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EXECUTIVE SUMMARY

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1 EXECUTIVE SUMMARY

1.1 National circumstances relevant to greenhouse gas emissions and removals

The population of Finland was 5.5 million at the end of 2015, and according to projections, it will increase to 6.0 million by 2060. The average population density is 18 inhabitants per km². As a result of the low population density and the geographical extent of the country, the average distances travelled for different purposes can be quite long.

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 km², it is Europe's seventh largest country.

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 9 per cent is farmed. Finland has more than 34,300 km² of inland water systems, which represents approximately 10 per cent of its total area. There are some 190,000 lakes and 180,000 islands.

The climate of Finland displays features of both maritime and continental climates, depending on the direction of air flow. Considering its northern location, the mean temperature in Finland is several degrees higher than in most other areas at these latitudes. The temperature is higher due to the Baltic Sea, because of the inland waters and, above all, as a result of air flows from the Atlantic Ocean, which are warmed by the Gulf Stream. The mean annual temperature is approximately 5.5°C in south-western Finland and decreases towards the northeast. The average annual temperature has increased during the last 150 years by slightly more than one degree.

Finland has an open economy with prominent service and manufacturing sectors. The main manufacturing industries include metal, chemical and forest industries. Foreign trade is important, with exports accounting for about 40 per cent of the gross domestic product (GDP).

In 2015, the total energy consumption was 1,301 PJ. Finnish industry used 45 per cent of the country's final energy consumption and 47 per cent of its electricity in 2015. For decades, the use of primary energy as well as electricity has been increasing, and they reached their top values in the years 2006-2007. Demand rose more rapidly than GDP until 1994. Since then, parallel with the structural changes in the economy, both the energy intensity and the electricity intensity of the economy have decreased.

The use of fossil fuels and peat in energy production causes considerable carbon dioxide (CO₂) emissions. Nevertheless, CO₂ emissions per total primary energy unit are lower than in many other European countries. This is due to the quite high share of non-fossil energy sources in power and heat production, i.e. hydro, nuclear and biomass sources.

The emissions trading scheme (ETS) of the European Union (EU) has become a significant factor in the energy market. In Finland, the number of installations needing an emissions permit under the EU ETS scheme is around 600.

Domestic passenger transport, measured in terms of passenger-kilometres, has increased by approximately 24 per cent since 1990. Cars account for around 83 per cent of the total passenger-kilometres. The total number of freight tonne-kilometres in Finland is almost double the EU average, mainly because of the long distances and the industrial structure.

Indoor heating is the biggest source of CO₂ emissions by households and also within the public and service sectors. However, during the past three decades the consumption of energy per unit of heated space has been reduced significantly, in particular due to tightening building regulations.

Forests (trees and soil) absorb a significant proportion of the carbon dioxide (CO₂) emissions. The forest sink varied between 19.3 and 51.3 million tonnes CO₂ equivalent (CO₂ eq.) during the years 1990–2015, which represents 25–75 per cent of Finland's total emissions. The proportion has varied considerably due to fluctuating trends in emissions and forestry activity.

1.2 Greenhouse gas inventory information, including information on the national system and the national registry

Finland's greenhouse gas emissions in 2015 totalled 55.6 million tonnes CO₂ eq., excluding land use, land-use change and forestry (LULUCF). The total emissions in 2015 were approximately 22 per cent (15.7 million tonnes) below the level for the 1990 emissions. Compared to 2014, the emissions decreased by six per cent (Table 1.1).

The most significant greenhouse gas in Finland's inventory is CO₂. Its share of the total emissions ranged between 80 and 85 per cent for the years 1990–2015. CO₂ emissions have decreased by 12.7 million tonnes since 1990. Methane (CH₄) emissions have gone down by 37 per cent from the 1990 level, whereas nitrous oxide (N₂O) emissions have decreased by 27 per cent. In 2015, the F-gas emissions (HFCs, PFCs and SF₆) were nearly 35 times higher than the emissions for 1995 (the base year for F-gas emissions¹).

Similar to other industrialised countries, Finland's largest source of greenhouse gas emissions is the energy sector. The cold climate, long distances and energy-intensive industries all contribute to the high emissions volumes of the energy sector. In 2015, the energy sector's share (including transport) of the total greenhouse gas emissions was 73 per cent (40.8 million tonnes CO₂ eq.). The emissions show strong annual variation in accordance with the amount of energy used and the proportion of imported electricity. The emissions from the energy sector are strongly affected by the availability of hydro power in the Nordic electricity market. If the annual precipitation in the Nordic countries is lower than normal, hydro power becomes scarce and Finland's net imports of electricity decrease.

Greenhouse gas emissions generated by transport amounted to 11.1 million tonnes CO₂ eq. in 2015 (20 per cent of total greenhouse gas emissions). Road transport accounted for 94 per cent of the total domestic transport emissions. The emission level in the transport sector has fluctuated between 11 to 13 million tonnes CO₂ eq. during 1990–2015 being 8 per cent lower in 2015 than in 1990.

¹ The base year for F-gas emissions is 1995 under the Kyoto Protocol

The greenhouse gas emissions generated by industrial processes amounted to roughly 6.1 million tonnes CO₂ eq. in 2015 (11 per cent). Emissions from the agricultural sector were some 6.5 million tonnes CO₂ eq. (12 per cent). Waste sector emissions amounted to 2.1 million tonnes CO₂ eq. in 2015 (4 per cent). The LULUCF sector acted as a greenhouse gas sink of 26.0 million tonnes CO₂ eq. in 2015.

Table 1.1
Greenhouse gas emissions (+) and removals (–) by sector, 1990, 1995, 2000 and 2005–2015 (million tonnes CO₂ eq.)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy	53.6	55.3	53.8	53.7	64.8	62.8	54.5	52.6	60.2	52.7	47.5	48.3	44.4	40.8
Indirect CO ₂ -emissions	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Industrial processes and product use	5.4	4.9	5.8	6.5	6.5	7.1	7.5	5.7	6.3	6.0	6.0	6.0	5.9	6.1
Agriculture	7.5	6.8	6.5	6.5	6.4	6.4	6.5	6.5	6.6	6.4	6.4	6.5	6.5	6.5
Waste	4.7	4.6	3.9	2.8	2.9	2.8	2.7	2.6	2.6	2.5	2.4	2.3	2.2	2.1
Total (without LULUCF)	71.3	71.8	70	69.6	80.8	79.2	71.2	67.4	75.7	67.7	62.4	63.2	59.1	55.6
Land use, land-use change and forestry ¹	-12.7	-12.4	-21.7	-27.1	-33.4	-25.8	-24.7	-38.0	-27.3	-28.7	-32.3	-26.3	-28.3	-26.0

¹ LULUCF, a negative figure denotes a net sink, which means that in this sector more greenhouse gases are absorbed from the atmosphere than are released into it.

Greenhouse gas inventory system

Statistics Finland is the national entity with the overall responsibility for compiling and finalising inventory reports and submitting them to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) and the European Commission. It bears the responsibility for the general administration and quality management of the inventory and for communicating with the UNFCCC, for coordinating participation in the inventory review and for publishing and archiving the inventory results.

The legal basis of Finland's national system under the Kyoto Protocol is defined by the resolution of the Finnish Government of 30 January 2003 on the organisation of climate policy activities by government authorities. The legal framework of the national system is further defined by an agreement between the Ministry of the Environment and Statistics Finland on operating the national system for estimating greenhouse gas emissions under the Kyoto Protocol and on the reporting requirements under the UNFCCC; it is also defined by the regulations concerning Statistics Finland (the Statistics Finland Act (48/1992) and the Statistics Act (280/2004)). Various expert organisations acting as parties to the inventory system are responsible for the inventory data of the different reporting sectors.

The UNFCCC, the Kyoto Protocol and the EU greenhouse gas monitoring mechanism all require Finland to annually submit a National Inventory Report (NIR) and Common Reporting Format (CRF) tables. The annual submission contains emission estimates for the year prior to the previous year. The methodologies, activity data collection and choice of emission factors are consistent with the guidance in the 2006 IPCC Guidelines and the IPCC 2013 Supplementary methods and Good Practice guidance arising from the Kyoto Protocol. The quality requirements set for the annual inventories — transparency, consistency, comparability, completeness, accuracy and timeliness — are fulfilled by implementing consistently the QA/QC plan and procedures.

National registry

The EU Emissions Trading Scheme (EU ETS) began in January 2005 and is mandatory for specific industries in the EU with emissions above a certain threshold. The EU ETS and wider international emissions trading under the Kyoto Protocol have operated paral-

led to one another since October 2008. Both emissions trading schemes are underpinned by a system of electronically linked national registries, which are intended to keep track of national and international transactions involving EU allowances and Kyoto units.

Every EU Member State has been required to establish a national registry for the EU ETS and for emissions trading under the Kyoto Protocol. National registries must meet the technical and functional specifications issued by the European Commission and the UNFCCC Secretariat.

The Consolidated System of EU registries (Union Registry) was certified on 1 June 2012 and went into production on 20 June 2012. The changes to the national registry, which have occurred since the last National Communication report are summarized in Table 3.4 of the Chapter 3. In Finland, the Energy Authority is the competent authority and the registry administrator for the national emissions trading registry.

1.3 Policies and measures

Policy framework and policy making process

Finland's climate policy is based on international agreements: the UNFCCC, the Kyoto Protocol and the Paris Agreement. The common policies of the European Union, such as the EU 2020 and 2030 Climate and Energy Packages have a key role in the implementation of the international agreements mentioned above. At national level Finland's climate policy is defined in government policies and programmes, and since 2003, strategic work has been steered by ministerial working groups. In addition, national energy and climate strategies have been prepared since 2001 to implement the international and EU commitments as well as national targets, and to define sectoral policies and measures.

The Finnish Government and Parliament make the most important decisions concerning climate policy. Parliament approves Finland's international commitments and decides on their implementation according to the constitution. The Ministry of the Environment bears the administrative responsibility for the climate negotiations. The Ministry of Economic Affairs and Employment coordinates the energy and climate strategy work. Municipal authorities also have a significant role in climate policy and emission reductions, for example due to their responsibilities in land-use and traffic planning, energy efficiency and waste management. The Finnish Climate Change Panel, which was nominated for the first time in 2011, strengthens the interaction between research and policy-making. Other stakeholders, including industrial and environmental non-governmental organisations (NGOs), research institutes and labour unions, can present their views on climate policy at the Ministry of the Environment's Climate Arena.

Finland has fulfilled its commitments under the first commitment period (2008 – 2012) of the Kyoto Protocol. By accepting the Kyoto Protocol's second commitment period (2013 – 2020) in June 2015, the EU, its Member States and Iceland are committed to reducing their greenhouse gas emissions jointly by 20 per cent compared to the base year. The individual emission reduction obligations of the Member States have been defined in the EU Effort Sharing Decision (ESD). The ESD sets individual binding annual emission reduction or limitation targets for the Member States for emissions not covered by the EU Emission Trading Scheme, ETS, (non-ETS emissions) in the period 2013 – 2020. The ESD defines Finland's reduction obligation for the sources not covered by the EU ETS as 16 per cent of the 2005 emissions.

The Finnish national ratification of the Paris Agreement, adopted in December 2015, was completed in November 2016. The Paris Agreement entails several uniform obligations for all Parties. Instead of specific top-down emission reduction commit-

ments, the Agreement is based on nationally determined contributions to mitigate the emissions. The EU's joint nationally determined contribution under the Agreement is to reduce the greenhouse gas emissions with 40 per cent by 2030 from the 1990 level. The details of the effort sharing between the Member States, including Finland, are being negotiated at present.

Finland prepares regularly strategies on energy and climate policy. The latest strategies were completed in 2001, 2005, 2008, 2013 and 2016.

In 2014, a parliamentary committee on energy and climate issues prepared an energy and climate roadmap towards 2050. The roadmap analysed the means of constructing a low-carbon society and achieving an 80–95 per cent reduction in greenhouse gas emissions from the 1990 level in Finland by 2050.

The 2016 strategy – National Energy and Climate Strategy for 2030 – outlines the actions that will enable Finland to attain the targets specified in the Government Programme of Prime Minister Sipilä (27 May 2015) and adopted in the EU for 2030, and to systematically set the course for a low-carbon society. The 2016 strategy also specifies key measures for achieving the binding emission reduction targets in the effort sharing sector by 2030. These measures are further specified and complemented in the Medium-term Climate Change Policy Plan which was finalized in 2017.

Sectoral policies and measures

The main policies and measures used for the with measures (WM) projection in the energy sector include the EU ETS, increasing renewable energy sources and energy conservation measures. The EU ETS is an EU-wide domestic measure, while renewable energy sources are supported by various national measures: investment grants, taxation, support for research and feed-in tariffs.

Within the energy sector (excluding transport), the promotion of the use of forest chips is estimated to have the largest mitigation impact by 2020 (9.9 million tonnes CO₂ eq in 2020), followed by energy efficiency agreements (6.3 million tonnes in 2020) and promoting wind power (3.6 million tonnes in 2020). For both new and existing buildings, building codes and regulation play an important role. The regulation for the energy performance of new buildings entails the emission reductions of 3.8 million tonnes CO₂ in 2020.

Within the transport sector, the most important measures in the WM projection include renewing the vehicle through performance standards for new cars, car and vehicle taxation, and information measures (estimated mitigation impact: 2.1 million tonnes CO₂ eq. in 2020). Promotion of the use of biofuels in transport is estimated to contribute to emission reduction by 1.6 to 1.7 million tonnes CO₂ eq. in 2020.

Most CO₂ emissions from industrial processes are included in the EU ETS. For F-gases EU regulations constitute the most significant emission reduction measure. The F-gas mitigation measures have been able to cut the almost exponential increase in emissions from refrigeration and air-conditioning equipment that started in the mid-1990s.

Within the agricultural sector, most of the measures fall under the sphere of the EU's Common Agricultural Policy, including the Rural Development Programme for Mainland Finland 2014 – 2020 which includes several measures for climate change mitigation and adaptation. The environmental compensation payments, which are part of the programme, cover approximately 86 per cent of Finnish farms and aim, among other things, to decrease the nutrient load on the environment and reduce greenhouse gas emissions.

Within the LULUCF sector, the most important policy measures include legislation, the National Forest Strategy 2025, financial support and extensive public forestry organisations, which promote sustainable forest management, including maintaining the forest carbon sink.

Within the waste sector, the most important policies and measures in the WM projection aim at increasing the recovery of waste fractions and reducing the amount of waste disposed to landfills including restrictions on biodegradable waste. Enforcement of the Waste Act and the Decree on Waste will continue to increase recycling and recovery, thus further replacing landfilling, and will contribute to reducing greenhouse gas emissions. The total mitigation impact of these waste sector measures is estimated at 2.3 million tonnes CO₂ eq. for 2020.

Policies and measures to mitigate emissions from international bunkers include implementing the measures of the International Maritime Organization (IMO) regarding the Energy Efficiency Design Index and Ship Energy Efficiency Management Plans. As a member of the European Union, Finland is implementing the EU ETS for aviation. Aviation has been included in the EU emissions trading scheme (EU ETS) since 2012. Between years 2013 and 2016, the EU ETS covered flights between aerodromes located in member states of European Economic Area (EEA). In February 2017 the European Commission proposed to continue the intra-EEA scope beyond 2016.

Besides the measures included in the WM projections Finland has decided on several additional measures in order to further reduce the emissions towards 2030. The additional measures are presented in the National Energy and Climate Strategy for 2030 and in the Medium-term Climate Change Policy Plan. The largest emission reductions in the non-ETS sector are planned to be delivered by the transport sector. The transport sector measures include increasing the use of biofuels within road transport to 30 per cent by 2030, improving the energy-efficiency of vehicles, and improving the energy-efficiency of transport system by promoting the choices of more environmentally friendly mode of transport and curbing the growth of vehicle kilometres.

The most important additional measures are:

- An operating aid for renewable energy based on a tendering process will be introduced. In 2018–2020, a tendering process for electricity production of 2 TWh would be organised.
- An obligation to blend 10 per cent of bioliquids into light fuel oil used for heating of buildings and into light fuel oil used for machinery
- Phasing out oil heating in central government premises by 2025 and encouraging all public-sector operators to do the same
- Improving energy efficiency and promoting the use of alternative fuels in machinery. Reductions in F-gas emissions by promoting the alternative low GWP non-HFC technologies in the refrigeration and air conditioning, including criteria for public procurements related to F-gases and information and education campaigns
- Activities relating to reducing emissions from organic soils in the agricultural sector and measures to replace fossil fuels with biogas
- Finland will phase out the use of coal for energy by 2030. During the current government term, a bill will be prepared. The bill will take into account aspects related to the security of energy supply and emergencies.

Finland strives to implement its climate policies in such a way that the social, environmental and economic impacts on other countries, and on developing countries in particular, are minimised. The Seventh National Communication provides updated information on how to minimise adverse impacts compared to the Sixth National Communication and the National Inventory Report submitted in 2017.

Effect of policies and measures on longer term trends

A large proportion of current Finnish climate and energy policies also contribute to the reduction of greenhouse gas emissions in the longer term. For example, buildings

have long lifetimes, and therefore, the regulations for the energy efficiency of new and existing buildings have long-lasting impacts. Land-use planning also results in permanent emission reductions in buildings and transport, for example, by allowing the use of low-emission heating modes or by improving possibilities for walking, cycling and using public transportation. Measures that promote investments in renewable energy and that improve the competitiveness of renewable energy sources also reduce greenhouse gas emissions in the longer term, since investments in the energy infrastructure have long lifetimes. According to the latest projections in transport sector, the GHG emissions start to decline at the end of the current decade and the main reasons for that are the use of biofuels, development in vehicle technology and CO₂-based taxation. Prohibiting certain F-gases or halting the disposal of biodegradable waste in landfills can be expected to lead to permanent changes in current practices, and therefore to yield long-term emission reductions.

1.4 Projections and total effects of policies and measures

With Measures and With Additional Measures projections

The with measures (WM) and with additional measures (WAM) projections are based on the National Energy and Climate Strategy for 2030 from November 2016 and the Medium-term Climate Change Policy Plan from September 2017. The WM projection includes measures that were implemented or adopted before autumn 2016.

Economic growth and the change in the structure of the economy play a key role in the estimation of energy consumption and emissions. The rate of economic growth is determined by the growth rates of labour input and average labour productivity. In the long term, economic growth is determined almost solely by the growth of labour productivity, because labour input cannot grow without bounds. In the short and medium term, however, factors affecting labour input growth matter, too, because changes in labour input affect directly the potential output of the economy. In Finland, the ageing population is the single most significant factor in terms of its effect on labour input and thus development of the national economy in the short and medium term. Another factor that affects the availability of labour is the level of structural unemployment. The population forecast of Statistics Finland is used in the projections. It estimates that the population will increase from the current 5.5 million to 5.9 million by 2035. The average size of households will decrease slightly, while the number of households is expected to grow from 2.6 million to 3.0 million during the period.

In 2016, the Finnish economy returned to a growth path after a long period of recession that began in 2009. The growth has been driven by increase in private consumption and recovery of public and private investment. The GDP is assumed to increase in the coming years. In the projections the annual growth during 2016-2020 is on average 1.6 per cent. In the 2020s the growth will be higher, 2.6 per cent per annum on average, as the Government's reforms are starting to pay off and the competitiveness of the Finnish economy increases.

The WM projection estimates that the total greenhouse gas emissions (without LULUCF) in 2020 and in 2030 will be 56 and 48 million tonnes CO₂ eq, respectively, whereas the WAM projection assesses that they will be 56 and 44 million tonnes CO₂ eq, respectively. The additional emission reduction measures in the WAM projection include all planned measures with a few exceptions for which the impact on the energy balance is not yet known.

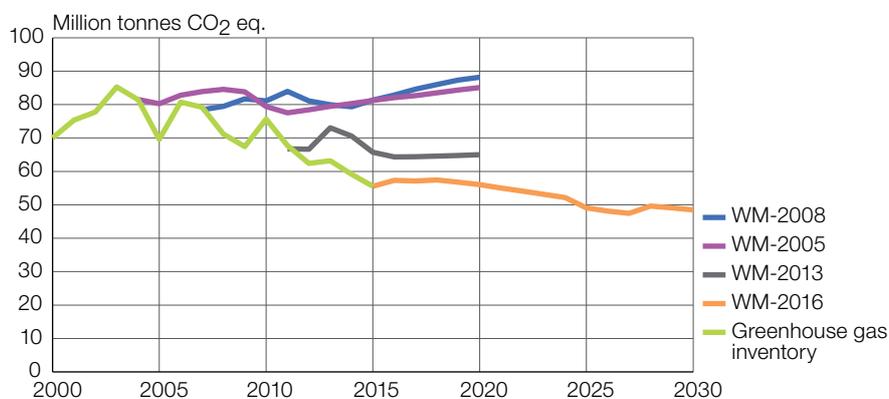
Finland is in the course of fulfilling its EU 2020 emission reduction goal and its corresponding emission reduction obligation under the second commitment period of the Kyoto Protocol with the existing policy measures. The effect of the additional measures is aimed at the 2020s and in full at the year 2030 at the latest. With the measures of the WAM projection the renewable energy share will rise to more than 50 per cent of final energy consumption and the use of imported oil for the domestic needs will be cut by half by 2030. This is also the target of the current Government Program.

Total effect of policies and measures

The total effect of the policies and measures is estimated by aggregating the impact estimates of individual policies and measures. The impact of already implemented individual policies and measures are 12, 20, 34 and 42 million tonnes CO₂ eq. for 2010, 2015, 2020 and 2030 (without LULUCF), respectively. The planned measures will reduce greenhouse gas emissions increasingly in the 2020s reaching an additional annual reduction of 6.3 million tonnes CO₂ eq. in 2030.

Figure 1.1 shows Finland's greenhouse gas emissions in the WM projections in the last four national climate and energy strategies, i.e. strategies from the years 2005, 2008, 2013 and 2016. The WM projections in the previous national climate and energy strategies projected significantly higher emissions for 2015 than those reported in the latest greenhouse gas inventory. This suggests that the additional measures implemented in the 2010s have had a substantial impact on the total emissions.

Figure 1.1
Greenhouse gas emissions according to the most recent inventory for 2000-2015 and in the WM projections of the climate and energy strategies published in 2005, 2008, 2013 and 2016 up to 2020 and 2030 respectively.



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

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

Supplementarity relating to the Kyoto Protocol mechanisms

During the first commitment period of the Kyoto Protocol, Finland's total national emissions were nearly 5 per cent (approximately 15.8 million tonnes CO₂ eq.) below Finland's assigned amount (approximately 355.0 million tonnes CO₂ eq.). For the second commitment period, the estimated total effects of the policies and measures for

2020 indicate that the Kyoto target will be met entirely by domestic actions, and any possible use of Kyoto Mechanisms would be supplemental to domestic actions. Therefore, the use of the Kyoto mechanisms has been supplemental in the first commitment period, and is expected to be that also in the second commitment period.

1.5 Climate change impacts, adaptation measures and vulnerability assessment

Climate projections for Finland

The temperature increase in Finland is expected to be more than 1.5–2 times as large as mean warming globally. The temperature change in Finland is expected, on average, to be 2.5°C by mid-century and 3.3°C by the end of the 21st century under the RCP4.5 scenario representing fairly moderate emissions, and 3.5°C and 5.6°C under the RCP8.5 scenario representing high emissions. Both the increases in temperature and precipitation rates will be larger in winter than in summer.

As a consequence of climate change, it is expected that heatwaves will become longer and more frequent; heavy precipitation events will intensify in summer; the number of days with precipitation will increase in winter; the snow season will become shorter and the duration and depth of soil frost will decrease, particularly in snow-free areas like roads and airports.

Vulnerability, risks and climate change impacts

Knowledge on climate change impacts, risks and vulnerabilities is continually accumulated by research activities. Vulnerabilities have been identified in all sectors, but their nature varies. A study of vulnerability in natural resource based sectors was recently completed and research is ongoing at national, Nordic and European scales to improve the evidence base for adaptation policies and measures.

Economic impacts of climate change have been estimated to be considerable for different sectors in Finland, although significant uncertainties and variable risks need to be taken into account. Estimated impacts are potentially beneficial for some sectors, however active and proactive adaptation is required to realise such opportunities. Cross-border effects of climate change is one area where economic impacts are likely to be notable in the future.

Adaptation

Finland was one of the first countries in the world to adopt a National Adaptation Strategy to Climate Change in 2005. The implementation of the strategy was evaluated in 2009 and 2013. The level of adaptation varied between the sectors and the importance for the collaboration between the sectors was recognized. The current national adaptation policy framework is described in the National Climate Change Adaptation Plan 2022 adopted in 2014. Its aim is that the Finnish society has the capacity to manage the risks associated with climate change and adapt to changes in the climate.

The implementation of national adaptation policy is coordinated by the Monitoring Group on Climate Change Adaptation chaired by the Ministry of Agriculture and Forestry. It is broadly-based, with representatives from the relevant ministries and other authorities, regional and local actors, research institutes, expert organisation in fire and rescue services, and financial services. It monitors and promotes the implementation of the adaptation plan together with a broad network of stakeholders.

Finland's Climate Act was approved in 2015. It stipulates that the Government approves long-term and medium-term strategic mitigation plans and at least every ten years a national plan on adaptation. Adaptation is also included in the National Risk Assessment 2015 and the National Energy and Climate Strategy for 2030.

Several sectors also have an action plan for adaptation, e.g. the environmental administration, administrative branches of the Ministry of Agriculture and Forestry and the Ministry of Transport and Communication. Most of the municipalities are undertaking systematic climate actions and, although their focus has been on climate change mitigation, adaptation has also been promoted. By the end of 2015, regional flood risk management plans were published for every significant flood risk area, and currently the measures are being implemented. In addition, several bigger cities and municipalities have been active in vulnerability assessment.

Currently, the most advanced sector in adaptation is **water management**, where adaptation has already been integrated into decision-making. Essential measures in water services include intake wells in groundwater bodies with favourable water yields and further emphasis on storm water management. Wastewater facilities, especially pumps, should be placed outside groundwater areas and flood risk areas. Other actions include preparedness planning, regular revision of dam safety, improved cooperation between waterworks, guidelines on land use and further development and utilisation of databases and models.

In the **energy sector**, measures include e.g. intelligent electricity networks which will work as a service platform in transition towards a more decentralised electricity system. Regulations aimed at improving the security of power supply have been included in the revised electricity market legislation.

Current legislation on building and other statutes include requirements for taking climate change into consideration in **land use planning and building**. According to the revised land use guidelines, new construction should not be located in areas that are prone to flooding. Local master and detailed planning should take account of the increasing possibility of extreme weather events in built areas. The management of flood risks and river basins is also regulated.

In **agriculture**, concrete risk management measures are being developed in co-operation between the government, producers, research and the private sector to reduce and prevent risks to agricultural production and income. Risk profiles and emergency plans have been made for various existing and emerging pests and diseases. Other adaptation measures include sustaining the soil structure and conditions by diversifying the crops and crop varieties, developing crop rotations and soil cultivation methods, favoring crops that provide soil cover for winters that are projected to get wetter and developing year-round water management systems to increase nutrient use efficiency and reduce drought-induced yield variability. Finnish plant breeding has expanded the breeding strategies to cover novel crops and to improve disease resistance and resilience, which are important elements in improving Finland's adaptive capacity in the future. In the energy sector measures to improve and increase farms' energy self-sufficiency and security of supply have been promoted and implemented.

Within the **forestry sector**, recent modifications to forest legislation take into account climate change adaptation by allowing more diverse forest management and by adjusting annual deadlines for removal of felled timber from forests as a precaution to earlier occurrence of pests. Additional measures promote the use of high quality seed suitable for different climatic conditions, establishment of a network of gene reserve forests and monitoring of the pest and disease situation in forests. The damage contingency plans with appointed regional experts assist rapid harvesting of wind damaged trees. Further adaptation measures include the site-specific selection of species and regeneration methods and awareness raising through means such as forest damage road shows.

The focus of the **industry** has been more on mitigation rather than adaptation. However, potential risks have been identified that should be taken into consideration. The Finnish mining industry has been subject to ‘stress tests’ in order to identify and reduce the risk of adverse environmental consequences, which climate change can aggravate.

The adaptation actions of **transport and communication sector** include improving the safety equipment, proactive planning, developing the design and procurement practices, technical development, developing information services and traffic management, product and market monitoring, as well as co-operation in international regulation development. Improved forecasting models and an early warning system as well as remote monitoring system of the climatic conditions have been developed.

The Roadmap for Growth and Renewal in Finnish **Tourism** for 2015–2025 reacts to the climate change and calls for new, innovative solutions for sustainable tourism products and experiences.

In the **insurance sector**, a new insurance programme for damage caused by exceptional floods was launched in 2013. In 2016, some private insurance companies introduced products which cover risks for extreme weather conditions.

In the **health sector**, a national water safety plan was introduced in 2016 to prevent water-borne epidemics. Measures taken to prevent tick-borne diseases include raising awareness of ways to protect from tick-bites, and providing free vaccines against tick-borne encephalitis in some high-risk areas.

Global impacts of climate change and international cooperation

A recent study on cross-border effects of climate change in Finland identifies seven different impact chains triggered by cross-border impacts: trade impacts, impacts through infrastructure, impacts on finance and insurance, human mobility, ecosystems, geopolitics, and cognitive changes. In many cases the strongest cross-border impacts originate in neighbouring areas.

Finland is a member of the Arctic Council (chair in 2017–2019) and the Barents Euro-Arctic Council (chair 2013–2015) and finds climate change one of the key areas of co-operation. In the context of the Baltic Sea Region cooperation on climate change Finland implements the EU Strategy for the Baltic Sea Region.

Climate sustainability has been one of the binding cross-cutting objectives of Finland’s development policy and development cooperation since 2012. Finland has adopted a climate sustainability tool in the annex of its new Manual for Bilateral Programmes for assessing and preventing climate change and the risks posed by natural disasters caused by climate change. Furthermore, the Manual includes a disaster risk reduction tool integrated into the Guidance and Checklist for Climate Sustainability tool.

Finland has been supporting the United Nations Office for Disaster Risk Reduction (UNISDR) since 2004, and has also participated as an observer to the World Bank Consultative Group of the Global Facility for Disaster Reduction.

1.6 Financial resources and transfer of technology

Finland has integrated the goals and objectives of the UNFCCC, the Kyoto Protocol and the Paris Agreement into its development policy, while taking into account the fact that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties. Climate sustainability has been one of the cross-cutting objectives of Finland’s development policy and development cooperation since 2012. Besides providing funds to the operating entities of the financial

mechanism of the UNFCCC and the funds under the Kyoto Protocol, Finland provides support through bilateral, regional and other multilateral channels.

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

While the fast-start finance period is now over, the international public climate finance that Finland has provided has continued to be higher than in the base year used for fast-start finance. The total allocations were about EUR 94 million in 2013, EUR 116 million in 2014, EUR 115 million in 2015 and EUR 43 million in 2016. The division between mitigation and adaptation support varies according to the year, but it is rather balanced. For example in 2016 about 58% was allocated to mitigation and about 42% to adaptation.

During 2013–2014 the government channelled all revenues from the auctioning of ETS allowances to Official Development Assistance activities, including climate finance. These revenues were used during the reporting period e.g. to support the Green Climate Fund (EUR 34.7 million).

Finland attaches particular importance to assisting countries that are least developed, as they are among the countries most vulnerable to climate change. Finland's LDC-partner countries in Africa include Ethiopia, Mozambique, Somalia and Tanzania. In Asia, Finnish bilateral support focuses on the three poorest, fragile states: Afghanistan, Myanmar / Burma and Nepal. Finland supports SIDS countries with regional programs in the Pacific and the Caribbean.

In long-term partner countries the co-operation is based on country programmes that are prepared in consultation with partners and that build on national development plans. The form of assistance varies between regions and programmes. The Energy and Environment Partnership (EEP) project, which began in Central America in 2003 and has since been replicated in the Mekong region, southern and eastern Africa, Indonesia and the Andes, accounts for a large part of the mitigation projects in the energy sector. Also, support for forestry projects (mitigation and adaptation) is substantial.

With regard to adaptation, the most important element has been capacity building in partner countries. Finland has been very active in the field of meteorological co-operation. It has supported, for example, co-operation between the Finnish Meteorological Institute (FMI) and the Secretariat of the Pacific Regional Environmental Programme (SPREP) and the Pacific national meteorological services since 2009.

Finland has specific programmes and financial arrangements for transferring environmentally sound technology to developing countries. These activities consist of transferring 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. For instance, Finland has supported the work of the Climate Technology Centre and Network (CTCN) with EUR 200,000 in 2015.

Private sector projects in developing countries are being supported, for example, by the Finnish Fund for Industrial Cooperation Ltd. (Finnfund) and Finnpartnership (the Finnish Business Partnership Programme). Both organizations are active in the climate change field. About half of all investments made in recent years can be regarded as climate finance because they have been used for renewable energy projects, as well as projects to prevent deforestation, to support energy and material efficiency, or to improve the ability of poor people to adapt to the challenges posed by climate change.

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

Table 1.2
Summary information on financial resources and technology transfer

Official development assistance (ODA)	2013: EUR 1,081 million (0.53% of GNI); 2014: EUR 1,232 million (0.59% of GNI); 2015: EUR 1,161 million (0.55% of GNI); 2016: EUR 956 million (0.44% of GNI)
Climate-related aid in bilateral ODA	2013: EUR 32 million 2014: EUR 44 million 2015: EUR 39 million 2016: EUR 26 million = amounts of the project funding directly directed to climate activities
Climate-related support programmes	e.g. Energy and Environment Partnership (EEP), Making agriculture part of the solution to climate change – Building capacities for Agriculture Mitigation project, Sustainable Forest Management in Changing Climate project, the Southeast Asia Climate Change Network; more information on projects and more projects available in: http://stats.oecd.org/Index.aspx?DataSetCode=RIOMARKERS
Total contributions to GEF	2013: EUR 13.650 million 2014: EUR 22.025 million 2015: EUR 14.325 million 2016: EUR 7.961 million
Pledge for sixth GEF replenishment	EUR 65 million in total
Jl and CDM under the Kyoto Protocol	Finland committed about EUR 12.2 million through ten bilateral projects for the purchase of project units during the prompt start phase and the first commitment period of the Kyoto Protocol. Two of these projects continued generating units also after 2012. Finland also invested in multilateral carbon funds. USD 10 million has been invested in the World Bank's Prototype Carbon Fund (PCF), EUR 4.25 million in the Nordic Environmental Financing Corporation's (NEFCO) Testing Ground Facility (TGF), EUR 10 million in the European Bank for Reconstruction and Development's Multilateral Carbon Credit Fund (MCCF), USD 25 million in the Asian Development Bank's Asia Pacific Carbon Fund, EUR 3 million in the Nordic Environment Finance Corporation's NEFCO Carbon Fund and USD 20 million in the Asian Development Bank's Future Carbon Fund. Of these funds, the World Bank's Prototype Carbon Fund, NEFCO's NEFCO Carbon Fund and the Asian Development Bank's Future Carbon Fund continue to generate units for 2013 to 2020.
Other (bilateral/multilateral)	The Global Gender and Climate Alliance (GGCA) project to strengthen the role of women and mainstream the gender perspective in global climate policy. The total contribution is EUR 8.9 million during the implementation period 2008 to 2016. The cooperation between the Finnish Meteorological Institute (FMI) and the Secretariat of the Pacific Regional Environmental Programme (SPREP) and the Pacific national meteorological services since 2009 seeks to improve the capacity of national meteorological institutes to deliver high-quality weather and climate services, and thus, to respond to the challenges posed by climate change and extreme weather events.

1.7 Research and systematic observation

Climate change has been recognised as an important topic in Finnish research policy for decades. Climate change research policies are cooperatively implemented by several ministries. Large cross-sectoral climate change programmes have aimed at strengthening the scientific understanding of climate change as well as the mitigation and adaptation impacts and options, including their socio-economic and environmental aspects.

The Academy of Finland, the umbrella of the national Research Councils, has three ongoing programmes related to climate and energy: the programme on biobased economy (BioFuture2025, 2017–2020), the Arctic research programme (ARKTIKO, 2014–2018) and the programme on energy transition (New Energy, 2015–2018). Many of the ongoing and recently finished programmes coordinated by Tekes – the Finnish Funding Agency for Innovation are related to the mitigation of climate change through research and development especially on renewable energy, bioeconomy and cleantech. A large number of research institutes, universities and consultants carry out research on climate change impacts, adaptation and mitigation in close cooperation with each other: for instance, nearly 20 organisations served as grant holders for Academy of Finland’s funding of EUR 59 million for climate change research in 2013–2016.

The focus in climate change research has gradually shifted from dominantly natural sciences to more comprehensive approaches that include socio-economic studies and inter- and transdisciplinary approaches. The Government’s annual plan for joint analysis, assessment and research activities as well as Strategic Research Council with the Academy of Finland are examples of new funding mechanisms that have been introduced to promote multidisciplinary research supporting knowledge based decision making and management. The current Strategic Research Council programmes with projects of particular relevance for climate change include research on energy transition and renewable energy, use of forest resources, offshore wind, circular economy of non-renewable substances, resource efficient food production, climate and resource scenarios as well as urban development. The Finnish Climate Change Panel consisting of scientists representing different areas of expertise continues its work of producing reports on climate change research and of communicating new research information to decision makers.

The Finnish Meteorological Institute (FMI) is an expert in climate change and related issues. With regard to climate process and climate system studies, the emphasis is on climate research and services, greenhouse gases as well as aerosols, clouds, trace gases and climate supported by routine surface and upper air weather observations. The FMI also measures greenhouse gas concentrations at a station in Lapland and monitors physical properties in the Baltic Sea.

The Finnish Environment Institute (SYKE) carries out research on climate change impacts, mitigation and adaptation, including policy evaluation. SYKE is also the national centre for monitoring the physical, chemical and biological state of inland waters. The Natural Resources Institute Finland (Luke) performs climate change related research activities on natural resources, and it does national forest inventories (NFIs) which produce information on the land use, forest resources, growth, condition and biodiversity of forests. About 60 national monitoring schemes or projects provide data of the changes in biodiversity and habitats in Finland.

The Universities of Helsinki and Eastern Finland and the FMI host the Finnish Centre of Excellence (CoE) in Physics, Chemistry, Biology and Meteorology of Atmospheric Composition and Climate Change. Its main objective is to reduce scientific uncertainties concerning global climate change issues, particularly those related to aerosols and clouds. Finnish research institutes with significant marine components have started a national marine research infrastructure consortium (FINMARI) coordinated

by SYKE. Finnish universities and research institutes also have extensive activities in paleoclimatology.

Open science is one of the spearheads of Finnish science policy. An example of current open science actions include free-of-charge online services based on data by the Finnish Meteorological Institute (FMI) and the Finnish Environment Institute (SYKE) and a web portal of Finnish open access journals.

Free and open international exchange of data and information has been further promoted by participation in several international research programmes, networks, data collection schemes, and databases. Finland is overseeing the implementation of two European organizations of distributed research infrastructure: the ICOS (Integrated Carbon Observation System) for online in-situ monitoring of greenhouse gases and ACTRIS (Aerosols, Clouds and Trace gases Research Infrastructure) for monitoring and research on short-lived climate forcers in the atmosphere. Finland has also actively participated in the work the Intergovernmental Panel on Climate Change (IPCC).

Finland has been operating extensive capacity building programmes to promote the exchange of information and know-how as well as to support endogenous capacities and capabilities in developing countries. The capacity building programmes have focused on climate observations, research, higher education cooperation relevant to climate change mitigation and adaptation, and the sustainable use of forests.

1.8 Education, training and public awareness

Climate change is already firmly anchored in the education and public awareness policies and practices of the Finnish Government, and these policies and practices are continuously being developed. Education policies are in the responsibility of the Ministry of Education and Culture. Training and public awareness policies are considered in several sectors and by many actors.

Climate change issues are included in the education given on sustainable development in Finland's compulsory basic education system. The present National Core Curriculum for Basic Education was given by the Finnish National Agency for Education in 2014. Many school subjects deal with sustainable development and climate change, and they are also dealt with as a cross-curricular theme. In addition, after basic education level, climate change issues are included in the upper secondary level education.

Universities and polytechnics provide climate change education as a part of different degree programmes. Some universities also offer postgraduate studies in climate change. Teaching related to climate change is closely tied to research in this field. Universities, polytechnics and several training institutes also provide continuing education programmes and vocational training in climate change and related issues, e.g. energy efficiency and environmental technology, for individuals and companies.

The training of experts from developing countries in managing forests and other natural resources is an integral part of the agricultural and forest science programmes at the University of Helsinki. In the Faculty of Science and Forestry at the University of Eastern Finland, six out of 12 master's degree programmes are directly targeted towards the sustainable use of natural resources and climate change mitigation. During the past decade, these programmes, which are partnered with programmes in other European, North American, Russian, Chinese, Brazilian and Ghanaian universities, have trained more than 100 experts from more than 50 different countries. In addition, many other higher education institutions and research institutions in Finland provide international

training and cooperate with research and higher education institutions as well as governmental institutions in developing countries to support institutional development.

Communication about climate change is performed by several ministries and government research organisations, each within the sphere of their own tasks and responsibilities. Since 2010, the Ministry of the Environment has been coordinating cooperation on climate communications. At the moment, the Steering group for Climate Communications consists of several ministries (the Ministry of Agriculture and Forestry, the Ministry of the Environment, the Ministry of Economic Affairs and Employment, the Ministry for Foreign Affairs, the Prime Minister's Office Finland), research organisations (the Finnish Environment Institute SYKE), the Finnish Meteorological Institute (FMI), VTT Technical Research Centre of Finland Ltd, Natural Resources Institute of Finland (Luke), regionally operating organisations (Centre for Economic Development, Transport and the Environment and the Association of Finnish Local and Regional Authorities), Tekes – the Finnish Funding Agency for Innovation, Sitra the Finnish Innovation Fund, Motiva Ltd (see Section 9.4.2), and the think tank Demos Helsinki. Many of the Government organisations provide training for various stakeholders both independently and through the Steering Group for Climate Communications. The FMI has, for example, organised a climate change course for journalists since March 2006. To date, the course has been attended by more than 200 journalists specialising in the economy, science and the environment.

There are several best practises of climate change information provided as free web based material. To name just two here: the website Climateguide.fi pools practical, studied and reliable information on climate change into one address and in a uniform format. The purpose of the website is to support society and citizens in mitigating climate change, and in adapting to it; the website Climate.now is a multidisciplinary study and teaching module on the basics of climate change. It contains written material, video lectures and interviews, assignments, tests and a guide for teachers that will help anyone familiarise themselves with the basics of the climate change.

More than one third of Finland's municipalities have a climate strategy or are in the process of preparing one. Several municipalities are actively promoting climate change awareness among their citizens through providing consumer advice and organising events, discussion forums and campaigns. In addition, the NGOs run climate change or energy related campaigns, some of which have received a great deal of publicity.