk mapping and assessment	Flood Risk Management Act
Cultural heritage	**Risk**	Increased rainfall and humidity as well as an increase in the freeze-thaw cycle affect the preservation of the built cultural environment, cultural landscapes and ancient remains	Risks and Vulnerabilities Related to Climate Change in Finland
		The rapid warming of the climate in the Arctic region threatens the cultural heritage of the indigenous peoples of the region. Climate change has already affected the environment, livelihoods and culture of the Sámi people.	Risks and Vulnerabilities Related to Climate Change in Finland
	Measure	Developing the availability, quality, usability and interoperability of cultural heritage and cultural environment data	NAP2030

4.4.2 Integration of adaptation into sector specific planning and development priorities

Water resources

In the water resources sector, climate change has been integrated into the implementation of the EU’s water framework and flood directives, national dam safety legislation, water supply site risk assessment and review process of water course regulation permits. The selection and prioritisation of measures proposed in the 2nd flood risk management plans and 3rd river basin management plans include estimation of climate resilience of different strategies and measures. The Finnish Environment Institute has produced general storm water flood maps for municipalities’ storm water risk assessments and together with regional ELY Centres prepared fluvial and coastal flood hazard maps to enhance preparedness and take into account in land use planning. Coastal flood maps have been prepared for different climate change scenarios. The methodology for assessment of drought impacts on water resources and water sufficiency has been developed and a pilot for regional drought management plan was carried out in 2020. National guidelines for drought risk management will be published in the autumn 2024. Lake and reservoir regulations require reassessment due to seasonal changes in water levels and discharges and regulation permits may need to be changed to adapt to these changes. Dam safety legislation requires the estimation of the design floods for classified dams. Climate change affects the magnitudes of the design floods and it should be taken into account in the estimation of the design floods in the watersheds, where the floods are expected to increase.

Climate change impacts have not previously been systematically included in the selection and prioritisation of flood risk management measures in Finland. For the 2nd planning cycle, a framework was developed to evaluate adaptability of the planned and proposed measures to the expected changes in climate and land use. This nationally consistent approach helps to identify robust measures that are applicable in a variety of conditions and include regional data for flood risk managers. Similar approach has been adopted for river basin management. Regionally tailored data on hydrological impacts was found useful in planning and communicating with stakeholders.

Forestry

The National Forest Strategy extending to 2035 was completed at the end of 2022. In its plenary session on 19 October 2023, the Government adopted a resolution on the National Forest Strategy 2035. The Government resolution provides public authorities with instructions and guidelines for the preparation and implementation of forest policy. The renewed strategy includes, in a more up-to-date manner, a comprehensive approach to sustainable development and the role of forests in climate change mitigation and adaptation. Climate resilient forestry is an integral part of the National Forest Strategy 2035. The main goal is to maintain and improve forests’ resilience by integrating climate change considerations in forest management. This is achieved by improving knowledge on and practical tools for the enhancement of carbon storage and sequestration in forests as well as on the impacts of forests and forest management on climate change adaptation. Increased financing for research as well as updated legislation and guidelines on forests and climate change also contribute to improved risk management carried out by forest owners, operators and authorities.

In order to stimulate forest growth, information on the use of processed forest reproductive material and new methods of forest reproduction have been developed. In order to diversify the range of tree species used in silviculture, seven alternative tree species (including oak and Siberian silver fir) have been identified, which could be used instead of spruce under certain conditions. In addition, the protection and availability of genetic collections of noble broadleaf tree species have been improved by defining practices for the sale of seeds. Project activities have also contributed to the development of the capacity of forest firefighting by scaling up static fire maps to a national level.

The most recent changes to the Forest Damages Act entered into force in April 2023, when the validity period of the aid scheme included in the Act was extended until the end of 2027. The aid scheme enables to provide compensation to landowners for the costs and damages caused by measures to prevent forest damages.

Agriculture

Adaptation measures for agriculture are included in the Ministry of Agriculture and Forestry’s sectoral adaptation plan for 2022 to 2027. Guidelines for water management in agriculture and forestry in a changing environment set out objectives and measures for sustainable water management in agriculture and forestry, including in the light of changing climate conditions. A work programme has been published to support the guidelines’ implementation.

Further development of cultivation methods and systems is required to reduce risks and increase the resilience and competitiveness of agricultural production in a changing climate. The existing networks in place for farmers, farmers’ associations, and advisory services help improve the exchange of knowledge about the means for adapting to climate change and variability. Agricultural research has been well designed to support and prioritise the development of primary adaptation measures. Research on climate change impacts and available adaptation means has thereby already provided useful information for farmers and agricultural entrepreneurs.

In the agricultural sector, measures for adaptation to climate change often also work as climate change mitigation measures. Adapting to a changing climate is also instrumental in achieving the climate mitigation targets set for the agricultural sector.

The adaptation measures include developing risk profiles and emergency plans for various existing and emerging pests and diseases. Although the main drivers for the risk assessment have been the pest and disease risks caused by increasing international trade, the impacts of climate change are also included where relevant.

Finnish plant breeding has expanded the breeding strategies to cover novel crops that will probably be introduced to diversify Finnish crop rotations in the future. These, coupled with improved disease resistance and resilience through plant breeding, are important elements in improving the future adaptive capacity of Finland’s agriculture.

The EU’s Common Agricultural Policy (CAP) provides many tools for the abovementioned adaptation needs. Diversified production, the stability of the business economy, and the management of the growing condition of the field and water management play a key role in adapting to climate change. Organic production also promotes biodiversity and thus helps farmers adapt to climate change. Investment subsidies, advice services and various data transfer projects have helped develop production and modernise the equipment base. Adaptation to climate change in livestock farming is strongly linked to animal welfare and production hygiene. Measures related to adaptation are included to the Finnish national CAP plan for the new CAP period from 2023 to 2027.

Adaptation measures on farms have been supported and monitored by several recent or ongoing research projects in collaboration with farmers, advisory services, farmers’ unions, policymakers and private companies. To enhance adaptation to exceptional weather conditions, measures to improve and increase farms’ energy self-sufficiency and energy security of supply have been promoted and implemented.

Health

Critical issues in adaptation in the health care sector are functioning environmental health governance and the supporting health protection infrastructure (energy and water supply and sanitation) as well as high housing standards coupled with functioning disease surveillance. More specific adaptation measures regarding health and wellbeing are included in the Climate change adaptation plan of Ministry of Social Affairs and Health (2021–2031). These measures include a heatwave warning system, various guidelines and action plans, education, training and communication.

Transport

Adaptation is part of standard sectoral policies, plans and programmes in the transport sector. The Ministry of Transport and Communications will incorporate climate change adaptation into its strategic guidance documents, such as the national 12-year transport system plan, which will be updated each government term. The updated National Transport system plan for 2025–2036 will be adopted by the Parliament in December 2024. It underlines the importance of adapting to climate change, i.e. preventing, reducing, and preparing for its impacts in the future. The Finnish Transport Infrastructure Agency, which operates under the Ministry of Transport and Communications, is responsible for road, railway and waterway construction and maintenance. One of the Agency's challenges for infrastructure management is to plan relevant adaptation measures for the transport network due to the impacts of climate change. This involves examining the functional limits, enhancing resilience based on vulnerability and risk analysis of existing structures and technical systems and targeting adaptation measures based on these analyses.

The airport company Finavia has assessed impacts of changing climatic conditions on runway and pavements winter maintenance and will update their internal guidance accordingly. The company has also investigated risks of flooding at airports and will take adaptation measures when upgrading infrastructure at airports.

Built environment

The Finnish parliament approved the new Construction Act on 1 March 2023. The new Construction Act will improve the effectiveness of regulation, particularly in order to mitigate and adapt to climate change and to promote the circular economy. The Construction Act will enter into force on 1 January 2025. Preparations for the reform of the Land use and Building Act continue, and one of the key objectives of the reform is to mitigate and adapt to climate change.

Another important method for steering land use in regard to adaptation has been the national land use guidelines (Government Decision 2008), one of the main focus areas of which is adaptation. According to the Land Use and Building Act, the national land use guidelines must be taken into account in regional level planning, municipal land use planning and in the operations of the authorities. In 2014, the Land Use and Building Act was amended with provisions on stormwater management. Increasing rain levels have been taken into consideration through the issuing of a decree on the preparation of moisture control plans in construction in 2014. Urban flood management is also covered by the Flood Risk Management Act.

Disaster risk management

In 2023, climate change impacts and risks were included in the National Risk Assessment, made in accordance with the EU Civil protection mechanism, by describing the diversity of weather and climate risks and the related challenges society, and by including weather and climate risks in the sectorial threat models. There is no single national disaster risk reduction strategy in Finland but there is legislation, government resolutions, different strategies and programmes that form together the necessary preparedness of the society to the different kind of disasters. Legislation and programmes include Emergency Powers Act, Rescue Act, Act on Security of Supply, other relevant documents: Security Strategy for Society, National Risk Assessment, Internal Security Strategy, The national targets for the rescue services for 2025. The Sendai framework goals are advanced in collaboration between actors.

The National Risk Assessment 2023 examines climate change as a driver of change in the security environment. Climate change is examined in various threat scenarios and disruptions linked to other drivers. Risks and conditions vary in different parts of country. Management of weather and climate risks is of high relevance in regional risk assessments, where impacts of climate change have been identified clearly. The risk assessments create the framework for the types of risks that different administrative branches and other actors must prepare for, and helps to identify development needs and support prioritisation. Furthermore, each actor assesses its risks more specifically.

Energy and climate

The new national climate and energy strategy takes into account and coordinates the Government Programme’s energy and climate policies, the long and medium term climate change policy plans referred to in the Climate Act and the EU’s energy and climate targets for 2030 as well as the Energy Union Strategy. It takes into account also security aspects as appropriate. The strategy includes reviews in line with five dimensions of the EU Energy Union: low-carbon economy, including renewable energy, energy efficiency, energy markets, energy security, and research, innovation and competitiveness.

Reindeer herding

Reindeer herding is vulnerable to the negative impacts of climate change, such as changes in snow patterns that make it difficult for reindeer to find food from under the snow. The CLIMINI project studies adaptation to climate change in reindeer husbandry and management, including by national and regional authorities. The project aims at identifying and establishing/rooting good, sustainable and climate-friendly practices in adaptation.

4.4.3 Sub-national and community-level plans and actions

The institutional and legal set up for climate change adaptation at sub-national level is based on multiple legislations: Local Government Act[102], Regional Development Act[103], Flood Risk Management Act, Water Services Act[104], Environmental Protection Act[105], Health Protection Act and Emergency Powers Act. The new Construction Act[106] in March 2023 includes adaptation, considering the location of construction and technical requirements set for building construction, and the preparations for the reform of the Land use and Building Act continue.

An analysis of adaptation action and strategic plans of the regional councils shows that regions are at different stages in their adaptation activities. According to the Regional Development Act[107], climate change mitigation and promotion of adaptation are part of regional development and the duties of regional councils. Adaptation can also be promoted in regional land use

[102] 410/2015
[103] 756/2021
[104] 119/2001
[105] 527/2014
[106] 01 March 2023
[107] 756/2021

planning, which under the Land Use and Building Act[108] belongs to the statutory tasks of the regional councils.

The Centres for Economic Development, Transport and the Environment (ELY Centres) are central government agencies responsible for numerous different expert, official and supervision duties. As regards climate change adaptation, some essential task areas of ELY Centres include land use, functionality of the transport system (incl. transport safety and road and traffic conditions), environmental protection, biodiversity conservation and protection, construction and the built environment, the cultural environment, flood risk management, use and management of water resources, and agriculture and fisheries. In addition, ELY Centres promote adaptation as part of regional development work, advisory, funding and development services for enterprises, promotion of competence and lifelong learning, and agricultural and rural development tasks. As regards climate change adaptation, their key tasks also include defending the public interest in environmental and water issues, generating and disseminating environmental information, and improving environmental awareness. Many tasks of the ELY Centres require addressing adaptation needs in practice, although not all of these activities are necessarily recognised as adaptation.

In regional-level adaptation action, the weather and climate risk perspective has already been integrated into documents including regional risk assessments conducted as assigned by the Ministry of the Interior and in regional preparedness exercises. Prepared at regular intervals, the regional risk assessments cover significant threats and incidents that require extraordinary management actions and have regionally significant impacts if they materialise. Data on weather- and climate-related risks is also used when preparing the risk assessments. Prepared in inter-administrative collaboration, the risk assessments are utilised in preparedness and related collaboration.

Rescue departments and Regional State Administrative Agencies coordinate the preparation of the regional risk assessments in broad regional cooperation in accordance with the assignment issued by the Ministry of the Interior. The Procedures Manual for Regional Risk Assessments was published in May 2022. It is the statutory duty[109] of the Regional Administrative Agencies to coordinate regional preparedness and related collaboration. The Regional State Administrative Agencies organise regular preparedness exercises in their area, with the region’s authorities and other actors taking part. The exercises promote the actors’ preparedness for various kinds of accident and incident. The Agencies are also responsible for organising wildfire lookout activities. At the regional level, there are also collaboration and coordination forums for preparedness and safety and security that differ slightly from each other and that are either appointed by Regional State Administrative Agencies or organised in accordance with the division the country into regions or into rescue services regions. Based partly on voluntary activity, these structures operate in accordance with the collaboration model for comprehensive security through broad-scale cooperation between the different regional safety and security actors. This means they are existing collaboration structures for the promotion of climate risk preparedness, too.

In municipalities, adaptation-related strategic planning and target-setting has mainly taken place in the largest cities. The municipal survey done for the KOKOSOPU report (2022)[110] showed that adaptation work is only in the initial phase in a large part of the municipalities. A third of municipalities with less than 10 000 inhabitants felt that there is no need to invest in adaptation. Almost 40 percent of municipalities that have a climate mitigation goal have also taken steps to

[108] 132/1999
[109] under Act 896/2009
[110] Hildén et al. 2022

promote adaptation. According to a survey by the Association of Finnish Local and Regional Authorities, municipalities have identified quite a broad range of climate change-related risks, such as storms, heavy rains and sudden snow loads, prolonged heatwaves and drought periods, lowering of groundwater table, and increases in slippery conditions during winter.

Initial steps in municipal-level adaptation planning are often facilitated through the Covenant of Mayors for Climate & Energy initiative, which mandates signatories to conduct vulnerability mapping and develop adaptation actions. To date, 18 Finnish municipalities have joined the Covenant of Mayors. Additionally, seven regions and four cities have signed the EU Mission Adaptation Charter and are actively developing their adaptation plans in collaboration with the Mission community. Furthermore, regional adaptation plans are being formulated with funding from the EU European Regional Development Fund (ERDF).

Climate risks also come up in statutory land use planning and construction. In these duties, action has been promoted through municipalities' own activities but also through the implementation of various types of sectoral legislation. For example, the municipalities are responsible under the Land Use and Building Act for stormwater management in areas covered by the local detailed plan and may also take charge of stormwater management in other areas. The requirements concerning building sites outside the local detailed plan state that, when considering the appropriateness of a site, care must be taken to ensure there is no danger from flood, earth or rock fall, or landslide. Weather and climate change preparedness in municipalities is currently included in some guides as well as various preparedness plans, such as environmental health preparedness plans of municipalities and administrative branches. It is important to ensure that these will remain up to date and are developed in the future, too. Climate change adaptation requires attention extending beyond the technical sector in the duties and services of municipalities. Two of the sets of duties important from the climate change adaptation perspective – healthcare and social welfare and rescue services – were transferred to the wellbeing services counties from the beginning of 2023. The role and responsibilities of the wellbeing services countries will need to be examined more closely as part of the work to develop regional adaptation in the next few years.

4.4.4 Private sector plans and actions

The private sector plays a significant role in developing climate change preparedness and adaptation solutions in Finland. Also, the identification of opportunities relating to new technologies in particular must be developed in cooperation with private-sector actors. In addition, operating models will be required to strengthen the adaptation action of private-sector actors in the various sectors.

In accordance with NAP2030, dialogue with the private sector will be strengthened and well-functioning means of cooperation will be explored, and the incorporation and strengthening of the climate change adaptation perspective will be strengthened as part of tried and tested cooperation forms. Furthermore, sector-specific low-carbon roadmaps have been drawn up. In conjunction with updating current or drawing up new roadmaps, in addition to climate change mitigation, assessments will be made of the needs and opportunities of businesses as regards both managing the adverse consequences of climate change to businesses and working life and benefitting from opportunities provided by climate change.

The NAP2030 also aims to improve funding possibilities for innovative adaptation solutions by assessing the existing funding opportunities for developing and introducing adaptation innovations for businesses.

The private sector is included also in various sectorial strategies and work which address climate resilience an adaptation. For instance, in the preparation of the National Forest Strategy 2035, various stakeholders, including the private sector, have been widely involved. The aim in the strategic work was to coordinate the regional interests and the needs of different stakeholders in a way that the strategic objects extensively benefit the forestry sector, e.g. by strengthening knowledge-based management and competence in the forest sector. In addition, several private sector forestry operators have been financed through different projects of various national programs and funding calls (e.g. Catch the Carbon Programme).

4.4.5 Scientific, indigenous and local knowledge and justice and fairness in adaptation planning

Research on climate change impacts and adaptation has become well-established in the field of climate research. Adaptation research is carried out in national projects, where significant funders include, for example, the Research Council of Finland, the Strategic Research Council (SRC) and national research institutes, universities and universities of applied sciences also actively participate in international research and development work, especially through funding received from the European Union.

Key research themes include:

- climate change impacts in different sectors and parts of Finland, for example agriculture and forestry, health, construction and other infrastructure, ecosystems and the Arctic region;
- specification of global and European scenarios for Finland, for example, Representative Concentration Pathways (RCP) and Shared Socioeconomic Pathways (SSP);
- assessment of climate risks, looking not only at the risk factors, but also at exposure and vulnerability at the national, regional or local level, as well as the assessment of the costs of inaction related to climate change;
- adaptation and improving resilience using, for example, nature-based solutions for managing floods and waterways in urban areas;
- cross-border impacts and policy actions for their management.

Project funding strongly directs R&D activities dealing with adaptation issues in Finland. Past Government's analysis, assessment and research activities funded projects (this funding instrument is no longer available) and the R&D funding of the ministries have produced targeted information for the needs of policy development. The projects are usually relatively short-term (about one year or shorter). In the projects, information can be compiled to support, for example, drafting of legislation or strategies. The research funding of the Research Council of Finland, SRC and the EU is more long-term and enables focusing on new topics such as cross-border impacts and the utilisation of scenarios. There is a special need for R&D activities that apply the results of long-term theory-oriented research to practical applications and tools and to the development of follow-ups. For example, LIFE -project funding, part of Business Finland's funding and EU mission funding are suitable for this. Demand for this type of R&D activity is growing, but its implementation requires joint development between private sector, research communities and administration. Finland has not yet been a pioneer in this.

One of the objectives of the Climate Act[111] and a development priority of climate policy planning system under the Act is to ensure justice and fairness in the context of climate measures. The justice-related objective can be regarded as including procedural and substantive

[111] 432/2022

aspects under the Climate Act. The procedural aspect would mean that the process to prepare a plan is just and transparent. The substantive aspect is based on the fundamental and human rights obligations that are binding on Finland. The European Climate Law also underlines that the transition to a more sustainable society should be just.

According to the Finnish Climate Change Panel, the social justice dimension of climate measures covers five main elements. In the adaptation context, distributive justice focuses on issues including how risks related to climate change are distributed and how the benefits and disadvantages of adaptation measures are distributed between groups of people and livelihoods and between regions.

Recognitional justice considers the sociocultural differences between people, groups of people and regions, their different positions in society, and specific needs and vulnerabilities born through these differences. The aim is to avoid the dominance of certain sociocultural groups and to advance the realisation of the rights of those who are in vulnerable positions.

Procedural justice is about how the needs of different groups are taken into account in the decision-making process. The two final elements are global (or cosmopolitan) justice and the human rights perspective, which mean possibilities for a good life for all, the acknowledgment of different needs and participation by all. Justice issues have not been assessed as extensively in the adaptation policy context as in the mitigation policy context.

The Finnish Climate Change Panel has pointed out that climate policy cannot mend all existing inequalities. Many of the factors increasing the vulnerability of groups of people to climate change, such as socioeconomic status, cannot be solved by adaptation policy or, consequently, by NAP2030. However, when planning measures and allocating resources for climate change adaptation, it is essential to strive to prevent current inequalities from worsening or new ones being created without adequate compensation.

NAP2030 includes a measure which aims to develop the assessment of fairness and justness of adaptation measures. Issues relating to fairness and justness of adaptation measures were examined during the process to prepare NAP2030, with methodological challenges discovered in relation to them. Development needs (including methods development and assessment development) and opportunities to solve them must be assessed more specifically on the basis of the results of ongoing projects.

The Finnish Environment Institute was involved in a project ‘Solidarity in climate change adaptation policies: towards more socio-spatial justice in the face of multiple risks’ (SOLARIS) which evaluates the design of (policy) instruments, local governance and implementation of on-going projects in terms of fairness in flood risk management in Finland. The project has organized engagement events with the local population facing significant flood risks to gain a better understanding of social vulnerabilities to floods and how to better address them. The results of the project provided guidance on how to improve the engagement of vulnerable groups in flood risk management.

Natural Resources Institute Finland coordinates a project: Youth and indigenous peoples' involvement in climate change adaptation in the Arctic and Barents region (ACAF). The project aims to promote adaptation to climate change through networking and research in the food, tourism, and forestry sectors in the Arctic region, with a particular focus on the Barents region. Specific attention will be paid to 1) indigenous peoples' and indigenous youth participation and involvement in the design and practical implementation of climate change adaptation measures and the use of traditional knowledge to support adaptation actions; 2) involving and engaging young people living in the Barents region in the design and practical implementation of climate change adaptation actions.

4.4.6 Nature-based solutions to climate change adaptation

Nature-based solutions have been discussed a great deal in recent years in adaptation planning, but their broad-scale use is yet to be established. Finland is well placed to increase the utilisation of nature-based solutions in contexts such as land use planning, stormwater management, development of urban regions, and water management in agriculture and forestry. For example, extreme water conditions increasing due to climate change pose a challenge to soil functionality and, consequently, water management in agriculture and forestry, but existing or correctly implemented wetlands and sites that are in their natural state help to regulate the water cycle. Correspondingly, in densely built urban environments, nature-based solutions can promote stormwater management and many other objectives.

Target 12 of NAP2030 is that 'Nature-based solutions are established and have increased society's preparedness for climate risks, improved water protection and increased biodiversity by 2030'. This means that

- The number and surface area of floodable parks and forests that retain water and nutrients is increased in flood risk areas from the 2022 level aiding water protection and management and improving biodiversity;
- Urban nature-based solutions are commonly used in rain, flood risk and heatwave management and water protection;
- Nature-based solutions have increased biodiversity in and around the implementation areas;
- Researched data on multifunctional impacts and benefits of nature-based solutions has increased;
- Research on the benefits and impacts of nature-based solutions has been supported;
- Nature-based solutions are examined as primary options as regards measures, and their societal appreciation is increased.

4.4.7 Co-benefits of adaptation actions

The revised Climate Change Act[112] strengthens the general framework of adaptation management with the obligation to promote climate resilience and sustainable development. In addition, according to the Act, the assessment of climate risks should include both sector and administrative sector-specific and cross-cutting evaluations, because harmful impacts of climate change appear across sectoral boundaries. The extension of the Climate Act's planning system to include the land use sector also emphasises that the possible impacts on biodiversity must be taken into account when preparing climate policy plans. Protecting biodiversity is a key action in terms of adaptation, and it creates opportunities for strengthening beneficial synergies.

According to the interim evaluation[113] of the National Adaptation Plan to 2022, there have been no major conflicts between adaptation planning and other planning. Instead, practical challenges are typically related to the coordination of mitigation and adaptation both in terms of practical work and resources. This can be seen, for example, in regional low-carbon roadmaps and in the emphasis of regions' and municipalities' climate action. Identified tensions between adaptation, mitigation and safeguarding biodiversity are, for example, related to the development of urban form and the built environment.

In addition to the challenges, useful synergies concern promoting biodiversity as part of both mitigation and adaptation activities. Both mitigation and adaptation require resources, which can

[112] 423/2022
[113] Mäkinen et al., 2020

be partially combined, although there may be differences in the emphasis of the activities. Legislation and the authority of various institutions direct the implementation of adaptation and emission reduction strategies, projects and tasks.

Integration of adaptation and mitigation has progressed in the different administrative sectors, for example, in the Ministry of the Environment and the Ministry of Agriculture and Forestry. The Adaptation Programme of the Ministry of the Environment promotes integration between different areas of responsibility. The actions included in the Climate Action Package of the Land Use Sector[114], compiled by the Ministry of Agriculture and Forestry, are cross-sectoral and have many synergies with respect to adaptation. Adaptation is also one of the goals.

In addition, guidelines have been developed to assess climate impacts in the application of the Act on Environmental Impact Assessment Procedure (for conducting Environmental Impact Assessments EIA) and the Act on the Assessment of the Effects of Certain Plans and Programmes on the Environment (for conducting Strategic Environmental Assessments SEA). The purpose is to promote the examination of adaptation to climate change across sector boundaries and better identify conflicts and synergies between adaptation and mitigation in the assessments.

4.5 Progress on implementation of adaptation

4.5.1 Steps taken update the national adaptation plan

Finland's previous Climate Act from 2015 specified that a national adaptation plan should be drafted at least once in a decade. The revised Climate Act 2022[115] specifies that the Government shall adopt a National Climate Change Adaptation Plan at least every second parliamentary term.

Four significant sets of background material were produced during the preparation of NAP2030:

1. A sectoral and cross-sectoral risk and vulnerability assessment and a regional vulnerability assessment. The assessment results have been utilised in the definition of targets and actions.
2. The results of the KOKOSOPU project, which was funded by the Government's analysis, assessment and research activities and which conducted an overall evaluation of the national adaptation policy, were utilised in the definition of targets and actions.
3. Scientific consultation conducted in collaboration with the Finnish Academy of Science and Letters that focused on an improved understanding of cost effectiveness and the concepts of vulnerability and justice in the context of adaptation. The synthesis was utilised in the preparation of NAP2030.
4. A report by the Finnish Meteorological Institute and the Finnish Environment Institute on climate and socioeconomic scenarios in climate change adaptation planning, which was utilised in the risk and vulnerability assessment in particular.

In addition, NAP2030 makes use of results from several projects funded by the Government's analysis, assessment and research activities, the Finnish Climate Change Panel (including the Climate Change Adaptation: Regional Aspects and Policy Instruments (SUOMI) project report)

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[114] Ministry of Agriculture and Forestry, n.d.

[115] 423/2022

and the mid-term evaluation of the implementation of Finland’s National Climate Change Adaptation Plan published in 2014.

4.5.2 Changes in regulations, policies and planning and implementation of sector specific planning

The implementation of sector specific actions and planning is also described in Section 4.4.2.

Since the mid-term evaluation of the previous national adaptation plan in 2019, several legislative reforms and plans have formulated the objectives of adaptation activities for different sectors. Most of the objectives are general in that they state the need to adapt or prepare for climate change, but do not set quantitative goals, such as limiting the amount of flood damage or the extent of forest fires or reducing the number of cases of illness caused by heatwaves.

Adaptation to climate change is included in the objectives of the new Nature Conservation Act[116]. Climate change relates, for example, to the proposed regulations on nature conservation planning and the nature conservation information system. To account for climate change, a nature reserve referred to in Section 43 of the Act could be established in the future also if the area is of particular importance to the adaptation of habitat types and species to the impacts of climate change. In addition, a new national Biodiversity strategy is currently being developed, in which reducing climate change impacts and vulnerabilities to climate change is emphasized.

In the ongoing legislation reform of the Rescue Act[117], the aim is to make the law more reflective of its operating environment, where climate change has been identified as a central megatrend. The impacts of climate change on comprehensive security have also been taken into account in the Government’s decision on the Objectives of the Security of Supply[118], which supplements Act on the Measures Necessary to Secure Security of Supply[119]. Update of the Government’s decision on the Objectives of the Security of Supply started in 2023.

After the mid-term evaluation of the previous National Adaptation Plan, the social and health services sector has compiled the sector’s first adaptation plan, which creates a basis for developing policies and regulation. The plan discusses the risks related to the protection and maintenance of the population’s health and cross-border impacts, which concern especially the security of supply. Actual sector-specific legislation has not been enacted in recent years. In the sector, activities promoting adaptation are presented especially in the separate legislation on environmental health and in the Emergency Powers Act[120]. In assessing heat-related harm the current action limits of the Housing Health Ordinance of the Ministry of Social Affairs and Health will be examined, as they are today for current indoor temperatures + 32 degrees and for the elderly + 30 degrees.

The water management sector is undergoing a National Water Supply and Sewage reform (2020–), which focuses on securing a reliable operation of water supply services and better

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[116] 9/2023

[117] 379/2011

[118] 1048/2018

[119] 1390/1992

[120] 1080/1991

future risk management, for example, as regards to climate change[121]. In addition, the Water protection programme (2019–2023) and its successor Ahti Programme (2023–2027) includes several cross-sectoral goals that serve climate change adaptation and preparedness. In contrast, in the Programme of Measures of Finland’s Marine Strategy (2022–2027) there are no specific objectives related to climate change, even though adaptation is considered a precondition for achieving other necessary developments. In addition, the Flood Risk Management Plans[122] for 2022–2027 were updated during 2021. River basin management plans for 2022–2027 were compiled and approved in 2021.

The new Adaptation Action Programme for the natural resources sectors was published in April 2024. The Climate Change Plan for the Land Use Sector (MISU) focuses on climate change mitigation, whilst its measures must promote also adaptation and safeguarding of biodiversity. Adaptation is also included among the goals of the national CAP strategic plan for agriculture. Revision of the Forest Damages Prevention Act[123] is a key means to promote adaptation in the forestry sector. A recent example of a renewal of legislation is setting an earlier deadline, because of the warming climate, for the removal of timber from the forest to prevent insect damage to the growing trees. With the latest revision of the Forest Damages Prevention Act[124] entered into force in 2023, compensation mechanism of costs and damages arising from preventing extensive forest damages will be prolonged.

Adaptation can also be promoted in regional land use planning, which under the Land Use and Building Act[125] belongs to the statutory tasks of the regional councils besides regional development work. There are regulations in the sectoral legislation that enable the setting of regional climate goals, for example the Land Use and Building Act (there will be separate laws for construction and planning in the future). However so far, few concrete goals have been set.

Specific adaptation needs have not yet been recognised in all areas of legislation that could be affected by climate change. For example, in the ongoing reform of the Mining Act[126] the goal is to improve the level of environmental protection, but thus far adaptation to climate change has not been addressed explicitly. Instead, a general reference has been made to the Environmental Protection Act[127], Section 15 that specifies an obligation to be prepared, requiring operators to draw up preparedness plans based on risk assessment[128].

4.5.3 Implementation of national level plans and actions

In Finland’s Eighth National Communication, Finland reported on the progress made during the previous Adaptation Plan (2014–2022). The mid-term evaluation of the current adaptation plan will take place in 2026 and therefore comprehensive information on its implementation is not yet available. Implementation of sector specific actions is described in section 3.4.3.

Evaluation of the previous national adaptation plan aimed at assessing financial resources for adaptation and climate resilience. From the evaluation results, it is evident that tracking funds

[121] Ministry of Agriculture and Forestry 2021a

[122] Ministry of Agriculture and Forestry 2021b

[123] 1168/2021

[124] 198/2023

[125] 132/1999

[126] 621/2011

[127] 1166/2018

[128] Vääriskoski-Kaukanen 2016, Vihervuori 2019

aimed at adaptation is challenging. Funds are not necessarily earmarked at the budget level and the approach of mainstreaming adaptation into regular activities in different sectors makes it difficult to track budgetary resources allocated for increasing climate resilience. Financial resources are both permanent (state budget framework) and temporary (projects, separate funding mechanisms). In some ministries, budget funds are directed to advisory work. Funding is also directed to salary costs, training, and communication. For example, four ministries jointly contribute to the funding of the Climate Guide -portal.

The Action Plan for the Adaptation to Climate Change of the Environmental Administration 2022 was adopted in 2016. The Action Plan contributed to the implementation of the National Climate Change Adaptation Plan 2022 (Government Resolution of 20 November 2014). In 2020, a final review of the action plan was published. The results show that the implementation of almost all measures described in the Action Plan for which a timetable had been set has progressed as planned and they have been completed. In terms of the steering instruments, progress has been made in taking the needs for adaptation into account, but the consistency of the guidance should be further improved. There is more information on the possible impacts of climate change, but work needs to be done in terms of the planning and knowledge base of adaptation measures. We still do not know enough about the consequences of changes in ecosystem services to livelihoods and ways of life that depend on them.

4.5.4 Implementation of regional and local adaptation actions and plans

The comprehensive evaluation of Finland's adaptation policy published in 2022 showed that the circumstances for adapting to climate change vary greatly between municipalities. Supporting fair adaptation measures requires a more detailed analysis of the areas, groups and individuals that may suffer the most from climate change impacts. For example, in the flood risk management plans (created for significant flood risk areas), the evacuation of the elderly, people with reduced mobility and children in a flood situation is mentioned as requiring special attention. In the recently completed 'Solidarity in climate change adaptation policies: towards more socio-spatial justice in the face of multiple risks (SOLARIS)'[129]) research project, the Finnish Environment Institute conducted an overall assessment of justice in flood risk management in Finland, and identified key areas for improvement for addressing justice issues nationally.

Regional adaptation needs and goals were examined in the 'SUOMI' report by the Finnish Climate Change Panel[130]. The analysis of adaptation action and strategic plans of the regional councils shows that regions are at different stages in their adaptation activities. In some regions, adaptation or preparedness were already addressed in climate strategies or programs or regional development plans completed in the beginning of the 2010s, although usually on a very general level. Adaptation needs were therefore unstructured and actual plans and systematic goals were missing. Only a few regions had considered how climate change affects the development of the region and how the region could adapt to the changes or benefit from the emerging opportunities. Moreover, the main focus in the regions' climate action has thus far been on mitigation. However, the situation is rapidly improving, and several regions have formulated adaptation goals in the recent (regional) climate roadmaps, reflecting regional contexts. Adaptation themes are also reflected in the regional strategic programmes 2022–2025.

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[129] https://www.syke.fi/projects/solaris
[130] Gregow et al., 2021

According to the Regional Development Act[131], climate change mitigation and promotion of adaptation are part of regional development and the duties of regional councils.

ELY centres are regional expert authorities of the state and regional implementers of numerous laws. Separate regional adaptation goals can be set based on some laws, and ELY centres participate in goal discussions with both regional councils and municipalities.

Practical-level measures have been taken in the technical sector in particular, where stormwater management and the reliability of water services have been increased. Detailed information about the goals, concrete measures and the status of implementation of municipalities' climate action is, however, still limited. Going forward, forming an overall regional and local picture will require well-functioning cooperation between the levels of government and actors. Cooperation will benefit the identification of risks and vulnerabilities related to climate change, the determination and prioritisation of the adaptation measures required, and the identification of opportunities.

As an example of local level adaptation work, in early 2023, the Tampere City Region published a list of various tools that help identify climate risks and their impacts and support preparedness and adaptation planning in different sectors and organisations, produced and compiled by the Tampere City Region. Also, Savonia University of Applied Sciences has developed the method to examine the interdependencies between mitigation and adaptation. This ensures that Do No Significant Harm and Leaving No One Behind are taken into account. The results will be utilized in the implementation of a regional climate road map.

4.6 Monitoring and evaluation of adaptation actions and processes

4.6.1 Establishment and use of domestic systems to monitor and evaluate the implementation of adaptation actions

So far, the monitoring and assessment of adaptation action have focused on monitoring progress made in policy measures. Monitoring of adaptation measures is an important part of the latest national climate change adaptation plan.

Flood risk management is the most advanced in terms of monitoring outcomes and effectiveness of adaptation plans and measures. A central guiding document is the EU Floods Directive as part of which Finland reports on indicators and other related information biennially. The regional measures proposed in the management plans have an estimated implementation schedule and their implementation is monitored annually through the Flood Information System. The indicator assesses the proportion of completed measures out of the total number of proposed measures that can be completed.

Several monitoring and development measures have been set in NAP2030, e.g. measure 24.3 'Updating the indicator base supporting adaptation monitoring and expanding the utilisation of indicator data in adaptation monitoring'. Indicators are one practical monitoring tool that can be used to monitor actions or the desired change. Indicators have been developed in Finland, but their use has not been mainstreamed. The indicators still need to be further developed and combined with, for example, the goals of the National Adaptation Plan, so that the progress of the goals can be better monitored. Some indicators are already used, especially in larger

[131] 756/2021

municipalities, e.g. indicators of sustainable development, and some of these indicators are related to adaptation.

The NAP outlines that by 2026, Finland has set up a monitoring system for climate change adaptation and ensured the conditions for its implementation. The Ministry of Agriculture and Forestry will be responsible for the overall operation of the national monitoring system.

In 2022, a comprehensive evaluation of the national adaptation policy with particular emphasis on the National Adaptation Plan 2022 was published. The results of the evaluation were used in the preparation of the NAP2030. The evaluation found that monitoring of climate change adaptation has not thus far been carried out widely or systematically in Finland. Thus far, the evaluation of adaptation action has focused on policy monitoring. In order to evaluate the development of the adaptive capacity and possible shortcomings in it, scenarios examining the progress of climate change are needed. Thus far, this work has not been carried out in the administration, but scenarios have been prepared and analysed in research projects[132], the EU project OPERANDUM and the VNTEAS KUITTI project, where costs were estimated in relation to a situation where adaptation or preparedness for climate change does not take place[133]. Monitoring data that supports adaptation is available, for example, from the databases of Statistics Finland and research institutes.

Besides mitigation, international agreements also require monitoring of adaptation measures to allow for evaluation of the implementation of the national adaptation policy. National adaptation reporting is done through the Annual Climate Report, which is part of the Finnish climate policy planning system under the Climate Act[134]. The Act requires that the report includes ‘to the extent necessary, an estimate of the adequacy and effectiveness of the adaptation measures contained in the adaptation plan [referred to in section 10 of the Act] and, if necessary, a report on the implementation of the planned adaptation measures in individual administrative branches and regionally’. The process is led by the Ministry of the Environment.

The Climate Act requires during the parliamentary terms when there is no obligation to prepare a national adaptation plan, that the up-to-dateness of the plan in force and the need for new measures must be assessed. A mid-term review of the previous adaptation plan was conducted in 2018–2019 and the up-to-dateness of the NAP2030 and the need for any additional measures will be assessed in a mid-term review in 2026.

4.6.2 Achievements, impacts, resilience, review, effectiveness and results

General awareness of the impacts and risks of climate change and adaptation to climate change has strengthened. This can be seen, for example, in numerous documents and public discourse referring to adaptation.

Flood risk evaluations every six years based on the Floods directive[135] show that implemented actions have reduced flood risk in certain areas. In 2024, ELY Centres made, based on a risk assessment, a proposal for significant flood risk areas, which would remove significant flood risk

[132] Lehtonen et al., 2021
[133] Perrels et al., 2022
[134] 423/2022
[135] 2007/60/EC

status from four areas, resulting to 18 significant areas. Three of these areas would be excluded from the list of significant flood risk areas due to successful implementation of flood risk management actions. The final list of significant flood risk areas will be named by the Ministry of Agriculture and Forestry by the end of 2024.

The revised Climate Act[136] strengthens the general framework of adaptation management with the obligation to promote climate resilience and sustainable development. In addition, according to the Act, the assessment of climate risks should include both sector and administrative sector-specific and cross-cutting evaluations, because harmful impacts of climate change appear across sectoral boundaries.

Moreover, a new content requirement for the development of National Adaptation Plans is that a regional risk assessment is to be carried out when necessary. The assessment should cover especially vulnerable sectors, ecosystems, groups and communities and identify adaptation measures that take place in different time spans. Efforts have been made to strengthen the strategic crosscutting nature of the Plan and the need to examine cross-border impacts has been emphasized. The extension of the Climate Act’s planning system to include the land use sector also emphasises that the possible impacts on biodiversity must be taken into account when preparing climate policy plans. Strengthening biodiversity is a key action in terms of adaptation, and it creates opportunities for strengthening beneficial synergies.

The progress in these areas contribute to a general reduction of vulnerabilities and risks, but it is not possible to quantify the extent of the reductions. There have been no disastrous climate/weather based impacts. However, weather extremes cause, for example, economic impacts in the current climate in several sectors (agriculture, forestry, electricity distribution), but an exact quantification has not yet been possible[137].

4.6.3 Effectiveness of implemented measures

Sensible adaptation policy is cost effective, as expressed in contexts such as the Finnish Climate Act. Policy is cost effective when the given or desired effect is achieved at a minimal cost or, to put it the other way around, when the given cost generates the maximum effect. The starting point of Finland’s adaptation policy – integrating climate risk management and adaptation into existing organisational structures, planning practices and approaches – contributes to cost-effective and appropriate implementation. This principle is supported by the NAP2030 measures, too.

Adaptive capacity has generally increased through the increased awareness of possible climate change impacts. Concrete actions have been taken for example in the built environment both at the level of regulation and in the practical implementation of, for example, storm water management in built areas[138]. One of the goals of the previous National Adaptation Plan was to increase and improve citizens’ awareness of climate change and adaptation activities. To improve the availability of reliable climate information, the update of Climateguide.fi-portal was initiated. Wider awareness and dialogue about the key issues of climate policy, including adaptation, have been maintained by the expert reports and statements prepared by the Climate Panel.

[136] 423/2022
[137] Tuomenvirta et al. 2018
[138] Mäkinen and Hildén 2020

In late 2020, the Ministry of Agriculture in cooperation with stakeholder groups participating in the National Monitoring Group on climate change adaptation started publishing a newsletter dedicated to climate change adaptation. The thematic newsletter was published four to five times in 2021–2022, and each letter contained articles and recent research results related to adaptation. Anyone can subscribe to the letter, and each letter was be promoted in social media in order to gain a broad audience. Furthermore, the Finnish Meteorological Institute publishes a monthly e-magazine (Climate Bulletin, Ilmastokatsaus in Finnish) on weather and climate.

In water resources and flood management, the capacity to adjust water flow and to react to flood risks has been increased by setting up a dedicated flood centre run jointly by SYKE and FMI. Flood risk maps are also being produced for areas subject to potential fluvial or sea surge floods. The flood maps of coastal flooding are currently being updated. Water levels are now defined according to three different SSP-scenarios for year 2020 (present situation), 2050 and 2100 for floods of various size.

In the agricultural sector farmers have diversified crop rotations by introducing novel crops for cultivation, shifting cultivation of crops northwards and even substantially expanding field areas under minor crops like pea, fava bean, caraway, oilseed rape. These measures not only improve long term sustainability and diversify agricultural land use, but also support improvements in adaptive capacity and resiliency of agricultural systems.

The mid-term evaluation of the previous adaptation plan also aimed at assessing financial resources for adaptation and climate resilience. When evaluating financial resources, the difficulty to evaluate the funds directly aimed at adaptation becomes again evident. They are not necessarily earmarked at the budget level.

Finland has received funding from the European Commission for two projects related to responding to climate-related events, mainly flooding and forest fires: High-Capacity Pumping module and Ground Forest Fire-Fighting using Vehicles. The projects received in total EUR 1.8 million.

4.7 Information related to averting, minimizing and addressing loss and damage associated with climate change impacts

Climate risks and their impacts are described in more detail in section 3.2. So far, limited information is available on the theme of loss and damage in Finland. Resilience to extreme weather events is relatively high in Finland, while climate change is not expected to cause enormous changes in their severity or frequency. However, further improvements are needed and planned for preventing damages from extreme events, e.g., flood damages and disruptions to power supply. Considering the high level of extreme weather resilience, from an economic point of view, the guiding principle of adaptation policy should be effectively coping with structural changes in the operating conditions of different sectors and regions. Adaptive actions that increase adaptive capacity and reduce negative impacts are described in more detail in previous sections.

Finland has previously estimated some figures in Finland’s 7th National Communication to the under the UNFCCC regarding the economic loss and damage relating to climate change. These figures have not since been updated. Since NC7, the KUITTI project has analysed the impacts of climate change to specific sectors, if no further adaptation was to be implemented. The project estimated effects on the forest sector and agriculture, effects of fluvial and coastal flooding, and effects of disruptions in electricity distribution, which subsequently propagate throughout the economy. Effects were included based on a prior review of likely significance and available data. However, several potentially significant risks, such as for health and healthcare, could not be accounted for. Even though Finland may be economically less affected than the global and European average, it pays off to timely adapt to foreseeable effects of climate change. The study found that proactive adaptation reduces losses incurred by climate change more effectively than reactive adaptation.

In 2022, a joint development project between the Finnish Meteorological Institute and the National Emergency Supply Agency compiled a database of weather and climate impact data from past decades. Impact data with sufficient temporal and spatial accuracy and linkability to weather were selected for the database. Real-time impact data have been combined with other meteorological observations and forecast data to monitor the development and accumulation of the weather impacts in different parts of Finland.

After compilation of the database, a large amount of historical weather forecast data and part of the impact database were selected as training material for a machine learning method. The method was used to generate real-time seven-day forecasts of traffic accidents, slip-and-fall accidents, emergency services' fire-fighting missions and forest fire missions for various regions of Finland. These forecasts update twice a day and show the predicted impacts of dangerous weather events for the next few days. Many of the event time series are years long and nationwide, so the data collected is rare even on a global scale. Impact forecast products help safety- and security-critical actors to prepare for dangerous weather situations in a timely manner and with properly sized resources.

4.8 Cooperation, good practices, experience and lessons learned

The comprehensive evaluation of Finland's adaptation policy in 2022 found that to promote adaptation, the interaction between national, regional, and local levels should be improved, for example, by increasing the governance of adaptation measures by the responsible ministries, and coordination and communication between sectors. The adaptation plans of administrative branches or sectors within the branches (for example, Ministry of the Environment, Ministry of Agriculture and Forestry, Ministry of Health and Social Services) with designated measures and identified information needs are steps in this direction.

The administrative sectors have different structures, regulation systems and practices to implement the interaction between different administrative levels. Administrative sectors where legislation requires planning at different levels (for example, water resources management and water supply and sewage, flood protection, land use planning, transport planning) have ready-made procedures for interaction that can be utilised for adaptation issues as well. This can also be seen, for example, in the implementation of local adaptation activities.

In many adaptation issues and practical activities, such as land use and flood protection, planning and decision-making take place in several linked administrative structures, which means that the responsible authority can be national, regional or municipal. For example, flood risk management and related water regulation is a key adaptation-related task and the implementation requires cooperation between several different actors. The Ministry of Agriculture and Forestry, regional state administrative agencies, ELY centres, municipalities, companies and the Finnish Environment Institute (SYKE) are involved. In the management of stormwater floods, local measures are emphasised, but regional and national land use and infrastructure planning also have an important role to play. In a recent report[139] by the Finnish

[139] Gregow et al., 2021

Climate Change Panel, flood protection was considered as an example of a particularly well-functioning area of cooperation between different organisations.

Networks have an important role in the implementation of climate action. So far, national networks have focused on curbing climate change, but adaptation is also on the agenda in international networks[140]. Networks are important sources of peer support, exchange of good practices, knowledge and experiences. Networks also motivate climate action, as their activities often involve preparation of climate plans and reporting of actions. National networks and regional cooperation are guided by the responsible ministries. In the state administration ELY centres have a key role in promoting and guiding local and regional level climate action. Based on the findings of the SUOMI project[141] , it is important to foster close connections between regional and state-municipal processes in the future. Municipalities, in particular, are hoping for concrete guidelines from the regional councils on how adaptation can be implemented, for example, in land use planning.

4.8.1 Efforts to share information, good practices, experience and lessons learned at the national level

Coordination across national authorities is currently at a crossroad due to the new NAP. Institutional arrangements for supporting the implementation and monitoring of the NAP2030 are being developed both at the national and regional levels, reflecting on earlier experiences and the broadening landscape of organisations involved in adaptation action. For example, there are various networks where climate change impacts and adaptation are addressed.

The Ministry of Transport and Communications coordinates adaptation work on a national level in the Ministry's administrative sector. The Ministry of Economic Affairs and Employment chairs the network of climate change officials and is in charge of the overall coordination and compilation of the strategy work. The Ministry of the Environment coordinates an adaptation group consisting of the environmental administration, concerning built environment, environmental protection, biodiversity, and water protection.

The network for flood and drought risk management is coordinated by the Finnish Environment Institute. The members include the regional government authorities, who are responsible for the implementation of the flood directive in their region. Under the Finnish Flood Risk Management Act, there are also Flood Management Groups for significant flood risk areas.

To promote the implementation of the Sendai Framework for disaster risk reduction in Finland, the Ministry of the Interior re-activated a large-scale and cross-administrative cooperation network in 2021.

During the preparation of NAP2030, consultations with a broad range of stakeholder representatives, including vulnerable groups such as the youth, the elderly, disabled and the indigenous Sami people were held:

- Digital Panel for young people in June 2022
- Meeting with councils for people with disabilities
- Meeting with councils for older people

[140] Heikkinen et al., 2020

[141] Gregow et al., 2021

- Meeting with the Sámi Parliament

4.8.2 Efforts to share information, good practices, experience and lessons learned at the subnational level

At the regional level, the ELY Centres' climate expert network develops communication and cooperation around adaptation issues relating to the environment, economic development (incl. rural development), and transport. The network geographically covers the whole country, allowing for best practices to be shared across different regions.

The ELY Centres' joint climate unit coordinates a national EU Adaptation Mission network for Mission Charter signatories, as well as other regional and local actors. This network offers opportunities for peer-to-peer learning, information sharing, and partner searches for potential funding applications. Additionally, it strengthens partnerships between regional and local actors and the private sector. Finland's Regional Councils have also recently formed a collaboration network on climate issues.

In the Tampere region, a number of measures of regional collaboration have been defined in the Climate Strategy of the Tampere City Region 2030: Preparing cooperation models for municipalities and sectors for extreme situations, define adaptation measures and recommendations for different sectors of municipalities, and plan and agree on cooperation between different sectors and municipalities. In Tampere region there is an active, regularly gathering climate group which focuses on Tampere region (the city of Tampere and its surrounding municipalities and cities). In collaboration various climate action tools and programs have been created.

Savonia University of Applied Sciences coordinates the business network of the climate security in Pohjois-Savo. The network provides information on extreme weather events, and adaptation to climate change, especially in agriculture and forestry.

Helsinki Metropolitan Area has had a regional monitoring group for climate change adaptation since 2013. In 2022, the monitoring group evolved into a network of adaptation experts and practitioners in metropolitan cities. The Adaptation Network will initiate new data and information needs required for effective adaptation planning, follow the implementation of externally (e.g., EU) funded adaptation projects, and share best practices and lessons learned at the city-level integration of adaptation into urban planning.

Helsinki Region Environmental Services Authority hosts a biannually updated dataset on land cover in the Helsinki Metropolitan Area. In the detailed dataset, the land area is classified into impermeable surfaces, such as streets and buildings, and permeable surfaces, such as vegetation of different heights. It is used, for example, in stormwater management planning. The newly published version of the dataset was done in collaboration with a company providing solutions powered by artificial intelligence. AI was used to enhance the classification of sand and asphalt, which had been recognised as an essential target for the development of the dataset.

In the comprehensive assessment of Finland’s adaptation policy it was found that municipalities’ own networks are important for municipalities of all sizes, while in small municipalities with less than 10,000 inhabitants, regional cooperation emerged as a particularly important source of adaptation ideas. Larger municipalities rely on networks and their own information acquisition. Cooperation with authorities and research institutes was also emphasised. Large municipalities are also more capable of utilising international networks to support the planning of adaptation measures. The study also showed that cooperation between municipalities in climate matters is the smoothest of all. The observation is significant when considering the kind of support that could best promote adaptation action in municipalities.

4.8.3 International cooperation to share information and to strengthen science, institutions and adaptation

The Finnish Environment Institute (Syke) is a member of the European Topic Centre on Climate Change and Adaptation (ETC CCA) of the European Environment Agency, and a member of the European Environmental Protection Agencies’ interest group on climate change adaptation (EPA IG CCA). Syke has contributed to reports and analyses in these capacities, most recently and significantly, the European Climate Risk Assessment (EUCRA). Syke has also been involved in the strategic planning supporting JPI Climate and in several EU funded research projects focusing on climate change impact modelling and adaptation.

The Finnish Meteorological Institute (FMI) participates actively in international co-operation, both in research and in consultancy. FMI supports hydro-meteorological institutes in various countries, especially in the global south, in capacity enhancement and the development of their meteorological services. FMI participates also in several international organisations and projects. Finland is a member in several meteorological and oceanographic organizations as well as in networks formed between institutes in Europe. The Nordic co-operation in meteorology has a long history and an important role in the development of weather services.

Finland is contributing to the Global Atmospheric Watch[142]. Finland takes part in WMO climate activities mainly through the Commission for Climatology (CCl) and its Open Panel of CCl Experts (OPACE), especially climate data and data management. Natural Resources Institute Finland participates to the European Environment Agency EIONET network with an expert in the adaptation group.

Finland is actively supporting and participating in adaptation science and knowledge development in the Arctic, Barents and the Baltic Sea region. The key mechanisms of cooperation are the regional councils (the Arctic Council, the Barents Euro-Arctic Council and the Council of the Baltic Sea States) and the Northern Dimension partnerships. Finland's participation in the multilateral regional cooperation is guided by the goals set in Finland’s strategy on Arctic policy, the EU policy for the Arctic, Finland’s Strategy for the Baltic Sea Region, the EU Strategy for the Baltic Sea Region, and the objectives of the Northern Dimension policy.

The appropriations allocated for cooperation in the Baltic Sea, Barents and Arctic Regions are administered by the Ministry for Foreign Affairs. The general principles guiding the use of this funding are set out in the policy on funding for cooperation in the Baltic Sea, Barents and Arctic regions in 2020–2023. In 2022, several projects related to climate change impacts and adaptation were funded using funding for cooperation in the Baltic Sea, Barents and Arctic regions: 1) a project to raise awareness of invasive alien species and the threat they pose to the fragile and unique Arctic wildlife in the Barents region of Finland, Sweden and Norway; 2) two projects on improved forest fire management; 3) a project on Youth and indigenous peoples’ involvement in climate change adaptation in the Arctic and Barents region with the objective to promote adaptation to climate change through networking and research in the food, tourism, and forestry sectors in the Arctic region, with a particular focus on the Barents region; 4) Arctic indigenous

[142] http://www.wmo.int

peoples' participation and knowledge co-creation and 5) The water cycle, sea ice melt, and their effects on the Arctic climate system.

Water expertise and development of internationally climate action relevant technical solutions are promoted that e.g. improve water efficiency and resilience of systems, including through synergies with research and innovation.

Finland has contributed to the European Climate and Health Observatory by sharing the Climate Change Adaptation Plan for the healthcare and social welfare sector. The Observatory is a joint initiative of the European Commission, the European Environment Agency and many other organisations that aims to support Europe in preparing for and adapting to the impacts of climate change on human health by providing access to relevant information and tools and fostering information exchange and cooperation between relevant actors. THL also actively participates in the International Association of Public Health Institutes (IANPHI) work on climate change and health.

Finland participates in the adaptation working groups under the Nordic Council of Ministers, and promotes adaptation in the Arctic and Barents Regions. The benefits of regional cooperation for Finland and its neighbouring areas include improved security and wellbeing, better state of the environment, lower level of harmful atmospheric emissions, as well as better health and improved business opportunities for people. Emphasis in the regional cooperation is on environmental and climate matters.

As part of regional transboundary cooperation, adaptation questions have been discussed particularly within the framework of cooperation concerning transboundary waters with Sweden, Norway and Russia with special focus on water protection and the management and use of transboundary waters, including water regulation, flood risk management, dam safety, combating invasive alien species. With Russia, since 2022, due to the political situation, only the bare operational minimum was done, notably the necessary in management of discharges.

Finland supports climate change adaptation internationally through official development assistance (ODA) and its different instruments including but not limited to:

- Multilateral funds, such as the Green Climate Fund (GCF), the Nordic Development Fund (NDF), Systematic Observations Finance Facility (SOFF) and the Climate Risk and Early Warning Systems Initiative (CREWS)
- Bilateral development cooperation projects in long-term partner countries
- The Public Sector Investment Facility (PIF)
- The Inter-Institutional Cooperation Instrument (ICI)
- Through civil society project and programme funding.

In 2022 Finland’s international climate finance for amounted EUR 169 million out of which EUR 158 million was official development assistance (ODA) and EUR 15 million other official flows (OOF). The share of adaptation finance of the total amount was 39 per cent.

Additionally, Finland participates in the following international partnerships:

- the Risk-informed Early Action Partnership (REAP)
- the Champions Group on Adaptation Finance
- the Water and Climate Coalition.

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5 Financial, technology development and transfer and capacity-building support

This section aims to give an overview of the financial, technological and capacity-building support to developing country Parties provided by Finland. Financial support provided with exact figures is reported in CTF tables III.1 and III.2 for 2021 and 2022. The provision of technology development and transfer support and capacity-building support is summarised in CTF tables III.4 and III.5.

5.1 National circumstances and institutional arrangements

5.1.1 The role of the Ministry for Foreign Affairs

The Ministry for Foreign Affairs of Finland (MFA) administers the exclusive ODA budget item, i.e. the development cooperation appropriations under the State budget. Climate finance is part of the ODA[143] (please see section 5.2.3). Finland does not have a separate agency for development cooperation. The Ministry for Foreign Affairs is responsible for reporting on the provision and mobilization of support.

Development cooperation appropriations are included in the annual public budget cycles and the rolling 3-year financial frames of the Government. The Parliament approves the annual budgets every year in December. The ability to commit for longer term i.e. to make multiannual commitments is used, for instance, at the level of multilateral institutions, like the GEF[144] and the GCF[145], and for individual projects. However, in practice even these longer-term commitments are still subject to the annual parliamentary approval. The actual disbursements are reported in various reports, as appropriate, including in the CTF tables of this report.

Development cooperation is guided by development policy. During the reporting period (2021–2022) 'Climate and natural resources' was one of the thematic priority areas of Finland's development policy. Even in the current policy (Report on International Economic Relations and Development Cooperation, 2024[146]) 'Climate action' continues to be a priority theme. All channels under the development cooperation can be used for climate finance, as appropriate. Besides providing funds to the operating entities of the financial mechanism of the UNFCCC and the Paris Agreement, Finland has provided support through bilateral, regional and other multilateral channels, including support to civil society organizations (CSO) and investment funding.

[143] Official Development Assistance
[144] Global Environment Facility
[145] Green Climate Fund
[146] https://julkaisut.valtioneuvosto.fi/handle/10024/165757

5.1.2 Challenges and limitations

The main challenge in reporting on the provision and mobilization of support is the limited human resources of the MFA. While the amount of climate finance disbursed each year is rather easily tracked and reported, further details can be challenging to report, especially because most of Finland's climate finance is channelled as core contributions through multilateral organizations. Below is a list of general challenges encountered, some of which may not be relevant for this report.

- Most multilateral organizations and funds operate globally, thus it is difficult to report on the geographical distribution of finance (including support to LDCs and SIDS[147])
- Most multilateral organizations and funds operate in multiple sectors, thus it is difficult to report on distribution of finance to certain sectors
- Many programmes and projects include various types of activities, including capacity building and/or technology transfer – however, it is difficult to track the share of each type of activity in each project. In the case of projects financed by multilateral organizations and funds, it would be impossible for an individual donor country to track and report on diverse type of activities.

Tracking private climate finance portraits additional challenges. These include, for instance, the following:

- The so called Rio-markers (OECD DAC[148]) have been developed to grant-based finance in which the donors themselves screen projects against the criteria of the markers. Private sector partners may not be so skilled in identifying eligible projects nor in screening the projects against the criteria of the markers.
- From the perspective of international development finance institutions, data reported in accordance with the OECD may include commercially sensitive information on, for example on different financing terms. Thus, they might only be willing to report aggregated figures, not data on individual investments.
- In blended finance, climate marking is carried out based on an ex ante assessment based on the fund's investment strategy. However, actual investments may be very different from what was thought at the assessment stage.

5.2 Assumptions, definitions and methodologies

5.2.1 Tracking climate finance

Finland uses the 'Rio markers' developed for the OECD Development Assistance Committee's Creditor Reporting System (OECD DAC CRS) to track adaptation and mitigation-related 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 to obtain quantitative results. Depending on whether adaptation or mitigation is the principal or a significant objective, the share usually varies between 10 and 100 per cent.

Based on the project document or other relevant documentation from the implementing organisations (e.g. budget information or agreed strategies), the desk officer responsible for the respective intervention gives a value for the markers. The shares of adaptation or mitigation of

[147] LDCs =Least Developed Countries, SIDS= Small Island Developing States
[148] OECD Development Assistance Committee

the core support for multilateral organisations are based on data provided by the organisation on exact thematic budget allocations, e.g. for each replenishment.

To avoid double-counting, an important element of this phase is to ensure that the total sum of all Rio markers does not exceed 100 per cent. It is worth noting that all four Rio markers are considered, thus Finland does not for example double-count climate and biodiversity finance.

5.2.2 Climate finance

Finland continues to channel climate finance as part of its ODA budget. 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 finance) 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.

Besides providing funds to the operating entities of the financial mechanism of the UNFCCC, Finland provides support through bilateral, regional and other multilateral channels. Funding is directed both at climate change mitigation and adaptation. In addition to grant funding, Finland uses investment-based and loan-based funding to accelerate private sector investment in climate solutions. Research, cooperation with universities and inter-institutional cooperation are supported to strengthen national capacity building in developing countries (see also Section 5.3). Most Finnish climate finance is provided as core contributions through multilateral channels (CTF table III.2).

From 2022, Finland has also started to report climate finance that was channelled as other official flows (OOF). According to the definition by the OECD DAC[149], other official flows (OOF) are official sector transactions that do not meet official development assistance (ODA) criteria. OOF include grants to developing countries for representational or essentially commercial purposes; official bilateral transactions intended to promote development, but having a grant element of less than 25 per cent; and, official bilateral transactions, whatever their grant element, that are primarily export-facilitating in purpose.

The total allocation in 2021 was about EUR 175 million (approximately USD 207 million); this is all ODA. In 2022 the total allocation was EUR 153 million ODA + EUR 15 million OOF (approximately USD 161 and USD 16, total USD 177). Details are provided in CTF tables III.1 and III.2.

The division between mitigation and adaptation support varies according to year, but Finland aims for balance. In 2021, the division was 53 per cent for mitigation and 47 per cent for adaptation. In 2022, the division was 61 per cent for mitigation and 39 per cent for adaptation.

5.2.3 Needs and priorities of developing country Parties

Finland's development cooperation is based on the development needs defined by the partner countries and their own development plans. The Ministry for Foreign Affairs has prepared a Country Programme for each of its long-term partner countries. Country Programmes have

[149] https://www.oecd.org/en/data/indicators/other-official-flows-oof.html

identified the areas of cooperation, forms of support, objectives and indicators. Country Programmes have built on the partner countries' own development plans, and their guidelines have been discussed with the authorities of the partner countries and with other cooperation partners operating in them, including civil society organisations (CSOs). The current Country Programmes cover the period 2021–2024.

However, most Finnish climate finance is channelled as core contributions through multi-lateral funds and organizations. Many of these support climate-resilient and low emissions pathways, e.g. development and implementation of NDCs and NAPs in developing countries. One example is the GCF and its Readiness and Preparatory Support programme, which finances the formulation of NAPs.

According to the evaluation of Finland's international climate finance [150](2023), the Ministry for Foreign Affairs' (MFA) interventions are strongly aligned with policy ambitions and priorities of development countries.

5.2.4 Alignment with the Paris Agreement

The Guideline for the Cross-Cutting Objectives in the Finnish Development Policy and Cooperation[151] acknowledges that the Paris Agreement, among other multilateral environmental agreements, is binding on Finland and instrumental in achieving the Sustainable Development Goals. Finland's development policy and cooperation has five cross-cutting objectives, including climate resilience and low emission development. The 'do no harm' is the minimum standard for the implementation of the cross-cutting objectives. Furthermore, opportunities to advance the cross-cutting objectives are proactively sought and supported through mainstreaming, targeted action and policy influencing.

Finland participates in various donor coordination groups that advocate for the alignment of development cooperation and finance with the Paris Agreement. One example is the Like-minded Group on MDB Paris Alignment that is a group of donors engaging with and influencing the multilateral development banks.

Finland considers it crucial to ensure that all financial flows are in line with climate goals. Finland is the founder of the Coalition of the Finance Ministers for Climate Action[152], a 90+ member global alliance that aims to accelerate climate action by mainstreaming climate change into fiscal and economic policy. Finland was the co-chair of the Coalition between 2018–2022.

[150] https://um.fi/development-cooperation-evaluation-reports-comprehensive-evaluations/-/asset_publisher/nBPgGHSLrA13/content/evaluation-of-finland-s-international-climate-finance-2016-2022/384998

[151] https://um.fi/documents/35732/0/Guideline+for+the+Cross-Cutting+Objectives+in+the+Finnish+Development+Policy+and+Cooperation.pdf/e9e8a940-a382-c3d5-3c5f-dc8e7455576b?t=1618230452564

[152] https://www.financeministersforclimate.org/

According to the evaluation of Finland's international climate finance[153] (2023), the Ministry for Foreign Affairs' (MFA) interventions are highly consistent with major global commitments under the Paris Agreement and UNFCCC processes.

5.2.5 Multilateral finance

Official financing mechanisms for international climate agreements, UN agencies, development finance institutions and multilateral climate funds play an important role in the mitigation of and adaptation to climate change. Finland defends the multilateral system and international law, recognises the significant results obtained through multilateral cooperation, and thus sees this system as one of the most important climate action. A large part of Finland's international climate finance is therefore channelled through multilateral organisations and funds as core funding. The strengths of multilateral cooperation are its wider coordination of climate finance and larger common funding base, which also has great potential for effectiveness.

The multilateral finance reported by Finland is based on the inflow contributions to the multilateral institutions. To determine the share of climate-specific finance, the shares agreed in each replenishment are used.

5.3 Technological development and transfer support, capacity-building support

Finland has specific programmes and financial arrangements for transferring environmentally sound technology to developing countries thus enhancing access to it (examples in CTF table III.4). These activities can 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 technologies are not always clear, and some activities have characteristics of both.

Many climate funds which Finland supports provide funding for technology transfer among other project types. These could be installation of renewable energy equipment in new areas or grey technology for adaptation, such as flood walls. However, it is rarely reported separately in their project portfolios.

Finland is a global leader in weather observation technology and systems. Over the years, Finland has transferred technology related to weather observation and climate services through bilateral and regional cooperation and concessional credit arrangements (CTF table III.4).

Finland supports capacity building through its climate finance to developing countries through several instruments. Most of the Finnish bilateral projects that have a climate-related objective as their principal or significant objective also include a capacity-building component as a response to existing and emerging capacity building needs in our partner countries. Several multilateral climate funds (such as GCF and GEF), which Finland supports, include a strong capacity-building component in their activities. This can be in the form of capacity building for developing country stakeholders for developing mitigation and/or adaptation projects to apply

[153] https://um.fi/development-cooperation-evaluation-reports-comprehensive-evaluations/-/asset_publisher/nBPgGHSLrA13/content/evaluation-of-finland-s-international-climate-finance-2016-2022/384998

for funding or capacity development in a specific climate change theme. In general, capacity building is an inherent part of most cooperation projects and programmes, as it is one of the key measures to ensure the sustainability of activities.

In addition, Finland has some funding instruments specifically aimed at capacity building. The institutional cooperation instrument (ICI) is used to support Finnish government agencies' and public bodies' participation in development cooperation. The projects' objective is to strengthen the skills and knowledge of state actors, such as ministries and government agencies, in developing countries. During the reporting period, the Higher Education Institutions Institutional Cooperation Instrument (HEI ICI) was used to support cooperation projects between higher education institutions (HEI) in Finland and the developing world to develop their subject-specific, methodological, educational and administrative capacity. Another similar instrument called Higher Education Partnership (HEP) has since replaced the HEI ICI.

For example, Finland is one of the world leaders as a donor in supporting the capacity building of partner countries’ national meteorological and hydrological services (NMHS). During the reporting period (2021–2022), ICI-projects to strengthen the weather, climate and early warning services were implemented in 11 countries. Detailed information these projects can be found in CTF table III.5.

Gender equality is one of the cross-cutting objectives of Finland’s development policy and cooperation[154]. Typical ways to enhance gender equality in capacity building projects are ensuring equal participation of women and men in training and events as well as advancing women’s leadership. Results data, for example number of persons trained, are disaggregated by gender.

Since 2004, Finland has funded an international course on environmental law and diplomacy. This ‘Course on Multilateral Environmental Agreements’ is organised annually by the University of Eastern Finland in cooperation with the UNEP and partners in developing countries. The course transfers 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 industrialized countries and thus support international environmental negotiations. Due to the Covid-19 pandemic, in 2021 course was held in virtual format. In 2022 it was decided to postpone the course until it could be implemented in-person.

Literature

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[154] https://um.fi/documents/35732/0/Guideline+for+the+Cross-Cutting+Objectives+in+the+Finnish+Development+Policy+and+Cooperation.pdf/e9e8a940-a382-c3d5-3c5f-dc8e7455576b?t=1618230452564

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Annex 1 Common tabular formats on information necessary to track progress

Description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates[a]

	Description
Target(s) and description, including target type(s), as applicable[b, c]	**Economy-wide net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990.** **The term 'domestic' means without the use of international credits.** **Target type: Economy-wide absolute emission reduction.**
Target year(s) or period(s), and whether they are single-year or multi-year target(s), as applicable	**Single year target, 2030.**
Reference point(s), level(s), baseline(s), base year(s) or starting point(s), and their respective value(s), as applicable	**Base year: 1990.** **Net greenhouse gas emissions level in 1990:** **4 699 405 kt CO_2eq.**
Time frame(s) and/or periods for implementation, as applicable	**2021-2030**
Scope and coverage, including, as relevant, sectors, categories, activities, sources and sinks, pools and gases, as applicable	**Geographical scope: EU Member States (Belgium, Bulgaria, Czechia, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden) including EU outermost regions (Guadeloupe, French Guiana, Martinique, Mayotte, Reunion, Saint Martin (France), Canary Islands (Spain), Azores and Madeira (Portugal)).** **Sectors covered, as contained in Annex I to decision 5/CMA.3:** **Energy** **Industrial processes and product use** **Agriculture** **Land Use, Land Use Change and Forestry (LULUCF)** **Waste** **International Aviation: Emissions from civil aviation activities as set out for 2030 in Annex I to the EU ETS Directive are included only in respect of CO_2 emissions from flights subject to effective carbon pricing through the EU ETS. With respect to the geographical scope of the NDC these comprise emissions in 2024-26 from flights between the EU Member States and departing flights to Norway, Iceland, Switzerland and United Kingdom.** **International Navigation: Waterborne navigation is included in respect of CO2, methane (CH_4) and nitrous Oxide (N_2O) emissions from maritime transport voyages between the EU Member States.** **Gases:** **Carbon Dioxide (CO_2)** **Methane (CH_4)** **Nitrous Oxide (N_2O)** **Hydrofluorocarbons (HFCs)** **Perfluorocarbons (PFCs)** **Sulphur hexafluoride (SF_6)** **Nitrogen trifluoride (NF_3)** **The included LULUCF categories and pools are as defined in decision 5/CMA.3.**

Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards NDCs under Article 4 of the Paris Agreement, as applicable	**The EU's at least 55% net reduction target by 2030 is to be achieved through domestic measures only, without contribution from international credits.** **The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA.**
Any updates or clarifications of previously reported information, as applicable[d]	**The information on the NDC scope contains clarifications/further details compared to the information provided in the updated NDC of the EU.**

Note: This table is to be used by Parties on a voluntary basis.

[a] Each Party shall provide a description of its NDC under Article 4, against which progress will be tracked. The information provided shall include required information, as applicable, including any updates to information previously provided (para. 64 of the MPGs).

[b] For example: economy-wide absolute emission reduction, emission intensity reduction, emission reduction below a projected baseline, mitigation co-benefits of adaptation actions or economic diversification plans, policies and measures, and other (para. 64(a) of the MPGs).

[c] Parties with both unconditional and conditional targets in their NDC may add a row to the table to describe conditional targets.

[d] For example: recalculation of previously reported inventory data, or greater detail on methodologies or use of cooperative approaches (para. 64(g) of the MPGs).

1. Structured summary: Description of selected indicators

Indicator(s) selected to track progress[a]	*Description*
{Indicator}	**Annual total net GHG emissions consistent with the scope of the NDC in CO_2eq.**
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate[b]	**The reference level is total net GHG emissions of the EU in the base year (1990). The reference level value for the EU is 4 699 405 kt CO_2eq.**
Updates in accordance with any recalculation of the GHG inventory, as appropriate	**This is the first time the reference level is reported, hence there are no updates.** **The value of the reference level may be updated in the future due to methodological improvements to the EU GHG inventory and to the determination of international aviation and navigation emissions in the NDC scope.**
Relation to NDC[c]	**The indicator is defined in the same unit and metric as the target of the NDC. Hence it can be used directly for tracking progress in implementing and achieving the NDC target.**

Notes: (1) Pursuant to para. 79 of the MPGs, each Party shall report the information referred to in paras. 65–78 of the MPGs in a narrative and common tabular format, as applicable. (2) A Party may amend the reporting format (e.g. Excel file) to remove specific rows in this table if the information to be provided in those rows is not applicable to the Party's NDC under Article 4 of the Paris Agreement, in accordance with the MPGs. (3) The Party could add rows for each additional selected indicator and related information.

[a] Each Party shall identify the indicator(s) that it has selected to track progress of its NDC (para. 65 of the MPGs).

[b] Each Party shall provide the information for each selected indicator for the reference point(s), level(s), baseline(s), base year(s) or starting point(s) and shall update the information in accordance with any recalculation of the GHG inventory, as appropriate (para. 67 of the MPGs).

[c] Each Party shall describe for each indicator identified how it is related to its NDC (para. 76(a) of the MPGs).

2. Structured summary: Definitions needed to understand NDC

	Definitions[a]
Definition needed to understand each indicator:	
Annual total net GHG emissions	**Total net GHG emissions correspond to the annual total of emissions and removals reported in CO_2 equivalents in the latest GHG inventory of the EU. The totals comprise all sectors and gases listed in the table entitled 'Reporting format for the description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates.' Indirect CO2 emissions are included from those Member States that report these emissions.**
Any sector or category defined differently than in the national inventory report:	
{Sector} **Not applicable**	
{Category} **Not applicable**	
Definition needed to understand mitigation co-benefits of adaptation actions and/or economic diversification plans:	
{Mitigation co-benefit(s)} **Not applicable**	
Any other relevant definitions:	
Not applicable	

Notes: (1) Pursuant to para. 79 of the MPGs, each Party shall report the information referred to in paras. 65–78 of the MPGs in a narrative and common tabular format, as applicable. (2) A Party may amend the reporting format (e.g. Excel file) to remove specific rows in this table if the information to be provided in those rows is not applicable to the Party's NDC under Article 4 of the Paris Agreement, in accordance with the MPGs. (3) The Party could add rows for each additional sector, category, mitigation co-benefits of adaptation actions and/or economic diversification plans, indicator and any other relevant definitions.

[a] Each Party shall provide any definitions needed to understand its NDC under Article 4, including those related to each indicator identified in para. 65 of the MPGs, those related to any sectors or categories defined differently than in the national inventory report, or the mitigation co-benefits of adaptation actions and/or economic diversification plans (para. 73 of the MPGs).

3. Structured summary: Methodologies and accounting approaches – consistency with Article 4, paragraphs 13 and 14, of the Paris Agreement and with decision 4/CMA.1

Reporting requirement	*Description or reference to the relevant section of the BTR*
For the first NDC under Article 4:[a]	
Accounting approach, including how it is consistent with Article 4, paragraphs 13–14, of the Paris Agreement (para. 71 of the MPGs)	**Net GHG emissions, calculated from emissions and removals from the GHG inventory of the EU and supplemented with data on international aviation and navigation collected in the Joint Research Centre’s Integrated Database of the European Energy System (JRC-IDEES), are used to quantify progress towards implementing and achieving of the NDC in respect of the NDC target. This approach promotes environmental integrity, transparency, accuracy, completeness, comparability and consistency and ensures the avoidance of double counting, as described below. Existing methods and guidance under the Convention are taken into account, as described below.**
For the second and subsequent NDC under Article 4, and optionally for the first NDC under Article 4:[b]	
Information on the accounting approach used is consistent with paragraphs 13–17 and annex II of decision 4/CMA.1 (para. 72 of the MPGs)	**The European Union accounts for anthropogenic emissions and removals corresponding to its NDC consistent with paragraphs 13–17 and annex II of decision 4/CMA.1, as detailed below.**
Explain how the accounting for anthropogenic emissions and removals is in accordance with methodologies and common metrics assessed by the IPCC and in accordance with decision 18/CMA.1 (para. 1(a) of annex II to decision 4/CMA.1)	**The accounting for anthropogenic emissions and removals is based on the data contained in the EU GHG inventory, which is compiled in accordance with the 2006 IPCC Guidelines. The accounting for emissions from international aviation and navigation in the scope of the NDC is based on activity data, emission factors and methods which are in line with the IPCC guidelines. The accounting approach is also in accordance with decision 18/CMA.1 because the EU GHG inventory conforms with the provisions of chapter II of the Annex to decision 18/CMA.1.**
Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party’s GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1)	**The GHG data used for accounting is based on the GHG inventory of the EU. The methodology used for accounting consists of a balancing of GHG emissions and removals, which is consistent with the methodologies used in the GHG inventory of the EU.**
Explain how overestimation or underestimation has been avoided for any projected emissions and removals used for accounting (para. 2(c) of annex II to decision 4/CMA.1)	**Not applicable. Projected emissions and removals are not used for accounting.**
For each NDC under Article 4:[b]	

Accounting for anthropogenic emissions and removals in accordance with methodologies and common metrics assessed by the IPCC and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement:	
Each methodology and/or accounting approach used to assess the implementation and achievement of the target(s), as applicable (para. 74(a) of the MPGs)	**The methodology used to assess the implementation and achievement consists of a comparison of the reduction of net GHG emissions from the GHG inventory national total, including a share of GHG inventory international aviation and navigation emissions in line with the NDC scope, with the NDC target.** **The EU will account for its cooperation with other Parties in a manner consistent with guidance adopted by the CMA.**
Each methodology and/or accounting approach used for the construction of any baseline, to the extent possible (para. 74(b) of the MPGs)	**Progress is tracked by comparing annual net emissions with net emissions in the base year. No baseline is constructed.**
If the methodology or accounting approach used for the indicator(s) in table 1 differ from those used to assess the implementation and achievement the target, describe each methodology or accounting approach used to generate the information generated for each indicator in table 4 (para. 74(c) of the MPGs)	**Not applicable. The methodology/accounting approach used for the indicator in table 1 is the same as the methodology/accounting approach used to assess the implementation and achievement the target.**
Any conditions and assumptions relevant to the achievement of the NDC under Article 4, as applicable and available (para. 75(i) of the MPGs)	**Not applicable. The NDC is unconditional.**
Key parameters, assumptions, definitions, data sources and models used, as applicable and available (para. 75(a) of the MPGs)	**Net GHG emissions are the key parameter used for tracking progress in implementing and achieving the NDC. The GHG inventory of the EU is the data source used. Details on assumptions, definitions and models used for determining net GHG emissions can be found in the National Inventory Document of the EU.**
IPCC Guidelines used, as applicable and available (para. 75(b) of the MPGs)	**2006 IPCC Guidelines; and 2019 refinement to the 2006 IPCC Guidelines for some source categories.**
Report the metrics used, as applicable and available (para. 75(c) of the MPGs)	**100-year time-horizon global warming potential (GWP) values from the IPCC Fifth Assessment Report.**
For Parties whose NDC cannot be accounted for using methodologies covered by IPCC guidelines, provide information on their own methodology used, including for NDCs, pursuant to Article 4, paragraph 6, of the Paris Agreement, if applicable (para. 1(b) of annex II to decision 4/CMA.1)	**Not applicable.**
Provide information on methodologies used to track progress arising from the implementation of policies and measures, as appropriate (para. 1(d) of annex II to decision 4/CMA.1)	**Progress arising from the implementation of policies and measures is expressed in a reduction of GHG emissions or increase of GHG removals. The methodology used to assess such progress is based on the estimation of GHG emissions and removals in the GHG inventory of the EU and on data on international aviation and navigation monitored in the Joint Research Centre's Integrated Database of the European Energy System (JRC-IDEES).**
Where applicable to its NDC, any sector-, category- or activity-specific assumptions, methodologies and approaches consistent with IPCC guidance, taking into	**Sector-, category- and activity-specific assumptions, methodologies and approaches applicable to the NDC are described in the**

account any relevant decision under the Convention, as applicable (para. 75(d) of the MPGs)	**national inventory document of the EU and are consistent with IPCC guidance.** **Emissions from international aviation and navigation in the scope of the NDC are determined based on activity data from the JRC-IDEES, using emission factors and methodologies consistent with IPCC guidance.**
For Parties that address emissions and subsequent removals from natural disturbances on managed lands, provide detailed information on the approach used and how it is consistent with relevant IPCC guidance, as appropriate, or indicate the relevant section of the national GHG inventory report containing that information (para. 1(e) of annex II to decision 4/CMA.1, para. 75(d)(i) of the MPGs)	**NA**[155]
For Parties that account for emissions and removals from harvested wood products, provide detailed information on which IPCC approach has been used to estimate emissions and removals (para. 1(f) of annex II to decision 4/CMA.1, para. 75(d)(ii) of the MPGs)	**The EU accounts for emissions and removals from harvested wood products as an integral part of net GHG emissions and removals in the scope of the NDC. GHG emissions and removals from harvested wood products are determined in accordance with the production approach, as defined in Annex 12.A.1 to Volume 4 of the 2006 IPCC Guidelines for National GHG Inventories.**
For Parties that address the effects of age-class structure in forests, provide detailed information on the approach used and how this is consistent with relevant IPCC guidance, as appropriate (para. 1(g) of annex II to decision 4/CMA.1, para. 75(d)(iii) of the MPGs)	**The EU does not address the effects of age-class structure in forests in the accounting approach for its NDC.**
How the Party has drawn on existing methods and guidance established under the Convention and its related legal instruments, as appropriate, if applicable (para. 1(c) of annex II to decision 4/CMA.1)	**The EU has drawn on existing methods and guidance established under the Convention by using an NDC target which is an advancement of the quantified economy-wide emission reduction target for 2020, which was communicated and tracked under the Convention.**
Any methodologies used to account for mitigation co-benefits of adaptation actions and/or economic diversification plans (para. 75(e) of the MPGs)	**The NDC does not consist of mitigation co-benefits of adaptation actions and/or economic diversification plans. Hence these co-benefits were not accounted for, and no related methodologies were used.**
Describe how double counting of net GHG emission reductions has been avoided, including in accordance with guidance developed related to Article 6 if relevant (para. 76(d) of the MPGs)	**GHG emissions and removals from the EU's GHG inventory, complemented with JRC-IDEES data for determining the share of emissions form international aviation and navigation in the NDC scope, are used for tracking the net GHG emission reductions. Emissions and removals are reported in line with IPCC guidelines, with the aim of neither over- nor underestimating GHG emissions.** **GHG emissions and removals are reported by the EU and its Member States in their respective GHG inventories. For tracking progress towards implementing and achieving the EU NDC, only those net GHG emission reductions are counted**

[155] To determine emissions and removals in the scope of the NDC, the EU does not disaggregate emissions and removals on managed land into those considered to result from human activities and those considered to result from natural disturbances.

	which are reported at EU level. **For cooperative approaches under Article 6, corresponding adjustments are made in a manner consistent with guidance adopted by the CMA.**
Any other methodologies related to the NDC under Article 4 (para. 75(h) of the MPGs)	**Not applicable.**
Ensuring methodological consistency, including on baselines, between the communication and implementation of NDCs (para. 12(b) of the decision 4/CMA.1):	
Explain how consistency has been maintained in scope and coverage, definitions, data sources, metrics, assumptions and methodological approaches including on baselines, between the communication and implementation of NDCs (para. 2(a) of annex II to decision 4/CMA.1)	**The scope, coverage, definitions, data sources, metrics and approaches are consistent between the communicated NDC and its implementation, as described in the BTR.**
Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party's GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1) and explain methodological inconsistencies with the Party's most recent national inventory report, if applicable (para. 76(c) of the MPGs)	**The GHG inventory of the EU is the primary source for the GHG data used for accounting. The share of GHG inventory emissions from international aviation and navigation in the scope of the NDC have been determined separately based on JRC-IDEES data, using emission factors and methodologies consistent with IPCC guidance. There are no methodological inconsistencies with the most recent national inventory report.**
For Parties that apply technical changes to update reference points, reference levels or projections, the changes should reflect either of the following (para. 2(d) of annex II to decision 4/CMA.1):	
Technical changes related to technical corrections to the Party's inventory (para. 2(d)(i) of annex II to decision 4/CMA.1)	**No technical changes related to technical corrections to the GHG inventory were applied to update reference points, reference levels or projections.**
Technical changes related to improvements in accuracy that maintain methodological consistency (para. 2(d)(ii) of annex II to decision 4/CMA.1)	**No technical changes related to improvements in accuracy were applied to update reference points, reference levels or projections.**
Explain how any methodological changes and technical updates made during the implementation of their NDC were transparently reported (para. 2(e) of annex II to decision 4/CMA.1)	**Methodological changes and technical updates are reported in the chapter entitled 'recalculations and improvements' of the National Inventory Document of the EU.** **GHG emissions from international aviation and navigation in the scope of the EU NDC are reported for the first time in this BTR (see Annex 2 to the BTR).**
Striving to include all categories of anthropogenic emissions or removals in the NDC and, once a source, sink or activity is included, continuing to include it (para. 3 of annex II to decision 4/CMA.1):	
Explain how all categories of anthropogenic emissions and removals corresponding to their NDC were accounted for (para. 3(a) of annex II to decision 4/CMA.1)	**The indicator used for tracking progress towards implementing and achieving the NDC target comprises all categories of anthropogenic emissions and removals corresponding to the NDC.**

Explain how Party is striving to include all categories of anthropogenic emissions and removals in its NDC, and, once a source, sink or activity is included, continue to include it (para. 3(b) of annex II to decision 4/CMA.1)	**The scope of the NDC of the EU covers all categories of emissions and removals reported in the GHG inventory, in line with IPCC guidelines. Member States report some specific source categories as 'not estimated' when the estimates would be insignificant as defined in paragraph 32 of the annex to decision 18/CMA.1. Information on these categories is provided in Common Reporting Table 9 of the respective Member States' GHG inventory submission.** **Besides including all sectors listed in decision 18/CMA.1, a share of emissions from international aviation and navigation are also included in the NDC scope.**
Provide an explanation of why any categories of anthropogenic emissions or removals are excluded (para. 4 of annex II to decision 4/CMA.1)	**All categories of anthropogenic emissions and removals contained in the national total of the EU GHG inventory are included in the NDC.**
Each Party that participates in cooperative approaches that involve the use of ITMOs towards an NDC under Article 4, or authorizes the use of mitigation outcomes for international mitigation purposes other than achievement of its NDC	
Provide information on any methodologies associated with any cooperative approaches that involve the use of ITMOs towards an NDC under Article 4 (para. 75(f) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable.**
Provide information on how each cooperative approach promotes sustainable development, consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable.**
Provide information on how each cooperative approach ensures environmental integrity consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable.**
Provide information on how each cooperative approach ensures transparency, including in governance, consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable.**
Provide information on how each cooperative approach applies robust accounting to ensure, inter alia, the avoidance of double counting, consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable, when applicable.**
Any other information consistent with decisions adopted by the CMA on reporting under Article 6 (para. 77(d)(iii) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable.**

[1] To determine emissions and removals in the scope of the NDC, the EU does not disaggregate emissions and removals on managed land into those considered to result from human activities and those considered to result from natural disturbances.

Notes: (1) Pursuant to para. 79 of the MPGs, each Party shall report the information referred to in paras. 65–78 of the MPGs in a narrative and common tabular format, as applicable. (2) A Party may amend the reporting format (e.g. Excel file) to remove specific rows in this table if the information to be provided in those rows is not applicable to the Party's NDC under Article 4 of the Paris Agreement, in accordance with the MPGs.

[a] For the first NDC under Article 4, each Party shall clearly indicate and report its accounting approach, including how it is consistent with Article 4, paras. 13–14, of the Paris Agreement (para. 71 of the MPGs).

[b] For the second and subsequent NDC under Article 4, each Party shall provide information referred to in chapter III.B and C of the MPGs consistent with decision 4/CMA.1. Each Party shall clearly indicate how its reporting is consistent with decision 4/CMA.1 (para. 72 of the MPGs). Each Party may choose to provide information on accounting of its first NDC consistent with decision 4/CMA.1 (para. 71 of the MPGs)

4. Structured summary: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement*[a]*.

	Unit, as applicable	Reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate (paras. 67 and 77(a)(i) of the MPGs)	Implementation period of the NDC covering information for previous reporting years, as applicable, and the most recent year, including the end year or end of period (paras. 68 and 77(a)(ii–iii) of the MPGs)		Target level[b]	Target year or period	Progress made towards the NDC, as determined by comparing the most recent information for each selected indicator, including for the end year or end of period, with the reference point(s), level(s), baseline(s), base year(s) or starting point(s) (paras. 69–70 of the MPGs)
			2021	**2022**			
Indicator(s) selected to track progress of the NDC or portion of NDC under Article 4 of the Paris Agreement (paras. 65 and 77(a) of the MPGs):							
Annual total GHG emissions and removals consistent with the scope of the NDC	**kt CO_2eq[16]**	**4 699 405**	**3 272 650**	**3 205 223**	**(at least 55% below base year level)**	**2030**	**The most recent level of the indicator is 31.8 % below the base year level.**
Where applicable, total GHG emissions and removals consistent with the coverage of the NDC (para. 77(b) of the MPGs)	**kt CO_2eq**	**4 699 405**	**3 272 650**	**3 205 223**			
Contribution from the LULUCF sector for each year of the target period or target year, if not included in the inventory time series of total net GHG emissions and removals, as applicable (para. 77(c) of the MPGs)	**NA**		**NA**	**NA**			
Each Party that participates in cooperative approaches that involve the use of ITMOs towards an NDC under Article 4 of the Paris Agreement or authorizes the use of mitigation outcomes for international mitigation purposes other than achievement of the NDC, shall provide (para. 77(d) of the MPGs):							
If applicable, an indicative multi-year emissions trajectory, trajectories or budget for its NDC implementation period (para. 7(a)(i), annex to decision 2/CMA.3)	**kt CO_2eq**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
If applicable, multi-year emissions trajectory, trajectories or budget for its NDC implementation period that is consistent with the NDC (para. 7(b), annex to decision 2/CMA.3)	**NA**		**NA**	**NA**			
Annual anthropogenic emissions by sources and removals by sinks covered by its NDC or, where applicable, from the emission or sink categories as identified by the host Party pursuant to paragraph 10 of annex to decision 2/CMA.3 (para. 23(a), annex to decision 2/CMA.3) (as part of para. 77 (d)(i) of the MPGs)	**kt CO_2eq**		**3 272 650**	**3 205 223**			

[16] Net GHG emissions in the scope of the NDC

Annual anthropogenic emissions by sources and removals by sinks covered by its NDC or, where applicable, from the portion of its NDC in accordance with paragraph 10, annex to decision 2/CMA.3 (para. 23(b), annex to decision 2/CMA.3)	**kt CO_2eq**		**3 272 650**	**3 205 223**			
If applicable, annual level of the relevant non-GHG indicator that is being used by the Party to track progress towards the implementation and achievement of its NDC and was selected pursuant to paragraph 65, annex to decision 18/CMA.1 (para. 23(i), annex, decision 2/CMA.3)	**NA**		**NA**	**NA**			
Annual quantity of ITMOs first transferred (para. 23(c), annex to decision 2/CMA.3) (para. 77(d)(ii) of the MPGs)	**kt CO_2eq**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
Annual quantity of mitigation outcomes authorized for use for other international mitigation purposes and entities authorized to use such mitigation outcomes, as appropriate (para. 23(d), annex to decision 2/CMA.3) (para. 77(d)(ii) of the MPGs)	**NA**		**NA**	**NA**			
Annual quantity of ITMOs used towards achievement of the NDC (para. 23(e), annex to decision 2/CMA.3) (para. 77(d)(ii) of the MPGs)	**kt CO_2eq**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
Net annual quantity of ITMOs resulting from paras. 23(c)-(e), annex to decision 2/CMA.3 (para. 23(f), annex to decision 2/CMA.3)	**kt CO_2eq**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
If applicable, the cumulative amount of ITMOs, divided by the number of elapsed years in the NDC implementation period (para. 7(a)(ii), annex to decision 2/CMA.3)	**NA**		**NA**	**NA**			
Total quantitative corresponding adjustments used to calculate the emissions balance referred to in para. 23(k)(i), annex to decision 2/CMA.3, in accordance with the Party’s method for applying corresponding adjustments consistent with section III.B, annex to decision 2/CMA.3 (Application of corresponding adjustments) (para. 23(g), annex to decision 2/CMA.3)	**kt CO_2eq**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
The cumulative information in respect of the annual information in para. 23(f), annex to decision 2/CMA.3, as applicable (para. 23(h), annex to decision 2/CMA.3)	**kt CO_2eq**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
For metrics in tonnes of CO2 eq. or non-GHG, an annual emissions balance consistent with chapter III.B (Application of corresponding adjustment), annex, decision 2/CMA.3 (para. 23(k)(i), annex to decision 2/CMA.3) (as part of para. 77 (d)(ii) of the MPGs)	**kt CO_2eq**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			

For metrics in non-GHG, for each non-GHG metric determined by participating Parties, annual adjustments resulting in an annual adjusted indicator, consistent with para. 9 of chapter III.B (Corresponding adjustments), annex to decision 2/CMA.3, and future guidance to be adopted by the CMA (para. 23(k)(ii), annex to decision 2/CMA.3)	**NA**		**NA**	**NA**			
Any other information consistent with decisions adopted by the CMA on reporting under Article 6 (para. 77(d)(iii) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA in a subsequent BTR or initial report, when applicable.**						

Notes: (1) Pursuant to para. 79 of the MPGs, each Party shall report the information referred to in paras. 65–78 of the MPGs in a narrative and common tabular format, as applicable. (2) A Party may amend the reporting format (e.g. Excel file) to remove specific rows in this table if the information to be provided in those rows is not applicable to the Party's NDC under Article 4 of the Paris Agreement, in accordance with the MPGs. (3) The Party could add rows for each additional selected indicator.

a This table could be used for each NDC target in case Party's NDC has multiple targets.

b Parties may provide information on conditional targets in a documentation box with references to the relevant page in their biennial transparency report

Annex 2: Methodology applied for the identification of GHG emissions from international aviation and navigation in the scope of the EU NDC

This annex contains common information for the EU and MS BTRs

The scope of the EU NDC goes beyond national GHG emissions and removals in the scope of the national GHG inventory; it also includes specific emissions from international aviation and navigation. This annex describes the methodology for identifying these emissions.

International aviation and maritime emissions are estimated by using the Joint Research Centre's Integrated Database of the European Energy System (JRC-IDEES).[156] It allows to split the international transport CO2 emissions into intraEU/extraEU and intraEEA/extraEEA and the departing flights from the EU to the UK and Switzerland, categories backwards in time (i.e. 1990) (i.e. for the time period back to 1990).[157]

For international transport, JRC-IDEES applies a decomposition methodology that reconciles the scopes of available primary statistics and harmonises historical data on international aviation and maritime emissions, energy use, and transport activity. The resulting annual dataset covers 1990-2021 and distinguishes domestic, intra-EU/intra-EEA, and extra-EU/extra-EEA activity for each EU Member State, Norway and Iceland.

In aviation, JRC-IDEES distinguishes passenger and freight modes, with three geographical categories of flight origin/destinations for each mode: domestic, intra-EEA + UK, and extra-EEA + UK. Intra-EU, the UK, and EEA[158] categories are also used internally during calibration but aggregated for reporting. For each mode/category combination, JRC-IDEES estimates activity (as passenger-km or tonnes-km), energy use and CO_2 emissions, aircraft stock (expressed as representative aircraft), load factors, and aircraft efficiencies. As country-specific activity statistics are not available, the decomposition first allocates EU-level activity data from the Transport Pocketbook[159] of the European Commission's Directorate-General for Mobility and Transport to each country and flight category.

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[156] European Commission, Joint Research Centre, Rózsai, M., Jaxa-Rozen, M., Salvucci, R., Sikora, P., Tattini, J. and Neuwahl, F., JRC-IDEES-2021: the Integrated Database of the European Energy System – Data update and technical documentation, Publications Office of the European Union, Luxembourg, 2024, doi:10.2760/614599.

[157] The JRC-IDEES analytical database is designed to support energy modelling and policy analysis, by combining primary statistics with technical assumptions to compile detailed energy-economy-emissions historical data for each key energy sector. For aviation, EEA emissions includes emissions related to the UK but not to Switzerland, where total CO_2 emissions for the scope are additionally estimated from EUROCONTROL data.

[158] In this annex, EEA stands for European Economic Area, which comprises the 27 EU Member States, Iceland, Liechtenstein and Norway.

[159] Statistical pocketbook 2023, https://transport.ec.europa.eu/facts-funding/studies-data/eu-transport-figures-statistical-pocketbook/statistical-pocketbook-2023_en.

For passenger modes, this allocation calculates average load factors using Eurostat data on total passengers and flights. These load factors and total flight numbers are combined with average flight distances from EUROCONTROL, the pan-European organisation dedicated to air traffic management, to yield an initial estimate for passenger transport activity. For intra-EU activity, a uniform scaling factor is then applied across Member States to match total EU-level Transport Pocketbook data. Freight activity follows a similar process, using a 'representative flight' concept with a common load factor across all Member States to account for mixed passenger-freight flights.

Next, the decomposition estimates fuel use from EUROCONTROL data, by deriving a distance-dependent average aircraft efficiency, then applying it to the country-specific ensemble of flights and routes. The final step scales the estimates to meet Eurostat energy balances for total domestic and international consumption back to 1990 values, maintaining intra-EEA/extra-EEA fuel use ratios derived from EUROCONTROL. JRC-IDEES additionally reports resulting differences with submissions by Parties to the UNFCCC. The above process is followed throughout the entire decomposition period (1990-2021). Data gaps are estimated from the existing indicators as follows:

- The process iterates backwards towards 1990, starting from the oldest years in which data is available in each Member State.
- Average flight distance is kept constant for early years without EUROCONTROL data (generally before 2004).
- If the load factor (passengers per flight) cannot be calculated due to a lack of passenger and/or flight data, it is estimated from the trend of the existing time series.
- Missing numbers of flights are calculated from the load factor and the passengers carried.
- If no passenger data is available, the total mileage is estimated from the energy consumption, and combined with average flight distance to estimate the number of flights. The number of flights is then combined with the load factor to estimate the total passengers carried.
- For early years without data, constant values are assumed for the factors used to *i)* scale intra-EU activity to the Transport Pocketbook, *ii)* adjust the estimated fuel use to EUROCONTROL data for specific routes, and *iii)* scale this adjusted fuel use to Eurostat energy balances (e.g. before 1995 for Transport Pocketbook data; before 2004 for EUROCONTROL data).

For international maritime transport, JRC-IDEES estimates data both for intra-EU/extra-EU and intra-EEA/extra-EEA geographical categories. The emission estimates in the GHG inventory already include CO_2, CH_4, and N_2O gases. Transport activity (tonnes-km) is estimated from Eurostat data on gross weight of transported goods, using port-level and country-level data for intra-EU and extra-EU categories, respectively. Intra-EU activities are then scaled to match the Transport Pocketbook totals, accounting for domestic coastal shipping (calibrated separately in JRC-IDEES). Next, transport activity is combined with data reported under the monitoring, reporting and verification system for maritime transport under the EU ETS ('THETIS MRV'[160]), namely EU-level mileage data and country-specific vessel sizes to estimate load factors (tonnes per movement). The load factors and resulting annual mileage (km) are calibrated to meet EU-level THETIS MRV mileage. The annual mileage is in turn combined with THETIS MRV average efficiency to yield a total technical energy consumption, with corresponding emissions derived

[160] THETIS MRV, https://mrv.emsa.europa.eu/#public/eumrv.

from default emissions factors. This energy consumption is scaled to Eurostat energy balances so as to minimise discrepancy to total intra-EU THETIS MRV emissions. As with aviation, JRC-IDEES reports corresponding differences to submissions under the UNFCCC. Early years with data gaps are estimated from existing indicators as follows:

- The process iterates backwards towards 1990, starting from the oldest years in which data is available in each Member State.
- Average distance of voyages is kept constant for early years without Eurostat activity data (generally before 1997-2000).
- If the load factor (tonnes per movement) cannot be estimated due a lack of activity data, it is kept constant.
- If activity data is not available, it is estimated from Eurostat energy consumption.
- Missing mileage data is derived from the activity and load factor estimates.
- For early years without data, constant values are assumed for the factors used to i) scale intra-EU activity to the Transport Pocketbook, ii) scale estimated mileage to meet EU-level THETIS MRV mileage, and iii) scale domestic and intra-EU CO_2 emissions estimated from energy consumption so as to match total THETIS MRV CO_2 emissions.
- Finally, the ratios between the estimated MRV emissions and the CO_2 emissions for the reported transport activity (for intra-EU/EEA and extra-EU/EEA categories) between 2018 and 2021 are used to calculate the MRV compliant estimates back to 1990 levels.

For the year 2022, the international navigation and aviation emissions under the EU NDC scope have been estimated by applying the same share of those emissions on the total international navigation and aviation emissions (as reported in the GHG inventory) as in 2021.

Aviation emissions covered by the EU NDC scope

Emissions	Domestic aviation		Intra-EEA aviation			Extra-EEA aviation
Current NDC commitment	Domestic EU flights (e.g. Palermo Milan	Domestic "non-EU EEA" flights (e.g. Oslo to Bergen)	Flights between "non-EU EEA" countries (from Oslo to Reykjavik)	Flights within the EEA, departing from EU airports	Flights to/from EU airports to OMRs	Departing flights from EU airports to UK and Switzerland
Current NDC commitment	Yes	No	No	Yes	Yes From Jan 2024	Yes

Maritime navigation emissions covered by the EU NDC

Emissions	Domestic maritime navigation		International maritime navigation				International maritime navigation	
	Domestic EU flights (e.g. Palermo Milan	Voyages within NO/IS (e.g. Oslo - Bergen	Voyages between two EU MS (e.g. Valencia - Rotterdam))	Voyages between a MS and NO/IS (e.g. Rotterdam - Oslo)	Voyages between an EU MS and a third country	Voyages between NO/IS and a third country (or IS/NO)	Emissions within a port of an EU MS (reported under domestic emissions)	Emissions within a port of NO or IS (or another third country)
Current NDC commitment (CO_2; CH_4; N_2O)	Yes	No	Yes	No	No	No	Yes	No

Annex 3 Methodologies and assumptions for projections and estimating effects of policy measures

This annex describes the approach, models and assumptions used for obtaining the projections and estimating the GHG emissions reductions and removals due to policy measures. The aim is to provide a more detailed account of the process than in the sector-specific sections of 3.4 and 3.6 which briefly list the most essential assumptions.

1. Approach and responsibilities

The approach and responsibilities in preparing the projections have not changed since the preparation of the Fifth Biennial Report.

The reported WM projections are integrated energy and climate projections based on comprehensive modelling and assessments conducted by experts from various research fields. The projections were modelled in an extensive project 'Baseline scenarios for energy and climate policy package towards zero emissions' (PEIKKO)[161] financed by the Government's analysis, assessment and research activities. The modelling covers the energy system and all GHG sources and sinks that are included in the GHG inventory. The projections of the PEIKKO project include those policy measures that have been implemented by the previous Government or earlier than that, i.e. before 1 April 2023. For this report, the projections of the PEIKKO project have been updated with information and data on a few recently adopted or implemented policy measures.

Finland uses a sectoral approach with detailed sector-specific modelling that is coordinated and manually interlinked across sectors. The Ministry of Economic Affairs and Employment coordinated the preparation of the reported WM projections and was responsible for the projections regarding the amount of energy used by industry, households and services and for calculations of fuel and carbon dioxide emissions in the energy production sectors as a whole. The Ministry of the Environment was responsible for the projection regarding space heating, the analysis of the regional and urban structure, and emission projections and calculations for F-gases, waste and machinery. The duty of the Ministry of Transport and Communications included projections for fuel and electricity use, as well as emissions from the transport sector and international bunkers. 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. The Ministry of Finance was responsible for forecasting short-term economic development and taxation.

The sectoral projections, assessments of policies and measures, and other calculations, modelling, and analysis were made by expert organisations, research institutes, and consultants selected for the purpose by the ministries. The following authorities and expert organisations contributed to the reporting: the Energy Authority; the Finnish Environment Institute; VTT Technical Research Centre of Finland Ltd; Motiva Oy; Natural Resources Institute Finland; the Finnish Institute for Health and Welfare; Pellervo Economic Research PTT; the Finnish Transport and Communications Agency; Sitowise Group Oyj; and Statistics Finland.

[161] Baseline scenarios for energy and climate policy package towards zero emissions (PEIKKO), http://urn.fi/URN:ISBN:978-952-383-219-0

The main models and methods used in the work are described below.

2. Assumptions underlying calculations

A summary of key variables and assumptions is presented in Table Annex 3-1.

The population growth in the projections is based on the population forecast drawn up by Statistics Finland in 2021. The population will increase only slightly from 5.56 million (end of 2022) to 5.60 million in 2030. In 2033, the population will start to decrease. The population’s age structure will change significantly over the next couple of decades as the proportion of older age groups increases.

The Covid-19 pandemic and its assumed effects on the economy were considered in the modelling of the WM projection whose starting point is the year 2021. In contrast to Finland’s Fifth Biennial Report (BR5), the energy crisis and changed energy scene following Russia’s unprovoked and unjustified invasion of Ukraine are now included in the projections. This is especially reflected in cutting off all energy imports from Russia throughout the modelling period. For the LULUCF sector, the most recent results from the national forest inventory on a decline in tree growth now form the base for the projection work. Most of the measures included in the WAM projection of the Fifth Biennial Report (BR5) have been implemented and are now part of the WM projection, such as improving energy efficiency and promoting alternative fuels in machinery, expansion of the EU Emissions Trading System (so called ETS2) and energy efficiency measures for transport.

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 macro-economic study for the ministries by Merit Economics. The current economic growth is modest but it is expected to improve toward the end of the decade. In the WM projection, the annual average increase in the national economic output is 1.3 per cent from 2020 to 2030 and 1.7 per cent from 2030 to 2040.

The following paragraphs describe the assumptions that underlie the same sectors as presented in the report, starting from energy.

The fuel taxation structure takes into account energy content and lifetime carbon dioxide emissions. They are applied to two categories shown in the table above and described in more detail in Section 3.4.4. The electricity tax is divided into two categories, of which the lower (category II) is applied to industry and heat pumps in district heat production, and the higher mostly to consumers, for example. As the table illustrates, the ongoing trend is that electricity for industry is taxed less and combustion fuels more. The 2025 figures in the table correspond to taxation in 2023. After 2025, the taxation structure and levels remain constant in real terms in the projections.

Assumed fossil fuel prices in the world market and the assumed prices of emissions allowances in the EU’s emissions trading system correspond to the recommended harmonised values provided by the EU Commission for greenhouse gas emission projections in 2022.

Table Annex 3-1 Key variables and assumptions used in the projections analysis for 1990 to 2040

	Unit	Historical								Projected			
		1990	1995	2000	2005	2010	2015	2020	2022	2025	2030	2035	2040
Population	Million inhabitants	5	5.12	5.18	5.26	5.38	5.49	5.53	5.56	5.58	5.60	5.60	5.59
Gross Domestic Product	Million EUR, 2023 prices	168 800	165 350	212 220	241 460	252 850	253 810	269 190	280 530	282 770	305 430	331 390	360 740
Coal wholesale price	EUR/GJ LHV [1]	NA*	3	4	5	5	8	10	13	3	3	3	3
Crude oil wholesale price	EUR/GJ LHV [1]	NA*	4	7	9	9	8	9	12	15	15	15	16
Natural gas wholesale price	EUR/GJ LHV [1]	NA*	4	5	6	9	13	13	33	13	11	11	11
Emission allowance price	EUR/t nominal prices	NO	NO	NO	23	14	7	25	80	80	80	82	85
Tax components: **													
Electricity, tax category I	cent/kWh, 2023 prices	NA*	NA*	NA*	NA*	1.14	2.70	2.61	2.38	2.24	2.24	2.24	2.24
Electricity, tax category II	cent/kWh, 2023 prices	NA*	NA*	NA*	NA*	0.33	0.83	0.80	0.05	0.05	0.05	0.05	0.05
Calculation basis of excise duty rates for heating, power plant and machinery fuels													
Energy content component	EUR/MWh LHV, 2023 prices	NA*	NA*	NA*	NA*	NA*	8.01	8.87	10.98	10.33	10.33	10.33	10.33
Carbon dioxide component***	EUR/tCO_2, 2023 prices	NA*	NA*	NA*	NA*	NA*	53.00	61.65	56.31	53.00	53.00	53.00	53.00
Calculation basis of excise duty rates for liquid transport fuels													
Energy content component	EUR/MWh LHV, 2023 prices	NA*	NA*	NA*	NA*	NA*	69.38	68.30	64.30	60.52	60.52	60.52	60.52
Carbon dioxide component****	EUR/tCO_2, 2023 prices	NA*	NA*	NA*	NA*	NA*	69.86	72.12	81.81	77.00	77.00	77.00	77.00

*No data available or regarding taxes, the taxation structure was significantly different from the present and thus not comparable

**The values in the table represent base case rates. Several reductions and exemptions exist

*** Life-time CO_2-emissions except for the year 2015 combustion only. Life-time emissions of fuels around 20 % higher than emission from combustion.

**** Life-time CO_2-emissions. Life-time emissions of fuels around 20 % higher than emission from combustion.

[1] 2020 prices for history, 2022 prices for the future

In addition, please note that the historical data on population and gross domestic production represents the data used in the projections and may slightly differ from the statistics

The primary energy by source, energy sources for district heat and combined heat and power production, electricity supply, and energy sources in the transport sector are presented in Tables Annex 3-2 to Annex 3-6.

Both gross final and primary energy consumption is levelled off in the projections despite economic growth because of increased energy efficiency in all sectors. The decreasing energy sector emissions are the result of policy measures that replace fossil fuels with renewables and electricity. The development of the primary energy supply and gross final energy consumption in the WM projection is shown in Figure Annex 3-1 and Table Annex 3-2.

Figure Annex 3-1. Historical development (1990 to 2022) and WM projection (until 2040) of the primary energy supply by energy source and gross final energy consumption (solid line), TWh.

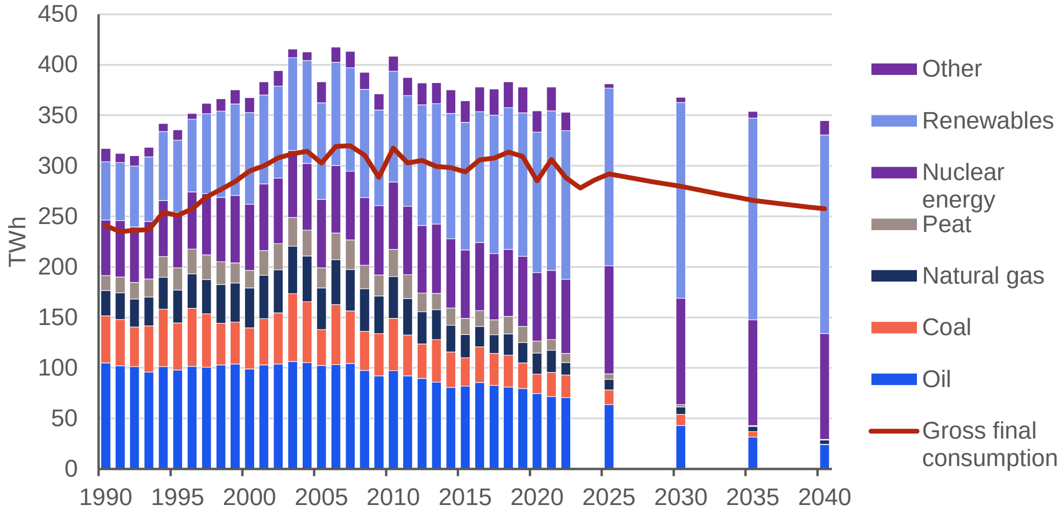


Table Annex 3-2 Primary energy by energy source and gross final energy in 2010, 2015, 2020, 2022 and in the WM projection for 2025, 2030, 2035 and 2040 in TWh

	Historical				WM projection			
	2010	2015	2020	2022	2025	2030	2035	2040
	TWh				TWh			
Oil	97.17	81.85	74.41	70.44	63.69	42.86	31.50	24.08
Coal	51.75	28.29	19.50	22.59	14.47	11.13	5.54	0.38
Natural gas	41.30	22.88	20.72	12.10	10.65	7.40	5.06	4.34
Peat	27.17	16.11	11.93	9.07	5.22	2.18	0.82	0.33
Nuclear energy	66.33	67.65	67.74	73.46	107.18	105.48	104.75	104.75
Renewables	109.95	126.29	139.19	147.07	175.80	193.60	199.63	196.69
Other	14.63	21.42	20.89	18.12	4.17	5.26	6.64	14.18
Gross final consumption	317.66	293.87	285.04	288.14	291.95	279.80	265.80	257.40

Source for historical data: Energy Statistics

The trend of replacing fossil fuels and peat with renewables and electricity is also clear in the district heating sector, as the table below illustrates. Especially the share of waste heat recovery as well as electric boilers is expected to grow rapidly in the coming years, being approximately double the 2020 level by 2030. Most of the increase is attributed to heat pumps and electric boilers, as almost all the waste heat streams that can be directly utilised are already harnessed.

The following table also presents the fact that the total district heat consumption, and therefore the energy sources, is in decline due to buildings' improving energy efficiency.

Table Annex 3-3 Energy sources for district heat and combined heat and power production in 2010, 2015, 2020, 2022 and in the WM projection for 2025, 2030, 2035 and 2040, in TWh

	Historical				WM projection			
	2010	2015	2020	2022	2025	2030	2035	2040
	TWh				TWh			
Fuel oils	3.46	1.46	0.78	1.40	0.40	0.28	0.27	0.11
Coal	14.20	11.68	6.86	9.34	1.63	0.00	0.00	0.00
Natural gas	25.70	11.91	9.12	2.36	1.81	1.80	1.10	0.18
Peat	13.28	9.29	7.68	5.73	3.56	1.47	0.61	0.18
Wood-based fuels	19.52	24.14	27.91	24.59	27.41	24.70	21.30	20.47
Other renewables[1]	1.01	2.30	2.99	2.53	3.13	3.07	2.81	2.74
Other fossil fuels[2]	0.95	1.86	2.52	2.35	2.80	2.60	2.29	2.24
Other sources[3]	1.19	2.57	4.53	3.32	6.51	8.34	7.72	6.78

[1] mainly biogas and renewable part of waste

[2] mainly non-renewable part of waste

[3] mainly waste heat and electric boilers, includes both electricity and heat of heat pumps

Source for historical data: Energy Statistics

As for electricity supply, especially the share of wind power is expected to grow even more rapidly than in the past. At the same time, the share of wood-based fuels will grow to some extent before starting to decrease after 2030. The need for electricity imports depends on many factors, but the annual net import should generally remain substantially lower than in the past, despite the continuously growing electricity demand that results from decarbonisation and electrification.

Table Annex 3-4 Electricity supply in 2010, 2015, 2020, 2022, and in the WM projection for 2025, 2030, 2035, and 2040, in TWh

	Historical				WM Projection			
	2010	2015	2020	2022	2025	2030	2035	2040
	TWh				TWh			
Hydro	12.70	16.60	15.70	13.34	14.61	14.69	14.81	14.92
Wind and solar	0.30	2.30	8.20	11.95	27.13	38.29	51.33	55.18
Wood-based biomass	10.00	10.10	10.30	10.71	12.31	12.34	11.08	10.76
Other renewables [1]	0.40	0.60	0.60	0.52	0.55	0.54	0.49	0.46
Nuclear	21.90	22.30	22.40	24.24	35.37	34.81	34.57	34.57
Oil	0.40	0.20	0.20	0.14	0.10	0.02	0.02	0.02
Coal	13.60	4.80	2.30	3.66	1.14	0.66	0.34	0.00
Natural gas	11.00	5.10	3.90	1.49	1.39	1.18	0.75	0.31
Peat	5.90	2.90	2.00	1.56	0.65	0.12	0.03	0.02
Others [2]	0.40	0.30	0.90	0.50	0.51	0.49	0.44	0.41
Imports	10.50	16.30	15.00	12.52	0.00	0.00	0.00	5.78

[1] mainly renewable part of waste

[2] mainly fossil part of waste

Regarding the forest industry, the basis for the WM projection is the same as in the BR5 but the latest market development, including some production capacity closures, has been taken into account. As a result, compared to the BR5, the total growth is more modest as the production volumes of pulp, cardboard and sawmill increase less and the volumes of other products, especially paper, continue to decline.

Nevertheless, the forest industry is both a significant energy consumer and an electricity and heat producer. Pulp mills especially produce large amounts of electricity and heat from black liquor, which is the main by-product from the kraft process, which digests pulpwood into pulp. In addition, biomass by-products from the forest industry, such as bark and sawdust from the mechanical forest industry, are utilised as fuels both in the forest industry and the energy sector. For example, these by-products amounted to approximately 25 TWh and black liquor to 40 TWh in 2022. At the same time, the total use of wood-based fuels in Finland was approximately 102 TWh.

The table below shows historical and projected electricity consumption in the forest industry. The product volumes are included in the table listing LULUCF parameters (Table Annex 3-10a).

Table Annex 3-5 Electricity consumption of the forest industry in 2010, 2015, 2020, and 2022 (historical), and 2025, 2030, 2035, and 2040 (WM projection)

	Historical				WM Projection			
	2010	2015	2020	2022	2025	2030	2035	2040
	TWh				TWh			
Electricity consumption								
Pulp and paper	20.60	17.50	15.60	13.73	16.70	16.50	14.80	14.80
Mechanical forest industry	1.60	1.30	1.40	1.65	1.50	1.60	1.50	1.50

In the transport sector, greenhouse gas emissions are influenced by a decline in specific energy consumption and especially by replacing fossil fuels with alternative transport fuels. The WM projection's annual distribution obligation percentages in road transport for 2024 to 2030 are 13.5, 16.5, 19.5, 22.5, 31, 32, and 34 per cent (from 2030 onwards). Biogas and electric fuels are included in the distribution obligation from 2022 onwards and renewable electricity from public charging stations from 2025 onwards. In the WM projection, the bio-share of transport gas will remain at the current 99 per cent. The bio-share of gasoline stays around the current 9 per cent. The bio-share of diesel varies: it rises at its highest to 38 per cent in 2030. The variation in the bio-share of diesel is due to the fact that the bio-share of gasoline is not expected to significantly grow from the current level, and biogas is already sold at the largest possible amount.

Table Annex 3-6 Energy sources in transport in 2010, 2015, 2020, and 2022 and in the WM projection for 2025, 2030, 2035, and 2040, in TWh

	Historical				WM Projection			
	2010	2015	2020	2022	2025	2030	2035	2040
	TWh				TWh			
Gasoline, fossil	17.84	15.82	13.55	12.63	11.69	8.71	5.96	4.17
Diesel, fossil	27.10	23.37	24.55	22.78	22.24	13.40	9.94	8.29
Biofuels	1.53	5.79	4.70	6.34	5.71	8.96	4.45	1.40
Aviation fuels, fossil	1.64	1.15	0.97	0.96	1.24	1.64	1.60	0.96
Light fuel oil	1.70	1.64	1.30	1.35	1.39	1.28	1.17	1.06
Heavy fuel oil, gas, hydrogen	0.53	0.14	0.21	0.41	0.87	1.30	2.83	3.54
Electricity	0.74	0.71	0.82	1.09	2.11	4.66	8.05	11.19

Source for historical data: Energy Statistics

Table Annex 3-7 Main assumptions for the transport sector

		Historical				WM Projection			
	Unit	2010	2015	2020	2022	2025	2030	2035	2040
Number of vehicles - in total	pieces	3 340 794	3 461 862	3 461 451	3 544 195	3 575 369	3 670 611	3 725 340	3 798 581
Passenger cars	"	2 486 283	2 612 922	2 748 448	2 739 908	2 783 563	2 891 014	2 950 803	3 028 280
Vans	"	289 824	307 706	338 389	343 713	330 584	320 432	320 319	322 027
Buses	"	11 610	12 455	9 955	11 109	11 055	12 044	13 047	13 835
Trucks	"	94 334	95 250	94 691	92 627	94 218	94 789	96 467	96 252
Motorcycles, mopeds, 4-wheels	"	458 743	433 529	269 968	356 838	355 949	352 332	344 704	338 187
Passenger cars by operating forces									
Petrol and Diesel	%	100 %	100 %	97 %	94 %	86 %	67 %	43 %	25 %
Battery Electric and Plug-in Hybrid	%	0 %	0 %	2 %	5 %	13 %	32 %	56 %	75 %
CNG Gas and Flexible Fuel Vehicles	%	0 %	0 %	1 %	1 %	1 %	1 %	1 %	0 %
Hydrogen	%	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Vehicle kilometres - in total	Million kilometers	54 860	56 365	49 668	48 941	50 876	53 461	58 591	62 904
Passenger cars	"	46 245	47 355	39 092	38 409	39 702	42 165	47 076	51 234
Others	"	8 615	9 010	10 576	10 532	11 174	11 296	11 515	11 670

The main assumptions for the F-gases are listed in Table Annex 3-8. More than 90 per cent of the emissions of F-gases originate from refrigeration and air-conditioning equipment. The single most significant emission source is commercial refrigeration. The sector is comprised of refrigeration in food retail stores and professional kitchens. The most significant factor affecting the emissions of F-gases is the replacement of HFC refrigerants with natural refrigerants (carbon dioxide and hydrocarbons). By 2035, it is assumed that all the remaining HFC refrigerants will have been replaced by natural refrigerants in existing commercial refrigeration equipment. The replacement is assumed to be slightly faster with the WAM measures.

Table Annex 3-8 Main assumptions for F-gases

	Historical				Projection			
	2010	2015	2020	2022	2025	2030	2035	2040
	%				%			
Share of centralized refrigeration systems with CO_2 or hydrocarbons annually in use								
in food retail stores	3	8	24	42	73	90	100	100
in professional kitchens	NO	NO	10	16	25	65	100	100

Source: Finnish Environment Institute

For agriculture, the development of livestock numbers has been estimated using the Dremfia agricultural sector model, which considers expected trends in domestic demand, the prices of agricultural inputs and outputs and agricultural policy. Slowly decreasing domestic demand for beef, pork and dairy products (observed 2018–2023) is expected to continue. This results in a modest reduction in beef, pork and dairy products consumption per capita over 2020–2040, while poultry meat consumption is expected to increase slightly in the period 2020–2040. Consumption of cereals and grain legumes for food are expected to increase slightly over 2020–2040. These trends in food consumption have been discussed with stakeholders in earlier research projects[162]. Population will remain close to the 2020 level until 2040 despite slightly decreasing after 2033.

Farm sizes and productivity are increasing in dairy cattle farming, which will see a large-scale shift from single dairy robot units to units of two or more robots between the 2020s and 2030s. Total milk production will slightly fall from the 2020 level by 2040, but the number of dairy cows will be reduced by approximately 14 per cent. Fewer cows will be needed to produce the same amount of milk because the average milk yield of dairy cows will increase in the future.

The development in the dairy sector is reflected in the lower numbers of calves and heifers. Instead, the number of suckler cows will increase by about 5,000 cows by 2035. The relatively low prices of beef compared to production costs and the expected constant agricultural subsidies for cattle animals do not give economic opportunities for greater suckler cow production growth despite the decreasing quantity of domestic production.

Production of pork and poultry meat, and hence also animal numbers, follow the trends of domestic food demand. Pork consumption is decreasing, but the annual consumption of poultry

[162] see e.g. Lehtonen et al. 2020

meat is expected to reach 150 million kilograms and remain at this level. It has been assumed that the number of sheep will remain the same.

In the Dremfia model, total fertilization, including synthetic nitrogen fertilization are determined according to nitrogen yield response and nitrogen and plant product prices. The amount of manure decreases as the numbers of farmed animals decrease. Hence, the amount of nitrogen input from the application of manure will decrease by 13 per cent between 2020 and 2040. Rising synthetic nitrogen fertilizer prices caused by rising fossil energy prices will reduce synthetic fertilizer application. Additionally, precision farming techniques will allow crops to meet their nitrogen requirements with lower amounts of nitrogen.

The increasing grassland area, due to extensification of beef production, and use of catch crops will increase the nitrogen emission of crop residues returned to soils. The total area of agricultural land will not change significantly by 2040.

Table Annex 3-9 Main assumptions for agriculture

		Historical				WM Projection			
	Unit	2010	2015	2020	2022	2025	2030	2035	2040
Livestock									
Dairy cattle	1 000 heads	289	285	260	248	231	225	221	223
Non-dairy cattle	"	636	630	587	588	565	548	547	540
Sheep	"	126	155	140	132	132	132	132	132
Pig	"	1 340	1 239	1 104	998	935	888	894	899
Poultry	"	9 587	12 927	13 577	14 356	14 876	14 914	14 912	15 007
Nitrogen input from application of synthetic fertilizers	kt of nitrogen	157	143	139	102	137	133	128	136
Nitrogen input from application of manure	'	72	75	71	67	78	76	78	79
Nitrogen in crop residues returned to soils	'	83	95	87	90	85	102	105	98
Area of cultivated organic soils	1 000 hectares	317	327	341	347	342	312	311	314

The main assumptions for the LULUCF sector are presented in Table Annex 3-10a, with additional information in Table Annex 3-10b. Assumptions are based on the PEIKKO scenario. The PEIKKO scenario for the LULUCF sector was published in June 2024.

Table Annex 3-10a Main assumptions for LULUCF

		Historical				WM Projection			
	Unit	2010	2015	2020	2022	2025	2030	2035	2040
4.A Forest land									
Roundwood removals									
for energy use	1 000 cubic meters	7 734	9 186	10 308	10 826	9 800	11 500	11 500	11 400
for non-energy use	"	51 957	58 849	58 546	64 286	67 500	70 400	70 400	70 100
Forest increment	"	106 400	105 520	103 570	103 570	103 700	103 200	103 200	106 400
Forest land remaining forest land	1 000 hectares	21 781	21 753	21 740	21 735	21 713	21 679	21 665	21 654
Land converted to forest land	"	163	134	112	106	123	151	173	188
4.B Cropland									
Cropland area	"	2 474	2 490	2 503	2 505	2 494	2 469	2 461	2 454
4.C Grassland									
Grassland area	"	238	238	242	247	245	241	239	236
4.D Wetlands									
Peat extraction area	"	108	111	105	99	83	62	29	15
Other wetlands area	"	6 336	6 325	6 319	6 319	6 328	6 345	6 347	6 343
4.E Settlements									
Lands converted to settlements	1 000 hectares	231	252	236	223	211	189	173	167
4.G Harvested wood products									
Production of sawn wood	1 000 cubic meters	9 473	10 640	10 916	11 273	12 900	13 450	13 450	13 450
Production of wood panels	"	1 347	1 314	1 202	1 391	1 271	1 396	1 398	1 400
Production of paper & paperboard	1 000 tonnes	10 508	10 247	10 121	9 840	10 220	10 670	10 270	10 270

Table Annex 3-10b Main assumptions for LULUCF: Additional information

Assumption	
Forest	
Roundwood demand	Based on production volumes of different branches of the forest industry and roundwood imports
Energy wood demand	Based on the development of the energy sector and energy wood imports
Wood imports	Imports from Russia are mainly substituted by domestic harvest
Wood prices	Average of 2012 to 2021
Costs of silviculture	Average of 2012 to 2021
Climate	The increase in temperature and CO_2 concentration has increased the increment of trees
Climate actions in state owned forests	Fertilisation of 30,000 hectares per year in state owned forests
Avoidance of remedial drainage	1,000 hectares less annually on drained most fertile and poorest peatland forests
Comprehensive peatland forest management, thinning from above	6,000 hectares annually on most fertile drained peatland forests
Ash fertilisation on peatland forests	50,000 hectares per year (increase of 26,000 hectares)
Forest fertilisation on mineral soils	67,000 hectares per year (increase of 24,000 hectares)
Increased volume of dead wood in commercially utilised forests	Increase of the number of retention trees left standing in connection with regeneration felling from 5 to 7 cubic metres per hectare
Rapid and efficient forest renewal	Immediate regeneration after regeneration felling
Agricultural lands	*For years 2025, 2030, 2035, 2040*
Raising the groundwater level in peaty agricultural land (grasslands) −30 cm	7,500, 20,000, 32,500, 32,500 hectares
Paludiculture, groundwater level −30 cm	2,000, 5,000, 10,000, 10,100 hectares
Paludiculture, groundwater level −5 to −10 cm	1,000, 2,500, 5,000, 5,000 hectares
Perennial grasslands without tilling	40,000, 40,000, 40,000, 40,000 hectares
Land-use change	
Afforestation of abandoned fields	3,000 hectares per year
Afforestation of low-yield arable land 2024 to 2028	1,800 hectares per year
Deforestation, from forest to arable land	Decrease of 900 hectares per year on organic soils and 800 hectares per year on mineral soils
Rewetting of poorly productive, thick peaty arable land or former peat production sites into wetlands	10,000 hectares (arable), 20,000 hectares (peat production) by 2030
Managed wetlands, peaty arable land to wetland (no longer in agricultural use)	1,500 hectares by 2025, 4,000 hectares by 2030, 7,500 hectares by 2035

The main assumptions for waste sector are listed in Table Annex 3-11. 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 (2,444 TJ) and in REF burning plants 313,000 tonnes (6,260 TJ). Several new waste incineration plants have been constructed in recent years and in 2020 the incinerated amount outside the emissions trading sector was already more than 18,400 TJ. The WM projection estimates from 2023 onwards the incinerated amount outside the emissions trading sector to be 20,200 to 20,400 TJ. Since 2017, there has been a comprehensive landfill ban on biodegradable waste and biodegradable waste could only go to landfills in waste batches (e.g. rejects) with a very low biodegradable fraction. In the WM projection it is assumed that 12 thousand tons of biodegradable municipal waste would go to landfills per year from 2023. The share of methane recovery from landfills in the WM projection is assumed to be around 20 per cent of the total methane generation for years 2025, 2030, 2035 and 2040. No new recovery plants are assumed to be built and no changes are assumed to the technical level of the plants' operation in the current situation.

Table Annex 3-11 Main assumptions for the waste sector

		Historical				WM Projection			
	Unit	2010	2015	2020	2022	2025	2030	2035	2040
Municipal solid waste (MSW) going to landfills	t	1 092 684	316 346	14 988	11 497	12 000	12 000	12 000	12 000
Share of CH_4 recovery in total CH_4 generation from landfills	%	28 %	28 %	20 %	19 %	20 %	20 %	19 %	19 %

For the projections, the division of emissions into those included in the EU Emissions Trading System (EU ETS) and those outside the EU ETS is based on a data set of greenhouse gas emissions covering 2005 to 2022 provided by Statistics Finland. The relative shares of EU ETS and non-ETS emissions to be used in the projections are set for the individual branches and greenhouse gases and are listed in Table Annex 3-12. The individual shares are assumed to remain constant for each branch over time in the projections.

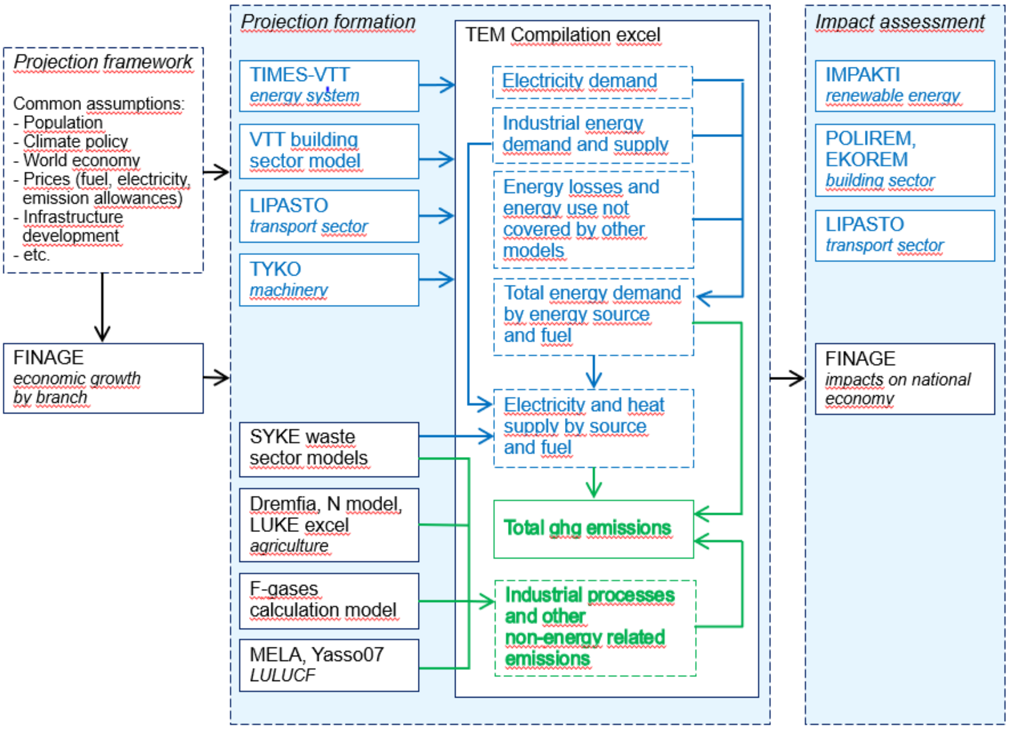
Table Annex 3-12 Projected EU ETS and non-ETS shares of GHG emissions.

CO_2 emissions	EU ETS %	Non-ETS %
Energy sector		
Energy industries excl. small plants	100	0
Energy industries, small plants	0	100
Waste incineration plants	0	100
Food industries and manufacture of beverages	48	52
Manufacture of wood and of products of wood	7	93
Manufacture of paper and paper products	95	5
Petroleum refining	98	2
Chemical industry excl. petroleum refining	80	20
Manufacture of non-metallic mineral products	88	12
Manufacture of basic metals, iron and steel production	100	0
Manufacture of basic metals, non-ferrous metal production	0	100
Other manufacturing industry	3	97
Civil aviation	99	1
Transport sector excl. civil aviation	0	100
Machinery	0	100
Building specific heating	0	100
Agriculture	0	100
Fishing	0	100
Other energy sector emissions	0	100
Fugitive emissions	90	10
Industrial processes		
Mineral industry	91	9
Chemical industry, hydrogen production	100	0
Chemical industry, production of phosphoric acid and other chemicals	0	100
Metal industry, iron and steel production	100	0
Other		
CO_2 captured	100	0
Liming	0	100
Other product and solvent use	0	100
Indirect CO_2 emissions	0	100
N_2O emissions		
Fuel combustion incl. transport and machinery	0	100
Nitric acid production	100	0
Manure management	0	100
Agricultural soils	0	100
Waste disposal and treatment	0	100
Other emissions	0	100
CH_4 emissions		
Fuel combustion incl. transport and machinery	0	100
Fugitive emissions	0	100
Enteric fermentation	0	100
Manure management	0	100
Waste disposal and treatment	0	100
F gas emissions		
F gas use	0	100

3 Description of models and methods

A fairly large number of models are applied for the preparation of the greenhouse gas emission projections and impact assessment of policy measures. The 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 Annex 3-2. Data from sector-specific models and studies are compiled by the Ministry of Economic Affairs and Employment in the module named 'TEM Compilation excel'. The same Excel spreadsheet is used to calculate 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 Energy demand and production heading.

Figure Annex 3-2 Schematic diagram of the relationship and data flow between the different models applied in the projections and impact assessment of policy measures.



Buildings

The development of the energy consumption of the building stock has been modelled in accordance with the Long-term Renovation Strategy (LTRS)[163], which follows the EPBD 2018/844/EU revision and covers the 2020 existing building stock. The calculation of the goals of the LTRS and the data were created by VTT and SYKE experts. To implement the strategy in Finland, three key actions were identified: 1) removal of buildings and improving spatial efficiency; 2) improvements in energy efficiency in connection with maintenance and repairs; and 3) ceasing the use of fossil fuels in heat production. The guidance of the Energy Efficiency

[163] Finland's Long Term Renovation Strategy 2020. https://energy.ec.europa.eu/document/download/58721db6-4127-4a14-9d59-b6ea055a58db_en?filename=fi_2020_ltrs_en.pdf

of Buildings Directive (EPBD) applies to residential and non-residential buildings in permanent use. Leisure, agricultural, industrial and storage buildings are therefore excluded.

The energy consumption scenario for buildings considers climate change, the removal of buildings, development of heating methods, repair measures and maintenance giving up the use of heating oil. The primary sources for the scenario are the data describing the building stock of Statistics Finland and energy certificates defined by Ministry of the Environment Regulation 1048/2017 of the register maintained by ARA.

The removal of buildings has been modelled by examining the life cycle of the building stock based on building register data. Based on this information, the expected service life has been calculated for buildings of different ages. The development of the strategy’s heating methods was modelled as part of the modelling project PITKO based on 2018 Statistics Finland data. The development of heating sources is based on the results of the TIMES-VTT optimisation model. The effect of global warming was considered in the strategy so that it reduced the heating energy demand of buildings and increased the cooling energy demand. The impact of repairs on the energy consumption of old buildings is based on energy efficiency improving measures in exterior envelope repairs and technical system repairs. The calculation assumes that terraced houses and apartment buildings will give up property-specific oil heating by 2030, and detached houses and non-residential buildings by 2050. It is assumed that fossil fuels and the electricity they consume will be replaced by heat pumps. An exception is that it is assumed that a small part of non-residential buildings will continue to be heated by oil. It is assumed that this oil heating will be completely covered by bio-oil in non-residential buildings in 2050. The Government Regulation on energy subsidies for residential buildings from 2020 to 2022 has also been considered – it is assumed that a third of the energy savings will be realised as an improvement in structural energy efficiency, and two thirds through an increase in the use of heat pumps.

The methodology and modelling of the building sector projections described above have been used since the Fifth Biennial Report. Earlier, the building sector projections were based on modelling by the Finnish Environment Institute.

The impacts of policies and measures in the WM projection were estimated using the 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 (2007) of the National Building Code of Finland: ‘Calculation of energy needs for heating of buildings’. The model can be used to calculate energy consumption and greenhouse gas emissions and to analyse the energy savings and greenhouse gas emissions reduction potentials achieved by various 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 visualisation approach for energy use and greenhouse gas emissions is presented.

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

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

POLIREM is also a bottom-up building stock model. It covers less technical details than the EKOREM model. Instead, it considers 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 suitable for 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.

Energy demand and production

The Ministry of Economic Affairs and Employment compiles the projections for energy production using demand projections for each sector as a basis. Except for 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. The demand projection assumptions are based on statistics, expert judgements, and surveys by consultants, research organisations, and branch organisations.

The global TIMES-VTT energy system model is the main tool for the energy system modelling. The energy needed from power and heat generation plants (main activity producer plants) is based on modelling the total electricity and heat demand, the calculated electricity and heat generated by the industry itself (auto-producer plants), as well as assumptions about electricity net imports. The model also uses information on existing and planned power plants and their possible dismantling and construction schedule, respectively.

The TIMES-VTT model has been developed by VTT Technical Research Centre of Finland Ltd, which also runs the model and produces projections and analyses for the ministry. TIMES-VTT contains a detailed representation of the Finnish, Swedish, Norwegian and Danish energy systems and data on other countries in a more aggregated form. The model is based on the global ETSAP TIAM model, which was developed through international cooperation, building on the IEA ETSAP TIMES modelling system[164]. Methodologically, it is a so-called partial equilibrium model, which maximises the total economic surplus of consumers and producers. The model includes detailed descriptions of both the current system of energy production and consumption and future technologies in terms of several different investment options. The TIMES-VTT model's extensive database contains a detailed description of the current energy system, including the energy production and distribution system, building stock, energy uses in housing and services, the stock of cars and other vehicles, processes and plants for manufacturing energy-intensive industrial products, other industrial energy end uses, as well as energy use in agriculture and forestry. The model database also covers estimates for energy system removals such as removals from energy production plants, buildings and vehicles. However, the largest part of the database naturally consists of technological descriptions of investment options and assumptions in future energy systems, including estimated trends in their costs and technical performance (energy production efficiencies, service life, usability, etc.). The model also depicts regional technical potential of energy commodities, the global fuel trade, and emissions trading, including trade in CO_2 transport and storage services. The TIMES-VTT model and its databases have been discussed in several scientific articles. Finally, energy sector CO_2 emissions projections are obtained by multiplying the fuel consumption of different fuels by the

[164] https://iea-etsap.org/index.php/applications/global

corresponding emission factors. Historical emissions and amounts of fuels are used to calculate CH_4 and N_2O emissions.

As for policy measures, the IMPAKTI calculation tool is used to calculate the emissions mitigation impact of measures that promote the use of renewable energy. The IMPAKTI calculation tool assumes that forest chips, wind power, and biogas from digesters will not be used without existing policies and measures. The aggregated impact of policies and measures promoting the use of these energy sources is therefore estimated based on energy production (wind power and biogas plants) or fuel use (forest chips) and the assumptions concerning 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 other fuels to a small extent. For agricultural farms, it is assumed that the use of forest chips will replace light fuel oil. It is assumed that the electricity produced by renewable energy sources (wind, biogas) will mainly replace marginal electricity, i.e. electricity produced by condensing power plants using fossil fuels or 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 may also replace other electricity generation modes or electricity imports. The emission factor used for replaced electricity (600 t CO_2/GWh) is therefore smaller than the emission factor used for electricity production in condensing power plants that use fossil fuels or peat (an average of 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 the energy efficiency measures presented in Chapter 3.4. Strengths of the IMPAKTI model include the strong methodological basis, consisting both of scientific knowledge and up-to-date understanding of the developments in the policy area, transparency owing to the relatively simple methodology and suitability to the national circumstances. A weakness of the model is the lack of a disaggregated impact. Due to strong interlinkages of policies and measures promoting renewable energy, the approach used in IMPAKTI would not produce meaningful results for disaggregated policies and measures.

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 Document for a description of the methodology). The LIPASTO calculation system includes five sub-models: LIISA for the road transport inventory; ELIISA for road transport projections; RAILI for the railway inventory; MEERI for the waterborne transport inventory; and TYKO for the non-road mobile machinery inventory. LIPASTO models are updated and compiled by VTT Technical Research Centre of Finland. Since 2022, the road transport projections have been calculated using a new stand-alone model called ELIISA, which is an upgraded version of its predecessor ALIISA. ELIISA computes the development of the vehicle fleet, kilometrage, consumption, and GHG emissions (includes CO_2, CH_4, and N_2O) until 2050. ELIISA considers all possible powertrain options for vehicles in Finland. The changes in the vehicle fleet are based on the estimated annual sales of new vehicles and imported vehicles and the vehicle scrappage rate. Fuel and energy consumption estimates are based on actual fuel sales.

The kilometrage projections for transport are based on the national projections modelled by Finnish Transport and Communications Agency. Since the national projection is produced only every four years, and road transport scenarios produced typically once a year, the national kilometrage projection is implemented through vehicles' average annual kilometrage (estimated per vehicle type, for passenger vehicles, also per powertrain, as in the national kilometrage projection). As vehicle fleet estimates change, road transport kilometrage estimates therefore also change and may not fully match the national projection.

The forecast for rail transport is based on the expert estimation of the development of diesel train transport volume (gross tonne kilometres). This development follows the national transport forecasts on transported tonnes by the Finnish Transport and Communications Agency Traficom. The developments in emission coefficients are based on expert estimates.

The projections for national waterborne transport have focused on experts' estimation of the development of port calls. These estimates have been updated based on Traficom’s (Finnish Transport and Communications Agency) national transport forecasts. The future development of the emissions coefficients for waterborne transport is based on estimates and research results from other countries.

When impact assessments of individual policy measures are needed, the modellers usually first determine the effect of the policy measure on the input data for the previously mentioned models, such as the vehicle fleet, kilometrage or consumption. This can be based on separate studies, for example. Finally, the model is run with and without the changes to the input data to obtain the impact assessment.

Machinery

Emissions for machinery are estimated with the TYKO model which is part of LIPASTO. 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 (NO_x); particles (PM); methane (CH_4); nitrous oxide (N_2O); sulphur oxide (SO_2); carbon dioxide (CO_2). The period of the calculations is 1980 to 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). For example, the method is widely used in the Nonroad model used by the US EPA (Environmental Protection Agency) and the CORINAIR Off-Road vehicle and Machines model. It has been adjusted for Finnish circumstances, e.g. the age and attrition of the machinery. The method is compliant with the 2006 ‘IPCC Guidelines for National Green House Gas Inventories’ and the EMEP/EEA’s ‘Emission Inventory Guidebook’.

The TYKO model has been the only machinery model of its kind in Finland and needs a renewal. The typical usage of machinery in different sectors is estimated based on secondary data; more research is needed to improve model assumptions, as usage of machinery is a key factor affecting the model’s output. The model also needs technical improvements: the extension of the time series until 2060 and inclusion of CNG[165]-powered, hybrid, and electric machinery. As a result, Statistics Finland launched the emission calculation system reform project LIIKE, funded by the Ministry of Transport and Communications, the Ministry of the Environment and the Ministry of Finance. The LIIKE calculation system with its models is planned to be completed by the end of 2024.

F-gases

The F-gas emission projections (including HFCs, PFCs, and SF6) are prepared by the Finnish Environment Institute.

The total F-gas emission projections are sums of the subsector emission projections. The F-gas emission sectors are: refrigeration and air-conditioning equipment; foam blowing and the use of foam products; aerosols; electrical equipment; and grouped emission sources (e.g. fixed

[165] compressed natural gas

firefighting systems and semiconductor manufacturing). The calculation model for F-gas emissions and emission projections in the refrigeration and air conditioning equipment sector (CRT 2.F.1) are part of the official Finnish GHG emission inventory reporting system. The model has 15 different subsectors (equipment types), and the total F-gas emissions of sector 2.F.1 are sums of the subsector emissions. Each of the 15 subsectors is linked to one of the six 2.F.1.a-f reporting sectors under the UNFCCC GHG inventory reporting. The model covers the years 1990 to 2055. The emissions estimation methodology in the model is the Tier 2 emission factor approach of the 2006 IPCC Guidelines (Volume 3, chapter 7.5).

Emission projections of F-gas sectors other than refrigeration and air-conditioning equipment (CRT 2.F.1) are calculated in separate simplified Excel spreadsheet calculation modes and are based on the calculation spreadsheets used in GHG emission inventory reporting.

The modelling builds on aggregating information for the F-gas sector, and there are therefore only limited opportunities to project the detailed effects of individual policy measures in terms of emissions reductions.

Agriculture

An economic model and several greenhouse gas calculation models were used to compile the projections for the agricultural sector (CH_4, N_2O). Natural Resources Institute Finland has prepared the projections for the agricultural sector.

Future agricultural production volume and intensity was estimated using the Dremfia agricultural sector model, which considers the prices of agricultural inputs and outputs and agricultural policy. The model has frequently been used to evaluate the impacts of agricultural and agri-environmental policies. The model has therefore also been continuously updated and revalidated based on the available statistical information about input and output prices, food consumption, use of inputs, production, land use, and productivity in agriculture[166]. The parameters and principles of agricultural policy have been updated annually, as well when necessary. The results from Dremfia were fed into the calculation models, which are used for the greenhouse gas emission inventory (see the Finland's National Inventory Document for details). Dremfia produced most of the input data for the greenhouse gas modelling: the area of cultivated farmland; the use of mineral fertilisers; and the numbers for the most important animal species in agriculture. In addition, the development of some variables (not included as such in the Dremfia model) in the future was estimated using expert judgements: the area of organic soils; the spread of manure management systems; and developments in the weight of cattle and N excretion of animals. It was assumed that the number of horses, sheep, fur animals, reindeer, and turkeys would remain stable.

Strengths and weaknesses of the Dremfia model can be summarised as follows:

Strengths: Regional disaggregation of the model is well suited for analyzing effects of agricultural policy; The data of the model is carefully selected from official statistics and research data so that the model includes relevant country specific bio-physical and economic relationships. The model produces development paths at annual time steps up to 2055. The model allows simultaneous imports and exports of the same commodity[167]. The food consumption per capita and the total consumption in the model follows the observed reality well. The model includes endogenous technological and structural change of dairy sector which

[166] Lehtonen et al. 2018, Koljonen et al. 2024

[167] Armington assumption

accounts appr. 50 per cent of the value of production. This means that the model considers economic factors such as input and output prices, on dairy farm structural change. Flows of nitrogen and phosphorous represent the production practices and intensity observed and thus they are very close to published studies on nutrient balances.

Weaknesses: Annual weather anomalies are not taken into account in the validation of the model. There is also some sensitivity of crop area allocation on exogenous EU prices due to the profit maximisation hypothesis, hence the areas of all individual crops are not exactly the same as their actual observed areas, while the total area of cereals, other crops and grasslands are close to the observed ones. Almost entirely exogenous food demand per capita, due to exogenous demand trends while only deviations of only few percents are allowed from the given trend value, rules out any large changes in the consumption of agricultural products (through consumer behaviour) because of price shocks (such shocks, however, have been observed to cause relatively small effects on food consumption). Fully exogenous farmland area per region do not consider any long-term changes in land use, e.g. lost farmland due to urban expansion, or clearing forest land for agriculture. Adding new products to the model requires a lot of data and validation work. The model excludes horticulture, reindeers, fur animals, horses, lambs and goats which however have a marginal impact on agricultural GHG emissions.

The method and assumptions were done in the same way as in the previous Fifth Biennial Report. The method makes it possible to consider all measures that are related to agricultural policies, and it produces time series that are consistent with the reported emissions.

Waste

The Finnish Environment Institute calculates the projections for the waste sector. The waste scenarios are based on statistics and modelling following IPCC guidelines. The projection tool is thus primarily an emissions calculation model, which is complemented by expert judgements on how rapidly the measures will affect the waste sector. The same basic modelling tool has been used for 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 different waste treatment facilities are introduced. The modelling deals separately with solid municipal waste, municipal sludge, industrial sludge, industrial solid waste, and construction 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 considered. CH_4 and N_2O emissions are treated separately. After the waste amounts have been defined, the greenhouse gas emissions are calculated according to the IPCC instructions and the methods used in the Finnish inventories.

The modelling builds on aggregating information for the waste sector, and there are therefore only limited opportunities to project the detailed effects of individual policy measures in terms of emissions reductions. There has thus far been only limited information about 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 LULUCF projection is a compilation of the projections for different land-use categories and harvested wood products (HWP). Projections are prepared for forest land, cropland, grassland, wetlands, and settlements. The emissions (CO_2, CH_4, N_2O) and removals (CO_2) are estimated and calculated using several models and GHG inventory calculation procedures modified for projections. Natural Resources Institute Finland has prepared the projection.

To produce the emission projections, areas for each land use and land-use change category were estimated applying trends and averages in land-use changes based on historical GHG inventory data complemented by the policy targets – for example, the increase in afforestation. The land-use input from the agricultural and energy sectors was considered. The area needed for peat extraction was based on the TIMES-VTT modelled peat consumption for energy, whereas the land-use change categories of former peat extraction areas were mainly based on previous scenario work. New land areas required for the construction of wind power and solar-power plants were based on TIMES-VTT modelling. The applied method is developed for LULUCF scenario work.

The development of forest resources was estimated using MELA software. The modelled results on tree biomass stocks, harvest volumes of commercial timber and energy wood, and natural mortality were used to estimate CO_2 emissions and removals of trees. Roundwood demand was determined from the wood consumption of the forest industry and production volumes. The demand for and consumption of wood energy use was derived from the TIMES-VTT energy system model results. The MELA model also provided the input data for the Yasso07 soil model (carbon stock changes in mineral forest soils) and CO_2 emission calculation from drained peat forest soils. These methods are the same as used in the GHG inventory. N_2O and CH_4 emissions from soils were also calculated using the GHG inventory methodology.

MELA has a long development history, starting with being an analysis tool for wood production potential. It is currently a tool for forest resource modelling, used for policy support and decision making at national and regional levels. The MELA programme has two parts: 1) an automated stand simulator based on individual tree growth and development models; and 2) an optimisation package based on linear programming. National forest inventory data are used to establish the initial state for the modelling. It is possible to incorporate climate scenarios into the programme. For these projections, the effects of changes in historical long-term temperature and CO_2 concentration on the increment of trees are included. MELA is developed for Finnish conditions and uses several country-specific models applying Finnish forest management recommendations. Due to optimisation, MELA seeks the best solution to reach the target. Compatibility with the historical GHG inventory data may therefore be weak.

The projections for cropland and grassland were produced with the GHG inventory methods, including the use of the Yasso07 soil carbon model for mineral croplands. The Dremfia agricultural sector model provided input data for the modelling. For some new policy measures which are not yet included in the GHG inventory, either national research-based or IPCC emission factors were used. This applies mainly to new measures for agricultural land. Yasso07 is a dynamic model for cycling the organic carbon in mineral soils. The model was applied for forest land, cropland, and land-use transition areas in the same way as in the GHG inventory.

The HWP projection was estimated with a model modified from the production-approach-based GHG inventory HWP model (see National Inventory Document, Chapter 6.11). The assumed production of the forest industry was an input in the model.

Many policy measures in the LULUCF sector affect each other and span across multiple land use categories, but it is not feasible to model an entire LULUCF sector scenario for each individual measure. Therefore, methods for assessing impacts of individual measures have been developed in separate studies, using partially different models than in the scenarios. For example, for the impact assessment of afforestation and increased fertilization, the growth of the tree stand was modelled with MOTTI, which is an alternative to MELA. Other climate actions, such as new measures on peatland fields, were assessed in the same way as in the scenarios, using country-specific or IPCC emission factors.

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 of the Victoria University in Australia. 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 Honkatukia (2009)[168].

Several factors explain the popularity of MONASH. The main ones are the advanced and user-friendly software packages that facilitate data handling and the setup of complicated policy simulations, which 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 timeframes. In a forward-looking policy analysis, MONASH-type models offer a disciplined way to forecast the baseline development of the economy. Last, but not least, they also allow the user to replicate and explain the historical development of an economy in greater detail, which is not true of most AGE models.

In FINAGE, there are normally three types of inter-temporal links connecting the consecutive periods in the model: (1) the accumulation of fixed capital; (2) the 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 it takes time for an industry to adjust to the changes in energy costs caused by emissions trading and 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. However, some industries gain from the subsidies granted to renewable energy, and even in energy-intensive industries, 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 the expected equilibrium wage growth, with the result that in the short run, adjustments will occur partly through increased unemployment levels. In the long run, wages will adjust fully to one-off shocks, and full employment will be restored. However, in the case of gradually tightening emissions targets, the shocks are not one-off, implying sustained above-equilibrium unemployment rates.

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Annex 4 Units and abbreviations

°C	degree Celsius
3-NOP	3-nitrooxypropanol
ACAF	a project ‘Youth and indigenous peoples' involvement in climate change adaptation in the Arctic and Barents region’
AEA	annual emission allocation
AFIR	Alternative Fuels Infrastructure Regulation
AGE	applied general equilibrium (model)
ALIISA	a road transport model to calculate the impact of policies and measures on the longer-term trend in greenhouse gas emissions
ARA	Housing Finance and Development Centre of Finland
ARC	Arctic Space Centre of the Finnish Meteorological Institute
BC	black carbon
BECCS	bioenergy with carbon capture and storage
BEV	a battery electric vehicle
billion	1,000 million
BR5	the fifth biennial report (under the UNFCCC)
CAAF	the ICAO Conference on Aviation and Alternative Fuels
CAP	Common Agricultural Policy
CCl	Commission for Climatology of the World Meteorological Organization (WMO)
CCS	carbon capture and storage
CCSU	carbon capture, utilisation and storage
CH_4	methane
CHP	combined heat and power
CLIMINI	a project on adaptation to climate change in reindeer husbandry and management
cm	centimetre
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CMIP5 and CMIP6	Phases 5 and 6 of the Coupled Model Intercomparison Project
CO_2	carbon dioxide
CO_2 eq.	carbon dioxide equivalent
CORINAIR	an off-road vehicle and machines model
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CRT	common reporting table

CSO	civil society organization
CSP	CAP Strategic Plan
CTF	Common Tabular Formats
Dremfia	a dynamic regional sector model of Finnish agriculture
e.g.	exempli gratia
EEA	European Economic Area
EEA	European Environment Agency
EED	(EU’s) Energy Efficiency Directive
EEDI	Energy Efficiency Design Index
EEX	European Energy Exchange
EEXI	Energy Efficiency Existing Ship Index
EIONET	European Environment Information and Observation Network
EKOREM	a calculation model for energy use of building stock developed by the unit of Construction Management and Economics at Tampere University of Technology and Technical Research Centre of Finland
ELIISA	an upgraded version of ALIISA (road transport model to calculate the impact of policies and measures on the longer-term trend in greenhouse gas emissions)
ELY Centre	Regional Centre for Economic Development, Transport and the Environment
EMEP	European Monitoring and Evaluation Programme
EPBD	Energy Performance of Buildings Directive
ERDF	EU European Regional Development Fund
ESR	EU’s Effort Sharing Regulation
et al.	et alia, and others
ETC CCA	European Topic Centre on Climate Change and Adaptation
ETS	Emissions Trading System
ETS2	Expansion of the EU Emissions Trading System
EU	European Union
EUCRA	European Climate Risk Assessment
EU ETS	EU Emissions Trading System
EU MAC Directive	EU Mobile Airconditioning Directive
EUR	euro
EUROCONTROL	a pan-European, civil-military organisation dedicated to supporting European aviation
EURO-CORDEX	the European branch of the international CORDEX initiative, which is a program sponsored by the World Climate Research Program
F-gases	fluorinated greenhouse gases (HFCs, PFCs, SF_6 and NF_3)

FINADAPT	a project and a report on assessing the adaptive capacity of the Finnish environment and society under a changing climate
FINAGE	a dynamic, applied general equilibrium model of the Finnish economy
FMI	the Finnish Meteorological Institute
FuelEU Maritime regulation	Regulation on the use of renewable and low-carbon fuels in maritime transport
GCF	Green Climate Fund
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GJ	gigajoule
GWh	gigawatt hour
GWP	Global Warming Potential
ha	hectare
HCT	high capacity transport
HDV	heavy-duty vehicles
HEI-ICI	Higher Education Institutions Institutional Cooperation Instrument
HELCOM	Baltic Marine Environment Protection Commission or the "Helsinki Commission"
Helmi	a programme that aims to strengthen biodiversity led by the Ministry of the Environment
HFC	hydrofluorocarbon
HWP	harvested wood products
IANPHI	International Association of Public Health Institutes
ICAO	International Civil Aviation Organization
ICI	Institutional Cooperation Instrument
IE	included elsewhere
IEA	International Energy Agency
IMO	International Maritime Organization
IMPAKTI	a calculation tool for emission mitigation impact of measures promoting the use of renewable energy
IPCC	Intergovernmental Panel on Climate Change
ISTO	a national adaptation research programme
JPI Climate	Connecting Climate Knowledge for Europe, Joint Programming Initiative
JRC-IDEES	Joint Research Centre's Integrated Database of the European Energy System
JTF	the EU Just Transition Fund
km^2	square kilometre

KOKOSOPU	a project for aa comprehensive evaluation of Finland’s national adaptation policy
KUITTI	Project ‘Assessment of the Cost of Inaction Regarding Climate Change’
kt	kilotonne
kVA	kilovolt-ampere
kWh	kilowatt hour
LDC	least developed countries
LIFE project	funded in the LIFE Programme, EU's funding instrument for the environment and climate action
LIIKE	a new transport and construction machinery emission calculation system
LIISA	a road traffic sub-model to the LIPASTO calculation system
LIPASTO	a calculation system for transport exhaust emissions and energy use in Finland
LTAG	Long Term Aspirational Goal
LTRS	Long-Term Renovation Strategy
LTS	long-term strategy
Luke	Natural Resources Institute Finland
LULUCF	Land Use, Land Use Change and Forestry
Luomus	Finnish Museum of Natural History
LVH	lower heating value
m^3	cubic metre
MAL agreements	land use, housing and transport agreements
MARPOL	International Convention for the Prevention of Pollution from Ships
MDB	Multilateral development bank
mm	millimetre
MEAs	multilateral environmental agreements
MEERI	a water-borne traffic sub-model to the LIPASTO calculation system
MELA	a forest decision support system tool generated for Finnish conditions
METKA	Act on temporary forestry incentive scheme
METSO	Forest Biodiversity Programme for Southern Finland
MEUR	million euros
MFA	Ministry for Foreign Affairs
MISU	The Climate Change Plan for the Land Use Sector
MJ	megajoule
mm	millimetre

MONASH	a large-scale economic model originally developed at Victoria University, Australia
Motiva	a state owned sustainable development company in Finland
MPG´s	the modalities, procedures and guidelines of the enhanced transparency framework under the Paris Agreement
MRV	monitoring, reporting and verification
Mt	million tonnes
MW	megawatt
MWh	megawatt hour
N_2O	nitrous oxide
NA	not applicable
NAP	National Adaption Plan
NC8	Finland's Eighth National Communication under the United Nations Framework Convention on Climate Change
NDC	Nationally Determined Contribution
NDF	Nordic Development Fund
NECP	National Energy and Climate Plan
NECPR	National Energy and Climate Plan Progress Report
NF_3	nitrogen trifluoride
NFS	National Forest Strategy
NGO	non-governmental organization
NID	national inventory document
NIR	national inventory report
NMHS	national meteorological and hydrological services
NMVOC	Non-Methane Volatile Organic Compounds
NOAA	National Oceanic and Atmospheric Administration (United States)
Non-SMEs	enterprises not categorized as small and medium-sized enterprises (SMEs)
NO_X	nitrogen oxides
NSDC	Sodankylä National Satellite Data Centre of the Finnish Meteorological Institute
ODA	official development assistance
OECD	Organisation for Economic Cooperation and Development
OECD DAC	OECD Development Assistance Committee
OECD DAC CRS	OECD Development Assistance Committee's Creditor Reporting System
OPACE	Open Panel of CCl Experts (CCl is the Commission for Climatology of the World Meteorological Organization
OOF	Other Official Flows

PEIKKO	a project called 'Baseline scenarios for energy and climate policy package towards zero emissions'
PFC	perfluorocarbons
PHEV	a plug-in hybrid electric vehicle
PITKO	Long-Term Development of Total Emissions project
PJ	petajoule
POLIREM	calculation model for energy use of building stock
PPR	Sub-Committee on Pollution Prevention and Response
PIF	Public Sector Investment Facility
PV	photovoltaic system
QA	quality assurance
QC	quality control
R&D	research and development
RAILI	a railway traffic emission sub-model of LIPASTO calculation system
RCPs	Representative Concentration Pathways
REAP	Risk-informed Early Action Partnership
REF	recovered fuels
ReFuelEU Aviation	Regulation on the use of renewable and low-carbon fuels in aviation
RRF	Recovery and Resilience Facility
SAF	Sustainable Aviation Fuels
SAR	synthetic aperture radar
SCF	Social Climate Fund
SCP	Social Climate Plan
SF_6	sulphur hexafluoride
SIDS	small island developing states
SIETO	a project on assessment of weather and climate risks
SMEs	small and medium-sized enterprises
SO_2	sulphur oxide
SOFF	Systematic Observations Finance Facility
SOLARIS	Project 'Solidarity in climate change adaptation policies: towards more socio-spatial justice in the face of multiple risks'
SOTKA	a project part of the Helmi habitats programme to improve the status of waterfowl populations
SRC	Strategic Research Council
SSP	Shared Sosioeconomic Pathway
SYKE	Finnish Environment Institute
t	tonne

TEM	Ministry of Economic Affairs and Employment of Finland
TEN-T	the trans-European transport network
THL	Finnish Institute for Health and Welfare
TIMES-VTT	an energy system model, which is based on the IEA-ETSAP TIMES energy system modeling framework and the global ETSAP-TIAM model
TJ	terajoule
Traficom	Finnish Transport and Communications Agency
TWh	terawatt hour
TYKO	a calculation model for non-road mobile machinery
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	the Environmental Protection Agency of the United States
VAT	value added tax
VATTAGE	a dynamic, applied general equilibrium model of the Finnish economy
VTT	Technical Research Centre of Finland
WAM	With Additional Measures
WM	With Measures
WMO	World Meteorological Organization
WOM	Without Measures
WSFS	Watershed Simulation and Forecasting System
Yasso07	A model of the cycling of organic carbon in soil

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