Photo: Timo Seppäläinen

2

National circumstances relevant to greenhouse gas emissions and removals

This chapter describes the national circumstances relevant to Finnish greenhouse gas emissions and removals. Government structure as well as population, geographical and climate profiles are illustrated. Thereafter, the characteristics and development of the economy, energy supply and consumption, transport, industry, building stock, urban structure, waste, agriculture and forestry are described.

2 National circumstances relevant to greenhouse gas emissions and removals

2.1 Government structure

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 head of state is the President of the Republic, who is elected for a period of six years and may serve a maximum of two consecutive terms. The President of the Republic directs foreign policy in cooperation with the Government, deciding, for example, on whether to join or withdraw from international organisations and on the signing, ratification, and entry into force of international conventions. In its narrower sense, the Government refers to the Cabinet, which runs the 12 ministries. The Prime Minister directs the activities of the Government and oversees the preparation and consideration of matters within the Government's mandate. Each ministry is responsible for the preparation of issues within its mandate and for the proper functioning of the departments and agencies within its administrative domain. 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.

Matters related to the United Nations Framework Convention on Climate Change (UNFCCC) fall within the administrative responsibility of the Ministry of the Environment, which acts as the national focal point for the UNFCCC.

More information about the institutional framework of Finland's climate policy is presented in Section 4.2.

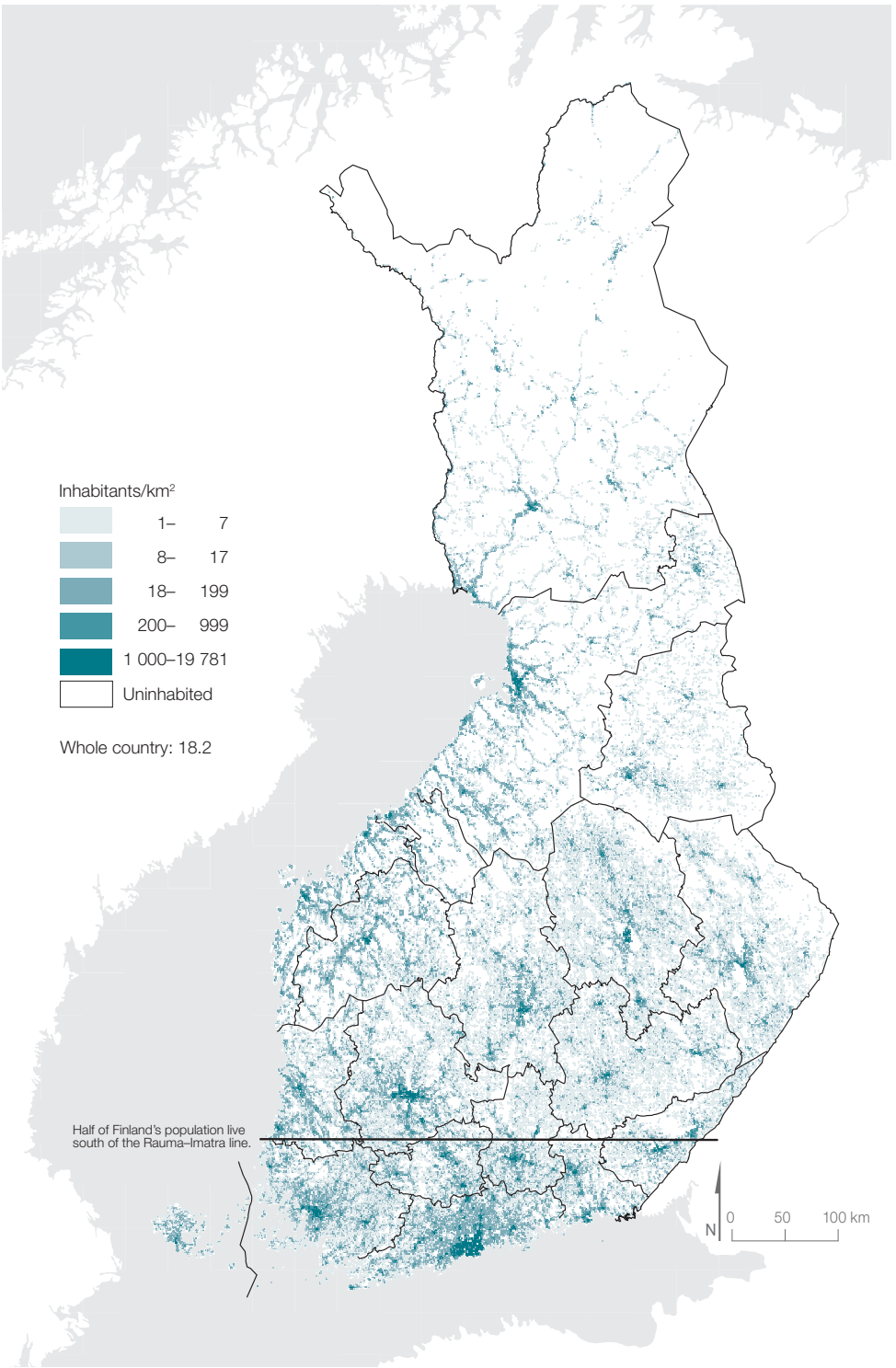
2.2 Population profile

The population of Finland was 5.5 million at the end of 2020. It increased by an annual average of 0.39 per cent between 1990 and 1999, by 0.35 per cent between 2000 and 2009 and by 0.30 per cent between 2010 and 2020. The population density averages 18 inhabitants per km^2 but ranges from two inhabitants per km^2 in Lapland in northern Finland to 187 inhabitants per km^2 in the south of the country in the Helsinki-Uusimaa region (Figure 2.1). The country's low population density and geographical extent mean long distances can be travelled for different purposes.

Many rural communities have a declining population, particularly in northern and eastern Finland. The urban population made up 72 per cent of the total

population in 2020. The corresponding figure in 1990 was 63 per cent of a total population of 5.0 million. Internal migration from rural to urban areas was strong in the mid and late 1990s, when urban municipalities gained more than 10,000 migrations. Internal net migration to urban municipalities declined in the early 2000s but has increased steadily since, reaching an average of 9,000 internal migrations between 2015 and 2019. However, internal net migration to urban municipalities decreased to 5,000 in 2020.

Figure 2.1
Population density in Finland, 1 January 2021



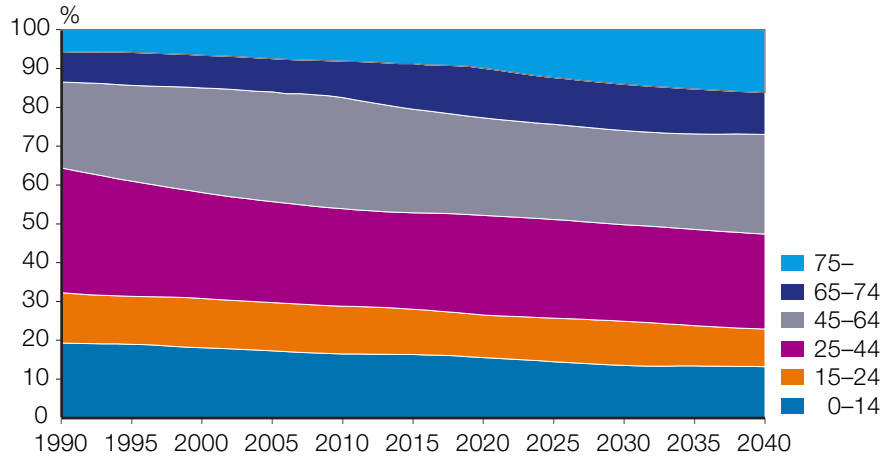
Source: Statistics Finland

Net migration to Finland increased steadily during the late 1990s and the 2000s. In 1994, the migration gain for Finland was about 3,000; in 2006, it reached more than 10,000 migrations. Between 2010 and 2020, net migration to Finland ranged between 12,000 and 18,000.

The number of one-person households has increased and the average household size has decreased. There was a total of 2.8 million households at the end of 2020. Forty-five per cent of households, or 1.3 million, consisted of only one person. The average size of a household was two people. In 1970, the average household size was still three people. Finland's current average household size is low compared with other countries.

The population is ageing. In 2020, the proportion of people aged over 65 was 29.2 per cent; in 1990, it was 13.5 per cent. This trend will accelerate in the coming years and decades. Life expectancy has risen rapidly during the past 30 years. At present, baby girls may expect to reach the age of 84.6, and baby boys the age of 79.0. The proportion of elderly people of the total population is increasing due to declining mortality rates and therefore longer life expectancy. Despite this trend, population growth has slowed down, and it is expected that the natural increase in population will decrease in the coming decades. According to population projections made by Statistics Finland in the autumn of 2021, it is estimated that the Finnish population will increase to 5.6 million by 2034 due to net migration gain but will then decline if fertility rates and amount of net migration remains at the current observed level in the future. By 2040, it is estimated that more than a quarter of Finland's population will be 65 years old or over (Figure 2.2).

Figure 2.2
Population profile for 1990 to 2040 (1990 to 2020 actual, 2021 to 2040 projected)



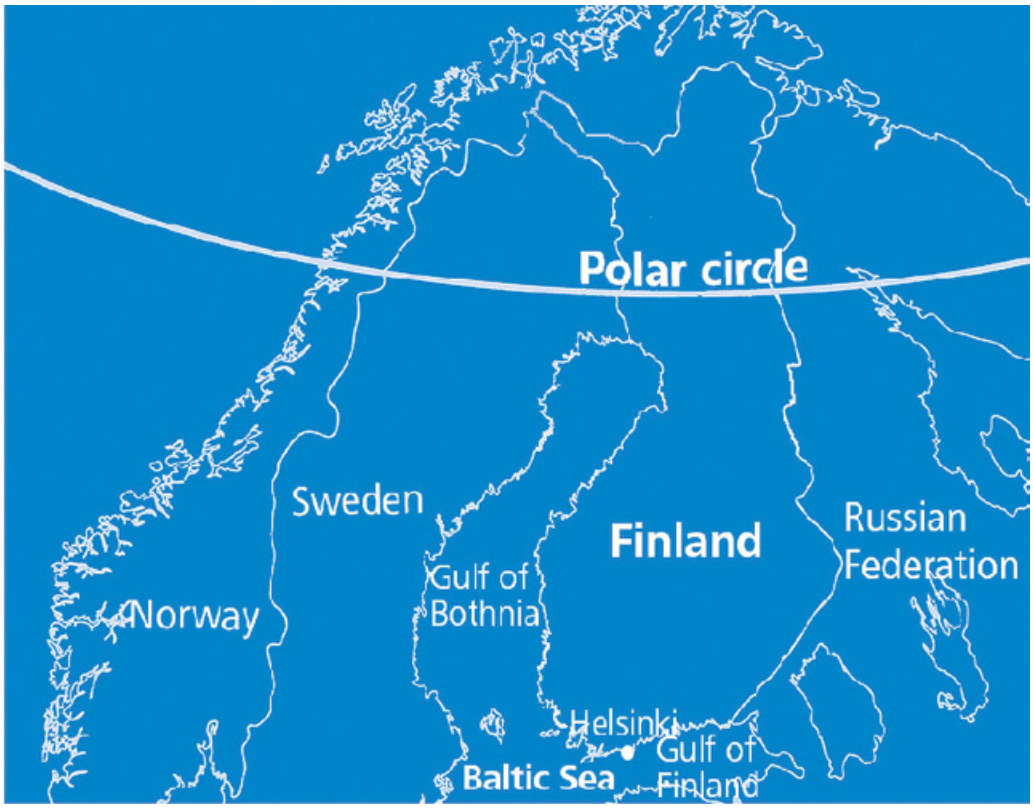
Source: Statistics Finland

2.3 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 (Figure 2.3). 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. The land boundary with Sweden is 614 km long, with Norway 736 km long and with Russia 1,340 km long.

Finland lies between the Scandinavian mountains and northern Russian plains. 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. 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. Finland has more than 34,300 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.

Figure 2.3
Finland's location



Source: Statistics Finland

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. The salinity of the surface water in the southern Baltic Sea is as high as 20 per mille, but in the northern reaches it drops to six per mille. 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 (settlements, industry, agriculture, and forestry) in the Baltic Sea region.

Changes in land use since 1990 are shown in Table 2.1. The area of settlements has increased by 15 per cent, and that of grassland has decreased by nine per cent, whereas changes in areas of other land use categories have been small, one per cent or less (Table 2.1).

Table 2.1
Land use in 1990 and 2020

Land use classification [1]	1990 (km^2)	2020 (km^2)	Change, %
Forest land	221,090	218,493	–1.2
Cropland	24,719	25,017	1.2
Grassland	2,663	2,427	–8.9
Wetlands	30,070	29,777	–1.0
Settlements	12,235	15,058	23.1
Other land	13,139	13,104	–0.3
Total	**303,916**	**303,875**	
Inland waters	34,518	34,560	
Total with inland waters	338,435	338,435	

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

Box 2.1
Peatlands

Peatlands cover almost one third of the total land area in Finland, approximately 9.1 million hectares. Regional differences in coverage are considerable. The majority of the peatlands are located in the north, while only seven per cent are in southern Finland.

In Finland, 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, three per cent of peatland is in agricultural use, i.e. cropland. Most of the drainage for forestry and agriculture has occurred in southern and central Finland.

The area of protected peatlands is approximately 1.3 million hectares, which is 14 per cent of peatlands. They consist mainly of areas under the national mire protection programme, areas in national parks and nature reserves, and old-growth forest conservation programme and wilderness areas. The total area of undrained peatlands is approximately four million hectares.

Peatland forests represent a significant share of the carbon sink of forests thanks to the increasing growing stock of trees. Undrained peatlands are

carbon accumulating ecosystems in the long term. Depending on weather conditions, a particular peatland can vary on a year-to-year basis from a net sink to a net source of emissions. It is estimated that since the last ice age, peatlands have accumulated some 5,400 million tonnes of carbon, forming the largest soil carbon stock in Finland.

Approximately 67,000 hectares, 0.7 per cent of the surface area of peatlands, were in active peat production in 2020. Peat is used both as energy source and as horticultural, environmental and animal bedding peat. In recent years peat has accounted for approximately four per cent of Finland's energy production. On the other hand, peat-based growing medium is important for the greenhouse production as well as for the production of tree seedlings. According to revised Environmental Protection Act[1] the peat extraction must be situated to peatlands that have been drained or whose natural state has otherwise been significantly changed in a way that does not cause damage to a nationally or regionally significant nature value.

In 2012, the Finnish Government approved a resolution on the sustainable and responsible use and protection of mires and peatlands. The decision directs human activities to peatlands that have been drained or whose natural state has otherwise been significantly changed. It is used to implement sectoral policies and measures for sustainable and responsible use of mires and peatlands and it is used to improve the status of the existing network of protected peatlands.

The Mire Conservation Group (2012–2015) identified the most valuable mires nationally in terms of their natural value, which would complement best the current network of conservation areas. By 2020, around 44,000 hectares state-owned and private mire land both in Southern and Northern Finland were protected based on the proposal of the Mire Conservation Group.

Ongoing Helmi Habitats Programme continues the work of the Mire Conservation Group, aiming to protect at least 60,000 hectares mires by 2030. The implementation of the programme started in 2020, and in 2020 to 2021 almost 12,000 hectares both state-owned and private mire land were protected. In addition, the Helmi Habitats Programme aims to restore about 60,000 hectares of drained mires.

1 527/2014

2.4 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 Gulf Stream.

The mean annual temperature is close to 7 °C in the southwestern archipelago of Finland, decreasing towards the northeast. The 0 °C mean limit is slightly north of the Arctic Circle. Temperature differences between regions are greatest in January, when the difference between southern and northern Finland is an average of approximately 10 °C. In June and July, it is closer to 5 °C.

Finland enjoys long periods of daylight around midsummer, when the length of the day, including 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 during which the sun never sets. Conversely, in winter, the northernmost region has two months of uninterrupted darkness.

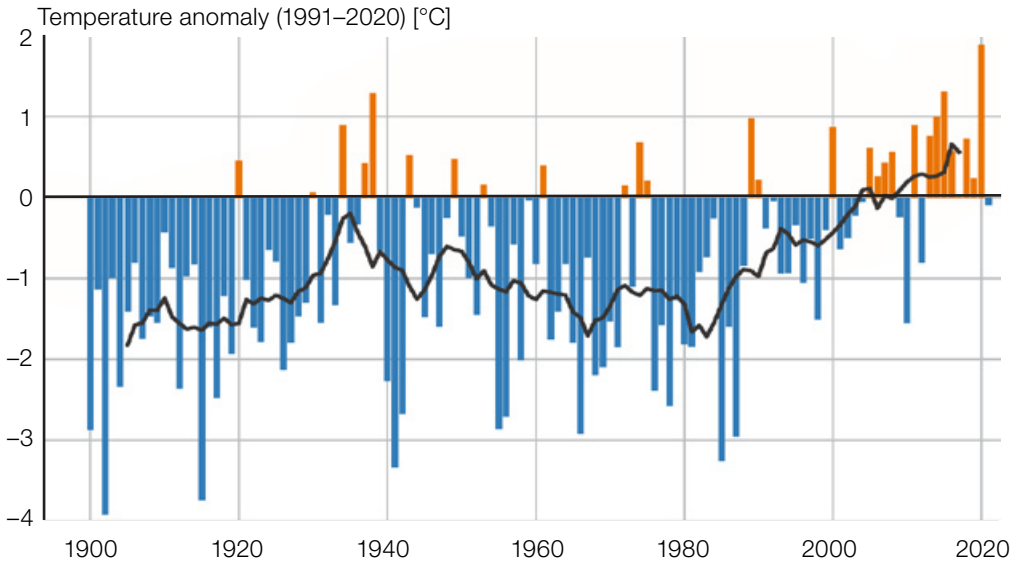
The Finnish climate is characterised by irregular precipitation, and there are typically rapid changes in the weather. The mean annual precipitation in southern and central Finland is usually between 600 and 750 mm, except near the coast, where it is slightly lower. In northern Finland, annual precipitation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

The seasonal variation in precipitation is quite similar throughout the country, with the driest months February, March, and April. Precipitation then gradually increases until July and August, or until September and October on the coast, after which it decreases towards the winter and spring. Daily precipitation of 40 mm occurs in a certain location on average once every five years. During an average year, more than half the days have some precipitation, except near the coastal regions. Even in southern Finland, some 20 per cent of annual precipitation falls in the form of 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 it 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 during mild winters, it remains open for the most part, except for the Bothnian Bay and the eastern part of the Gulf of Finland. However, during the very mildest winters, even the Bothnian Bay does not freeze over completely.

The most common wind direction (around 20 per cent) is from the south or southwest. The average wind speed is three to four m/s inland; it is 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 autumn and winter, increasing from the northwest towards the southeast. The long-term average for the monthly cloud cover ranges from approximately 50 per cent in May to June to about 80 per cent in September to November.

The average annual temperature has increased since the beginning of the 20th century by about two degrees Celsius (Figure 2.4). 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 between 1961 and 1990. Nevertheless, considerable temperature fluctuations occur between individual years, particularly in winter.

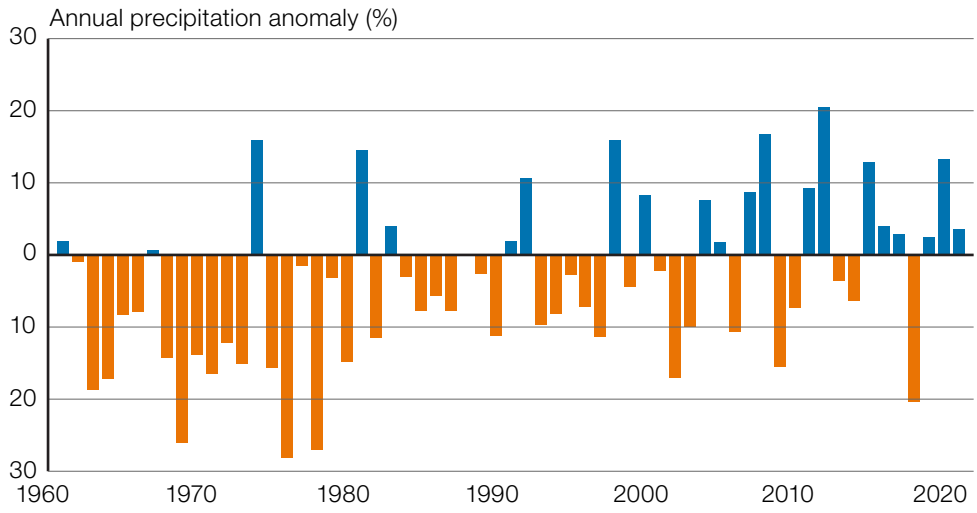
Figure 2.4
Annual mean temperature in Finland from 1900 to 2021, presented in anomalies (°C) relative to the reference period 1991 to 2020. The black line represents the 10-year moving average.



Source: Finnish Meteorological Institute

The average annual precipitation level shows significant variations from year to year (Figure 2.5). 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 the winter.

Figure 2.5
Annual mean precipitation in Finland, 1961 to 2021, presented as anomalies (%) for the reference period 1991 to 2020 in terms of mean precipitation

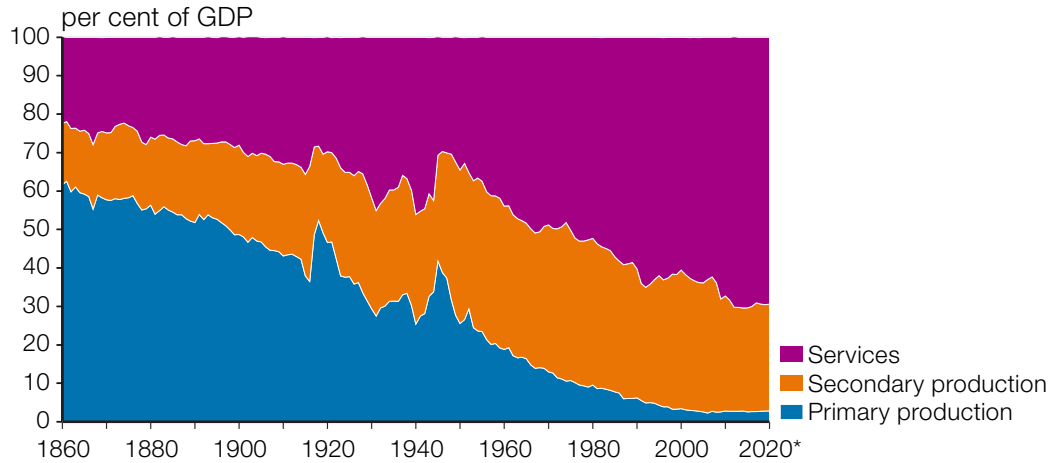


Source: Finnish Meteorological Institute

2.5 Economy

Finland has an open economy with prominent service and manufacturing sectors (Figure 2.6). As a member of the European Union and euro area, Finland's economy is integrated with the economies of other EU countries. The main manufacturing industries include the metal, electrical and electronics, chemical and forest industries. Foreign trade is important, with exports accounting for approximately 40 per cent of the gross domestic product (GDP). The cold climate, energy intensive industry structure and long distances have led to a relatively high energy intensity and per capita greenhouse gas emissions.

Figure 2.6
Structural change in the Finnish economy between 1860 and 2020



* Preliminary data

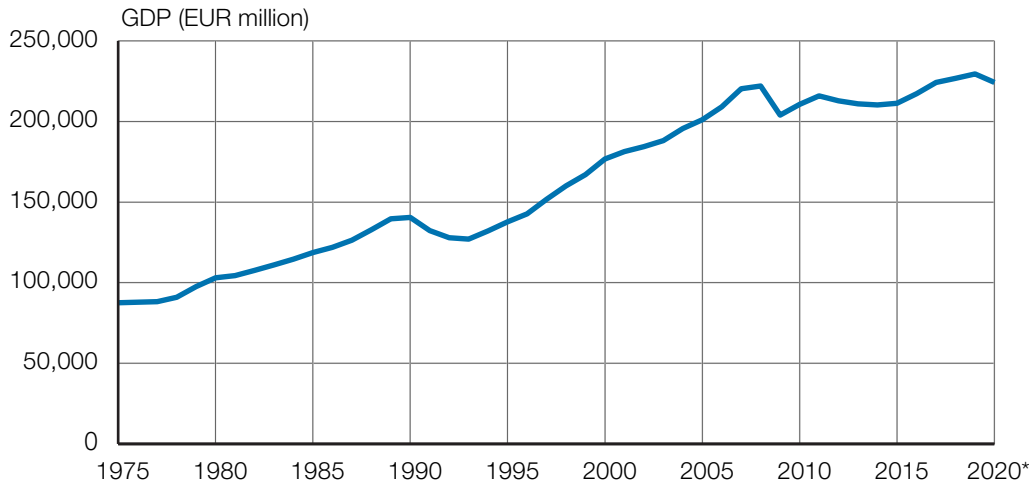
Source: Statistics Finland, Annual national accounts

For several decades, the Finnish economy was characterised by rapid growth combined with vulnerability to international cyclical fluctuations. Finland went through severe economic recessions in the early 1990s and again between 2008 and 2009 (Figure 2.7). The economy recovered rapidly after the first recession. During the 2008 to 2009 recession, the Finnish economy contracted by 10 per cent in the peak-to-trough period. By 2017, the Finnish economy had recovered from the recession that began in 2008.

In 2018 and 2019, GDP growth was modest. In 2020, the volume of Finland's GDP fell by 2.3 per cent as the Covid-19 pandemic prevailed but grew by 3.5 per cent the following year. The output of the national economy stood at EUR 43,440 in 2019, 43,032 in 2020, and 45,644 in 2021[2]. The national economy reached the pre-pandemic level in 2021. However, it is predicted that average GDP growth will remain moderate in the next few years because of a predicted decline in exports and manufacturing output due to economic sanctions imposed against Russia and declining growth in private consumption as a result of increases in consumer prices.

In 2020, net national income declined 1.3 per cent in real terms, which was significantly less than the decline in gross domestic product. The volume of investments decreased by one per cent, but aggregate demand in the economy was mainly maintained by consumption. The volume of total consumption contracted by three per cent from the previous year. However, net national income grew by 4.3 per cent in 2021.

Figure 2.7
Finnish gross domestic product 1975 to 2020 (at 2015 prices)



* Preliminary data

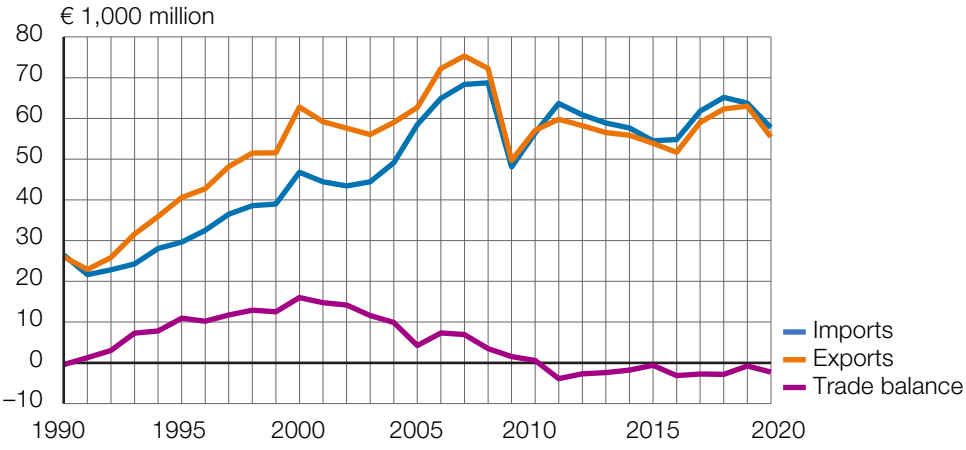
Source: Statistics Finland, Annual national accounts

2 Economic variables for 2021 are preliminary estimates published by the Annual National Accounts at Statistics Finland.

Finland's exports have recovered slowly from the recession of 2008 (Figure 2.8) and have yet to reach 2007 levels. Recovery has been slow particularly in the information and communication technology (ICT), forestry, and metal sectors. The slow recovery reflects falling demand for many products Finnish firms produce for the global market. To some extent, this development reflects a normalisation of the ICT sector's performance, following a lengthy boom before the 2008 recession.

The volume of exports of goods was 46 million tonnes in 2020, and the total value was EUR 57.3 billion, reflecting a decrease due to the Covid-19 pandemic (Figure 2.8). Machinery and equipment, forest and chemical industry products and metals and metal products have been the most significant groups of exported goods in recent years. More than half the total value is exported to the EU countries. The total value of exports of services was EUR 25.4 billion in 2020. Telecommunications, computer and information services are the largest item among exported services. The export of services has shown an increasing trend in recent years, except for 2020, when the Covid-19 pandemic decreased the export of travel and transport services especially. The degree of refining in exported goods is higher than in imported goods.

Figure 2.8
Finnish imports, exports, and trade balance of goods, 1990 to 2020 (at 2015 prices)



Source: Finnish Customs, Foreign trade of goods

Finland imported nearly 55 million tonnes of goods in 2020. The total value of imported goods was EUR 59.4 billion with a visible decline due to the Covid-19 pandemic (Figure 2.8). Industrial products represented some 80 per cent of the total value, with products of the chemical and electrical and electronics industries and vehicles the most significant groups of goods. For import of services, the most significant item was other business services. The import of services has usually exceeded the export of services in recent years; this was also the case in 2020, when the value of imports of services (EUR 27.8 billion) was greater than that of exports (25.4 EUR billion).

2.6 Energy

2.6.1 Energy supply and consumption

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. 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 started to increase. The rapid increase levelled off after the oil crisis and with the advent of nuclear power (Figure 2.9). Renewable energy has increasingly replaced fossil fuels during the 2010s and is the main reason for the decreased greenhouse gas emissions despite the growth in energy consumption.

The use of fossil fuels and peat in energy production causes CO_2 emissions (see also Section 3.2.1). Nevertheless, the CO_2 emissions from fuel combustion per total primary energy supply are lower than in most other European countries. This is due to the high share of non-fossil energy sources in power and heat production, i.e. hydro, nuclear, and biomass sources (Table 2.2). Finland's share of renewable energy (43 per cent) in gross final energy consumption in 2019 was the second highest in the EU and continued at the same level in 2020 (44.6 per cent).

Table 2.2
Total energy consumption by sources in 2020

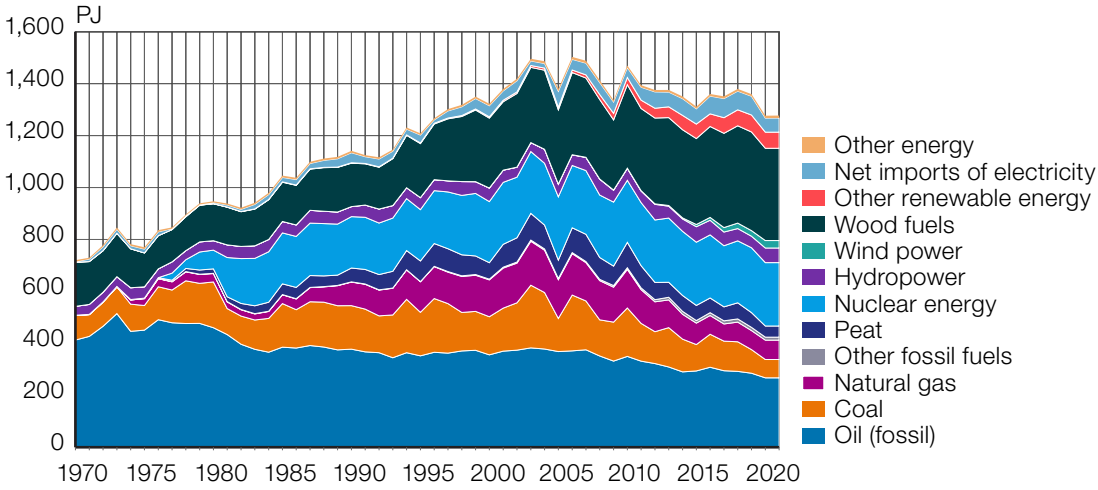
2020	Quantity (TJ)	Share of total energy consumption (%)
Wood fuels	355,404	27.8
Oil (fossil)	268,085	21
Oil (bio)	16,756	1.3
Nuclear energy	243,864	19.1
Coal	70,363	5.5
Natural gas	74,586	5.8
Peat	43,116	3.4
Net imports of electricity	53,917	4.2
Hydropower	56,410	4.4
Wind power	28,577	2.2
Heat pumps	23,723	1.9
Others (bio)	21,606	1.7
Others (fossil)	11,440	0.9
Others	9,391	0.8
Total	**1,277,238**	**100**

Source: Statistics Finland, Energy supply and consumption

For several decades, both total energy consumption and electricity consumption were increasing, and they reached their peak values in 2006. Demand rose more than GDP until 1994. Thereafter, both the energy intensity and the electricity intensity of the economy have decreased. The decrease reflects the structural change within the economy from basic industry towards services and less energy-

intensive industry. Furthermore, increased energy efficiency has contributed to the positive development of energy intensity.

Figure 2.9
Total energy consumption, 1970 to 2020



Source: Statistics Finland, Energy supply and consumption [3] [4]

Total energy consumption

In 2020, total energy consumption was 1,277 PJ (355 TWh) (Table 2.2). Consumption fell by six per cent from the previous year due to both the Covid-19 pandemic and the exceptionally warm weather. The consumption of fossil fuels and peat dropped in total by 10 per cent compared to 2019, and their share of total energy consumption decreased to 37 per cent. The consumption of hard coal declined by 34 per cent and that of peat by 24 per cent. The ban on the use of hard coal for energy production, which will enter into force in 2029, is already affecting the use of hard coal.

In 1990, the share of renewable energy in total energy consumption was just 18 per cent, after which it has grown steadily. The growth of the share of renewable energy of total energy consumption has been the overall trend during the 2010s. Renewable energy has replaced the use of fossil fuels. In 2020, the share of renewable energy continued to grow, being 44.6 per cent of total final energy consumption in 2020 (i.e. 39.3 per cent of total energy consumption). Finland significantly exceeded the national target of 38 per cent of total final energy consumption by 2020 set in the EU's Renewable Energy Directive. In 2010, an extensive national package of specific targets concerning different renewable energy sources was launched to achieve the target. The package promoted the use of forest chips and other wood-based energy in particular, alongside wind power, the use of transport bio-fuels, and increased utilisation of heat pumps. Since 2010, measures have been strengthened and adjusted when required.

3 Coal includes hard coal and coke, blast furnace gas, coke oven gas, and until 1994, town gas.

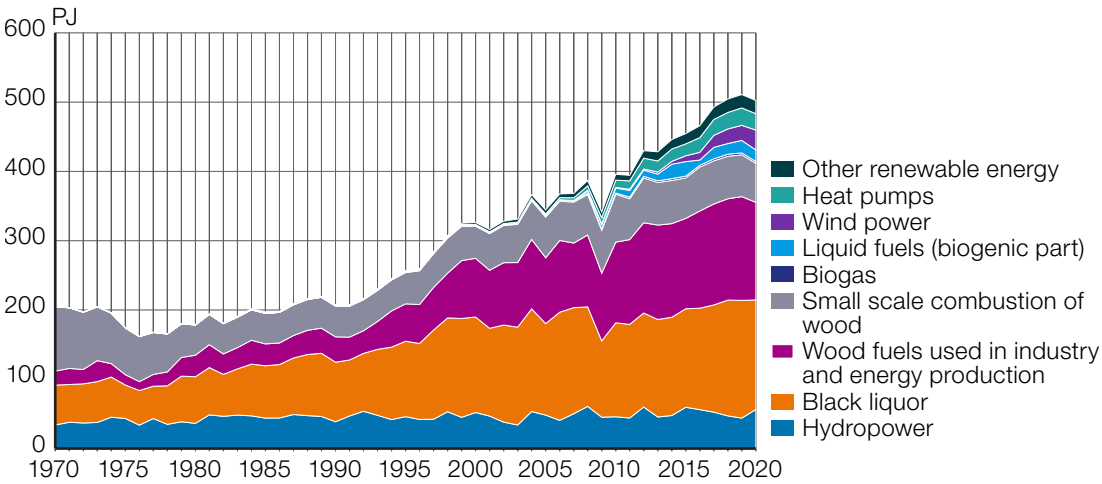
4 Other energy includes reaction heat of industry and hydrogen.

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 tax support, the fastest relative growth can be seen in solar energy, even though the absolute amounts remain modest.

In 2020, wood fuels accounted for 28 per cent of total energy consumption, and they were the most used energy source in Finland from 2012 during the period from 1990 to 2020 (Figure 2.10). Their consumption fell by six per cent due to the warm weather and decreased production of energy-intensive industries in 2020. A major share of wood fuels is derived from the by-products of the forest industry, including black liquor derived 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 generation. The share of black liquor from the consumption of wood fuels was 44 per cent in 2020.

Concerning fossil fuels, Finland depends on imports. Finland's domestic energy sources are wood-based fuels, hydropower, wind power, waste, peat and heat pumps. Its energy dependence, calculated as the proportion of imported net energy in the total primary energy supply (TPES), was 42 per cent in 2020. In reality, Finland relies more on imports than this energy dependency figure indicates, as the indicator considers nuclear energy to be domestic.

Figure 2.10
Total consumption of energy from renewable sources, 1970 to 2020



Source: Statistics Finland, Energy supply and consumption

Electricity supply

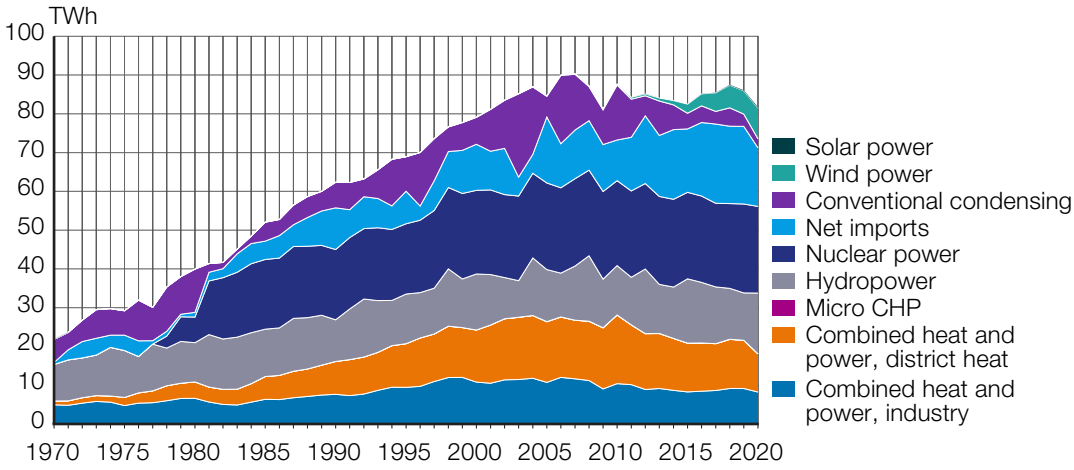
In 2020, the volume of electricity used in Finland amounted to 81.6 TWh. Compared to the previous year, the use diminished by five per cent. In 2020, the production of electricity in Finland amounted to 66.6 TWh. This consisted of combined heat and power production (27 per cent), both

in connection with district heat production and by industry for its own use, nuclear power (34 per cent), hydropower (24 per cent), conventional condensing power (three per cent), wind power (12 per cent) and solar power (0.3 per cent) (Figure 2.11).

In 2020, more than half Finland's electricity production was produced with renewable energy sources for the first time in around 50 years. The production of electricity with renewable fuels amounted to 10.9 TWh, of which 6.0 TWh were produced with black liquor and 4.3 TWh with other wood-based fuels.

Of total electricity consumption, 18 per cent (15 TWh) was accounted for by net imports of electricity from the Nordic countries, Russia and Estonia in 2020. Net imports contracted by 25 per cent from the previous year. Net imports vary considerably from year to year, mainly due to variations in hydropower production in the Nordic countries. Between 1990 and 2020, maximum net imports were 20.4 TWh (in 2017), while minimum net imports were 3.7 TWh (1996). When the availability of hydropower in the Nordic electricity market is scarce, Finland's net imports of electricity decrease. During such years, Finland has generated additional electricity using coal- and peat-fired power plants, which has resulted in higher CO_2 emissions for the years in question. However, in recent years, the share of electricity generation with conventional condensing power has declined, because the availability of wind power has grown (Figure 2.11). Installed wind power capacity has increased steadily in Finland since 1990 as a result of the Government's support measures. While Finland's wind power capacity was only about 1 MW in 1992, at the end of 2020, Finland's wind power capacity was 2.6 GW.

Figure 2.11
Electricity supply by production mode, 1970 to 2020 TWh



Source: Statistics Finland, Energy supply and consumption

District and industrial heat production

In 2020, the production of both district (35.1 TWh) and industrial heat (51.1 TWh) decreased by eight per cent from the previous year. Sixty-three per cent (54.7 TWh) of the production of district heat and industrial heat was produced with renewable fuels and 28 per cent (24.4 TWh) with fossil fuels and peat.

The reason for the decline in the production of district heat was the exceptionally warm year and winter in 2020. Most district heat was produced with wood fuels (38 per cent). The utilisation of excess heat with flue gas scrubbers and heat pumps has grown significantly in recent years, being 13 per cent in 2020. Although the use of peat in the production of district heat decreased from the previous year, it retained its position as the third most important source of energy for district heat production with a share of 13 per cent. In Finland, 57 per cent of district heat production is obtained in combined heat and power (CHP) generation. The share has diminished recently compared to previous years. Combined heat and power production (CHP) provides opportunities for the cost-effective use of renewables, both by industrial producers and at district heating plants. The amount of energy Finland saves annually through CHP approximately corresponds to a tenth of all primary energy used in the country compared with the same amount of electricity and heat produced separately.

The decline in the production of industrial heat in 2020 was affected by the lower production of the energy-intensive forest industry, which is one of the biggest users of industrial heat. The forest industry uses its own fuels like black liquor and other wood fuels in the production of industrial heat. Fifty-four per cent of heat produced for the needs of manufacturing came from black liquor[5].

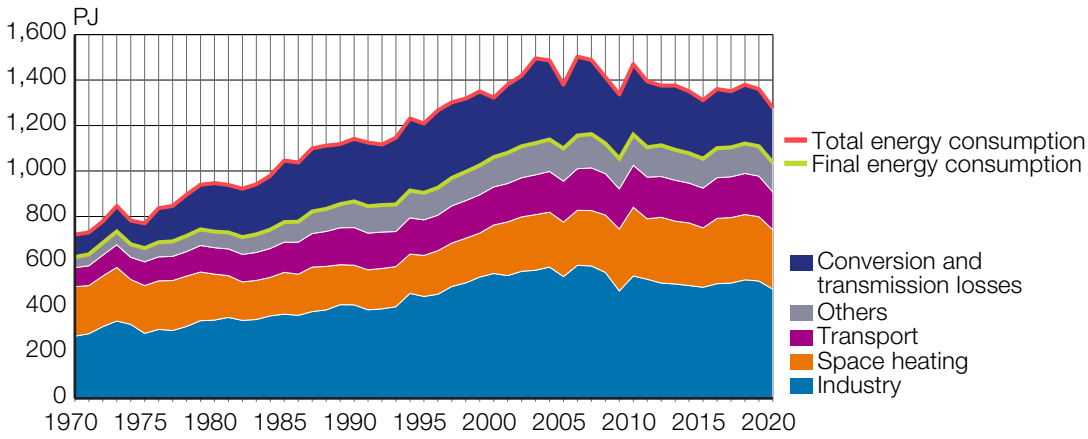
Final energy consumption

In 2020, final energy consumption fell by 6.5 per cent from the previous year, totalling 288 GWh (1,036 PJ). Most energy was consumed in manufacturing, whose share in final energy consumption was 46 per cent (Figure 2.12). Space heating accounted for 25 per cent, and transport for 16 per cent, of final energy consumption, while the share of energy used for other purposes was 12 per cent.

In 2020, energy use in manufacturing decreased by seven per cent, being 133 TWh (480 PJ). Manufacturing was spared the worst Covid-19-related damage, because the long delivery cycles of the investment-commodity- intensive export industry boosted production. In 2020, record warm weather saw a decreased need for heating, and household energy consumption fell by seven per cent from the previous year. Reduced transport saw a decrease in the use of energy in transport by seven per cent in 2020.

5 In the chemical, forest and metal industries, part of the use of heat is considered direct fuel use in the statistics and is thus not visible in the production figures for industrial heat.

Figure 2.12
Total energy consumption and final energy consumption by sector, 1970 to 2020



Source: Statistics Finland, Energy supply and consumption

2.6.2 Energy market

The Finnish electricity market was opened gradually to competition with the enactment of the Electricity Market Act in 1995. Since the autumn of 1998, it has been possible for all electricity consumers, including households, to invite tenders for their electricity purchases. The electricity generation sector is characterised by a large number of actors. The total number of companies producing electricity is around 150, and there are around 400 production plants. To serve Finland's 3.3 million electricity customers, there are currently about 70 retail suppliers.

The Finnish electricity wholesale market is part of the coupled European power market. For more than a decade, Finland has formed an integrated wholesale electricity market with Denmark, Norway, and Sweden, and in the 2010s, Estonia, Latvia and Lithuania joined the common market. Since 2014, the Nordic and Baltic power market has been price coupled with the continental electricity markets. Physical day-ahead and intra-day trading takes place in the Nord Pool power exchange and the EPEX Spot power change that started operations in Finland in June 2020. The formulation of area prices and the allocation of cross-border capacity between Finland and the other countries are managed by implicit auctions in the power exchange's day-ahead market. In 2020, 45.2 TWh electricity was sold and 59.0 TWh bought, in the economic area of Finland. Electricity is also traded on the Over-the-Counter-Market and directly between the buyer and the seller.

The transmission system operator, Fingrid Oyj, is responsible for managing the national power balance and ensuring that the transmission system is maintained and used in a technically appropriate manner. With the other Nordic system operators, Fingrid is responsible for safeguarding the necessary reserves for the operation of the power system.

The natural gas market in Finland was opened to competition at the beginning of 2020 after the Balticconnector pipeline from Finland to Estonia was commissioned. Finland has since been part of the Finnish-Baltic gas market and since the commissioning of the GIPL pipeline on 1 May 2022, the Finnish-Baltic area has also had a gas pipeline connection with the Central European gas network. Now it is possible for all gas consumers to choose their gas supplier in Finland. However, when choosing a gas supplier other than the incumbent, a remotely readable gas meter is required. A total of 20.7 TWh of natural gas was consumed in 2020. The largest natural gas user groups are the energy companies, the pulp and paper industry and the chemical industry; together, they use approximately 90 per cent of the gas. There are about 20 natural gas retail suppliers and approximately 29,000 retail customers. The majority of retail customers use gas only for cooking, and the share of the retail supply is small.

A long-term objective is to increase the alternatives for the supply of natural gas. This is important for the safeguarding of both the security of supply of natural gas and the functioning of the market. Until the end of 2019, natural gas was imported only from Russia. The commissioning of the Balticconnector pipeline has provided additional sources for natural gas. It enables the Finnish market actors and gas users to import gas via Klaipeda LNG terminal in Lithuania and to use Inčukalns underground gas storage in Latvia. In 2020, about a third of gas was imported via the Balticconnector pipeline. In addition, Finland has two off-grid LNG terminals in Tornio and Pori, serving mainly industrial customers in those regions. A grid-connected LNG terminal in Hamina will be commissioned in the autumn of 2022. After the Russian invasion of Ukraine, the Government commissioned the gas transmission system operator, Gasgrid Finland Oy, to negotiate and rent a floating FSRU LNG terminal in April 2022 with the Estonian transmission system operator.

Emissions trading within the EU is a market-based instrument for reducing emissions in the energy sector. The EU emissions trading system applies to large industrial installations and installations with a total rated thermal input exceeding 20 megawatts and to flights within the European Economic Area (EEA). In Finland, the system also applies to district heating plants with a generating capacity of 20 megawatts and to smaller combustion installations connected to the same district heating network. Any installation covered by the emissions trading system needs an emissions permit. In Finland, around 600 installations need a permit.

2.7 Transport

Transport demand and supply are influenced primarily by developments in the economy, demographic factors, employment patterns and infrastructure provision. Increased access to high-speed transport has increased the commuting distance between work and home.

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. The Finnish road network has approximately 78,000 km of public roads. In addition, there are 350,000 km of smaller private roads, many of which are used for forestry purposes. Finland has about 933 km of motorways and 136 km of semi-motorways. The rail network amounts to a total of 5,918 km, of which 3,349 km is electrified.

Three quarters of Finland's foreign trade goes by sea, most of it from the country's principal ports. Most of Finland's many ports and harbours are small, and traffic flows vary considerably. Icebreakers play an important role, with eight responsible for assisting freighters and passenger ships access the 27 ports and harbours kept open all year round. In a normal winter, the harbours in the Bothnian Bay require icebreakers for half the year, while in the Gulf of Finland, they are needed for about three months.

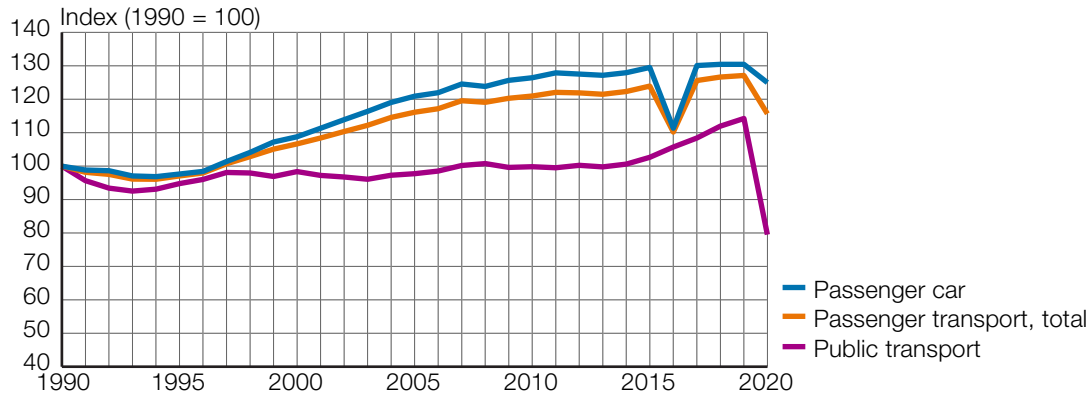
Finland has a network of 24 airports, of which 20 are maintained by Finavia (formerly the Civil Aviation Administration). Approximately 95 per cent of the country's international air traffic operates via Helsinki Vantaa Airport.

2.7.1 Passenger transport

Domestic passenger transport, measured in terms of passenger-kilometres, has increased by approximately 16 per cent since 1990. Cars account for approximately 86 per cent of the total passenger-kilometres. In 2020, the number of passenger-kilometres travelled by car was 25 per cent greater, and the number of passenger-kilometres by public transport was 20 per cent smaller compared to 1990 (Figure 2.13). The passenger-kilometres volumes in public transport were 30 per cent smaller in 2020, the first year of the Covid-19 pandemic, compared to the previous year. The decline was 78 per cent in air travel, 42 per cent in rail travel and 14 per cent in bus travel. Greenhouse gas emission trends in the transport sector are presented in Section 3.2.1.

The number of electric passenger cars in traffic has increased rapidly in recent years in Finland. The share of new passenger car registrations of alternative propulsion increased by 20 per cent between 2019 and 2020. An especially significant change happened in the number of full electric passenger cars registered in 2020, an increase of 124 per cent from the previous year. At the end of 2020, there were 45,260 plug-in hybrid electric cars in traffic and 9,697 all-electric cars.

Figure 2.13
Development of passenger-kilometres in domestic transport, 1990 to 2020*



* Due to changes in calculation methods figures since 2016 are not fully comparable with figure before 2016

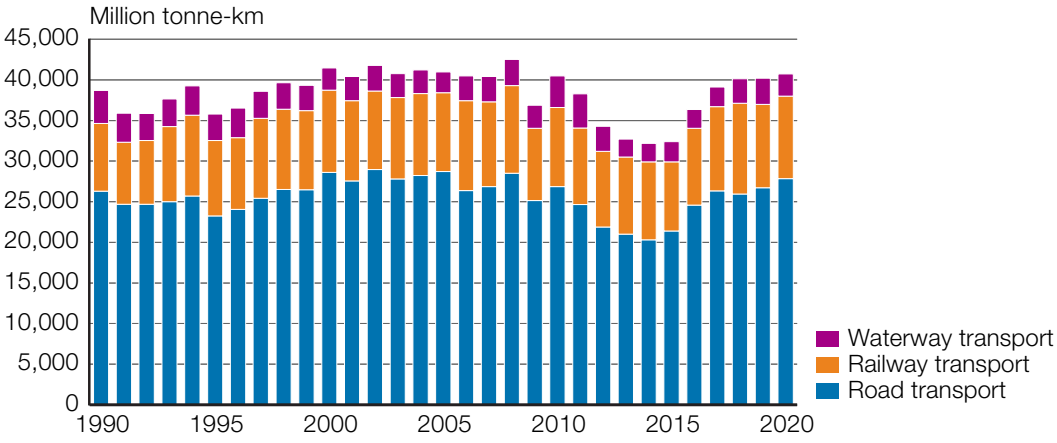
Sources: Statistics Finland and the Finnish Transport and Communications Agency Traficom

2.7.2 Freight transport

The number of freight tonne-kilometres in inland Finland per capita in 2020 was about 1.4 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 2.14). More than 66 per cent of all freight is transported by road, while rail transport accounts for 26 per cent of all transport, and inland waterways for just under eight per cent. The volume of domestic air freight has declined sharply during the 21st century, and air transport's share in domestic goods transport is almost negligible.

Figure 2.14
Tonne-kilometres in domestic goods transport, 1990 to 2020



Source: Statistics Finland

Almost 92 per cent of overseas freight travels by sea, while approximately six per cent travels by road. Air freight is almost negligible in terms of tonnes, whereas in terms of value, it accounts for more than nine per cent of all transport. Products with a high added value, such as electronics, are transported by air.

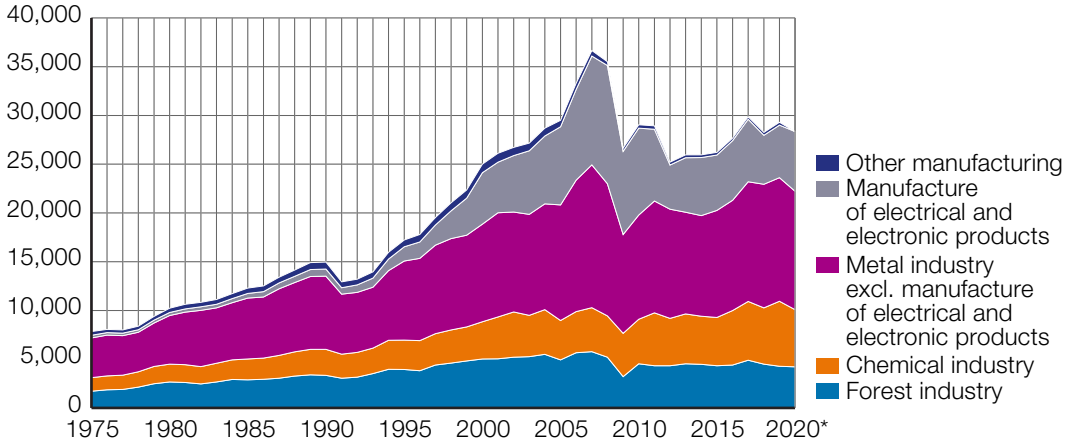
2.8 Industry

The main manufacturing industries include metal, chemical and forest industries. The rapid expansion of the metal products industry, especially electronics, has changed the traditional industrial structure starting from the mid-1990s (Figure 2.15). The share of electrical and electronic products of the total output of the metal industry has grown considerably from nine per cent in 1990 to 30 per cent in 2020. The increase in the technology intensity of the country's manufacturing sector has been strong.

The value of the output of industry was around 84 billion in 2020, the first year of the Covid-19 pandemic, whereas it was 77 billion in 2015. The value fell by 9.7 per cent from the previous year, which is notably more than what the average year to year fluctuation, two per cent, has been during the last decade.

In 2020, the metal industry accounted for 45 per cent in total value of sold output of manufacturing industries. The chemical industry accounted for 19 per cent, the forest industry 17 per cent, and the food industry 11 per cent. Proportional contribution of the industries has not undergone notable changes in the past decade. Total industry accounted for 20 per cent of the GDP in 2020 (25 per cent in 1990).

Figure 2.15
Output of manufacturing industries by sector, 1975 to 2020 (at 2015 prices)



* Preliminary data

Source: Statistics Finland, Annual national accounts

The value of sold industrial output of the metal industry, has grown over six per cent from 2015 to 2020. The Covid-19 pandemic affecting, the value of the metal industrial output diminished by six per cent in 2020. The annual change in volume of the metal industry from 2019 to 2020 however was 3.8 per cent, and especially the volume of manufacturing electronic products grew clearly generating an almost seven per cent change in the value of sold industrial output 2020.

The value of the sold output of the chemical industry has grown 22 per cent from 2015 to 2020. In 2020, the Covid-19 pandemic had a particular effect on the value of the output of the chemical industry, which contracted over twenty per cent.

The value added produced by forestry and the forest industries, one of Finland's traditional industrial sectors, diminished by 10 per cent to 7.7 billion in 2020, comprising 3.8 per cent of the total value added of the national economy. 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 2020. In general, the trend in industrial output at constant prices is fairly similar to that of the GDP. In the chemical industry, especially in oil refining, the production of renewable fuels is growing.

In 2020 a total of 45 mines and quarries were operating in Finland. The yearly volume of mining has increased from around 30 million tonnes in 2001, to 115 million tonnes in 2020. The increase is mainly caused by few open pit operations. From 2015 to 2020, mining and quarrying products have accounted for a small, one to two per cent portion of the total sold output of total industry.

In 2020, Finnish industry used 38 per cent of the country's total primary energy and 45 per cent of its total electricity (Figure 2.12). In 2020 the most significant energy sources of the final energy consumption by the industrial sector were biomass (40 per cent), purchased electricity (21 per cent), purchased heat (10 per cent), and oil (10 per cent). Over the last ten years the share of biomass as an energy source has risen significantly, while the share of oil and heat have decreased (Figure 2.16).

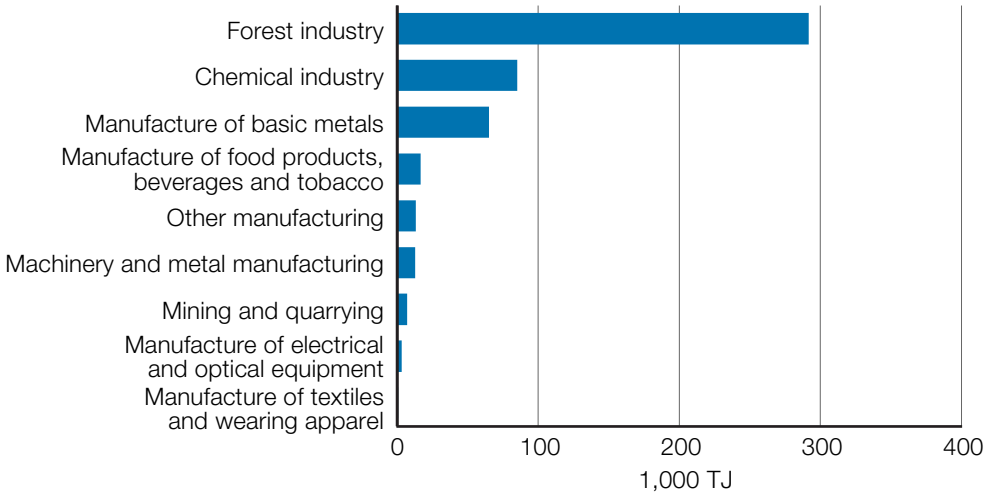
Figure 2.16
Energy use in manufacturing by source in 2010 and 2020

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

Source: Statistics Finland, Energy use in manufacturing

The forest industry uses more energy than any other industrial sub-sector (59 per cent), followed by the chemical industry (17 per cent) and the manufacturing of basic metals (13 per cent) (Figure 2.17). 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.

Figure 2.17
Energy use in manufacturing by industry in 2020



Source: Statistics Finland, Energy use in manufacturing

Because of their high energy demand, energy-intensive industries have worked hard to improve their energy efficiency. For example, between 1990 and 2020 industrial output increased by over 58 per cent (measured in terms of value added in 2015 prices), while the final consumption of energy rose by only about 17 per cent. In other word, the overall intensity fell by a quarter. 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 (bark,

sawdust, 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, in their search for higher profit margins, industrial installations have increasingly outsourced their electricity generation to the open electricity market.

2.9 Building stock

Finland's largest cities are in the southern and western parts of the country, and the size of settlements tends to decrease towards the northern and eastern parts of the country. Outside the relatively few larger towns and cities, Finland is a land of small towns and rural communities. Most of the economically important cities are on river estuaries along the coast or inland at the intersections of the various lake systems.

In 2020, the total heated building area amounted to 505 million m^2. Residential buildings accounted for 63 per cent of the area, while office, commercial, public and industrial buildings made up 36 per cent of the area. The remainder consisted of free-time residences, agricultural buildings and other small outbuildings. There were a total of 3,157,671 dwellings, of which 38 per cent were one-dwelling and two-dwelling houses, 13 per cent terraced houses, 47 per cent dwellings in blocks of flats and two per cent other buildings in 2020.

The number of dwellings increased by 42 per cent between 1990 and 2020. In addition to this increase in the number, there has previously also been a gradual increase in the average size of dwellings. In 1990, the average residential floor space per dwelling was 74 m^2; by 2015, it had increased by six square meters to 80 m^2. From 2015 to 2020, the average residential floor space per dwelling remained nearly the same. The figure for residential floor space per person grew by more than the figure per dwelling. In 1970, the residential floor space per person was 19 m^2; by 1990, it had increased to 31 m^2. By 2020, it had increased to 41 m^2. On average, Finns spent 25 per cent of their disposable income on housing in 2020, including energy costs. There have been no radical changes in the share of income spent on housing in recent decades.

The building stock is fairly new, with more than 50 per cent of all buildings having been constructed since 1970. More than 98 per cent of dwellings have flush toilets, and more than 99 per cent have a sewer and running water. In 2020, a total of 35,800 new dwellings was completed.

2.9.1 Energy use for indoor heating

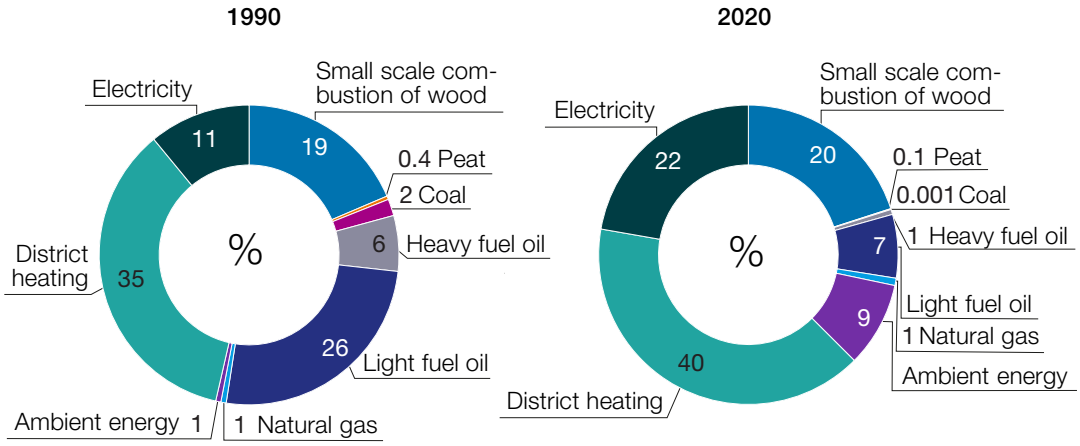
Because of the country's northern location, a great deal of energy is used for indoor heating in Finland. The total area of heated buildings increased by some 50 per cent between 1995 and 2020. The heating of indoor spaces consumes

roughly 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 (see also Section 3.2.1).

The composition of energy sources used for heating changed significantly between 1990 and 2020 (Figure 2.18). As the share of district heating in the heating of indoor spaces has increased with an increase in the use of electricity in heating, there has been a shift in heating-related greenhouse gas emissions from the accounting under the EU Effort Sharing Decision to the EU Emissions Trading System. The use of heavy fuel oil has decreased by 90 per cent and the use of light fuel oil by 60 per cent. At the same time, energy obtained from natural gas has increased 40 per cent. Light fuel oil has lost some of its market share to electric heating and later also to heat pumps in detached houses.

The use of electricity in heating has doubled (Figure 2.18). In addition to electric heaters, this category contains the electricity used by heat pumps, as well as secondary electric heating. Heating with heat pumps has become more common. The share of heating energy produced by heat pumps was only one per cent in 1990, but in 2020, their share was nine per cent. 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 has increased by 31 per cent since 1990. It is often used as a secondary heating system, but it is also used as the principal heating source in rural areas.

Figure 2.18
Energy sources for heating residential, commercial, and public buildings in 1990 and 2020



Source: Statistics Finland, Energy Statistics

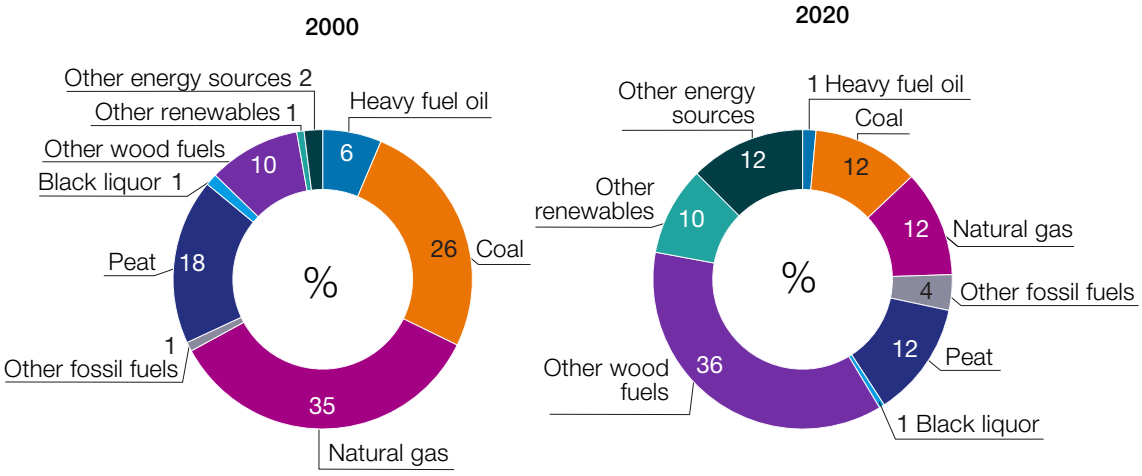
District heating has also increased considerably, by 39 per cent. The district heating network now covers most areas with a cost-effective potential. The share of district heating was 40 per cent of the total heating energy in 2020. District heating is the primary heating system in blocks of flats, and half the country's total building stock relies on it. A wide range of fuels is used to produce district heat (Figure 2.19). Shares of coal and oil in the production of

district heat have decreased in recent decades. Peat, an indigenous fuel, is used especially in inland areas.

Combined heat and power (CHP) accounts for more than 65 per cent of the total heat produced in district heating, i.e. practically all the potential for CHP has been exploited. CHP improves efficiency, especially compared with separate condensing power production. CHP is also an efficient way to decrease CO_2 emissions from energy production.

The share of renewable energy sources in the production of district heating has increased considerably (Figure 2.19). Government and industry efforts have helped increase the use of wood fuels, mostly in the form of by-products from forestry and the forest industry, such as chips made of harvesting residues and black liquor.

Figure 2.19
Fuels in district heating production in 2000 and 2020



Source: Statistic Finland, Energy Statics

In recent decades, demand for heating energy has decreased. According to the Finnish Meteorological Institute, winters especially have become generally milder. The figure for heating degree days (HDD) is a quantitative index, designed to reflect the demand for the amount of energy needed to heat a building; it is calculated using a 17 °C indoor temperature as the base. The HDD has decreased from a 5-year average of 4,700 in Helsinki, in southern Finland, to 3,200 per year from 1981 to 2020. In Oulu, in northern Finland, the corresponding decrease was 5,900 to 4,200.

In addition, energy conservation in heating has been aided considerably 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.

2.9.2 Urban structure

The regional development in Finland has been characterised by increasing differences between regions. Population growth and new jobs have concentrated mainly on a few big growing urban regions, principally Helsinki, Tampere, Turku, Oulu, Jyväskylä and Kuopio. Growth has occurred due to migration, immigration, and large shares of young fertile age groups. Most middle-sized and small urban centres have either kept the number of population or have been suffering from population decline since 2010. In the rural areas close to the urban areas population grew in the beginning of the 2000's but has turned to decline since. Population decline has also worsened in the rural heartland areas from 2000 to 2020. In sparsely populated rural areas population has declined approximately 1.5 per cent per year for a long time.

Urbanization has accelerated in Finland since 2000. Share of population living in the urban regions has increased from 64 per cent in 2000 to 73 per cent in 2020 and share of workplaces in the urban regions from 73 per cent to 80 per cent. Pre-pandemic population and workplace growth centered to fewer urban regions than previously. The Covid-19 pandemic resulted in a period of more balanced regional growth when several municipalities that previously suffered net migration loss, gained positive net migration for the first time in a long time. Population projections estimate the population to peak in Finland in 2030's due to ageing population, low fertility, and relatively low immigration level. In the future, urbanization continues but slows down. Population growth will concentrate on the four biggest urban regions.

Finland became urbanized relatively late, and the urbanisation process is still continuing. The share of the population in densely built-up areas (urban areas and rural localities) has risen continuously, and these areas accounted for 87 per cent of the population in 2021. 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 km^2 in 2021. Density has declined by 70 inhabitants per km^2 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. The percentage has declined until 2011 but increased after that by 1.4 per cent. Approximately 72 per cent of the inhabitants of urban areas live in pedestrian or transit zones, and 28 per cent in car-dependent zones in 2020. Compared with the other Nordic and European countries, the population density of these built-up areas is still quite low. It is less than half the population density of comparable areas in Sweden or Norway.

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. Urban areas have

typically expanded inexorably outwards, leading to the creation of unstructured, low-density built-up areas. These low-density districts of built-up areas outside the urban plan cover 35 per cent of the land surface of the country's urban areas — even in the main growth centers. Low-density development causes problems in terms of arranging services, maintaining infrastructure and planning urban form. Many of the households in these areas need more than one car to manage their daily lives (commuting, school trips, acquiring services, and engaging in free-time activities). Despite the expansion of low-density areas, the share of population living in low-density areas and scattered settlements within urban regions has declined by 2.6 per cent since 2000.

Figure 2.20a
Share of commuting directed towards urban areas, 2000

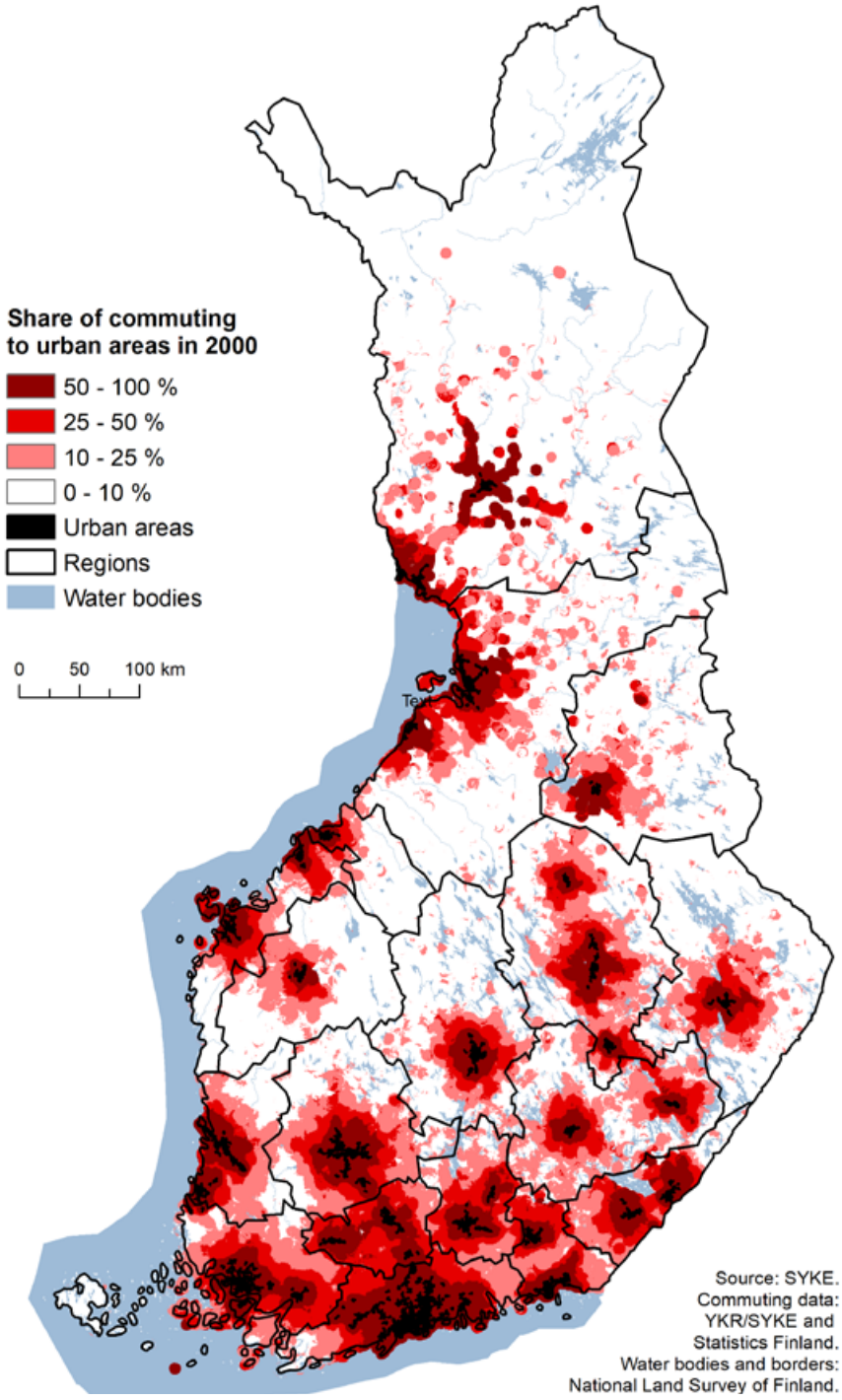
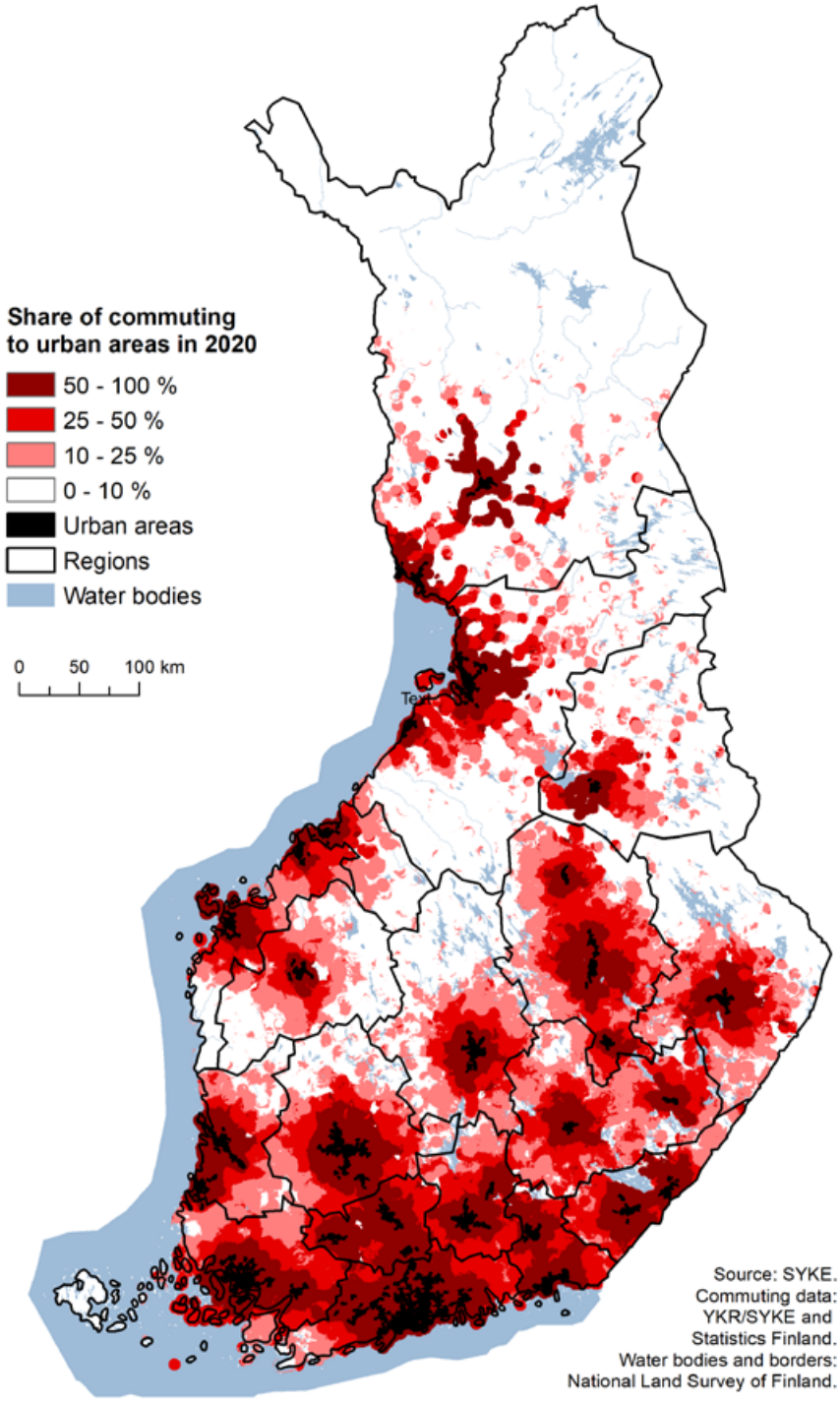


Figure 2.20b
Share of commuting directed towards urban areas, 2020

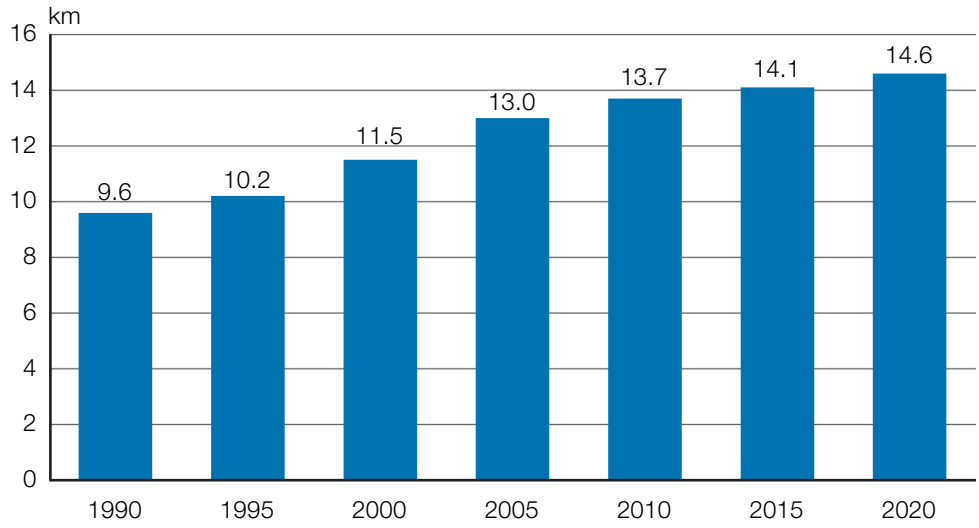


The average amount of kilometers travelled daily has increased due to the sprawl of residential areas, but also because of increased commuting distances and service-related mobility. Particularly retail trade has concentrated into bigger units, which are partly located on the fringe of urban areas.

The improvement of transport infrastructure has enabled people to travel longer trips to work than before. Commuting areas of cities have expanded significantly. This development can be seen in Figures 2.20a and 2.20b, which show the development in commuting to urban areas from 2000 to 2020.

The average distance to work has risen only moderately from 1990 to 2020 (Figure 2.21). The opportunities to use sustainable means of transport in commuting depend on the commuting distance and the location of both the home and the workplace in relation to public transport services. There are big differences between urban areas in the availability of sustainable options in commuting trips. The share of commuting trips, where sustainable means of transport are available, ranges between 46 and 80 in urban areas of urban regions. In most regions, the share declined until 2018 and a small increase has taken place since.

Figure 2.21
Average daily commuting distance, 1990 to 2020



Source: Statistics Finland

2.10 Agriculture

Farming in Finland is possible as a result 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. As Finland is nearly 1,100 kilometres long from north to south, there are considerable regional variations in the climate. Rainfall in the growing period is 370 mm on average in southern Finland and 260 mm on average in northern Finland. The thermal growing season (the period with an average daily temperature of more than +5 °C) varies from six months in the south to four months in the north. The growing season in Finland is too short for many cultivars grown elsewhere, and frost-resistant varieties have therefore been developed. Because of the short growing season, the yield levels of 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.

Climatic conditions are a decisive factor affecting the feasibility of crop production. Cultivation of wheat and oilseed plants is restricted 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.

Finnish agriculture is based on family farms. In 2020, private persons owned 86 per cent of farms, while heirs and family companies owned 11 per cent of farms and other companies and entities about three per cent of farms.

Between 1990 and 2020, the number of active farms fell from 130,000 to 45,600. At the same time, the average utilised agricultural area increased from 17 to 50 hectares. The total cultivated area has remained at almost the same level since 1990, but the shares of cultivated crops have varied somewhat over the years. The main change has been a shift from annual to perennial crops – mainly by decreasing the area cultivated for cereals by approximately 1.7 km^2, while the cultivation area of fodder grasses has increased by approximately 1 km^2 in three decades. The share of grassland crops was 38 per cent of the cultivated area, while the share of barley was 22 per cent, oats 17 per cent and wheat 10 per cent in 2020. In 2020, the utilised agricultural area was 22,700 km^2. Structural changes in agriculture among other factors have also led to a reduction in greenhouse gas emissions from the agriculture sector (see Section 3.2.3).

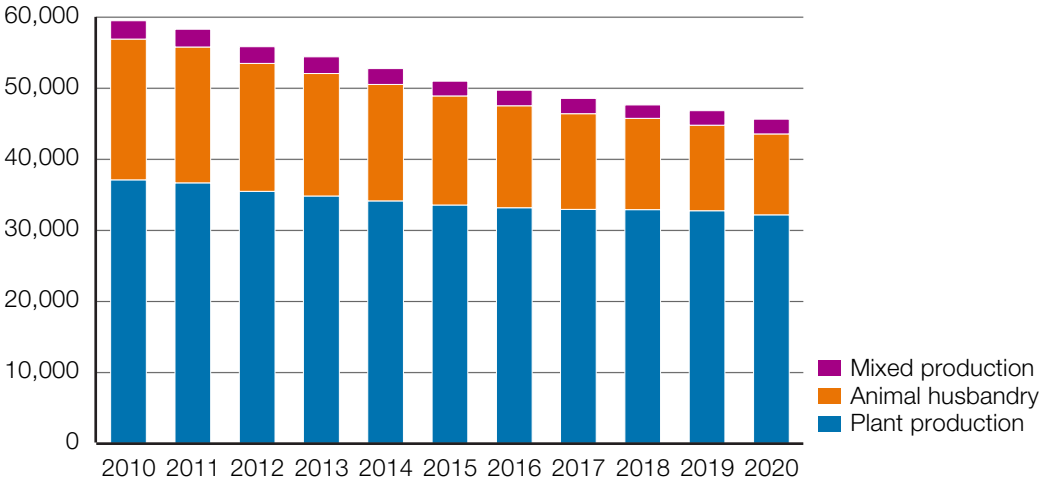
Nearly 70 per cent of active farms practise crop production as their main line of farming, and only 25 per cent have livestock as their main line of farming (Figure 2.22). Livestock production has undergone a structural change. Compared to 1990, beef production has decreased; poultry production has increased its relative share. The number of dairy cows decreased in this period from 490,000 to 260,000. Dairy production is the main production line of animal husbandry, with 12 per cent of all farms having it as their main line of farming. Approximately seven per cent of farms have beef production or combined dairy and beef production as the main production line. Approximately one per cent of farms specialise in pig husbandry, and one per cent in poultry husbandry. The share of other production lines (sheep, goat and horse husbandry) is approximately four per cent. The remaining four per cent of farms have mixed production, i.e. they have no dominant product. About eleven per cent of all farms are organic.

In 2020, agriculture, forestry, hunting and fishing together accounted for 2.8 per cent of Finland's gross domestic product (GDP). The economic significance of the total food chain is much greater than this percentage alone indicates. Transport and processing increase the role of food materials in the national economy considerably. Agriculture is 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

the environment, climate and animal welfare into account. An important aim of the CAP is also to promote the vitality of rural areas.

Figure 2.22
Number of farms by production sector, 2010 to 2020



Source: Natural Resources Institute Finland

2.11 Forestry

According to the national classification, forestry land covers 26 million hectares, or 77 per cent of the total area, including inland waters, in 2020. Land classified as forestry land consists of the subcategories of forest land, poorly productive land and unproductive land. Of the total forestry land area, 22.6 million hectares are classified as productive or poorly productive forest land according to the national definition, which is based on annual tree growth. The area of forest land according to the national greenhouse gas inventory is 21.8 million hectares, because the inventory uses a definition based on FAO's definition.

Within the EU, the significance of forests for the national economy and society at large is greatest in Finland. The forest sector contribution has been two to five per cent of Gross Domestic Product and some 20 per cent of the export of goods (18 per cent in 2020).

Approximately twenty indigenous tree species grow in Finland. The most common are the Scots pine (Pinus silvestris), Norway spruce (Picea abies) and silver and pubescent birches (Betula pendula and B. pubescens). Usually, two or three tree species dominate a forest stand. More than one half the forest land area consists of mixed stands.

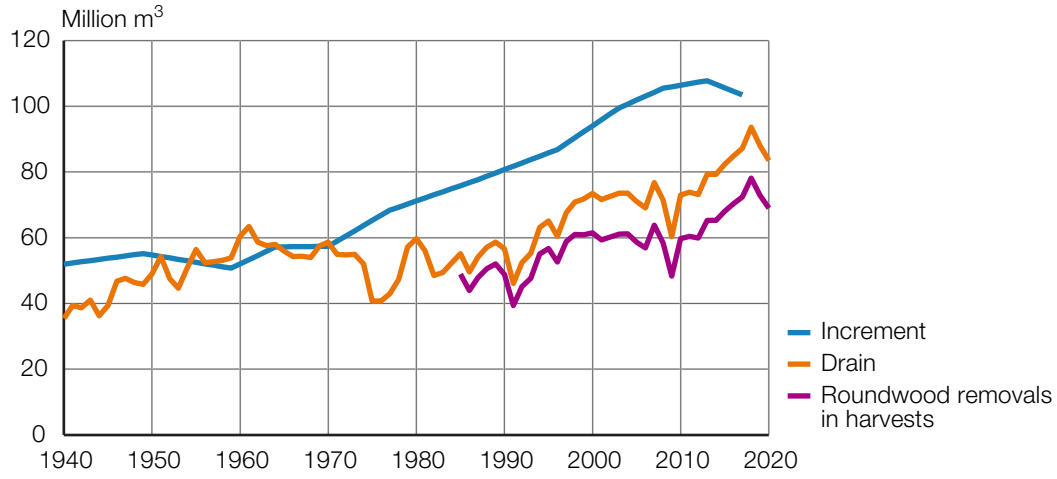
Sustainable forest management is the basis of Finland's forest policy. The aim is to ensure welfare founded on the use of forests and the diversity of forest nature. Policy measures include the Forest Act and other legislation, Finland's

National Forest Strategy 2025 (2014), financing and public forestry extension organisations (see Section 4.3.5: National forest legislation and programmes).

Finnish forests are managed sustainably. About a fifth of forests are regenerated naturally, while the rest are generated artificially using indigenous tree species with local provenance. According to the Forest Act, measures for the establishment of a new seedling stand must be completed within three years of the end of felling. Natural regeneration is based on seeding from trees already growing on the site, usually by leaving a number of seed trees standing at the time of felling. In forest cultivation with seedlings and seeds, a new stand is established on a clear-felled area, which accounts for approximately 100,000 hectares annually. Every year, 150 million seedlings are planted in forests.

The total volume of Finland's forest stock amounts to 2,506 million m^3 according to the results of the ongoing 13th 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 2.23).

Figure 2.23
Total roundwood removals in harvests, annual increment and drain of growing stock 1940 to 2020



Source: Natural Resources Institute Finland

In 2020, the total drain was 83.5 million m^3, while the total increment of the growing stock was 103.5 million m^3. The total drain includes cutting removals, harvesting losses and natural mortality. Of the total area undergoing felling annually, thinning accounts for roughly three quarters, while other cutting, e.g. clear felling and seed and shelter wood felling, accounts for the rest.

The growing stock has increased by 65 per cent in the last 40 years. Pine has contributed most to the increase due to the large number of rapid growth young stands. The draining of mires in the 1960s and 1970s has also improved the growing conditions for trees in peatlands. This has also added to the increase in the growing stock.

More than 50 per cent of Finland's forests are owned by private individuals, 35 per cent by the state, about seven per cent by private companies and the rest by other owners (in 2020). The average size of a forest holding owned by private individuals is small, approximately 30.5 hectares, averaged over holdings with a minimum size of two hectares. About 11 per cent of Finns are forest owners, i.e. 620,000 Finns with 344,000 forest holdings of at least two hectares of forest land in 2016. Forest management associations provide forest owners with advisory services in forest management and felling.

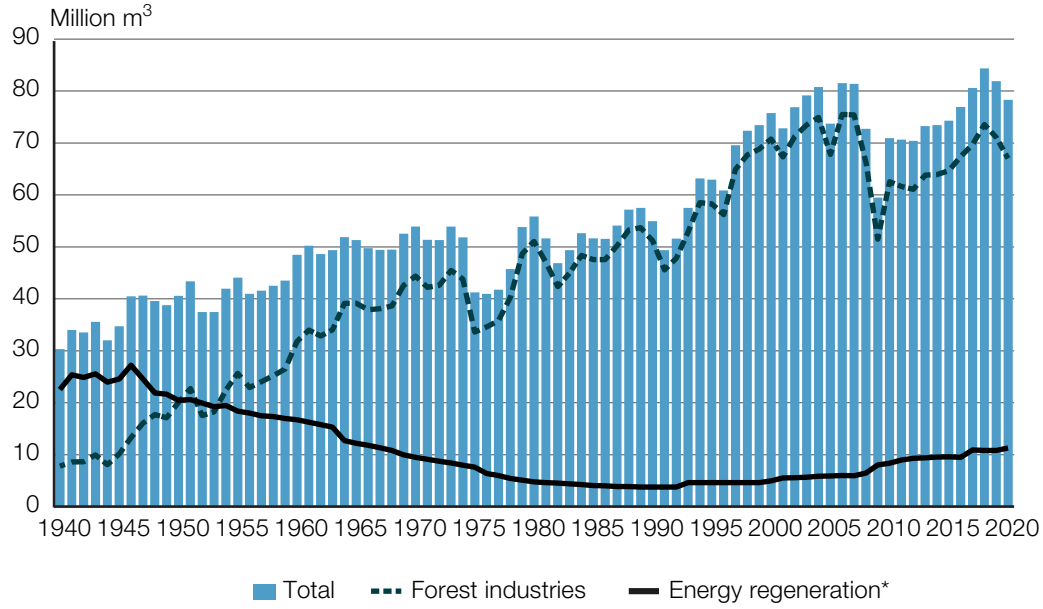
Earnings for wood production of non-industrial private forestry owners, organisations and companies whose primary line of business was other than wood production, averaged EUR 1.9 billion calculated as annual stumpage earnings. Investments in wood production, i.e. costs from silvicultural practices such as forest regeneration and young stand management, represent 77 per cent of the total average annual costs of EUR 280 million between 2015 and 2020. Some three quarters of the costs of silvicultural practices are financed by the owners, and the rest is covered by state subsidies. Some 90 per cent of Finland's forests are certified according to the national Programme for the Endorsement of Forest Certification (PEFC) standard or Forest Stewardship Council standard.

In 2020, the total use of round wood (raw, unmanufactured timber) in Finland was 78.3 million m^3. The great majority, that is, 86 per cent (67.1 million m^3), was used in the forest industry, and 11.3 million m^3 was used for energy production (Figure 2.24).

Forests (trees and soil) absorb a significant proportion of Finland's carbon dioxide (CO_2) emissions. Fluctuating trends in forestry activity have caused considerable variation in net removals from forest land (see Section 3.2.4). The forest land sink varied between 14.6 (in 2018) and 47.2 (in 2009) million tonnes CO_2 eq. during the period between 1990 and 2020, equalling 26 and 70 per cent of Finland's total emissions without the LULUCF sector for the years in question.

In recent decades, forest protection and biodiversity in managed forests have received special attention. Numerous protection programmes and decisions have contributed to a threefold increase in the area of protected forests over the last 30 years.

Figure 2.24
Total roundwood consumption 1940 to 2020



* 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

Thirteen per cent of the forest area (productive and poorly productive forest land), or 2.9 million hectares, is protected or in restricted forestry use. Most of this, 2.3 million hectares, is in northern Finland, where the protected areas together account for 20 per cent of the forest area. In southern Finland, the protected area is approximately 0.6 million hectares, which is five per cent of the forest area. Some 75 per cent (2.2 million hectares) of the areas that are protected or in restricted forestry use are completely excluded from felling, i.e. under strict conservation.

The National Forest Strategy 2025 and national policies on nature and biodiversity conservation are mutually supportive and coherent. The Forest Biodiversity Programme for southern Finland from 2008 to 2025 (METSO) targets both private and state-owned land. It combines the protection and commercial use of forests. The funding used for the programme was approximately EUR 120.8 million between 2019 and 2021. A new tool for halting loss of biodiversity in Finland is the Helmi programme (2021 to 2030). The main objective of the Helmi programme is to take a comprehensive view of habitats and the necessary restoration and management measures. Actions are carried out both within and outside protected areas. The participation of landowners is voluntary.

2.12 Waste

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.

Almost 116 million tonnes of waste was generated in Finland in 2020, which was nearly the same amount of waste as in the previous year. The largest quantities of waste came from mining and quarrying and construction and manufacturing, and they were primarily of mineral origin. The amount of mineral waste was nearly 105 million tonnes, or 90 per cent of all waste. The amount of wood waste was 3 million tonnes.

The rest of the waste in the total waste figure is mixed waste, which comprises the solid municipal waste generated by households and services. The amount of solid municipal waste generated in Finland in 2020 was 3.3 million tonnes. Though accounting for only 2.7 per cent of the country's total waste, this solid municipal waste is responsible for most of the greenhouse gas emissions from the waste sector (see also Section 3.2.6). The quantity of municipal waste has been between 2.4 and 3.3 million tonnes per year in Finland since 2000. Total municipal waste generation was 596 kg per capita in Finland 2020, slightly more than the EU average of 505 kg.

The manufacturing industry generated more than 9 million tonnes of waste in 2020. The largest quantities of manufacturing waste were waste wood, mineral waste from the basic metal industry and the chemical industry. In 2020, the waste recovery rate was more than 95 per cent, i.e. 113 million tonnes of waste was recovered; altogether, 11.7 million tonnes of waste was recovered as material and 6.2 million tonnes as energy. The latter figure comprises nearly half of wood waste (almost 2.7 million tonnes). Wood waste was especially comprehensively recovered as material in addition to the high energy recovery rate.

Table 2.3
Waste generation by source and waste category in 2020

2020	Chemical waste	Wood waste	Mineral waste	Other waste[1]	Total
	Amount of waste, 1,000 tonnes				
Mining and quarrying	0	0	87,194	0	87,194
Electricity, gas, steam, and air-conditioning supply	3	1	848	105	957
Water supply; sewerage, waste management and remediation activities	44	16	241	826	1,127
Construction	0	273	12,453	963	13,689
Manufacturing	369	2,743	4,182	2,211	9,505
Households and services	42	103	1	3,376	3,522
Total	**458**	**3,135**	**104,919**	**7,483**	**115,995**

1 Metallic waste, paper and cardboad, animal and vetegal waste, household and mixed waste, sludges, other waste

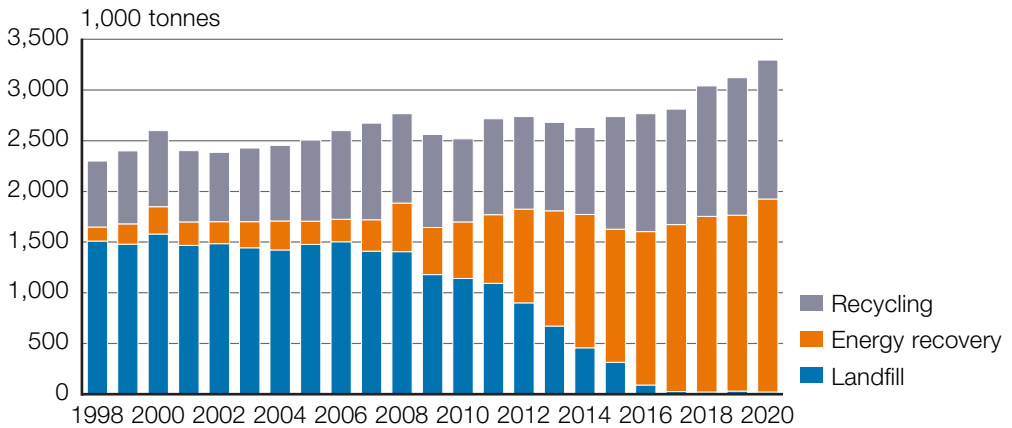
Source: Statistics Finland

In 2020, more than 95 per cent of all municipal waste was recovered as material (41 per cent) or energy (58 per cent) (Figure 2.25). Biowaste recycling doubled from 2006 to 2015, mainly due to improved sorting and the separate collection of municipal waste and the extension of treatment to anaerobic digestion. The amount of separately collected biodegradable waste has increased slightly every year since 2015. In 2020, 494 tonnes of biodegradable waste was collected, six per cent more than in 2019. According to the Finnish Forest Industries Federation, almost 94 per cent of all paper waste (e.g. newspapers, printed paper and cardboard) consumed in Finland in 2020 was recovered; the European-wide paper recycling rate in 2020 was about 74 per cent.

At the end of the 1990s, almost 65 per cent of all municipal waste was disposed of in landfills. The proportion of municipal 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 waste disposed of in landfills was 62 per cent, and in 2015, it amounted to 11 per cent, or 315 thousand tonnes. Due to the landfill prohibition of organic waste that came into force in 2016, biodegradable municipal waste has no longer been deposited at landfills. The share of landfill disposal of municipal waste in 2020 was about 20 thousand tonnes, or less than one per cent of the total amount of municipal waste.

The share of waste incineration has increased considerably in the last two decades. Initially, in the early 1990s, the focus of waste policy was on waste prevention and recycling. Waste incineration has started to become more important in municipal waste management, and there have been many investments in waste incineration plants since 2006. The amount of incinerated municipal waste has more than doubled since 2010. In 2020, a total of nine waste incineration plants were in operation. In 2015, 48 per cent of the total amount of municipal waste was incinerated, and in 2020, approximately 56 per cent of municipal waste was incinerated. All waste incineration plants produce heat and electricity for municipalities and industry.

Figure 2.25
Municipal solid waste treatment in Finland, 1998 to 2020



Source: Statistics Finland

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