REPORTS OF THE MINISTRY OF THE ENVIRONMENT 21en | 2017

# Government Report on Medium-term Climate Change Policy Plan for 2030

## Towards Climate-Smart Day-to-Day Living

MINISTRY OF THE ENVIRONMENT

Reports of the Ministry of the Environment 21en/2017

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## Towards Climate-Smart Day-to-Day Living

Ministry of the Environment, Helsinki 2017


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ISBN Nid.: 978-952-11-4751-7

ISBN PDF: 978-952-11-4752-4

Layout: Government Administration Department, Publications, Teija Metsänperä

Cover photo: Pixabay

Helsinki 2017


## Description sheet


| | | | |
|---|---|---|---|
| **Published by** | Ministry of the Environment | | October 2017 |
| **Authors** | | | |
| **Title of publication** | Government Report on Medium-term Climate Change Plan for 2030 – Towards Climate-Smart Day-to-Day Living | | |
| **Series and publication number** | Reports of the Ministry of the Environment 21en/2017 | | |
| **ISBN (printed)** | 978-952-11-4751-7 | **ISSN (printed)** | 1796-1696 |
| **ISBN PDF** | 978-952-11-4752-4 | **ISSN (PDF)** | 1796-170X |
| **Website address (URN)** | http://urn.fi/URN:ISBN:978-952-11-4752-4 | | |
| **Pages** | 146 | **Language** | English |
| **Keywords** | climate change, climate policy, greenhouse gas emissions, transport, agriculture, waste management, heating, F-gases, consumption, municipalities and regions, public procurement | | |



**Abstract**

Provisions on the medium-term climate policy plan have been laid down in the Climate Change Act (609/2015). The plan sets the emissions reduction target for greenhouse gases to 2030 and specifies the actions to be taken to ensure that the targets are reached and that they are compatible with the long-term climate change objective.

The plan applies to the non-emissions trading sectors, i.e. the so-called effort sharing sector. This comprises transport, agriculture, building specific heating, waste management and F-gas emissions. Together with the Energy and Climate Strategy completed at the end of 2016, the plan implements the climate and energy policy objectives set in the Government Programme. The plan further specifies and supplements the emissions reduction actions set out in the Energy and Climate Strategy. Linkages and cross-cutting themes between the sectors are also examined, including the role of consumption and work on climate change issues done locally. The preparation of the plan was based on the same baseline scenario as was used for the Energy and Climate Strategy.

According to the Commission's proposal, the Finnish target for emissions reduction in the effort sharing sector by 2030 is 39% compared to 2005. The actions now included in the baseline scenario are not sufficient to achieve this. The medium-term plan assesses what kind of measures should be taken to reduce the gap, also taking account of the factors of uncertainty we are aware of. The emissions reduction measures included in the plan also support the attainment of the long-term emissions reduction objective, i.e. the objective set to 2050.



| | |
|---|---|
| **Publisher** | Ministry of the Environment |
| **Printed by (place and time)** | Lönnberg Print & Promo, 2017 |
| **Publication sales/ Distributed by** | Distribution by: julkaisut.valtioneuvosto.fi<br>Publication sales: julkaisutilaukset.valtioneuvosto.fi |

## Kuvailulehti


| | | | |
|---|---|---|---|
| **Julkaisija** | Ympäristöministeriö | | Lokakuu 2017 |
| **Tekijät** | | | |
| **Julkaisun nimi** | Valtioneuvoston selonteko keskipitkän aikavälin ilmastopolitiikan suunnitelmasta vuoteen 2030 – Kohti ilmastoviisasta arkea | | |
| **Julkaisusarjan nimi ja numero** | Ympäristöministeriön raportteja<br>21en/2017 | | |
| **ISBN painettu** | 978-952-11-4751-7 | **ISSN painettu** | 1796-1696 |
| **ISBN PDF** | 978-952-11-4752-4 | **ISSN PDF** | 1796-170X |
| **URN-osoite** | http://urn.fi/URN:ISBN:978-952-11-4752-4 | | |
| **Sivumäärä** | 146 | **Kieli** | englanti |
| **Asiasanat** | Ilmastonmuutos, ilmastopolitiikka, kasvihuonekaasupäästöt, liikenne, maatalous, jätehuolto, lämmitys, F-kaasut, kulutus, kunnat ja alueet, julkiset hankinnat | | |



**Tiivistelmä**

Keskipitkän aikavälin ilmastopolitiikan suunnitelman laatimisesta on säädetty ilmastolaissa (609/2015). Suunnitelmassa asetetaan kasvihuonekaasujen päästövähennystavoite vuodelle 2030 ja määritellään, millä toimilla varmistetaan tavoitteen saavuttaminen sekä yhdenmukaisuus pitkän aikavälin ilmastotavoitteen kanssa.

Suunnitelma koskee päästökaupan ulkopuolisia sektoreita eli ns. taakanjakosektoria. Tähän kuuluvat liikenteen, maatalouden, rakennusten erillislämmityksen, jätehuollon sekä F-kaasujen päästöt. Rinnakkain vuoden 2016 lopulla valmistuneen energia- ja ilmastostrategian kanssa suunnitelman avulla pannaan toimeen hallitusohjelman ilmasto- ja energiapolitiikan tavoitteet. Suunnitelma täsmentää ja täydentää energia- ja ilmastostrategiassa määriteltyjä toimia päästöjen vähentämiseksi. Työssä tarkastellaan myös sektorien välisiä kytkentöjä sekä poikkileikkaavia teemoja, kuten kulutuksen ja paikallisen ilmastotyön merkitystä. Suunnitelman laatimisen perustana on energia- ja ilmastostrategian kanssa yhteinen perusskenaario.

Komission ehdotuksen mukaan Suomen kasvihuonekaasujen päästövähennystavoite taakanjakosektorille vuodelle 2030 on 39 % verrattuna vuoden 2005 tasoon. Perusskenaarion nykyiset toimet eivät riitä tavoitteen saavuttamiseen. Keskipitkän aikavälin suunnitelmassa arvioidaan, millä toimilla ero saadaan kurottua umpeen. Suunnitelmassa otetaan huomioon tiedossa olevia epävarmuustekijöitä. Suunnitelman päästövähennystoimet tukevat myös pitkän aikavälin eli vuoden 2050 päästövähennystavoitetta.



| | |
|---|---|
| **Kustantaja** | Ympäristöministeriö |
| **Painopaikka ja vuosi** | Lönnberg Print & Promo, 2017 |
| **Julkaisun myynti/ jakaja** | Sähköinen versio: julkaisut.valtioneuvosto.fi<br>Julkaisumyynti: julkaisutilaukset.valtioneuvosto.fi |

## Presentationsblad


| | | | |
|---|---|---|---|
| **Utgivare** | Miljöministeriet | | Oktober 2017 |
| **Författare** | | | |
| **Publikationens titel** | Statsrådets redogörelse om en klimatpolitisk plan på medellång sikt fram till 2030 – Vägen till en klimatsmart vardag | | |
| **Publikationsseriens namn och nummer** | Miljöministeriets rapporter<br>21en/2017 | | |
| **ISBN tryckt** | 978-952-11-4751-7 | **ISSN tryckt** | 1796-1696 |
| **ISBN PDF** | 978-952-11-4752-4 | **ISSN PDF** | 1796-170X |
| **URN-adress** | http://urn.fi/URN:ISBN:978-952-11-4752-4 | | |
| **Sidantal** | 146 | **Språk** | engelska |
| **Nyckelord** | klimatförändring, klimatpolitik, växthusgasutsläpp, trafik, jordbruk, avfallshantering, uppvärmning, F-gaser, konsumtion, kommuner och regioner, offentlig upphandling | | |



**Referat**

I klimatlagen (609/2015) föreskrivs att en klimatpolitisk plan på medellång sikt ska utarbetas. I planen ställs ett mål för minskningen av växthusgasutsläppen fram till 2030, och det anges med vilka åtgärder man kan säkerställa att målet uppnås och att åtgärderna ligger i linje med det långsiktiga klimatmålet.

Den klimatpolitiska planen på medellång sikt gäller sektorerna utanför utsläppshandelssystemet, dvs. den s.k. bördefördelningssektorn. Till den räknas utsläpp från trafiken, jordbruket, separat uppvärmning av byggnader, avfallshantering och F-gaser. Planen ska tillsammans med den energi- och klimatstrategi som färdigställdes i slutet av 2016 förverkliga de mål för klimat- och energipolitiken som har ställts i regeringsprogrammet. Planen preciserar och kompletterar de utsläppsminskande åtgärder som ingår i energi- och klimatstrategin. Inom ramen för arbetet analyseras också kopplingar mellan sektorerna och genomgående teman, såsom konsumtionens inverkan samt det lokala klimatarbetets betydelse. Energi- och klimatstrategin och den klimatpolitiska planen baserar sig båda på samma referensscenario.

Enligt kommissionens förslag ska Finlands mål vara att inom bördefördelningssektorn minska utsläppen av växthusgaser med 39 % fram till 2030 jämfört med 2005 års nivå. De åtgärder som ingår i referensscenariot räcker inte till för att uppnå målet. I den klimatpolitiska planen på medellång sikt bedöms vilka åtgärder som krävs för att fylla denna lucka. I planen beaktas de osäkerhetsfaktorer som har kunnat kartläggas. Utsläppsminskningsåtgärderna i planen stöder också utsläppsminskningsmålet på lång sikt, dvs. målet fram till 2050.



| | |
|---|---|
| **Förläggare** | Miljöministeriet |
| **Tryckort och år** | Lönnberg Print & Promo, 2017 |
| **Beställningar/ distribution** | Elektronisk version: julkaisut.valtioneuvosto.fi<br>Beställningar: julkaisutilaukset.valtioneuvosto.fi |

# Contents

# Summary

## General

The preparation of the medium-term plan for climate change policy is governed by the Climate Change Act (609/2015). The plan sets a medium term target for reducing greenhouse gas (GHG) emissions by 2030. It also determines measures for ensuring that the target will be reached and that it will be in line with the long-term climate goal. The target set in the plan is based on the European Union's (EU) 2030 target of reducing emissions by at least 40% compared with 1990 levels.

This medium-term policy plan concerns sectors not covered by the EU Emissions Trading System (ETS), i.e. the 'effort sharing sector'. Alongside the national Energy and Climate Strategy adopted at the end of 2016, this plan implements the climate policy objectives of the Government Programme. The medium-term policy plan specifies and complements the emission reduction measures outlined in the Energy and Climate Strategy. It also examines links between different sectors and cross-cutting themes, such as the role of consumption and local climate action. The plan takes into account the energy policy measures included in the strategy, because they will impact the development of emissions. The plan is based on the baseline scenario that was published in the summer of 2016 and also served as the basis for the Energy and Climate Strategy.

According to a proposal issued by the European Commission, Finland should by 2030 reduce its greenhouse gas emissions in the effort sharing sector by 39% compared with 2005 levels. This means that in 2030 the emissions may not exceed 20.6 Mt $CO_2$. In practice, the binding target imposed by the EU will be achieved following a linear trajectory established for cutting emissions in the period 2021–2030. The need to reduce emissions will increase towards the end of the period. The medium-term policy plan is based on the premise that Finland will use the one-off flexibility mechanism of 2% included in the Commission proposal to reach its target. The flexibility will correspond to annual emissions of 0.7 Mt $CO_2$. The LULUCF flexibility mechanism included in the Commission proposal has not been taken into account at this stage because the issue is still unresolved. Finland is

aiming for a solution that would allow the limited use of credits generated by forest sinks to achieve the target set for the effort sharing sector in the period 2021–2030.

The existing measures included in the baseline scenario will not be sufficient to achieve the target. The gap between the baseline scenario and the emission reduction trajectory will steadily increase during the years 2021–2030, amounting to 6 Mt $CO_2$ in 2030. When applying the flexibility mechanism, the difference will be slightly more than 5 Mt $CO_2$ in 2030. This medium-term policy plan will assess which measures will enable Finland to close the gap. The measures will primarily comprise national emission reduction measures. It is also important to be prepared to apply other flexibility mechanisms than the one-off flexibility, particularly towards the end of the period when the reduction need will increase.

Decisions concerning the medium-term policy plan will be made before final agreement is reached on the contents of the Effort Sharing Regulation and LULUCF Regulation proposed by the Commission. This causes a certain level of uncertainty about the exact emission reduction trajectory and the use of flexibility mechanisms. The EU's sectoral legislation will also be amended, which will have an impact on the room for manoeuvre in selecting policy measures at national level. There is also uncertainty about the effectiveness and timing of the proposed emission reduction measures, but the level of uncertainty will reduce as implementation progresses and the provisions of EU legislation are specified in further detail.

The risks associated with various uncertainty factors should be managed amongst other things by preparing for the use of flexibility mechanisms and by determining enough emission reduction measures. For example, introducing a biofuel blending obligation is a key measure in the transport, heating and machinery sectors.

The emission reduction measures outlined in this medium-term policy plan also support the long-term emission reduction targets set for 2050. When developing long-term solutions for a low-carbon society, sustainable and consistent solutions will already be sought by 2030. It is clear that the long-term targets set in the Paris Agreement will require further emission reductions, and many of the necessary measures will concern the effort sharing sector.

## Policy measures to reduce emissions

The following provides a summary of the key additional measures needed in each sector to close the gap of approximately 5 Mt $CO_2$ between the baseline scenario and the 2030 emission target and thus ensure the achievement of the 2030 target.

### Transport and land use

In the effort sharing sector, the greatest potential for reducing emissions is in the area of transport. Therefore, the goal is to reduce transport emissions by approximately a half by 2030 compared to 2005 levels. Measures will be focused on road transport, which presents the greatest potential for emission reductions. Additional measures in the transport sector are estimated to result in a reduction of approximately 3.1 Mt $CO_2$ equivalent by 2030. Thus, transport emissions would be below 7 Mt $CO_2$ equivalent in 2030.

The emission reduction measures can be grouped into three sets:

1. Replacing fossil fuels with renewable and low emission fuels and power sources (reduction of approximately 1.5 Mt $CO_2$ equivalent)

- An appropriation of 3 million euros is reserved in the central government budget for 2018 for promoting the infrastructure for electric vehicles and use of biogas in transportation and an appropriation of 1.5 million euros for promoting the infrastructure for electric vehicles in residence houses.
- Nordic cooperation will be enhanced to reduce transport emissions. Common Nordic target indicators will be developed for different emission reductions measures in the transport sector.

2. Improving the energy efficiency of vehicles and other means of transport (reduction of approximately 0.6 Mt $CO_2$ equivalent)

- Low emission modes of transport, such as electric or gas-powered cars as well as the conversion of old cars into vehicles powered by ethanol or gas, will be promoted. An appropriation of 6 million euros is reserved for the purpose in the central government budget for 2018.
- An appropriation of 8 million euros is reserved in the central government budget for 2018 for the car scrapping incentive.
- A Green Deal model will be developed for car dealers, directing them to present low emission vehicle alternatives to customers.
- The availability and effectiveness of advisory services for public procurement in the field of energy efficient transport and vehicles will be ensured. Joint municipal authorities and other public-sector operators will be encouraged to introduce various financial incentives to increase the share of alternative technologies in procurement.

3. Improving the energy efficiency of the transport system (reduction of approximately 1 Mt $CO_2$ equivalent), including the impact that the development of land use will have on emissions

- The State will participate in the coordination of transport and land use in urban regions and in work concerning the transport system, for example through agreements on land use, housing and transport (MAL). The aim is to ensure that projects promoting walking, cycling and public transport will be prioritised in urban transport planning and project funding.
- An appropriation of 3.5 million euros is reserved in the central governmental budget for 2018 for promoting digitalisation and services in large city regions' public passenger transport development.
- An appropriation of 2 million euros is reserved in the central governmental budget for 2018 to increase contractual rail transport services.
- The location of jobs and services in growing urban regions will be steered towards regional centres, subcentres and public transport nodes with a high service level.
- Infill construction, the creation of locations that are good for the urban structure and the use of such locations for new construction will be promoted in urban areas.
- The joint programme of the State and urban regions for promoting walking and cycling will be implemented in 2018–2022.
- Park-and-ride facilities will be developed in transport nodes.
- Station areas will be developed through market experiments and urban development pilots.
- The introduction of congestion charges based on emissions will be examined.

### Agriculture

In the agricultural sector, additional emission reduction measures mainly concern limiting emissions from organic soils.

1. Growing crops in organic soils for several years with zero tillage
2. Raising the water table through controlled subsurface drainage
3. Planting forest and wetland forest in areas with organic soil
4. Promoting biogas production
5. Promoting the increased sequestration and storage of carbon in soil and the implementation of the 4per1000 initiative through research projects and experiments

By 2030, the above-mentioned measures would reduce the greenhouse gas emissions from agriculture by approximately 0.5 Mt $CO_2$ equivalent, leading to total agricultural

emissions of approximately 5.9 Mt $CO_2$ equivalent in 2030. Moreover, the promotion of biogas production would cut emissions in the effort sharing sector by some 0.31 Mt $CO_2$ equivalent by 2030. Measures to reduce greenhouse gas emissions in agriculture would also have an effect on the land use sector in which the above-mentioned measures could reduce emissions by approximately 1.15 Mt $CO_2$ equivalent by 2030.

## Building-specific heating

The effort sharing sector also includes emissions from building-specific heating. Most of them are caused by oil heating. Emissions from oil heating can be reduced by improving the energy performance of buildings with oil heating, increasing the use of bio fuel oil or changing the heating method. The example set by the central government and other public operators as they phase out oil heating by 2030 will also have a significant impact.

1. Frontloading the introduction of an obligation to blend light fuel oil used for heating with a 10% share of bioliquids
2. Phasing out oil heating in central government premises by 2025 and encouraging all public-sector operators to do the same
3. Improving energy efficiency and promoting the use of renewable energy in the existing building stock
4. Promoting the clean combustion of pellets and firewood

By 2030, the combined impact of measures 1 and 2 will be of the order of 0.2 Mt $CO_2$ equivalent. Taking into account that the blending obligation also concerns the oil used in industry, the total reduction by 2030 will be approximately 0.3 Mt $CO_2$.

## Waste management

Emissions from waste management originate from landfilling, composting, digestion and the treatment of waste water. Even though the incineration of waste produces carbon dioxide emissions, it is a highly cost-effective way to cut greenhouse gas emissions compared to landfilling.

1. Examining the possibility of including waste incineration emissions in the emissions trading system.

Including waste incineration in the emissions trading system could reduce emissions in the effort sharing sector by up to approximately 0.6 Mt $CO_2$ equivalent per year during the period 2021–2030. Furthermore, the plan also proposes monitoring and following up the implementation of the Decree on Landfills.

## F-gases

Fluorinated greenhouse gases, or F-gases, are emitted by various appliances that use these industrial gases that are highly harmful to the climate. Existing measures will reduce F-gas emissions efficiently but with a certain delay.

1. Avoiding appliances containing F-gases in public procurement
2. Promoting the introduction of alternative technologies and enhancing the recovery of F-gases through education and information activities
3. Exploring and demonstrating alternative technologies suited to local conditions.

By 2030, the combined impact of these measures will be approximately 0.3 Mt $CO_2$ equivalent. Thus, F-gas emissions in the effort sharing sector would be approximately 0.5 Mt $CO_2$ equivalent in 2030.

## Machinery

Emissions from machinery can be reduced by increasing the energy efficiency of machinery or by switching to alternative fuels or power sources.

1. Frontloading the introduction of a bioliquid blending obligation and increasing the blending ratio (for light fuel oil) towards the 10% target set for 2030. The steering instrument used to accomplish this will be an amendment to the act on promoting the use of biofuels in transport (laki biopolttoaineiden käytön edistämisestä liikenteessä 446/2007).
2. Promoting the use of biogas in machinery.
3. Participating in the development of $CO_2$-related regulation on machinery at EU level.
4. Increasing the share of energy-efficient and low emission machinery through public procurement.
5. Promoting the energy-efficient use of machinery through guidance by information.
6. Building a stronger knowledge base on reducing the $CO_2$ emissions of machinery.
7. In order to increase the steering effect, taxation of heating fuels will be amended as agreed in the August 2017 governmental budget session.

These measures are estimated to reduce emissions by 2030 by approximately 0.5 Mt $CO_2$ equivalent. Thus, the greenhouse gas emissions from machinery would total approximately 1.8 Mt $CO_2$ equivalent in 2030.

## Other energy-related emissions

The primary source of energy-related emissions in the effort sharing sector is the consumption of fuels. The following measures are proposed to reduce these emissions:

1. Introducing an obligation to blend light fuel oil with 10% of bioliquid and frontloading its implementation
2. Promoting the replacement of fuel oil-fired boilers with boilers fired with solid fuel
3. Enhancing the efficiency of energy audits in accordance with the policies proposed in the Energy and Climate Strategy
4. In order to increase the steering effect, taxation of heating fuels will be amended as agreed in the August 2017 governmental budget session.

## Cross-cutting measures

Influencing consumption and consumer behaviour is a key way of influencing consumption-related greenhouse gas emissions. The present plan outlines an array of measures to cut consumption-related emissions. In emission inventories, the effects of these reduction measures will, in practice, be visible in the effort sharing sector in emissions from areas such as transport, building-specific heating and agriculture. For instance, sustainable food choices can have an impact on consumption-related carbon dioxide emissions.

Energy efficiency also involves multiple cross-cutting measures and new technologies that help reduce emissions both in the ETS sector and the effort sharing sector. For example, EU-wide energy labelling requirements improving the energy efficiency of appliances and ecodesign values (e.g. phasing out incandescent bulbs from the market) setting minimum requirements mainly influence the effort sharing sector.

Small-scale burning of wood generates black carbon that spreads in the atmosphere and accelerates Arctic warming.  Promoting clean burning will reduce adverse effect on climate and human health.

This plan pays attention to the climate policies of municipalities and endeavours to support and strengthen them whenever possible. The interaction between the State and municipalities should be increased in the field of climate policy. Public procurement offers a relevant opportunity to promote climate policy objectives in the concrete activities of the public sector.

## Impacts of the plan

Biofuel production and related investments will have the most significant impact on the national economy. However, the impact will be very limited, and the assumed loss in GDP growth by 2030 will be approximately 0.6%. Over time, the transition to biofuels and low emission vehicles will also, to some extent, be reflected in central government tax revenue. The cost effectiveness of separate emission reduction measures has also been analysed, and an indicative average cost curve has been calculated for the measures.

In addition to greenhouse gas emissions, the policies outlined in this plan will affect areas such as air pollution, human health, natural resources use, biodiversity, water systems and human living conditions. Some of the impacts will be felt in Finland also in the ETS sector and the LULUCF sector or even outside the Finnish borders.

The majority of the negative health impacts of air pollution are caused by fine particulate matter. The main domestic sources of particulate matter are small-scale burning of wood, road transport and machinery. In Finland, air pollution emissions are estimated to reduce by 2030 from the current level as a result of existing or future EU legislation that will especially limit exhaust emissions from transport and emissions from combustion plants. The policies defined in this plan will have a limited impact on these developments.

A separate impact assessment report has been published regarding the plan. The assessment has been conducted as a Government analysis, assessment and research project (TEAS). Economic impacts have been assessed by model calculations at the level of individual measures and the plan as a whole. As in all calculations, underlying assumptions play a key role.

## Involvement and monitoring

During the preparation of the climate change policy plan, several consultations and workshops were organised for stakeholders and all the material from these events was published on the plan's website. During summer 2016, anyone could openly comment on the measures planned by public servants for the Energy and Climate Strategy prepared by the Ministry of Employment and the Economy and the climate change policy plan prepared under the leadership of the Ministry of the Environment on the website energiajailmasto.fi. Comments on the whole climate change policy plan could be submitted when the plan was circulated for comments in May 2017. A total of 84 comments were received during the consultation round. They included numerous concrete proposals that support the implementation of policies and the planning of implementation.

The implementation of the climate change policy plan will be monitored, for example, through annual climate change reports that the Government will provide to Parliament

each calendar year. The reports will include information on emission trends, the achievement of emission reduction targets and additional measures required to reach these targets. Every other year, the report will include monitoring information on the implementation of policy measures.

If monitoring reveals that the measures set out in the plan are insufficient to fulfil the emission reduction obligation, the plan must be reviewed. The strengthening of EU legislation on 2030 targets may also require the contents of the climate change policy plan to be further specified.

The long-term plan for climate change policy, as referred to in the Climate Change Act, will examine the carbon neutrality target for 2045.

# Introduction

The present plan is Finland's first medium-term plan for climate change policy. It is part of the planning system defined in the Finnish Climate Change Act to ensure a coherent and long-term approach to climate policy. The planning system consists of a medium-term policy plan, a long-term policy plan and an adaptation plan.

The target year of the first medium-term policy plan is 2030. The planning horizon and premises of this plan are well coordinated with the National Energy and Climate Strategy and the legislation being prepared at EU level, such as the new Effort Sharing Regulation. Similar coordination with other processes central to climate change policy should be sought also in the future.

Medium-term plans for climate change policy are adopted once per electoral term. The plans will form a continuum: policies and measures can be complemented in future plans. The plan can also be amended as scientific information and knowledge improve or if problems are identified when monitoring its implementation.

The medium-term policy plan concerns the effort sharing sector, meaning sectors not covered by the Emissions Trading System (ETS). It specifies and complements the emission reduction measures set out in the 2016 Energy and Climate Strategy. In the strategy, analyses concerning the effort sharing sector were based on draft sector-specific plans drawn up for the climate change policy plan. The climate change policy plan defines the measures with which Finland will begin to reduce its emissions to reach the level set by the European Commission by 2030. When determining the measures, cost-effectiveness and other key aspects have been taken into account.

Preparing the long-term plan for climate change policy will become relevant during the next term of government. The long-term plan will set targets until 2050. When drafting the medium-term policy plan, it is important to take into account the fact that increasingly efficient emission reduction measures will be needed after 2030. In practice, this means prioritising measures that reduce emissions in the long term.

The emission reduction target set for the effort sharing sector is challenging. It requires us to find cost-effective emission reduction measures in all sectors. The machinery sector is an example of a field for which concrete measures for cutting carbon dioxide ($CO_2$) emissions have been proposed for the first time. In many sectors, particularly in agriculture, research and development needs have been identified in order to promote the future introduction of emission reduction measures that will be socially acceptable.

The climate change policy plan draws attention to the role of climate action by municipalities and in relation to consumption. Decisions taken by municipalities will influence the mobility and housing environment, which has an important impact on the choices made by municipal residents. Energy citizenship also challenges companies in a new way to develop their products.

Debate over the carbon neutrality of Finland has intensified lately. Carbon neutrality would involve measures like taking into account how sinks influence the emission balance. The scenario calculations available indicate that it could be possible to achieve carbon neutrality around the middle of the century, depending on underlying assumptions. The present medium-term policy plan is an important step towards carbon neutrality.

This medium-term policy plan was prepared by a working group appointed by the Ministry of the Environment. In addition to the Ministry of the Environment, the group included representatives of the Ministry of Agriculture and Forestry, the Ministry of Employment and the Economy, the Ministry of Transport and Communications, the Ministry of Finance, the Ministry of Defence and the Ministry of Social Affairs and Health. The Finnish Climate Panel participated in the working group as an expert member. When drafting the plan, a broad and diverse range of stakeholders and citizens were consulted. Planning was also supported by numerous studies and reports. A comprehensive report on the impacts of the plan was drawn up with Government funding for analysis, assessment and research projects (TEAS), and the work also involved developing methodology for assessing impacts on costs. The draft plan was discussed in the ministerial working group on bioeconomy and clean solutions in the spring term of 2017.

## Aiming for carbon neutrality by 2045

According to the Paris Agreement on climate change, it is necessary to rapidly reduce emissions so as to achieve a balance between anthropogenic emissions by sources and sinks of greenhouse gases in the second half of this century. The Climate Change Act does not set carbon neutrality as an objective, but a related goal can be set in the long-term policy plan required by the Act. Thus, it will be justified for Finland to set carbon neutrality as its objective for the post-2030 period. Achieving carbon neutrality will require rapidly reducing greenhouse gas emissions as well as maintaining and strengthening sinks.

By strengthening current climate policy, carbon neutrality could be achieved by 2045. The intention is to carefully examine the carbon neutrality target for 2045 and the related trajectories in the long-term plan for climate change policy. The present medium-term policy plan is an important step towards carbon neutrality.

# 1 International climate agreements and other commitments

At international level, the most important climate policies are laid down in the UN Framework Convention on Climate Change (UNFCCC). The Convention entered into force in 1994, and its objective is to bring greenhouse gas concentrations in the atmosphere down to a harmless level. The Convention itself does not contain quantitative country-specific obligations, but industrialised countries undertook to reduce their $CO_2$ emissions in the Kyoto Protocol linked to the Convention.

The Kyoto Protocol further specifies the UNFCCC. It entered into force in 2005. The Protocol is the first legally binding instrument that has managed to reduce greenhouse gas emissions internationally. It sets binding targets for industrialised countries to mitigate climate change. The current, second commitment period of the Kyoto Protocol was agreed on at the 2012 Conference of Parties in Doha, and it spans the years 2013–2020.

The first commitment period under the Kyoto Protocol covered the years 2008–2012. Finland ratified the Kyoto Protocol together with the other European Union Member States in 2002. Finland's target was to keep its emissions at the 1990 level in compliance with the calculation rules set out in the Protocol. The target was successfully achieved.

## 1.1 Paris Agreement

The Paris Agreement was adopted at the Conference of the Parties to the UNFCCC in December 2015. It applies to the period after the year 2020, which marks the end of the second commitment period under the Kyoto Protocol.

The Paris Agreement does not set binding emission reduction targets for the Parties; instead, the Parties pledge to prepare, communicate, maintain and achieve national emission targets.

The objective enshrined in the Paris Agreement is to strengthen the global response to the threat of climate change, including by:

- holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels
- increasing the Parties' ability to adapt to climate change and foster low greenhouse gas emissions development in a manner that does not threaten food security
- making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

In order to achieve the temperature goal, the Parties aim to reach global peaking of greenhouse gas emissions as soon as possible and to undertake rapid reductions thereafter, so as to achieve a balance between anthropogenic emissions and removals by sinks of greenhouse gases in the second half of this century.

As part of the negotiations on the Paris Agreement, states communicated the climate measures they are prepared to implement after the year 2020. They must communicate new or updated national contributions to the secretariat of the Agreement by 2020 and every five years thereafter. The Parties also committed themselves to the principle of progression in future national contributions. This means that new contributions must become more stringent and/or expand beyond the Party's previous contribution. Each successive nationally determined contribution must reflect the Party's highest possible ambition. Moreover, Parties may at any time adjust their existing nationally determined contributions to enhance their level of ambition.

Parties may cooperate with each other by linking emissions trading systems or by using the international emissions trading mechanism. Such cooperation must, however, be transparent and may not undermine the emission reduction targets.

The countries' collective progress towards achieving the objectives of the Paris Agreement will be assessed every five years by conducting global stocktakes. The first stocktake will be undertaken in 2023.

If fully implemented, the contributions communicated to the secretariat so far will have a significant impact on emissions and global warming. They would limit the increase in temperature to 2.7–3 °C (above pre-industrial levels), an improvement to the previous development trajectory of approximately 3.5–4 °C. Despite the improvement, the commitments

that countries have made so far are insufficient to put the global emission trend on a pathway towards the objective of the Paris Agreement: limiting the temperature rise to 2 °C.[1]

The Paris Agreement entered into force on 4 November 2016, less than a year after its adoption. The EU ratified the agreement on 5 October 2016 and Finland on 14 November 2016. The first session of the Parties to the Paris Agreement was held in Marrakech, Morocco, on 15 November 2016. At the Marrakech meeting, the main focus was on the work programmes of the Paris Agreement and their practical implementation: the Parties agreed on steps to develop the monitoring, transparency and comparability of emission reduction measures by 2018. However, no agreement has yet been made on the details of the process to accelerate emission reductions in accordance with the Paris Agreement.

## 1.2 Other international initiatives

The international Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC) was established in 2012. Short-lived climate pollutants (SLCP) warm the climate and have a negative impact on human health, agriculture, forestry and ecosystems. Reducing climate pollutants will deliver desired results relatively quickly.

Finland joined the CCAC in June 2012. The United Nations Environment Programme (UNEP) acts as the coalition secretariat. CCAC partners include countries, the private sector, international organisations and non-governmental organisations (NGOs). Together they aim to reduce SLCP emissions. CCAC projects to reduce emissions have been launched in several fields, including agriculture, brick production, domestic heating and cooking, diesel, oil and gas production, HFCs and waste. In 2016, CCAC raised more than USD 70 million in funding from its partners.

The '4per1000' initiative[2] was launched in December 2015 in connection with the Paris Climate Change Conference. The initiative aims to increase the quantity of carbon contained in soils by 4‰ each year. The sequestration of atmospheric carbon in soils will contribute to limiting the temperature increase to 1.5–2 °C. It will also increase the productivity of soil and improve food security. Finland supports the initiative and is a member of its decision-making body. The first stage of the initiative focuses on launching cooperation in the field of research.

1 Ekholm, T. & Lindroos T.J., An analysis of countries' climate change mitigation contributions towards the Paris agreement, VTT TECHNOLOGY 239, 2015. http://www.vtt.fi/inf/pdf/technology/2015/T239.pdf UNEP, The Emissions Gap Report 2016, Synthesis Report, 2016. http://web.unep.org/emissionsgap/

2 http://4p1000.org/understand

The Plenary Session of the International Civil Aviation Organisation (ICAO) agreed on the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) on 6 October 2016. The scheme enables the carbon neutral growth of aviation without distorting global competition. The scheme will be introduced in phases. In the scheme, airlines will offset the increase in international aviation emissions by purchasing emission reduction units, mainly from other sectors. These units are sold by projects that reduce greenhouse gas emissions. The primary means of reducing aviation emissions include technological advances, operational improvements and advanced biofuels. They will not, however, help achieve the goal of carbon neutral growth in the near future, which is why the offsetting scheme is necessary.

The International Maritime Organisation (IMO) has designed technical and operative measures and financial steering instruments to limit greenhouse gas emissions. To cut greenhouse gas emissions, new ships have since 1 January 2013 been required to meet energy efficiency performance standards that will become gradually more stringent. All ships are also required to draw up a mandatory energy efficiency management plan. The energy efficiency requirements apply to ships that exceed 400 gross tonnage. So far, no agreement has been made on introducing a comprehensive financial steering instrument, but the IMO has begun preparing a strategy to reduce greenhouse gas emissions. The plan is to adopt a preliminary strategy in 2018 and the final strategy in 2023.

## 1.3 Arctic cooperation

The Arctic Council's work on black carbon and methane is driven by the idea that the rapid change in climate can be slowed down not only by reducing $CO_2$ emissions but also through global action on emissions of short-lived climate pollutants.

Black carbon absorbs thermal radiation and amplifies Arctic warming. It has been shown that emissions transported to Arctic glaciers by air streams from nearby regions have the largest relative impact on the temperature increase. This means that even though the Member States of the Arctic Council only produce 6% of global black carbon emissions, they are responsible for a third of Arctic warming. Black carbon is produced by incomplete combustion, for example, in power and industrial plants using outdated technology, in small-scale burning of wood, diesel vehicles, flaring of excess methane at oil drilling sites, incineration of organic waste and controlled burning of agricultural land.

At the 2015 Ministerial Meeting of the Arctic Council, Member States adopted a political framework document in which they commit to reporting their black carbon emissions, emission trend forecasts and measures to reduce emissions. Observer states are

also encouraged to participate. At the Ministerial Meeting held in May 2017, the Arctic States adopted a collective target of reducing black carbon emissions by 25–33% by 2025. The Arctic Council Expert Group on Black Carbon and Methane (EGBCM) will continue its efforts to reduce black carbon and methane in the Arctic region during the Finnish Chairmanship in 2017–2019. The Arctic Council Member States – and hopefully as many observers as possible – will prepare new national reports by the end of 2017.

During the Finnish Chairmanship, the Council will focus on the implementation of the Paris Agreement and its importance for the Arctic region as well as on raising awareness of Arctic issues and information in global climate talks. Under Finnish Chairmanship, the Arctic Council will produce data and information for special reports on the Arctic region prepared by the Intergovernmental Panel on Climate Change (IPCC) and contribute to adaptation measures in the region, for example, by putting into practice the report *Adaptation Actions for a Changing Arctic* published at the 2017 Ministerial Meeting and by promoting follow-up action on the Arctic Resilience Action Framework. The agenda also includes the implementation of the Arctic Council's *Framework for Action on Black Carbon and Methane*.

# 2 EU climate policy

## 2.1 Objectives and policy packages

The European Council has set the long-term objective of reducing the EU's greenhouse gas emissions by 80–95% by 2050 compared to 1990 levels. This is in line with the recommendations put forward by the IPCC in its Fourth Assessment Report.

The European Union's current framework for climate objectives is based on its 2020 targets that were agreed on as part of the EU climate and energy package in 2008. The key elements and methods in the 2020 package include the EU emissions trading system (ETS), binding national emission reduction targets for the non-ETS sector (the EU Effort Sharing Decision) and binding national targets for the use of renewable energy.

The EU's 2020 and 2030 packages (Figure 1) have a very significant impact on the starting points and objectives of Finland's climate policy in the near future and in the medium term. The European Commission has also adopted several communications on roadmaps for EU climate policy. Long-term reduction targets for greenhouse gas emissions are discussed in the Roadmap for moving to a competitive low carbon economy in 2050 adopted by the Commission in 2011 and in a separate communication on an Energy Roadmap. The Commission has also issued communications on a Roadmap to a Resource Efficient Europe and an Action Plan for Energy Efficiency.

The low carbon economy roadmap establishes a trajectory until 2050 for all key economic sectors in order to achieve the target of reducing emissions by 80%. The roadmap suggests that the EU can cost-effectively reduce its domestic emissions by 40% by 2030 and by 60% by 2040. These reductions should primarily be accomplished through domestic measures within the EU. The analysis in the roadmap is based on multiple scenarios and diverse model calculations.

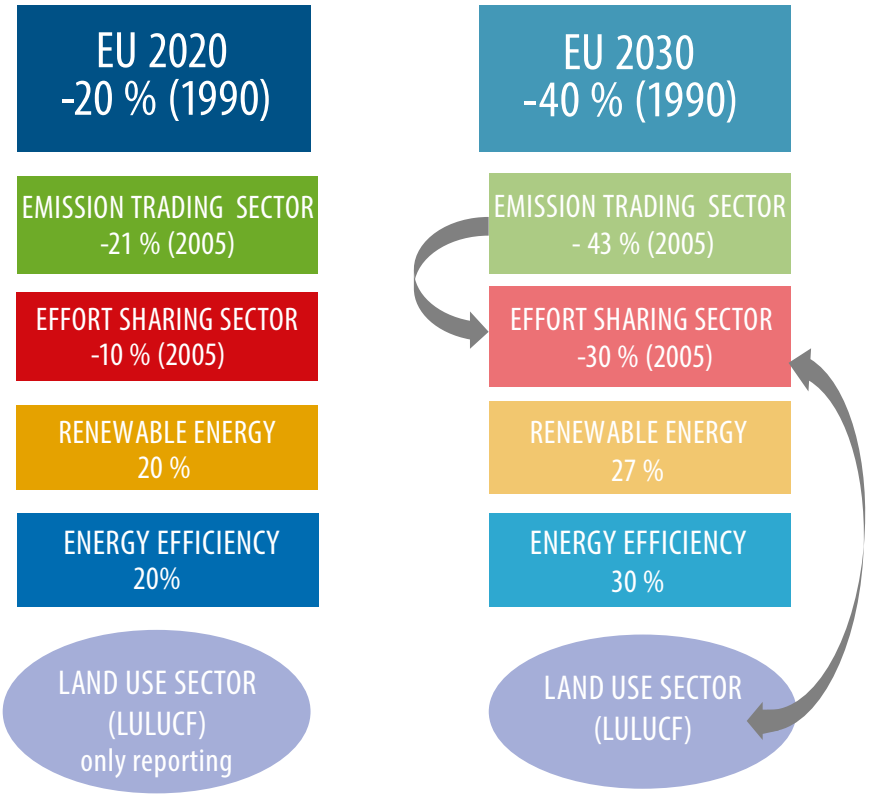


**Figure 1. The EU climate and energy framework: the 2020 climate and energy package is currently in force and the 2030 package is under preparation (negotiations on exact figures still pending). The legislative framework includes the 2020 'percentage targets' and their reference years. The 2030 climate package that is still under preparation will build on the same premises as the 2020 package.**

The European Council agreed in October 2014 on a 2030 Climate and Energy Policy Framework for the EU. This decision also serves as a basis for the Intended Nationally Determined Contributions (INDC) communicated by the EU and its Member States under the Paris Agreement. In its conclusions, the European Council endorsed a target of an at least 40% reduction in greenhouse gas emissions by 2030 (compared to 1990 levels). The emission reduction target of at least 40% is in line with the long-term trajectory proposed by the Commission in the low carbon roadmap in 2011. The conclusions do not specify what the emission reductionss of at least 40% will entail in practice.

The European Council has also outlined in detail how the ETS Directive and Effort Sharing Decision should be amended. Based on the changes put forward by the European Council, the Commission presented in the summer of 2015 a proposal for revising the ETS Directive. In the summer of 2016, it also issued proposals on emission reductions in the effort sharing sector and on including the land use, land-use change and forestry (LULUCF) sector in the EU's 2030 climate objectives.

## 2.2 EU emissions trading system

The EU emissions trading system (EU ETS) covers slightly less than a half of the Union's $CO_2$ emissions. It applies to large industrial plants and power plants with capacity in excess of 20 MW (thermal output). Aviation has been included in the system since the beginning of 2012, but the scope of the ETS is currently limited to flights within the EU. Since 2013, a single EU-wide emission cap has been set for all sectors covered by the ETS. The cap will decrease each year in a linear fashion so that by 2020 emissions in the ETS sector will be 21% lower than in 2005.

In 2015, a 'market stability reserve' was included in the emissions trading system to reduce its vulnerability to disruptions. The reserve will start operating in 2019. The Commission's 2015 proposal for amending the ETS Directive will include changes to the free allocation of emission allowances and the rules to address the risk of carbon leakage. The funding mechanisms established in the emissions trading system will also be updated and clarified.

## 2.3 Effort sharing regulation

The EU's 2020 Effort Sharing Decision was adopted in 2009. It sets binding targets for reducing emissions in the non-ETS sectors, excluding the LULUCF sector and international shipping. Key sectors covered by the Effort Sharing Decision are transport, building-specific heating, agriculture, waste management and industrial gases.

The Effort Sharing Decision establishes binding emission reduction targets for each Member State in the non-ETS sectors. Finland must reduce its emission by 16% compared to 2005 levels by 2020. Emissions must be reduced annually from 2013 to 2020 following a linear trajectory. The Effort Sharing Decision contains various flexibility mechanisms to help Member States achieve their targets. Among other things, Member States can use emission reduction measures implemented in other countries to achieve their own national targets.

In the summer of 2016, the Commission presented a proposal for a new Effort Sharing Regulation for 2021–2030. The proposal is based on the same approach as the Effort Sharing Decision for 2013–2020. Binding targets will be set for all Member States, requiring them to cut their emissions by 2030 following a linear trajectory. As before, the proposed Regulation will include different flexibility mechanisms for achieving the reduction targets.

According to the Commission proposal, Finland should cut its emissions by 39 % by 2030 compared to 2005 levels. The target proposed for Finland is the second most stringent in

the EU, as the highest national target is 40%. The proposal allows Finland the new flexibility of accessing allowances from the EU ETS sector amounting to a maximum of 2% each year compared to 2005 emissions. Member States have to give a binding notification to the Commission by the end of 2019 if they want to use this flexibility mechanism.

In addition to this one-off flexibility, the Commission proposes that Finland could use credits from the LULUCF sector amounting to 1.3% annually compared to the emission level in the effort sharing sector in 2005. However, the possibility of accessing this flexibility mechanism appears uncertain due to the accounting rules proposed for the LULUCF sector. Therefore, the mechanism has not been taken into account in this plan in assessments concerning Finland's need to reduce its emissions. However, Finland will aim to ensure that a limited amount of LULUCF units from forests could also be used to meet the target for the effort sharing sector in 2021–2030.

In addition to the new flexibility mechanisms described above, current flexibility mechanisms established in the 2020 package include the banking, borrowing and trading of allowances between Member States. Banking and borrowing allow Member States to use surplus allowances in later years and borrow allowances from the following year under certain conditions. No allowances have yet been bought and sold between Member States, but in practice the mechanism means that they can trade in allowances. The preconditions for allowance trading are good, because some Member States are estimated to have a significant surplus of emission units and some Member States a clear deficit.

The Commission proposal for an Effort Sharing Regulation is based on emission reduction targets expressed in percentage points. A delegated act will be adopted later on the Member States' emission allocations expressed in tonnes. According to the Commission proposal, average emissions in 2016–2018 would be used as the starting point of the linear trajectory. Negotiations on the Commission proposal began in autumn 2016. The adoption process is unlikely be completed until late 2017 at the earliest.

## 2.4 Land Use, Land-Use Change and Forestry (LULUCF) sector

Greenhouse gas emissions or removals from land use, land-use change and forestry (LULUCF) have so far not been included in the binding emission reduction targets set by the EU. Under the Kyoto Protocol, LULUCF emissions, sinks and targets are monitored in an international monitoring and accounting system.

In summer 2016, the Commission presented a proposal for a regulation determining how to integrate the LULUCF sector into the EU climate policy framework as of 2021 when the

system under the Kyoto Protocol will expire. The proposal sets binding commitments for Member States in the LULUCF sector. It also describes calculation rules for different land-use categories, the choice and improvement of accounting rules and the use of forest reference levels.

According to the proposal, a limited amount of calculated net removals from certain categories in the LULUCF sector can be used to meet the emission reduction target set for the effort sharing sector. Similarly, if the calculated LULUCF sector emissions in a Member State exceed calculated removals, units may be transferred from the effort sharing sector to meet the LULUCF sector target.

At EU level, the LULUCF sector absorbs more greenhouse gas emissions than it produces. The emissions of different land-use categories and their importance as sinks vary greatly across Member States. In Finland, forests are an important carbon sink, while other categories are mainly sources of emissions. Overall, the Finnish LULUCF sector absorbs more emissions than it produces. In recent years, its carbon sink has covered more than 30% (more than 20 Mt $CO_2$) of Finland's total annual emissions.

## 2.5 Renewable energy

The Directive on renewable energy sources (RES Directive) was adopted in 2009. It establishes binding national targets for the use of renewable energy by 2020. The binding target set for Finland requires that renewable energy must account for 38% of the country's gross final consumption of energy by 2020. To meet their targets, Member States must adopt a national renewable energy action plan and report to the Commission every two years on their progress in achieving the targets. The Directive also lays down sustainability criteria for biofuels and bioliquids. The RES Directive has been amended, in particular to take into account indirect land-use changes.

The RES Directive also sets a target of increasing the share of energy from renewable sources to 10% of the final consumption of energy in transport by 2020. Finland has set a national target of 20%.

On 30 November 2016, the Commission adopted a proposal for a directive to establish a framework for the promotion of energy from renewable sources by 2030. The aim is to increase the share of renewable energy to at least 27% of final energy consumption in the EU by 2030. Member States shall collectively ensure that the target will be met, and the proposed Directive does not lay down national renewable energy targets for 2030. The collective target set by the EU target will be binding. The Commission proposes policy

measures to ensure that the collective EU-level target will be achieved in a cost-effective manner in electricity production, heating and cooling, and transport. The aim is to have the Directive enter into force at the beginning of 2021.

For transport fuel suppliers, the Commission proposes an obligation to supply on the market an increasing share of advanced biofuels, certain other biofuels and biogas, fuels of non-biological origin, renewable electricity and waste-based fossil fuels. In 2021, this share must be at least 1.5% of the energy supplied by the transport fuel supplier, increasing up to 6.8% in 2030.

In addition to biofuel and biogas used in transport, the proposal for a new RES Directive includes sustainability criteria for the use of solid and gaseous biomass fuels in the generation of electricity and heat and in cooling. Binding EU-level sustainability criteria are also proposed for solid biomass. The criteria laid down by the current RES Directive only apply to transport biofuels and other bioliquids. According to the proposal for the new Directive, sustainability criteria will apply to all forms of biomass used in the production of electricity, heat and liquid biofuels. The aim of the sustainability criteria is to ensure that the increased use of bioenergy after the year 2020 will deliver substantial greenhouse gas emission reductionss compared to fossil fuels. Sustainability criteria will also be established for biomass production.

The Fuel Quality Directive establishes a binding 6% target for reducing emissions in the transport sector by 2020 compared to the average lifecycle emissions from fossil fuels in 2010. The Fuel Quality Directive includes sustainability criteria for biofuels and bioliquids, similar to those established in the RES Directive.

## 2.6 Energy efficiency

The 20% energy efficiency target set by the EU for the year 2020 applies to primary energy consumption in the EU, and energy savings are compared to an EU baseline for consumption projected in 2007. The energy efficiency target has not been divided into national targets for Member States. Under the Energy Efficiency Directive, each Member State must set an indicative national energy efficiency target. The Directive also requires Member States to prepare National Energy Efficiency Action Plans every three years. The first one had to be submitted by 2014.

The energy performance of buildings is regulated by a separate directive. The Energy Performance of Buildings Directive requires Member States to set minimum energy performance requirements for new buildings and buildings that will undergo major renovation. Member States also have to ensure that by 2021 all new buildings are nearly zero-energy

buildings. The Commission proposed an update to the Energy Performance of Buildings Directive at the end of 2016. The proposed Directive would require Member States to draw up a long-term renovation roadmap to improve the energy efficiency of the building stock. The goal is to decarbonise the building stock by 2050.

The Commission has been asked to review the possibility of increasing the energy efficiency target to 30% for 2030. In its 2016 proposal, the Commission proposes a binding 30% energy efficiency target instead of an indicative 27% target. Member States would need to set their own indicative targets taking into account the requirements of the Directive.

## 2.7 Circular Economy Package

In December 2015, the European Commission put forward a new Circular Economy Package, which includes a comprehensive action plan for the circular economy and related proposals for amending six directives concerning the waste management sector. The action plan (2015–2018) focuses on measures that need to be taken at EU-level to promote the circular economy. The analysis takes into account production, consumption, waste management and the market for secondary raw materials. Key sectors include plastics, food waste, critical raw materials, construction and demolition as well as biomass and bio-based products. The aim of the action plan is to create an environment that enables a circular economy and to improve the balance between regulation and other measures.

The circular economy is a key element of the transition towards a more sustainable economic system. So far, awareness and assessments of its impacts on greenhouse gas emission have been limited. The circular economy will play an increasingly important role in the mitigation of climate change when all 'easy' emission savings have been achieved in energy production.

## 2.8 Progress in achieving the EU 2020 targets

At EU level, greenhouse gas emissions had decreased by 23% already by 2014, which means that the EU exceeded its 20% reduction target for 2020 several years in advance. According to preliminary estimates, emissions slightly increased in 2015 compared to 2014 levels but were still clearly below the 2020 target. The European Environment Agency (EEA)[3] has estimated that the EU is well on track to meet its emission reduction target

3 EEA, Trends and projections in Europe 2016: http://www.eea.europa.eu/publications/trends-and-projections-in-europe

for 2020. According to the EEA, the effort sharing sector target of reducing emissions by 10% compared to 2005 levels will also be clearly achieved. The estimate is based on Member States' own projections. At EU level, the 10% reduction target in the effort sharing sector was met already when the period began in 2013.

At the level of individual Member States, the analyses show that most Member States will achieve their emission reduction targets with existing measures. Only five Member States seem to be unable to reach their 2020 targets with the measures currently in place. According to the EEA, Finland will achieve its 2020 target with current measures by an extremely small margin. The analysis of the situation in Finland is based on a projection from 2016. However, according to the national baseline scenario, Finland may not necessarily meet its 2020 target without flexibility mechanisms, such as banking emission reduction units.

The EEA estimates that a surplus of approximately 1.6 billion emission units will accumulate in the EU effort sharing sector by 2020. Countries that are unable to meet their targets with their own measures can use this surplus if other Member States are willing to sell their excess units. In practice, this would mean transferring units between Member States.

In summer 2016, the European Commission published a new reference scenario, often referred to as REFSCEN2016. It projects energy, transport and greenhouse gas emission trends in the EU until 2050. The scenario includes projections for the EU and individual Member States. It is based on numerous calculation models. One of the most important ones is the PRIMES model that emphasises the energy sector.

The Commission's Reference Scenario 2016 greatly differs from the Finnish national baseline scenario in terms of emission trends. In the Commission's Reference Scenario 2016, emissions from the effort sharing sector decline earlier than in the national baseline scenario, and the cumulative emissions in 2021–2030 are significantly below those in the national baseline scenario. The differences in emissions are greater in 2020 than in 2030, and they concern in particular agriculture and F-gases. When comparing the Commission Reference Scenario to the target trajectory for 2021–2030, one of the key observations is that the projected emission trend will remain below the target trajectory practically during the whole period. This would mean that Finland would meet its 2020 target with existing measures and would not need to implement additional measures or use flexibility mechanisms. If emissions evolve as projected in the scenario, Finland would meet its 2020 target well ahead of schedule.

# 3 Main characteristics of Finland's climate policy

## 3.1 Overview

Since 2001, the key objectives and measures of Finnish climate policy have been outlined in energy and climate strategies. This practice has been based on each Government's policy of drawing up a strategy. The strategies have examined energy and climate policy in a comprehensive manner, based on the premise of fulfilling Finland's binding international and EU-level obligations. The main focus has been on decisions concerning the implementation of energy policies outlined in the government programme in force at the time of each strategy. In addition to national strategies, some ministries have prepared sector-specific climate programmes and action plans.

Alongside strategies, visions for national climate and energy policy until 2050 have been elaborated in the Government Foresight Report on Long-term Climate and Energy Policy published in 2009. The report includes a general long-term target of reducing emissions by at least 80% by 2050 compared to 1990 levels.

This objective became legally binding when it was enshrined in the Climate Change Act adopted in 2015. According to the Act, the goal of the planning system for climate change policy is to ensure that emissions will be reduced enough to meet at least the target mentioned above. It also stipulates that national total emission reduction targets must be consistent with international and European Union legislation binding on Finland.

The Energy and Climate Roadmap[4] prepared in 2014 by a parliamentary committee established by Prime Minister Jyrki Katainen's Government will serve as a strategic guide on the

4 Energy and Climate Roadmap 2050. Report of the Parliamentary Committee on Energy and Climate Issues on 16 October 2014.

journey towards a carbon neutral society. The roadmap does not specify a single pathway towards 2050; instead, it explores different alternatives and their impacts on the cost-effectiveness of emission reductions and the competitiveness of the society.

## 3.2 Finland's 2020 emission target and its attainment

The 2008 and 2013 energy and climate strategies outline the key policies for Finland to reach its 2020 targets. The 2020 emission framework was last analysed on the basis of the baseline scenario published by the Ministry of Employment and the Economy in summer 2016. It also estimates the development of energy use and production as well as greenhouse gas emissions until 2030. The scenario takes into account existing policy measures and their impacts but no new measures.

According to the national baseline scenario, Finnish emissions in the effort sharing sector will be well below the linear trajectory in the first part of the period 2013–2020 but slightly above the target in the final years 2018–2020.

The Effort Sharing Decision allows, for example, the flexibility mechanisms of banking and borrowing to meet the target. This means that Finland will be able to use the above-target progress achieved in the early years to compensate for its underperformance later. The positive development in 2014–2015 is attributable particularly to the substantial emission reductions achieved in the transport sector through the rapid increase in the use of biofuels. In total, the surplus of emission allowances accumulated in the early years will be well sufficient to cover the deficit during the final years.

The current Government Programme sets as an objective that Finland will achieve the 2020 climate objectives already during the government term. In practice, this means that Finland should meet its 2020 target set in the Effort Sharing Decision already in 2018. The Government Programme does not specify measures for achieving the target ahead of schedule.

The objective has a significant impact on the climate policy plan, because reaching the required 16% emission reduction by the end of 2018 will have an indirect effect on the linear trajectory of the 2030 target. In quantitative terms, the 2020 target means that emissions must be reduced to 28.4 Mt $CO_2$ in 2018.

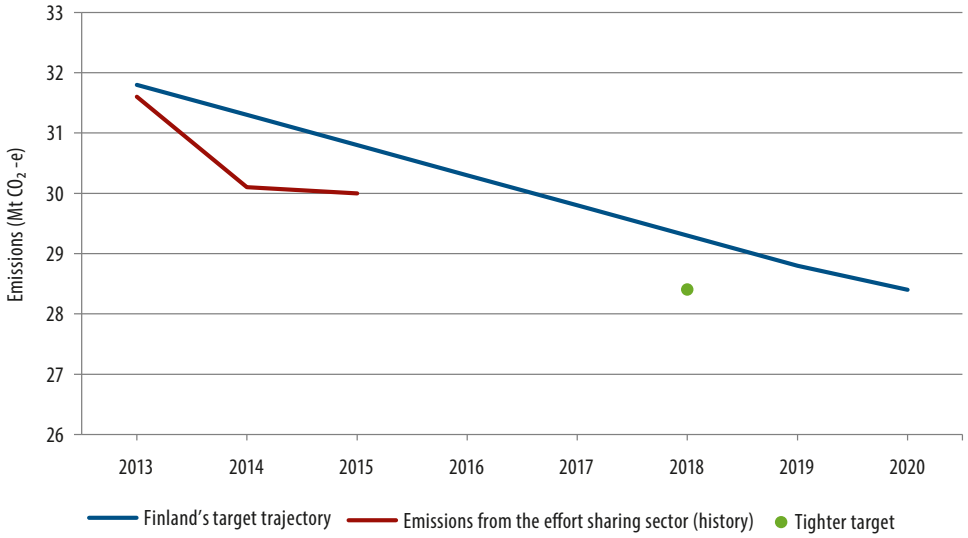


**Figure 2. Finland's recorded emissions in the effort sharing sector (Statistics Finland 2016), the target trajectory for its emissions and the more stringent target for 2018.**

## 3.3 Energy and climate strategies and the Energy and Climate Roadmap 2050

The energy and climate policies of Prime Minister Juha Sipilä's Government Programme have been determined in the key project '*Towards carbon-free, clean and renewable energy cost-efficiently*'. On 24 November 2016, the Government published the National Energy and Climate Strategy for 2030. It outlines the concrete actions and objectives that will enable Finland to achieve the energy and climate targets specified in the Government Programme and jointly adopted in the EU for 2030, and to systematically set the course for reaching the 2050 targets.

The strategy was submitted to Parliament as a government report. It presents key policies to achieve energy policy objectives. They state, among other things, that Finland will phase out the use of coal for energy by 2030, draw up a report on the health and environmental impacts of wind power and subsequently prepare technology-neutral competitive tendering processes for the years 2018–2020 to ensure that aid for electricity production will only be paid to the most cost-effective and competitive investments in renewable electricity production, and introduce an obligation to blend light fuel oil used in machinery and heating with a 10% share of bioliquids. The strategy sets the objective of increasing the physical share of biofuel energy content in all fuels sold for road transport to 30% by 2030. Moreover, Finland should have a minimum of 250,000 electric vehicles and a minimum of 50,000 gas-fuelled vehicles in 2030. The operation of the electricity market will be developed from the perspectives of regional and European mar-

kets. The flexibility of electricity demand and supply and, in general, system-level energy efficiency will be improved. The new alternating current connection planned between northern Finland and northern Sweden will be a key project for securing sufficient transmission lines.

Energy efficiency measures in the transport sector and the obligation to distribute biofuels will deliver the greatest emission cuts in non-ETS sectors. Emissions will also be reduced by the obligation to blend light fuel oil with a 10% share of bioliquids.

With the measures outlined in the strategy, the share of renewable energy in final energy consumption will reach approximately 50% and Finland's self-sufficiency in energy supply will increase to 55% of final consumption by 2030. The use of renewable energy will increase in several sectors, such as electricity and heat production and transport. In the transport sector, energy efficiency measures, increasing the mandatory share of biofuels to 30% of energy content and increasing the number of electric and gas-powered vehicles will bring the share of renewable energy use in transport to a level well above the target set in the Government Programme. The proposed policy measures will help achieve the target of halving the use of imported oil.

Aid for industrial-scale electricity production will increase wind power production and other renewable electricity generation by a total of 2 TWh. Promoting the use of gas-powered vehicles and other measures to encourage biogas use and production will increase the use and production of biogas to some extent.

## 3.4 Climate Change Act and the planning system for climate change policy

The Climate Change Act (609/2015) entered into force in June 2015, establishing a framework for long-term and cost-effective planning and monitoring of climate policy in Finland to reduce anthropogenic emissions of greenhouse gases into the atmosphere, mitigate climate change and adapt to climate change through national actions. The Climate Change Act is a goal-oriented framework act that applies to state authorities but does not contain substantive legislation on different sectors.

The act sets as the long-term target of reducing greenhouse gas emissions by a minimum of 80% by 2050 compared to 1990 levels.

The act also establishes a climate change policy planning system that includes a medium-term climate change policy plan adopted by the Government once every government

term as well as a long-term climate change policy plan and a national adaptation plan for climate change to be adopted at least once every ten years.

The act gives Parliament and the public better possibilities for participating in and influencing the planning of Finnish climate policy. The Government shall submit a report to Parliament on the climate change policy plans it has formulated, and the annual climate change report to be included in the Government's annual report keeps the Parliament informed of progress in achieving climate targets and the effectiveness of the measures introduced.

The inclusion and access to information of the general public will contribute to broad-based and high-quality preparation of decisions and thus the acceptability of climate policy decisions. The appointment of a Climate Panel, as referred to in the Climate Change Act, will promote dialogue between policy-making and scientific knowledge. The purposes of the Climate Change Act also include enhancing and coordinating the activities of state authorities in planning climate policy and monitoring its implementation.

Of the national climate change policy plans, the long-term and medium-term plans concern the mitigation of climate change. The long-term policy plan includes a 2050 emission reduction target, which gives clear direction to long-term efforts to mitigate climate change. The medium-term policy plan only applies to the non-ETS sector. To provide a background for the actions included in the plans and to support decision-making, the plans will include a report on actual greenhouse gas emissions and assessments of future developments in emission levels and in global and EU climate policies. The national adaptation plan for climate change shall include a risk and vulnerability review, as well as action plans on adaptations specific to each administrative branch, if necessary. The plans provide a basis and direction for the detailed preparation of climate policies in various branches of administration.

The plans will be reviewed at intervals defined by the Climate Change Act (once per electoral term or ten years), which enables emerging needs and new information on climate change to be flexibly taken into account in the plans. If necessary, plans can be reviewed at shorter intervals and additional measures adopted to ensure the timely achievement of emission reduction targets. Under the act, climate change policy plans must be prepared in an open manner and in consultation with various parties.

The policy plans are prepared as a collaborative effort among the relevant ministries, and they are approved by the Government. For each plan, one ministry will have overall responsibility, compiling and coordinating the work of others. Long-term and medium-term climate change policy plans and the adaptation plan must be coordinated as necessary. Moreover, the plans should be coordinated with the preparation of other energy and climate policies, such as the energy and climate strategy in its current form.

The Government submits reports to Parliament on the climate change policy plans, enabling Parliament to comment on the plans.

According to the Climate Change Act, the state authorities shall in their activities promote the implementation of plans in accordance with the act as far as possible. Thus, authorities must take the plans into account within the limits of legislation regulating their activities. Other legislation in force should naturally be considered already when preparing the plans.

The goal of drawing up climate change policy plans is to attempt to mitigate climate change and adapt to it in a cost-effective and acceptable way. The goals and measures relating to climate change mitigation and adaptation included in the plans shall be based on research data, so that the progression of climate change, its probable positive and negative effects, the related risks and hazards, and the possibilities to prevent accidents and limit their adverse effects are taken into account. In planning related to agricultural production, it shall be ensured that the measures related to mitigating climate change are planned and implemented so that they do not compromise domestic food production or global food security.

In addition, the following issues shall be taken into account in drawing up climate change policy plans:

1. Obligations under international treaties binding on Finland and under the legislation of the European Union;
2. Information generated in the national inventory system for greenhouse gas emissions and in the national system for policies and measures and projections;
3. Current research data on climate change, and assessments of developments in international climate change policies and European Union climate change policies;
4. Environmental, economic and social factors based on the principle of sustainable development;
5. The development and level of technology related to the reduction of greenhouse gases, mitigation of climate change and adaptation to climate change;
6. Other essential factors in terms of societal development.

## 3.5 Other legislation

The national legislation on activities in non-ETS sectors includes several acts that influence efforts to limit greenhouse gas emissions or maintain and enhance carbon sinks that mitigate climate change.

For example, regulation on transport, land use and building, agriculture and forestry, waste management and environmental protection can contribute at least indirectly to climate change mitigation and adaptation, for instance, through obligations concerning sustainable development and the promotion of energy and material efficiency. The water sector includes numerous provisions that are directly linked to climate change adaptation.

## 3.6 Reporting system for greenhouse gas emissions and policy measures

As an EU Member State and a party to the UN Convention on Climate Change (UNFCCC) and the Kyoto Protocol, Finland must report on certain information (emission trends and measures) concerning climate change mitigation and adaptation in various reports. At EU level, the main provisions on the system for monitoring greenhouse gas emissions and the related reporting are laid down in the EU Regulation on a mechanism for monitoring and reporting greenhouse gas emissions (MMR Regulation).

Key reports include the annual greenhouse gas inventory submitted to the EU and the UNFCCC Secretariat and the Policies and Measures Report (PAMS) submitted to the European Commission on the policy measures planned to reduce greenhouse gas emissions and on their implementation. Furthermore, Finland must submit national communications and biennial reports to the UNFCCC Secretariat.

The purpose of reporting information on climate policy is to support the monitoring of obligations and national policy-making. If emission reduction targets are not achieved, ex post assessment of policy implementation will help review earlier decisions on policy measures so that future resources can be allocated to more effective measures.

Because climate reporting is governed by EU legislation and provisions based on international agreements, the national Climate Change Act does not include separate substantive provisions on the matter. The goal of the Climate Change Act and the planning of climate change policy carried out in accordance with it is to ensure the fulfilment of obligations under the treaties binding on Finland and under the legislation of the European Union to reduce and monitor greenhouse gases. For this purpose, existing monitoring and report-

ing systems should be used in the preparation of climate change policy plans as extensively as possible.

Certain highly important climate policy themes and measures are currently being discussed or adopted at international and EU level, and they will be reflected in climate reporting obligations in the near future. The Paris Agreement also includes provision that will influence climate reporting.

# 4 Formulation of the medium-term climate change policy plan

## 4.1 Starting point for preparing the climate change policy plan

According to the Climate Change Act, the Government shall approve a medium-term plan for climate change policy once per electoral term. The plan shall include an action plan that proposes the measures for reduction of anthropogenic greenhouse gas emissions and mitigation of climate change in the sectors outside emissions trading. It shall also contain projections of greenhouse gas emissions and the effects of policy measures on the emissions. This first plan will examine emission trends until 2030. This scope is consistent with the interpretation of the concept 'medium term' in the rationale of the Climate Change Act and is also compatible with the time horizon applied in EU climate policies.

The plan is to a great extent based on sector-specific plans concerning the possibilities and costs of cutting emissions. The sector-specific plans look at both historical trends in emissions and future scenarios up to 2030. The scenarios analyse the adequacy of existing measures and the methods that could be used to achieve greater cuts in emissions. Proposals for new policy measures for achieving the required cuts in emissions are at the core of the plans.

In the next phase, the sector-specific plans were combined to form a plan that covers all non-ETS sectors. In this stage, the challenge was to ensure that, when combined, the proposed measures will be sufficient to meet the total emission reduction target for all non-ETS sectors. Achieving overall balance requires applying a common methodological framework for assessing sector-specific measures. The starting point is to have some criteria for comparing sector-specific measures.

In early 2016, the Finnish Climate Panel submitted its views on methodological issues concerning the preparation of the medium-term policy plan at the request of the Ministry of the Environment. The panel was asked to assess in particular how and on which criteria

the possibilities of reducing emissions in different sectors should be assessed to ensure comparability. The panel was also requested to state its views on how to best ensure that sector-specific emission reduction measures will in total be sufficient to achieve the binding general emission reduction target imposed at EU level. The methodological memorandum submitted by the Climate Panel will be discussed in more detail in section 7.1.

## 4.2 Coordinating the climate policy plan and the energy and climate strategy

According to the Climate Change Act, the medium-term plan for climate change policy must be coordinated with the national energy and climate strategy in terms of schedule and contents. This requires that the two documents must be drawn up approximately at the same time. Coordination also involves using a similar basis for calculations in both processes.

The conditions for coordinating this plan with the strategy adopted at the end of 2016 were good, because they were prepared simultaneously. In terms of contents, coordination was ensured, for example, by having the same public servants participate in the working group in charge of drafting the climate policy plan and in the formulation of the strategy. Moreover, progress in drafting the strategy and the plan was regularly discussed in the meetings of the network of public servants from the ministries responsible for energy and climate issues. When coordinating the processes, efforts were made to avoid overlapping work.

# 5 2030 emission reduction target for the effort sharing sector

## 5.1 Finland's target and the related uncertainties

In the medium-term climate change policy plan, targets are set on the basis of the European Commission's 2016 proposal for an Effort Sharing Regulation. Under the proposal, Finland should cut its emissions by 39% by 2030 compared to 2005 levels. According to Statistics Finland, Finnish emissions in the effort sharing sector amounted to 33.7 Mt $CO_2$ in 2005. Thus, Finland's emission **target for 2030 will be 20.6 Mt $CO_2$**.

Under the Commission proposal, the emission reduction target for the period 2021–2030 would be based on a linear trajectory ending with the target for 2030 and starting with average emissions in 2016–2018. The calculated starting point of the trajectory would be 2020. Because flexibility mechanisms can be used to meet the binding target, emissions can in some years exceed the annual emission target as long as the cumulative emissions remain within the total emission allocation. Annual emission allocations shall be defined later in a separate delegated act adopted by the Commission.

There are still several uncertainties regarding Finland's emission reduction trajectory. The most important one concerns the development of emissions in 2016–2018, which will serve as basis for determining the starting point of the trajectory. Currently, the only information available on emissions in 2016–2018 are estimates calculated on the basis of scenarios.

The methodology for calculating the starting point also involves a certain level of uncertainty because it is one of the key issues in the negotiations on the Effort Sharing Regulation. Other alternatives for determining the starting point have also been proposed, and the majority of them would increase Finland's target for reducing emissions. Negotiations on the EU Effort Sharing Regulation are likely to last at least until the end of 2017, when Finland's 2030 emission target will also be confirmed. This plan is based on the assumption that the Finnish emission reduction target proposed by the Commission will not change

during the process. This assumption is made for calculation purposes and is not connected to the formulation of the Finnish position on the matter.

There is also a certain level of uncertainty about whether the current binding emission reduction targets will remain in force until 2030. The EU has made a commitment to reduce its emission in the effort sharing and ETS sectors in total by at least 40%, but current legislative proposals will, in practice, result in a reduction of precisely 40%. It is possible that discussions on increasing the current target will begin in the early years of the period 2021–2030, depending on the progress achieved in implementing the Paris Agreement.

## 5.2 Assessment of the importance of flexibility mechanisms

Finland's need to reduce emissions is assessed on the basis of the national baseline scenario published in 2016. The national baseline scenario gives a more conservative estimate of emission trends than the reference scenario used by the European Commission or the baseline scenario calculated by VTT Technical Research Centre of Finland Ltd (VTT). In this context, 'conservative' means that emissions will reduce at a slower pace than in the other scenarios. However, the conservative approach is justified in terms of risk management. Any assessments of the need to reduce emissions should be based on the premise that the reduction target can be achieved with sufficient certainty. Underestimating the reduction need would increase the risk of being unable to meet the target.

According to the national baseline scenario, the target will be achieved without new policy measures during the first years of the period 2021–2030, but the need for additional emission reductions will increase towards the end of the period. In 2030, emissions will be approximately 6 Mt $CO_2$ above the target. When determining the scale of the necessary measures and flexibilities, it must be considered how the need to reduce emissions will develop both annually and cumulatively over the whole period. The development of the cumulative reduction need over the period 2021–2030 will be discussed further in section 7.3. The cumulative reduction need is an important aspect to consider because emission reduction units can be transferred from one year to another.

The Commission proposal for an Effort Sharing Regulation provides Finland and certain other Member States with the possibility of using a one-off flexibility, which would in practice mean cancelling emission allowances in the ETS and creating corresponding units in the effort sharing sector. For Finland, the annual maximum amount of flexibility would be 2% of its 2005 emissions in the effort sharing sector. In quantitative terms, this would amount to approximately 0.7 MT $CO_2$ of units per year and approximately 7 Mt $CO_2$ of units over the whole period. In further preparations, it will be justified to assume that Finland

will make use of this flexibility mechanism because, in light of the foreseeable development of prices, its costs will be very reasonable compared to the general costs of reducing emissions in the effort sharing sector.

According to the Energy and Climate Strategy, utilising the flexibility mechanism will reduce the central government's revenue from emission allowance auctions by an estimated total of EUR 160 million during the period 2021–2030. This corresponds to an average price of EUR 23 / t $CO_2$. However, most measures in the effort sharing sector will be more expensive. Thus, utilising the flexibility mechanism would clearly improve the cost-effectiveness of meeting the target. It would cut the amount of emissions that Finland will need to reduce, and the 2030 target would decline to a level of 37%.

Other flexibility mechanisms included in the Effort Sharing Regulation could also present Finland with relevant opportunities for reaching its emission reduction target. However, the usability of some the mechanisms is still uncertain. The starting point is that flexibility mechanisms can help improve the cost-effectiveness of emission reduction measures in the effort sharing sector. The matter nonetheless requires comprehensive and diverse analyses.

Flexibility mechanisms also provide a good opportunity to manage the risks associated with achieving the target. Even though national emission reduction measures are planned and assessed on the basis of best available information, there will always be a certain level of uncertainty about their effectiveness and implementation. To manage this uncertainty, we will need measures that can be implemented quickly to fill any gaps. Flexibility mechanisms can enable such action.  A separate detailed plan will have to be drafted on the use of flexibility mechanisms at the latest at the beginning of the commitment period, when national reduction percentages and detailed rules on the use of the mechanisms will have been established.

# 6 Emission trends and outlook up to 2030

## 6.1 Assessment of the 2030 baseline (WEM)

A new national baseline scenario was finalised in the summer of 2016 in a project led by the Ministry of Employment and the Economy. It takes into account currently implemented and adopted emission reduction measures. According to the baseline scenario, greenhouse gas emissions will be below the linear trajectory defined in the EU Effort Sharing Decision by a small margin until 2017, but they will exceed the trajectory in the last years of the period. After 2020, the emission trend will follow the pre-2020 path until 2030. According to the scenario, emissions would total 26.4 Mt $CO_2$ in 2030. They will reduce by approximately 0.2 Mt $CO_2$ per year, which corresponds to an annual rate of circa 1%.

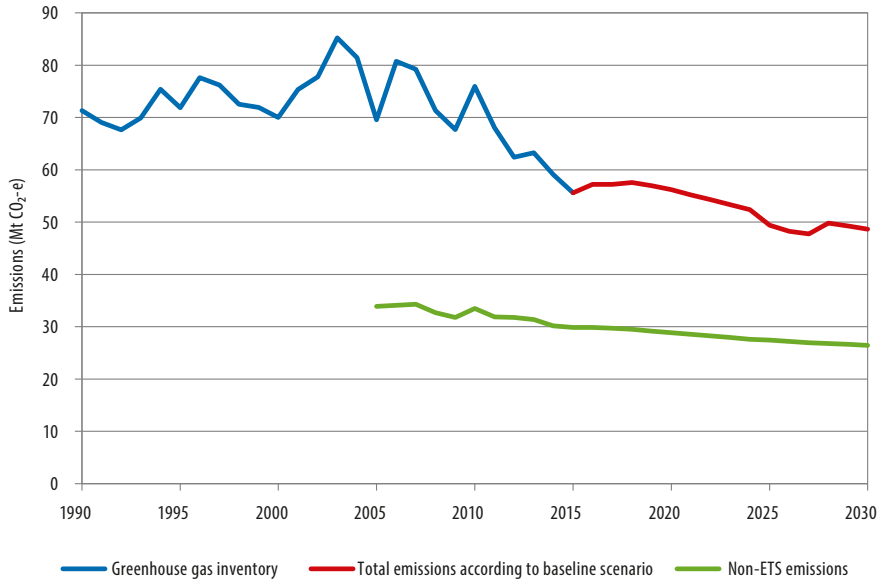


**Figure 3. Baseline scenario until 2030, published in 2016.**

If the trends of individual greenhouse gases are examined separately, the scenario reveals that the relative shares of methane and nitrous oxide will increase while $CO_2$ emissions from transport, in particular, will decrease. According to the baseline scenario, other emissions than $CO_2$ will account for almost 40% of emissions in the effort sharing sector in 2030. The sources of these emissions are specified in the sector-specific analysis presented in section 6.3.

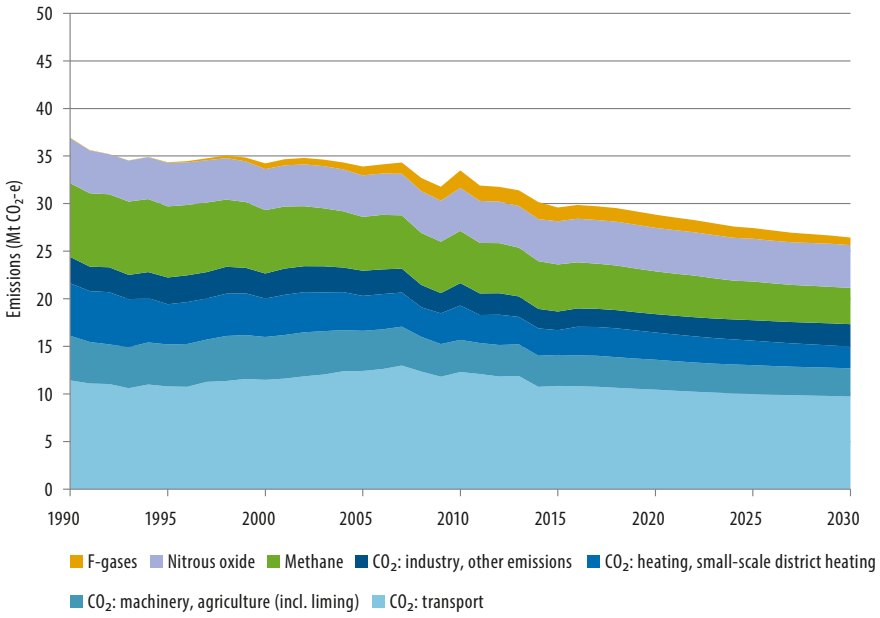


**Figure 4. National baseline scenario until 2030 for emission trends in the effort sharing sector (based on the scope of the ETS in 2013), presented by gas (Ministry of Employment and the Economy 2016/9).**

## 6.2 Adequacy of existing measures for reaching targets

The Commission proposal for an Effort Sharing Regulation does not include targets for 2030 expressed in tonnes. The linear emission reduction trajectory for 2021–2030 will be determined later by a delegated act. Only an estimate of the future linear trajectory is currently available due to the uncertainties associated with the trajectory.

Figure 5 shows that the difference between the linear trajectory of the emission reduction target and the national baseline scenario will be very small in the early years of the period 2021–2030, and a small surplus may even be accumulated. However, towards the end of the period the gap between the baseline scenario and the trajectory will increase rapidly, leading to a deficit of approximately 6 Mt $CO_2$ in 2030. The cumulative deficit for the whole period will be approximately 26 Mt $CO_2$. The Commission estimates the difference

between the target trajectory and the baseline scenario to be much smaller: circa 4 Mt $CO_2$ in 2030. Based on the information available, it is nonetheless clear that existing measures will not be sufficient to reach the emission reduction target proposed for 2030.

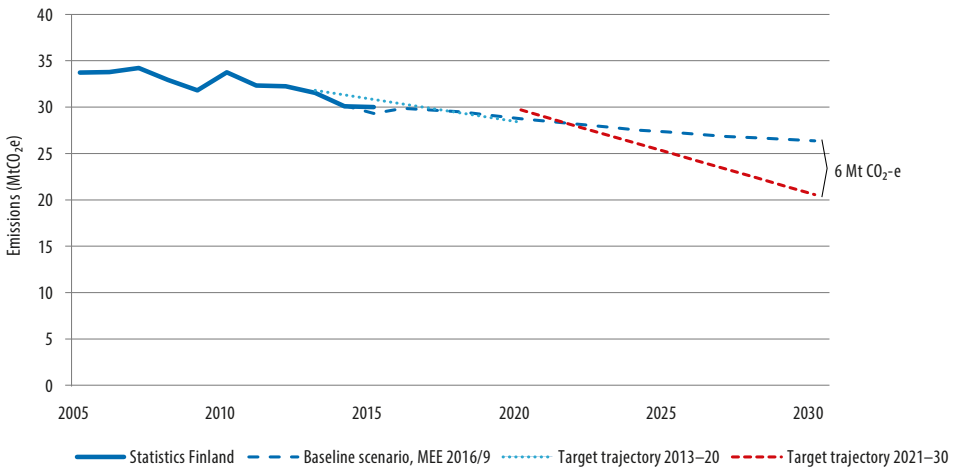


**Figure 5. National baseline scenario (Ministry of Employment and the Economy 2016/9) and the Finnish target trajectory (Target trajectory 2021–2030).**

## 6.3 Analysis of the effort sharing sector by subsector

### 6.3.1 Transport

#### Emission trends

The greenhouse gas emissions of domestic transport totalled 11.1 Mt $CO_2$ in 2015. Transport emissions account for approximately a fifth of Finland's total greenhouse gas emissions and some 40% of emissions in the effort sharing sector. Thus, transport will play a key role in reducing emissions in the effort sharing sector. Greenhouse gas emissions from domestic transport increased from the economic depression in the early 1990s until 2007. Since 2008, they have mainly decreased. From 2005 to 2015, greenhouse gas emissions from transport decreased by a total of approximately 1.8 million tonnes or 14%.

Some 90% of emissions from domestic transport are produced by road transport. Approximately 58% of road transport emissions are caused by passenger cars, 37% by vans and trucks and the remainder by buses, coaches, motorcycles etc. Railway transport accounts for approximately 1% of the emissions, aviation about 2% and waterborne transport some 4%. In the monitoring of the Effort Sharing Decision, Finnish transport emissions are con-

sidered to include emissions from road transport, emissions from waterborne transport in the Finnish economic territory and emissions from rail transport excluding emissions from the production of electricity. In the field of aviation, emissions from air transport within the EU are covered by the Emissions Trading System and measures concerning emissions from international aviation are adopted by ICAO (see chapter 1).

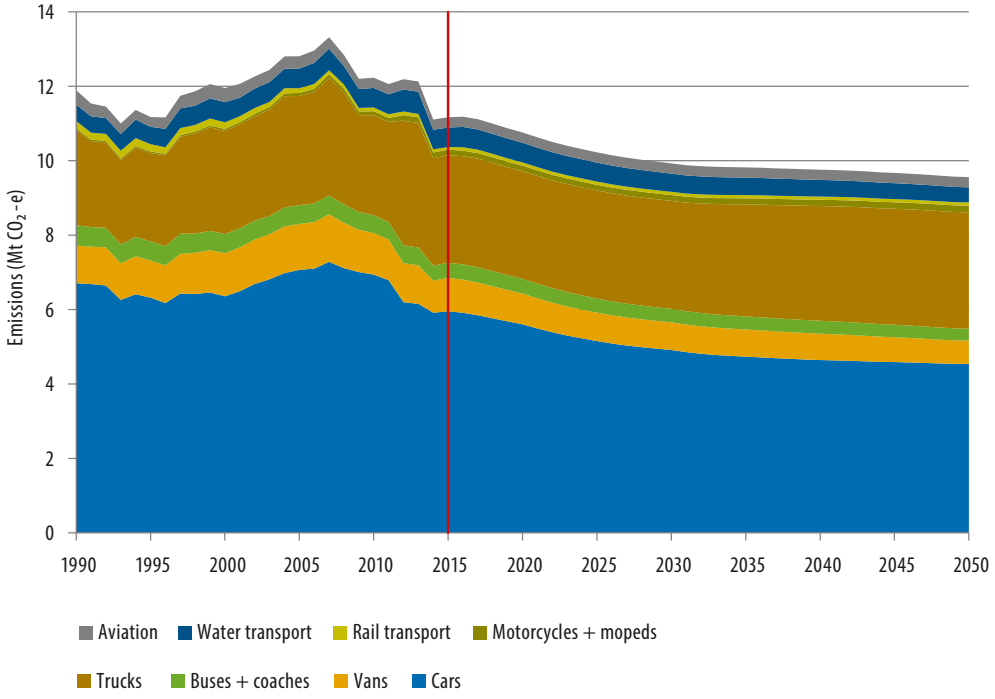


**Figure 6. Greenhouse gas emissions from domestic transport in 1990–2015 and projected emissions until 2050.**

## Trends

The baseline scenario for transport is based on the traffic performance projected until 2030 by the Ministry of Transport and Communications and VTT. According to the projection, road transport performance will increase in 2016–2020 by approximately 0.9% a year and in 2021–2030 by approximately 0.8% a year. This rate would result in a total increase of 12% in road transport performance by 2030.

Another key assumption in the baseline scenario is the car fleet replacement rate and the average $CO_2$ emissions of new vehicles. In the baseline scenario, approximately 5% of the passenger car fleet is assumed to be replaced each year, which would translate into 127,000 new cars sold each year in the period 2016–2020 and 146,000 new cars sold in the

period 2021–2030 (Table 1). In 2020, the specific emissions of new cars would be close to the limit of 95 g/km that the EU has established for car manufacturers but they would no longer decrease after 2020 without new (EU-level) measures.

Based on the model calculations conducted, the number of electric vehicles would increase in the baseline scenario (without additional measures) to approximately 18,000 in 2020 and to approximately 120,000 in 2030. The number of gas-powered cars would reach approximately 3,600 in 2020 and 13,000 in 2030 (Table 2).

The third factor with a substantial impact on transport greenhouse gas emissions in the baseline scenario is the share of biofuels in the total consumption of fuel in transport (Table 3). In the baseline scenario, the actual share of biofuels is estimated at 13.5% in 2020 and onwards. The estimate is based on the act on promoting the use of biofuels in transport (*laki biopolttoaineiden käytön edistämisestä liikenteessä* 446/2007), which stipulates that biofuels must account for a calculated share of 20% of all transport fuels sold in 2020. The binding target allows 'double counting', in which certain biofuels that do not compete with food production count double for compliance with the target. The baseline scenario is based on the assumption that starting from 2020 the share of non-double counted biofuels will be 7% and the share of double counted biofuels 6.5%. Thus, the calculated share of biofuels would be 20% while their actual share would be 13.5% in 2020–2030.

According to the counting rules for biofuels and electricity consumption, their $CO_2$ emissions during use are zero. Thus, the use of biofuels and electricity in transport fully reduce $CO_2$ emissions.

**Table 1. Annual sales of new cars.**

| | Number of new cars sold | | | |
|---|---|---|---|---|
| **Cars** | **2015** | **2020** | **2030** | **2050** |
| **Petrol** | 68,103 | 83,300 | 89,300 | 93,600 |
| **FFV (high-blend ethanol)** | 26 | 110 | 300 | 360 |
| **Diesel** | 39,796 | 46,400 | 45,040 | 36,000 |
| **Gas** | 109 | 540 | 1,500 | 1,800 |
| **Electricity** | 778 | 4,630 | 13,800 | 46,800 |
| **Hydrogen** | 0 | 20 | 60 | 1,440 |
| **Total** | **108,812** | **135,000** | **150,000** | **180,000** |

**Table 2.** **Annual car fleet.**

| | Number of cars | | | |
|---|---|---|---|---|
| **Cars** | **2015** | **2020** | **2030** | **2050** |
| **Petrol** | 1,932,253 | 1,909,600 | 1,814,500 | 1,840,400 |
| **FFV (high-blend ethanol)** | 8,396 | 8,270 | 6,800 | 6,600 |
| **Diesel** | 678,739 | 856,000 | 1,005,000 | 855,000 |
| **Gas** | 1,921 | 3,660 | 13,100 | 30,000 |
| **Electricity** | 1,608 | 18,400 | 120,050 | 593,000 |
| **Hydrogen** | 0 | 70 | 550 | 15,000 |
| **Total** | **2,622,917** | **2,796,000** | **2,960,000** | **3,340,000** |

**Table 3.** **Consumption of fuel components in road vehicles.**

| | Consumption of fuel components in road vehicles | | | |
|---|---|---|---|---|
| **Fuel component** | **2015** | **2020** | **2030** | **2050** |
| **Fossil petrol [t/a]** | 1,234,417 | 1,070,000 | 890,000 | 946,400 |
| **Fossil diesel [t/a]** | 2,012,907 | 2,040,000 | 1,960,070 | 1,796,300 |
| **Renewable diesel [t/a]** | 397,257 | 415,000 | 389,500 | 364,800 |
| **Ethanol [t/a]** | 97,211 | 101,000 | 86,500 | 91,700 |
| **Fossil gas [t/a]** | 2,032 | 2,200 | 6,950 | 14,500 |
| **Biogas [t/a]** | 1,187 | 2,000 | 6,900 | 14,500 |
| **Hydrogen [t/a]** | 0 | 10 | 80 | 1,800 |
| **Electricity [GWh/a]** | 2.8 | 50 | 350 | 1,330 |

## Existing measures

Finland's national targets for biofuel blending shares until 2020 have been determined in the act on promoting the use of biofuels in transport. According to the act, the energy content of biofuel must account for a calculated share of at least 20% of the total energy content of the petrol, diesel and biofuels a supplier supplies for consumption in 2020. The share must be at least 6% in 2011–2014, 8% in 2015 and 10% in 2016. In 2017, it must reach 12% and in 2018 15%. The 2020 target clearly exceeds the target of at least 10% that was set for EU Member States in the RES Directive.

In 2011, the Finnish energy taxation of transport fuels was transformed into a system based on environmentally related taxes. The excise duty previously applied to fuels per litre was replaced by an energy content tax based on the energy content (calorific value) of fuels and a carbon dioxide tax based on the specific $CO_2$ emissions emitted in the combustion of fuels. The carbon dioxide tax is a differential tax with three different rates depending on how much biofuels and bioliquids can reduce lifecycle $CO_2$ emissions compared to fossil fuels.

Since 2008, the car tax percentage of cars and vans has been a differential tax that depends on the $CO_2$ emissions corresponding to a car's fuel consumption. The lowest rate (4.4%) applies to vehicles with zero $CO_2$ emissions and the highest (50%) to vehicles with emissions of at least 360 g/km. The lowest tax percentage will decrease to 2.7% in 2019. The Finnish vehicle tax also depends on the $CO_2$ emissions of the vehicle. At present, the lowest amount of tax is EUR 106.21 per year. It applies to vehicles with $CO_2$ emissions of 0 g/km. The lowest tax rate is also applied as the basic tax on electric cars. The highest tax rate of EUR 654.44 applies to vehicles with $CO_2$ emissions of at least 400 g/km.

In addition to national measures, the $CO_2$ limits binding on EU vehicle manufacturers will have a significant impact on the development of vehicle emissions in Finland. The binding limits currently apply to cars and vans. According to EU legislation, the average $CO_2$ emissions of cars shall not exceed 95 g/km in 2020. The corresponding limit for vans is 147 g/km. If vehicle manufacturers fail to reach these targets, they will have to pay a penalty fee for the excess emissions. The limits have had a very significant impact on the specific emissions of new vehicles and thereby the specific emissions of entire vehicle fleets in all EU Member States, including those that have not adopted national measures to regulate the emissions trends of their vehicle fleets.

The organisation of public transport has changed substantially in Finland. The Public Transport Act (869/2009) entered into force in 2009. It is based on the EU Regulation on public passenger transport services. The licenses for route traffic granted under the old act on passenger transport (*laki luvanvaraisesta henkilöliikenteestä tiellä* 343/1991) were changed into public service contracts for a transitional period. They will gradually expire between 2014 and 2019. In the new system, public transport services must be organised on purely market-based terms without public support or they must be put out to tender in accordance with legislation on public procurement and public transport if public funds are used for transport services. This reform has opened up routes for competition, and new operators and price competition have emerged in the sector. The increased competition in bus and coach transport has also been reflected in rail transport services and ticket prices.

The promotion of walking and cycling has also received more and more attention in recent years. The two modes have been promoted by funding for basic transport infrastructure management and separate strategies on walking and cycling. The Ministry of Transport and Communications published in March 2011 a National Strategy for Walking and Cycling (2011–2020), and the Finnish Transport Agency published a national action plan for implementing the strategy in early 2012. The strategy and the action plan both aim to increase the share of journeys undertaken on foot or by bicycle. The goal is that in 2020 at least 20% more journeys are made on foot or by bicycle than in 2005. This would mean an increase of more than 300 million journeys compared to the reference year 2005.

In 2013, the Finnish Transport Agency updated its guidelines for the planning of pedestrian walkways and bicycle paths.

People's mobility choices have also been influenced through guidance, campaigns and the development of various information services. Since 2010, these mobility management services have been organised so that the Finnish Transport Agency and Motiva Ltd share the responsibility for national activities, and in urban regions activities are supported with calls for R&D projects and state budget appropriations allocated to state aid for mobility management (EUR 0.9 million). Mobility management activities are already implemented in almost all large and medium-sized cities across the country.

The Mobility as a Service (MaaS) model has recently emerged as a strong alternative to the promotion of 'traditional' public transport, walking and cycling in Finland. In the MaaS model, the public sector, companies and service users together create a seamless and sustainable transport system by utilising information, data and digitalisation. The aim of MaaS is to create high-quality and affordable market-based services that meet the needs of customers and service users. In the model, the public sector is primarily an enabler, removing obstacles and promoting compatibility. Business activities will create growth and jobs as well as business concepts that can be adapted to international markets. To support and develop the model, the Ministry of Transport and Communications launched in 2016 the Transport Code project, an overall reform of transport market legislation. Moreover, experiments and pilot projects have been launched in different areas to re-organise passenger transport services as larger entities. Monitoring activities concerning the implementation of the Public Transport Act have been continued, and legislation has been developed as a response to changes in the operating environment.

The energy efficiency of heavy-duty vehicles can be improved by increasing the size of transport loads. The Ministry of Transport and Communications drafted in 2013 a decree on new dimensions and weights of vehicles and vehicle combinations. The reform increased the maximum height of vehicles from 4.2 metres to 4.4 metres and maximum weight from 60 tonnes to 76 tonnes. The decree entered into force on 1 October 2013. The reform is expected to reduce greenhouse gas emissions from transport, improve Finland's competitiveness and bring transport costs closer to the Central European level.

The Finnish Transport Safety Agency (Trafi) has also developed a new responsibility model for companies engaged in commercial transport. The voluntary model also covers environmental responsibility, including the energy efficiency of transport. It will replace the Energy Efficiency Agreements that were previously used in the transport sector and expired in 2016.

## Land use and community structure[5]

Emissions from land use and community structure are calculated towards the emissions from the transport sector discussed above. The impacts of decisions concerning land use and construction extend far into the future, as infrastructures are slow to change. The most significant solutions to cut emissions are associated with urban structure and effective functioning of urban regions. Effective urban regions are also a prerequisite for a thriving business life and Finland's competitiveness. There may be significant differences between the practical solutions used to reduce emissions in different parts of the country.

## Trends

The physical structure of communities changes relatively slowly. According to calculations by VTT, the demand for new housing production in 2015–2040 will be approximately 21% in relation to the number of existing housing and approximately 26% even in the scenario of rapid urbanisation.[6] The changes caused by new construction will be emphasised in the most populous sub-regional units. The sub-region of Helsinki accounts for 44% of the demand for housing production, Tampere and Turku for 16%, 11 other large sub-regional units for 25% and smaller sub-regional units for 15% of the demand.

The planning practices of many municipalities have changed in recent years, and the changes can be seen, for example, in the shift of focus towards locations that are good in terms of the transport infrastructure.[7] It will take years for some parts of this change to be implemented in practice, but the shift will form the basis for improving the effectiveness of community structure and controlling greenhouse gas emissions. The development of different sub-regions varies greatly depending on their size, as some of them are growing and others diminishing. However, to reduce emissions, it is essential to take into account the indirect impacts of community structure. Many measures to improve the community structure of urban regions are a precondition for the success of other energy efficiency measures that enable emissions to be reduced.

Ways to make the transport system more sustainable also vary within sub-regional units. In large and medium-sized urban regions, public transport can be improved through a wide range of measures.[8] In less populous sub-regions, everyday destinations should be accessible on foot, by bicycle or a short car journey. In the fringe areas of cities, emissions

5 Further information on land use and community structure is available in the sector-specific review for the medium-term climate change policy plan prepared by the Ministry of the Environment (in Finnish): http://www.ym.fi/download/noname/%7BACD31597-FD1E-4425-BC3D-6A0191F291A9%7D/127554

6 Statistics Finland, 2016. Vainio, T. Asunnontuotantotarve 2015-2040, VTT Technical Research Centre of Finland Ltd, 2016.

7 The Urban Zone 3 project of the Finnish Environment Institute (SYKE).

8 The Urban Zone 2 project of the Finnish Environment Institute (SYKE).

can be cut, for example, by reducing mobility needs and creating seamless travel chains in which the majority of journeys can be travelled using public transport and only the access distances by car, as well as by fostering teleworking and digitalisation.

### Existing measures

Of existing measures, the planning and steering of land use play a key role in the mitigation of climate change. The objective of the Land Use and Building Act (132/1999) is to ensure that the use of land and water areas and building activities on them create preconditions for a favourable living environment and promote ecologically, economically, socially and culturally sustainable development. The system of land use planning laid down in the Land Use and Building Act includes national land use guidelines and statutory land use planning. The national land use guidelines are a tool for the Government to steer policy on land use issues that are of national importance.

Currently, the coordination of land use, housing and transport is promoted in urban regions, for example, with agreements concerning land use, housing and transport (MAL). The State has concluded these agreements with the four largest urban regions (Helsinki, Tampere, Turku and Oulu). The agreements include provisions on common objectives and measures concerning land use, housing and transport in the sub-region in question. As a precondition for major infrastructure projects in growth centres and their surroundings, the State requires that plot and housing production are significantly increased in mutual cooperation between the State and municipalities and between municipalities in accordance with the partnership principle. The agreements are a tool for promoting land use that enables sustainable mobility and for reducing people's mobility needs.

## 6.3.2 Agriculture

Greenhouse gas emissions from agriculture are reported in several reporting sectors. Methane and nitrous oxide emissions, which mainly originate from livestock, manure, and soil, are covered by reporting on the agricultural sector. Reporting on the land-use, land use change and forestry (LULUCF) sector covers $CO_2$ emissions from agricultural land excluding emissions from liming, which are also reported in the agricultural sector. Furthermore, the emissions from machinery and building-specific heating are reported under energy-related emissions in the effort sharing sector.

This medium-term climate change policy plan covers emissions from the non-ETS sector. In the field of agriculture, these include emissions from the agricultural sector, machinery and building-specific heating. Because measures to reduce greenhouse gas emissions in the agricultural sector also influence the LULUCF sector, the sections concerning agriculture aim to present impacts on both sectors.

## Emission trends

In 2015, emissions from the agricultural sector[9] totalled approximately 6.5 Mt $CO_2$ equivalent. The agricultural sector accounts for approximately 10% of Finland's total emissions and some 20% of emissions from the effort sharing sector. In 2015, emissions consisted of nitrous oxide emissions from arable land (53%), methane emissions from enteric fermentation (32%), nitrous oxide and methane emissions from manure management (11%) and $CO_2$ emissions from liming and urea fertilisation (3%). Emissions from controlled burning of fields are marginal in Finland. From 2005 to 2015, emissions from the agricultural sector have varied slightly from year to year, but the order of magnitude has remained stable.

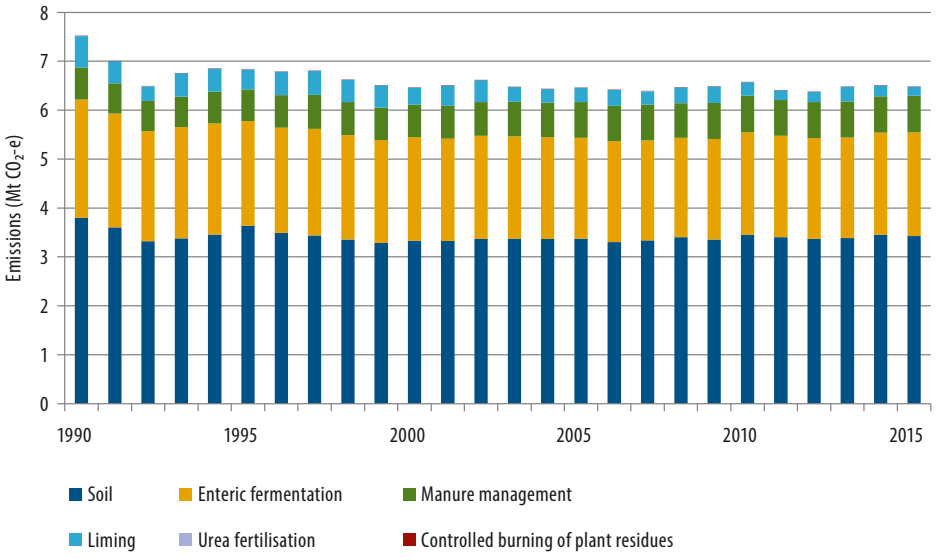


**Figure 7. Emission trends in the agricultural sector in 1990–2015 by emission source (Statistics Finland 2017).**

## Trend

According to the baseline scenario[10], total emissions from agriculture will increase by 3% from 2005 to 2020, but in 2030 they will be 0.5% below the 2005 level. Emissions from fer-

9 In the field of agriculture, emissions from the agricultural sector, machinery and building-specific heating are counted towards emissions from the effort sharing sector. Emissions from machinery and building-specific heating in agriculture are discussed below in the main sections on machinery and building-specific heating.

10 The baseline scenario is based on a calculation by the Natural Resources Institute of Finland (Luke). Luke, in turn, based its calculation on the assumptions made by the Ministry of Employment and the Economy in its baseline scenario framework, for example, regarding energy prices and demographic trends. Estimates by OECD-FAO regarding the prices of agricultural products in 2015–2024 have also been used in the baseline scenario.

tilisation and peat soils will increase until 2020, while emissions from ruminants and fertilisation will decrease after the year 2020.

According to the assumptions made in the baseline scenario, which is based on calculations by the Natural Resources Institute of Finland (Luke), prices in the agricultural sector will on average slightly decrease in relation to inputs. For example, the assumed increase in energy prices will reduce cereal production by making it less profitable. Similarly, pork production will decrease by a few percentage points, and growth in poultry production will become stagnant due to further decreasing profitability but it will not decrease because of high demand. Cereal production will decrease by more than 10%, but milk production may begin to slowly increase. The total number of cattle is estimated to decrease and beef production to fall by approximately 10% by 2030 compared to 2015 levels. Overall, this will result in a baseline in which the production of cereals, beef and pork will reduce but milk production will increase by 4% in 2015–2030.

Due to the decline in the cereal sector, the area of cultivated land would reduce by up to 150,000 hectares. Only some of this area would become fallow land, and an increasingly large share would become 'marginalised' land that would be outside active production but could still be taken in agricultural use. The future partial replacement of commercial fertilisers with recycled fertilisers has not been taken into account in the baseline scenario even though strong efforts are currently made to develop recycled fertilisers and create a market for them.

The area of organic soil will increase by 1,100 hectares per year from 2015 onwards, which corresponds to approximately one half of the average clearance rate in 2000–2014. The share of grassland on organic soils will remain at its current level (57%). The impact of controlled subsurface drainage has not been taken into account, because the area is still very limited. The use of slurry (liquid manure) systems will increase in 2015–2020 but will remain unchanged in 2020–2030. Slurry emits more methane and less nitrous oxide than solid manure.

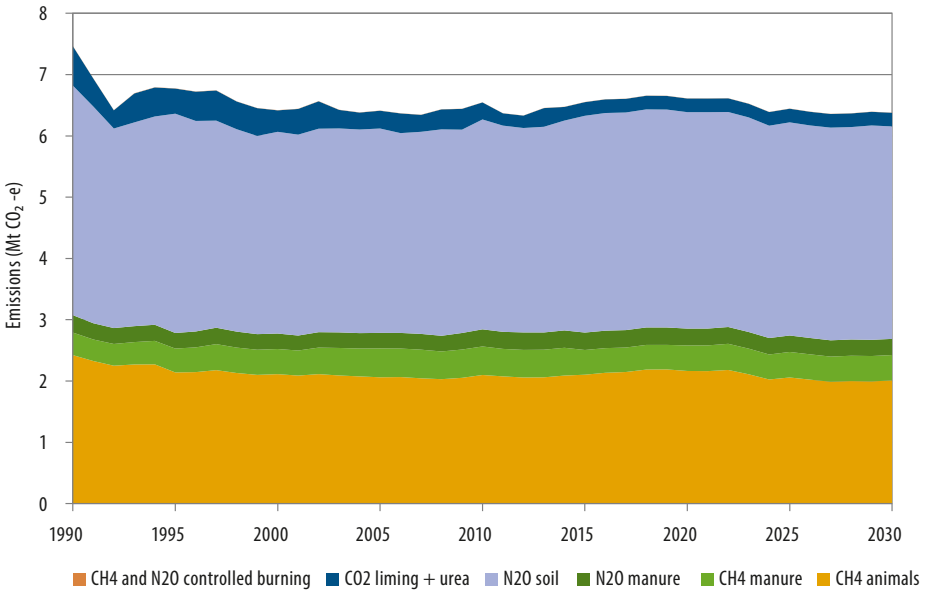


**Figure 8. Total emissions from the agricultural sector in 1990–2014 according to statistics and in 2015–2030 according to the baseline scenario (Luke 18 February 2016).**

## Existing measures

Existing measures in the agricultural sector include the measures of the Rural Development Programme for Mainland Finland 2014–2020:

- environmental compensation for perennial grasslands on peat and mull soil[11]
- environmental compensation and investment support for controlled subsurface drainage[12]
- investment support for biogas plants[13].

11 Payments under the measure are EUR 50/ha/year, and the measure covers an area of approximately 3,000 ha. The measure will be implemented throughout the programme period 2014–2020.

12 Investment support may be granted for the establishment of controlled subsurface drainage systems covering up to 40% of eligible costs. Moreover, environmental compensation may be granted under the controlled subsurface drainage measure or the measure for subirrigation and drainage water recycling.

13 The level of investment support for farm-specific plants (including plants shared by several farms) whose energy is used for production activities on the farm was increased to 40% in 2016. Plants that are intended for producing energy to be sold outside the farm can be granted business support under the Rural Development Programme at the level of 30%. The environmental and climate benefits of biogas plants and the positive impacts of nutrient recycling should be taken into account in various support schemes, for instance, when scoring projects.

### 6.3.3 Building-specific heating

#### Emission trends

Emissions from heating buildings are divided between the ETS sector and the effort sharing sector. The ETS sector covers emissions from the generation of electricity and district heating, which accounted for approximately 87% of all emissions from the heating of buildings in 2013. In the effort sharing sector, the main source of emissions was building-specific oil heating, which accounted for 12% of all heating emissions from buildings. Emissions from certain small heating plants are also included in statistics concerning the effort sharing sector.

In 2015, the emissions from building-specific heating amounted to 2.4 Mt $CO_2$ in the effort sharing sector, i.e. some 7% of the sector's total emissions. The majority of these emissions were generated by oil heating. Emissions from building-specific heating have declined in recent years, but there has been some fluctuation because of year-to-year variation in temperatures.

The majority of emissions from building-specific heating are produced in the heating of residential buildings followed by the heating of commercial and public buildings. Oil heating in the latter group of buildings has not been studied as extensively as oil heating in residential buildings. The baseline calculated by VTT is based on the assumption that the Energy Efficiency Directive and improvements in the energy performance of buildings will reduce the energy demand for heating public and commercial buildings.

According to an emissions projection until 2030, emissions from building-specific heating will steadily decrease as a result of the replacement of existing buildings, renovations and changes in heating systems. According to the baseline scenario, emissions will decrease by a total of approximately 1.2 Mt $CO_2$ equivalent by 2030 compared to 2008 levels, resulting in a reduction of 39%.

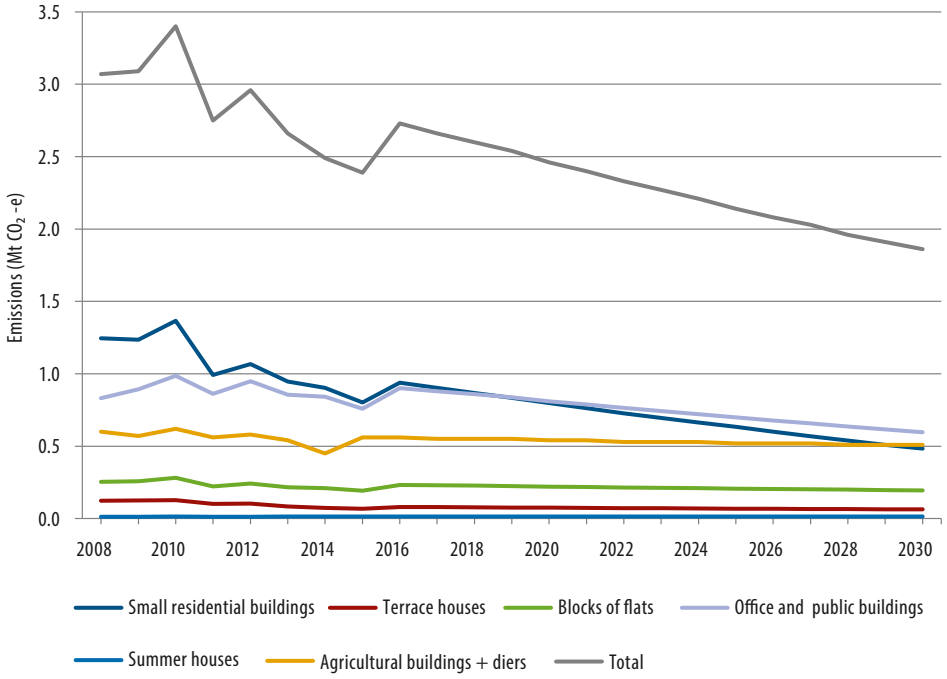


**Figure 9. Emissions from building-specific heating in 2008–2014[14] and the baseline scenario 2015–2030.**

## Existing measures

The largest reductions in emissions from building-specific heating can be achieved in the oil heating of low-rise buildings because the use of heating oil will decline as other heating solutions become more common and buildings become more energy efficient. Currently, heating oil is not blended with biofuel oil, and this option has not been taken into account in the baseline. The development of the oil-fired boiler stock has been estimated based on the number of oil-fired boilers installed in new construction and the replacement rate of existing boilers.

In 2016, there were an estimated 200,000 oil-fired boilers in old residential buildings in Finland. The majority of these are found in detached houses, but some terraced houses and blocks of flats are also heated with oil. According to the baseline scenario of energy consumption in the building stock prepared by the Finnish Environment Institute, oil heating will be phased out in detached houses by 2050. In other types of buildings, oil would still account for 2–3% of all energy purchased. The scenario is based on the assumption that the transition to other forms will continue at the same rate as in recent years. Oil heating is replaced by either heating with heat pumps or district heating. According to a scenario

14 Unlike in other sectors, no data on emissions from building-specific heating is available for the years 2005–2007.

drawn up by Pöyry Oy, the energy used for oil heating will decrease from the current level of approximately 4.5 TWh/year to 1.6 TWh/year in 2030.[15] This would result in a slightly more rapid decline in emissions than in the baseline scenario.

In addition to the main heating system, low-rise buildings often have supplementary heating devices, such as electric radiators, fireplaces and air source heat pumps. According to statistics compiled by the Finnish Heat Pump Association (SULPU ry), the sales of ground source heat pumps has increased by approximately 40% compared to 2008–2010, and some 50,000 air source heat pumps are sold each year. Heat pump investments have largely been market-driven, and consumers have played an active role, particularly as innovators and developers of online peer support concerning heat pumps.

Heat pumps are used to replace oil heating and thereby reduce the demand for heating oil. Heat pumps use F-gases, which means that F-gas emissions must be taken into account when assessing the emission reductions delivered by heat pumps. It must be ensured that F-gas emissions will not cancel out the energy efficiency benefits and emission reductions that heat pumps deliver in the effort sharing sector.

Energy consumption in residential buildings can be reduced by renovations that improve energy efficiency and by changing the ways we use energy. Small-scale maintenance and repairs to improve energy efficiency, such as draught-proofing windows and doors, may be profitable as such, but larger energy efficiency renovations are often economic only in connection with other repairs. Therefore, potential energy savings will be realised only partially, and even that will take time. Renovations will reduce emissions in the effort sharing sector when heating methods are replaced with other alternatives in connection with renovations and when renovations reduce heat loss. The availability of renovation and energy grants for limited liability housing companies has been limited. Among other objectives, grants have been used to stimulate the economy and manage employment. Beneficiaries have not been required to improve energy performance to a level exceeding the requirements in force.

The level of energy performance requirements was established in the spring of 2013, and it will be kept at a cost-optimal level. Any financial incentives for renovations should be long-term, predictable and targeted measures. According to the Energy Performance of Buildings Directive (EPBD), the requirements shall be reviewed every five years. The next report on cost-optimal levels will be submitted to the Commission in the spring of 2018.

15 Pöyry Oy, *Hajautetun uusiutuvan energian potentiaali, kannattavuus ja tulevaisuuden näkymät Suomessa,* 2017

In Finland, voluntary energy efficiency agreements are a key tool for achieving the targets for increased efficiency in energy use as laid down in the Energy Efficiency Directive (EED). They also support the implementation of the EPBD, in which the energy efficiency agreement on the distribution of heating oils (Höylä IV) replaces the statutory obligation to inspect heating systems, as referred to in Article 14 of the EPBD, and the control system for inspection reports with respect to buildings heated with oil. A similar voluntary agreement on an advisory procedure to improve the energy efficiency of biomass boilers (Kutteri agreement) has been adopted for heating systems that use biofuels.

### 6.3.4 Waste management

#### Emission trends

Greenhouse gas emissions from waste management totalled 2.1 Mt $CO_2$ equivalent in 2015, i.e. 7% of Finnish emissions in the effort sharing sector. The most significant greenhouse gas produced in waste management is the methane emitted from landfills. Waste management emissions in the effort sharing sector also include the greenhouse gases produced in the biological treatment of waste and in the disposal and treatment of waste water: $CO_2$, methane and nitrous oxide. These emission sources are of a limited importance, and their emission volumes are stable.

Greenhouse gas emissions from waste management have reduced by approximately a third from 2005 to 2015. Greatest reductions have been achieved in methane emissions from landfills as landfilling of organic waste has decreased. The increased use of digestion in the biological treatment of waste has slightly reduced the $CO_2$ emissions of biological treatment. However, $CO_2$ is still being emitted from the digestion residue that will be composted and the remaining compost windrows.

According to the baseline scenario, emissions from the waste management sector will decrease by 61% by 2030 compared to 2005 levels.

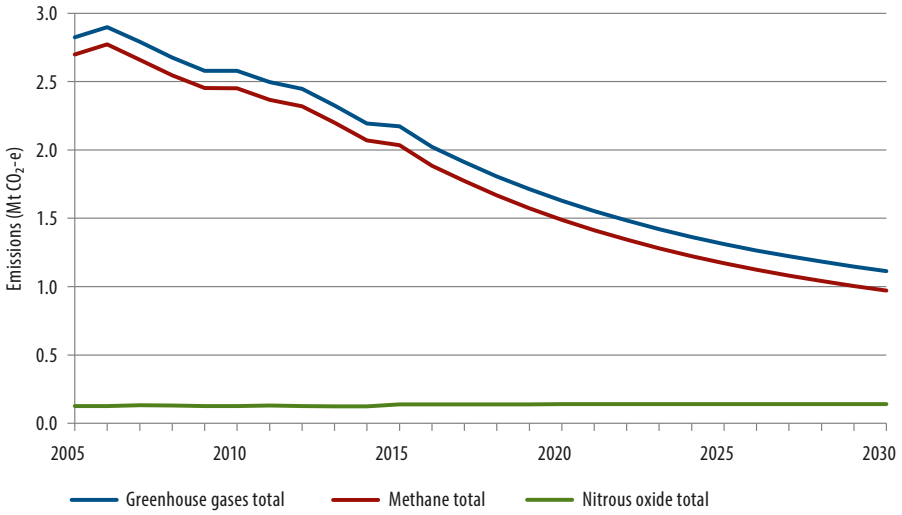


**Figure 10. Emissions from waste management in 2005–2014 and the baseline scenario 2015–2030.**

Emissions from waste used as energy are included in the energy sector. They are covered by the ETS when waste is being burned together with other fuels as 'co-incineration' for example in power plants at industrial facilities. In 2030, total emissions from waste incineration will amount to approximately 0.8 Mt $CO_2$ equivalent, of which some 0.6 Mt $CO_2$ equivalent will be emissions from waste incineration plants included in the effort sharing sector.

In recent years, the focus in waste management has shifted from landfilling to energy recovery from waste (waste-to-energy). While emissions from landfilling have decreased, emissions from waste incineration have increased. Energy recovery from waste is part of waste management even though its emissions are not included in statistics concerning the waste management sector. Waste incineration plants operate in a similar manner as other energy production plants and have mainly been used to replace other forms of energy production, including the consumption of imported fuels.

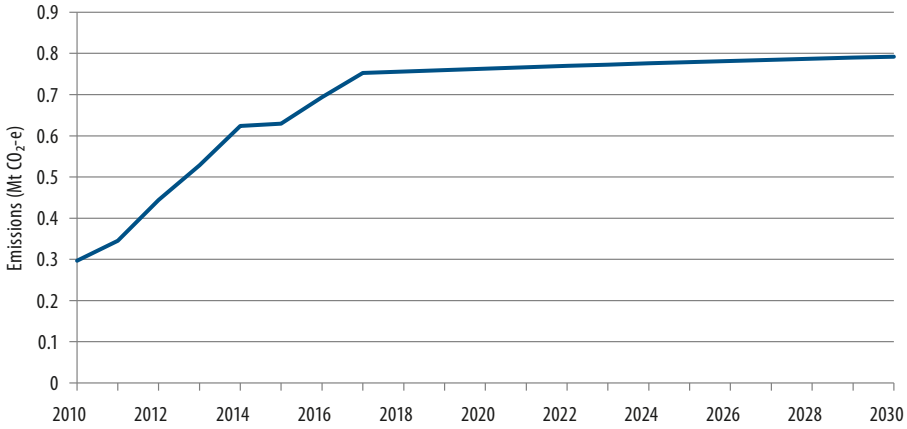


**Figure 11. Development of emissions from waste incineration in 2010–2030.**

## Existing measures

Waste management has greatly improved in Finland during the country's membership in the EU. Landfill emissions have rapidly declined in the 2000s as a result of, for example, the adoption of the Waste Tax Act (1126/2010), the implementation of the EU Landfill Directive and restrictions on the landfilling of organic waste. Landfill operators have a statutory duty to collect and treat landfill gas. The price of landfilling has been increased through technical and financial steering instruments, making it less competitive with alternative treatment methods. Legislation and fees have significantly contributed to a shift in the management of biodegradable waste from decomposing in landfills to aerobic composting.

The restriction on the landfilling of organic waste entered into force at the beginning of 2016. It helped reduce greenhouse gas emissions from landfills already before entering into force, and after having fully entered into force it will continue to cut landfilling to a minimum. The disposal of waste by landfilling will be almost completely replaced by energy recovery from waste and recycling. Thus, emissions from waste-to-energy activities will continue to increase to some extent. The limited emissions from the disposal and treatment of waste water will remain at the current level.

The Circular Economy Package currently discussed in the EU will further shift the focus of waste management from waste incineration to recycling and circular economy. Prime Minister Juha Sipilä's Government Programme also includes the objective of raising the recycling rate of municipal waste to 50%. Increasing recycling rates and moving towards a more circular economy will reduce greenhouse gases in the long term.

### 6.3.5 F-gases

#### Emission trends

In 2014, F-gas emissions totalled 1.8 Mt $CO_2$ equivalent, which currently equals to approximately 3% of all greenhouse gas emissions and approximately 5% of emissions in the effort sharing sector. The emissions peaked in 2010 at approximately 1.84 Mt $CO_2$ equivalent.

Fluorinated greenhouse gases (F-gases) are used for example as refrigerants and extinguishing agents and in plastic foaming. The use of F-gases will increase as appliances, such as air-conditioning equipment in cars and heat pumps, become more common. Heat pumps are becoming an ever more common application of F-gases. F-gas emissions must be taken into account when assessing the emission reductions delivered by heat pumps. F-gas emissions from heat pumps are estimated to peak in 2020–2030, after which F-gases with low global warming potential (GWP) and alternative refrigerants are expected to become more common and reduce emissions. At their highest, F-gas emissions from heat pumps will amount to 0.25 Mt $CO_2$ equivalent (2026). In 2030, they will be approximately 0.23 Mt $CO_2$ equivalent and will continue to decline thereafter.

Measures under the original F-gas Regulation, applied in 2007–2014, and the new F-gas Regulation are estimated to reduce F-gas emissions to 0.8 Mt $CO_2$ equivalent by 2030 and further to 0.3 Mt $CO_2$ equivalent by 2040. According to the baseline scenario, the emissions will reduce by 15% by 2030 compared to the reference year 2005.

#### Existing measures

F-gases are regulated at EU level. The Regulation (EU) No 517/2014 on fluorinated greenhouse gases has been applied since 1 January 2015. It will gradually reduce the amount of F-gases placed on the market until 2030. This is estimated to reduce emissions at EU level by 60% from the 2005 level by 2030. The Regulation also aims to prevent emissions by laying down provisions, for example, on mandatory leak checks of equipment, certification of staff and certain sector-specific bans on using F-gases. F-gas use and emissions are also reduced by the Directive 2006/40/EC relating to emissions from air-conditioning systems in motor vehicles (MAC Directive). It prohibits the use of F-gases with a global warming potential exceeding 150 in the air-conditioning systems of new cars.

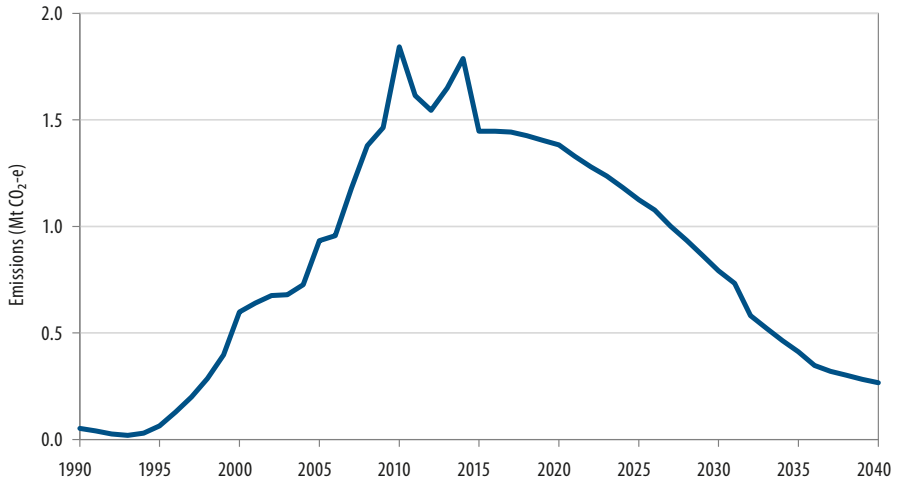


**Figure 12. F-gas emission statistics from 1995–2015 and the baseline scenario for 2016–2040.**

### 6.3.6 Machinery

#### Emission trends

In total, various types of machinery currently account for 8% of emissions in the effort sharing sector. In recent years, their greenhouse gas emissions have remained stable at approximately 2.5 Mt $CO_2$ per year. Figure 13 presents the emissions from machinery according to the baseline scenario and their estimated development from 2005 to 2030. The figures are based on the TYKO calculation model for machinery[16] developed by VTT.

Machinery is used in industry and construction, trade, services, the public sector, households, agriculture and forestry. Machinery is usually equipped with combustion engines. Quantitatively, the most common fuel is gasoil (approximately 8.2 TWh) but petrol is also used (1 TWh). Among machinery emissions, $CO_2$ is the most significant greenhouse gas, but machinery also emits small quantities of methane and nitrous oxide.

16 http://lipasto.vtt.fi

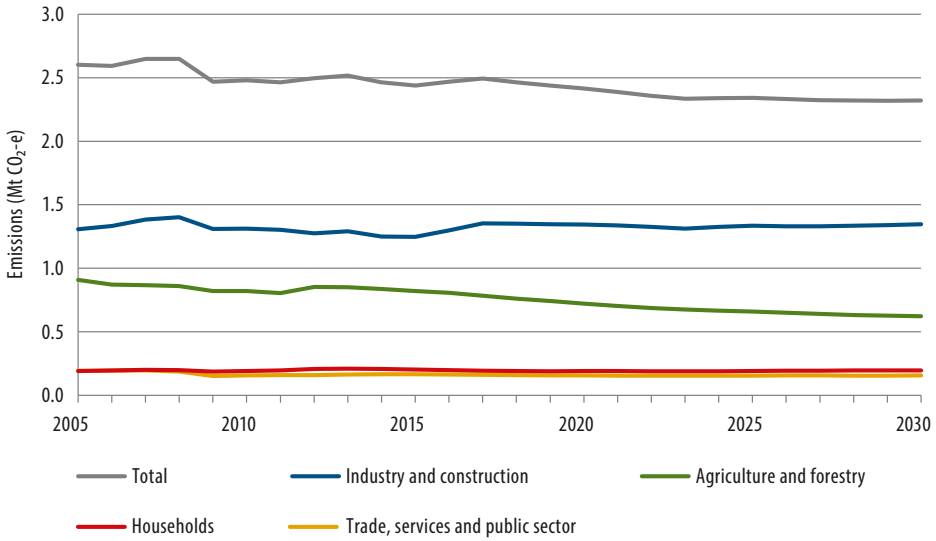


**Figure 13. Emissions from machinery in 2005–2014 and estimated emissions until 2030.**

Most of the environmental impacts of machinery are caused during the use of appliances. The environmental burden caused during use depends, in particular, on the characteristics of machinery but also on how it is operated and how different work stages are planned. The most important environmental impacts caused during use include $CO_2$ emissions and exhaust emissions that are harmful to human health. Exhaust emissions from machinery are typically much greater than those of cars. Machinery also generates noise. The impacts of unhealthy exhaust emissions and noise are emphasised in (densely) populated areas.

## Existing measures

According to the baseline scenario, the estimated reduction in emissions will be very limited. No emission reduction measures have so far been adopted for the sector.

The petrol used in machinery already contains a biocomponent because petrol machinery uses the same petrol as transport vehicles. This has been taken into account in the emission calculations concerning machinery. Machinery based on diesel technology uses gasoil, which may also include a biocomponent.

In autumn 2016, the EU adopted a new Regulation on type-approval for machinery. It establishes requirements concerning traditional air pollutants (particulate matter, hydrocarbons, nitrogen oxides and carbon monoxide) for a wide range of machinery from small motor-operated machinery, such as chainsaws, to large machinery and railway vehicles. The Regulation will enable the use of 'dual fuel' engines in biogas tractors and thus clarify the situation for manufacturers and developers.

The Regulation does not address energy efficiency. Extending its scope to $CO_2$ emissions would steer the development efforts of manufactures in the EU machinery sector and guarantee a decline in greenhouse gas emissions as machinery would be replaced with new ones. This would promote the roll out of innovative technical solutions to energy consumption. Reducing both $CO_2$ emissions and traditional air pollutants simultaneously is a challenge in the field of machinery.

### 6.3.7 Industry

Energy-related and process emissions from industry are mainly covered by the ETS. The ETS covers power plants exceeding a certain capacity threshold and other combustion plants, oil refineries, coke plants, foundries and steel plants as well as the cement, glass, lime, brick, ceramic, pulp, paper and paperboard industries. The scope of the ETS was extended in 2013 to cover, for example, $CO_2$ from the production of certain petrochemicals and nitrous oxide from the production of nitric acid.

The energy-related emissions from industry total 10 Mt $CO_2$, of which 0.7 Mt $CO_2$ originated from non-ETS activities in 2014. Energy-related emissions are mainly $CO_2$ emissions and are distributed evenly among all branches of industry.

These days, the ETS also covers more than 90% of industrial process emissions. Process emissions refer to emissions released during industrial processes and the use of raw materials and fuels as raw material. Process emissions not covered by the ETS amounted to approximately 0.3 Mt $CO_2$ in 2014. The majority of these emissions originate from the production of chemicals and chemical products.

According to the baseline scenario, industrial activities will follow a positive trend. As a result, non-ETS process emissions will also slightly increase, amounting to approximately 0.4 Mt $CO_2$ equivalent in 2030. Industry will become more energy efficient and produce fewer emissions, which will offset the increase in emissions due to growth in industrial activities. Thus, according to the baseline scenario, energy-related non-ETS emissions from industry will remain on their current level throughout the 2020s.

The ETS/non-ETS division of industrial emissions in scenario calculations is based on Statistics Finland's branch-specific data on the distribution of emissions. Emissions are classified in three categories depending on whether they have been covered by the ETS during all phases of emissions trading, entered the ETS later or remain outside the ETS. In accordance with international practices, scenario calculations are based on the assumption that the shares of these categories within the branch will remain the same as the actual shares recorded in the past few years. Branch-specific percentages have been published in a background report to the Energy and Climate Strategy.

In forest industry, some of the $CO_2$ emitted during combustion is recovered and used in the production of precipitated calcium carbonate and further as filler in paper production. These $CO_2$ transfers will reduce emissions by 0.1–0.2 Mt $CO_2$ per year. Since 2013, the transfer of $CO_2$ is no longer allowed in emissions trading. In greenhouse gas inventories, $CO_2$ transfers are reduced from paper industry emissions. In the baseline scenario, $CO_2$ transfers will follow the development of paper and paperboard production volumes, reducing emissions by 0.1 Mt $CO_2$ in 2030.

## Existing measures

Based on project assessments, the Ministry of Employment and the Economy and Tekes, the Finnish Funding Agency for Innovation, may grant energy aid to companies, municipalities and other organisations particularly for investment and research projects that promote the use of renewable energy or energy efficiency (Tekes has replaced the centres for economic development, transport and the environment in this task). The purpose of energy aid is particularly to promote the introduction and placing on the market of new energy technology. This will promote exports by Finnish companies and the creation of jobs. Supporting first pilot projects may also later deliver substantial energy savings or an increase in the use of renewable energy in Finland, especially if the technology in question has high potential for duplication. Energy aid is granted on the basis of project assessments and only to projects that genuinely need support, ensuring the maximum effectiveness of the limited budget authority. These principles, and thereby energy aid itself, are easy to accept. The supported projects will reduce $CO_2$ emissions, but the reductions are not separately recorded in statistics.

Energy aid is also an important incentive for joining voluntary energy efficiency agreements because it helps applicants receive aid. Thus, energy aid is in integral part of the framework of energy efficiency agreements and energy audits, which has formed the basis for energy efficiency measures in Finland since the 1990s. Its benefits are visible particularly in the ETS sector but also in the effort sharing sector.

The measures implemented by the business, municipal and real estate sectors and reported in the energy efficiency system reduced energy consumption in Finland by 14.2 TWh per year during 2008–2015. $CO_2$ emissions, correspondingly, declined by 4.3 million tonnes per year (mainly in the ETS sector). During the same period, a total of EUR 95.2 million was granted in energy aid to energy audits and investments that produced energy savings.[17] Assuming that the average life of investments is ten years, emission reductions will cost the State approximately EUR 2.4/t $CO_2$ (excluding the management costs of energy efficiency agreements, energy audits and energy aid).

17 http://www.energiatehokkuussopimukset.fi/en/activities_and_results/

To extend the validity period 2008–2016, energy efficiency agreements were renewed for the term 2017–2025 at the end of 2016. Energy efficiency agreements are a key part of Finland's Energy and Climate Strategy and a primary tool for promoting the efficient use of energy in Finland. They are mainly used to meet the energy savings obligation established by the Energy Efficiency Directive or some other corresponding measure.

In recent years, some EUR 35 million of energy aid has been granted each year, the majority of it to non-ETS sectors. The budget authority for energy aid is established annually in the central government budget. In the past few years, aid has also been granted to certain separate purposes through separate budget reserves. In total, Prime Minister Sipilä's Government has allocated EUR 100 million to investments in renewable energy and new technology in 2016–2018.

Aid applications undergo a comprehensive assessment of needs to ensure that aid is only granted to those who genuinely need it. Moreover, particularly in projects concerning new technology, the aim is to keep the percentage of aid at the lowest possible level that will still enable the project to be launched. Due to these principles, the aid can be considered cost-effective.

### 6.3.8 Other fuel consumption

Small power plants and boilers are not covered by the ETS. The total emissions of these plants excluding waste incineration plants amount to approximately 0.5 Mt $CO_2$ equivalent. In the baseline scenario, these emissions are expected to slightly reduce to 0.3–0.4 Mt $CO_2$ equivalent by 2030.

Emissions from the greenhouse gas inventory category *1.A.5 Other non-specified emissions of fuels* equal to 1.2 Mt $CO_2$ equivalent. The unknown consumption of light and heavy fuel oil, LPG, and natural gas, account for the largest shares of consumption in this subcategory. In practice, the consumed amounts are determined as the difference between total sales and known consumption. The subcategory also includes the fuels consumed by the Finnish Defence Forces, statistical adjustments and smaller emission sources, such as helicopters. According to the greenhouse gas inventory report, uncertainty regarding emissions in this subcategory may be up to ±10–50%, depending on the fuel, which is substantially higher than in other energy subcategories. According to the baseline scenario, emissions from this subcategory are expected to increase to approximately 1.4 Mt $CO_2$ equivalent by 2030 due to growing economic activity.

The Finnish Defence Forces published in 2014 an energy and climate programme, which includes the target of reducing greenhouse gas emissions by 30% by 2020 compared to 2010 levels. It also sets a target of 20% energy savings in properties used by the Defence

Forces compared to 2010 levels. The target is to be achieved by 2020. Measures will focus on improving the energy performance of buildings. The share of renewable energy in purchased energy will be increased, and efficiency in the use of space will be improved. The operational energy performance of the Defence Forces will be improved so that in future the same level of performance can be achieved with less energy. The activities of the Defence Forces emit approximately 0.3 Mt $CO_2$ each year. Military aviation accounts for a significant share of the total emissions. The energy and climate programme will be updated in 2017, when 2030 targets will be discussed.

# 7 Assessment of additional measures required to achieve current or anticipated targets

## 7.1 Principles for determining additional measures

At the request of the Ministry of the Environment, the Finnish Climate Panel drew up a memorandum in early 2016, expressing its views on methodological questions associated with the medium-term climate change policy plan and, in particular, on how and on which criteria opportunities for reducing emissions in different sectors should be assessed to ensure mutual comparability.[18] The panel was also requested to give its views on how to best ensure that sector-specific emission reductions measures will in total be sufficient to achieve the binding general emission reductions target imposed at EU level.

In the memorandum, the panel notes that the single most important principle in preparing climate change policy plans is cost-effectiveness, i.e. attaining the 2030 emission reductions target set for non-ETS sectors at least cost. In practice, this principle means that marginal abatement costs should be equal in all non-ETS sectors. While ensuring the cost-effectiveness of attaining the 2030 target, the 2050 target must not be forgotten. This applies especially to long-term investments, which should be assessed from a 2050 perspective.

In the panel's view, emission reductions measures should be assessed on the basis of net reductions. This means takin into account the fact that reductions in one sector could increase emissions in another sector. As additional criteria, the panel highlights social acceptability and budgetary implications. The former refers to ensuring that a measure will not cause unreasonable additional costs to any group or actor or increase social ine-

18 *Keskipitkän aikavälin ilmasto-ohjelma: menetelmäkehikko ja tietotarpeen arviointi*, http://www.ym.fi/ilmastosuunnitelma2030

quality in general. Budgetary implications refer to assessing the feasibility of the selected measures in terms of central government finances.

In the methodological framework put forward by the panel, each sector will propose a set of emission reductions measures in order of their cost-effectiveness. Estimates of their emission reductions potential and an allocation of their costs must also be provided. Sectors will also assess which steering instruments should be used to implement the measures.

According to the framework designed by the panel, emission reductions measures will be selected for the climate change policy plan starting with the cheapest option, adding measures until the required total savings are achieved. The total impact of measures must be calculated in accordance with the principle of net reductions, as described above. In the panel's memorandum, this is illustrated with the following graph (Figure 14).

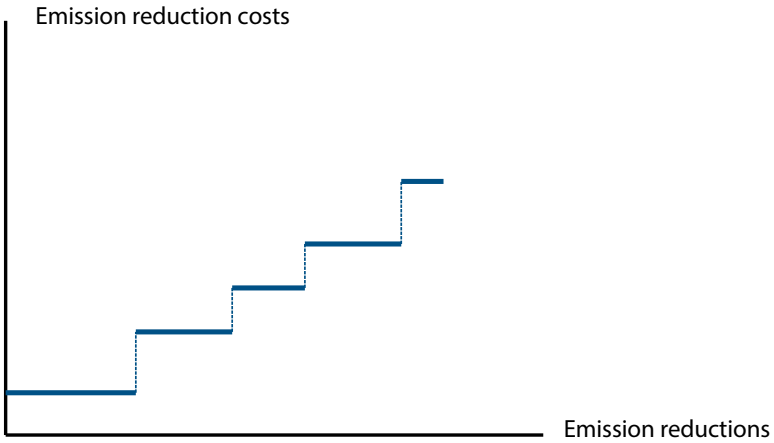


**Figure 14. Emission reductions measures in order of cost-effectiveness (Climate Panel memorandum 2016).**

The methodological framework put forward by the Climate Panel constitutes a clear and coherent approach for selecting measures for the climate change policy plan. However, its application will require a sufficient knowledge base of the cost-effectiveness and emission reductions potential of the measures being assessed. The knowledge base available is often incomplete with gaps or at least significant uncertainty. These aspects make it difficult to directly apply the framework in practice.

It is difficult to establish detailed rules for assessing social acceptability and its impact on the outcome. These aspects require a wider assessment of the feasibility of proposed emission reduction measures. In addition to social acceptability, it will involve budgetary implications and, in general, any other impacts the measures may have, including environ-

mental impacts. If a measure has positive side effects, these should be taken into account in cost calculations. When assessing measures, it should also be considered how effective they will be in terms of other policy objectives. These may include energy policy objectives, such as the promotion of renewable energy, energy efficiency or self-sufficiency. The obligation to blend fuel with biofuel is a good example of a multidimensional measure: it will help reduce emissions from the consumption of oil while also reducing our dependence on oil and supporting national bioeconomy objectives.

## 7.2 Required additional sector-specific measures and their effectiveness

Possible additional measures have been identified for all sectors, and their costs and impacts have been assessed. The following sections discuss these measures sector by sector, assessing their impact on emission reductions based on the information currently available. It should be noted that the estimated emission reductions of different measures cannot be simply added up, because some of them are mutually exclusive or overlapping. Thus, the emission reductions potential of each measure has been estimated individually, and any links to other policy measures have been discussed to the extent possible. Measures that require funding will be implemented within the limits of the General Government Fiscal Plan and the Budget. In accordance with the Climate Change Act, each sector is responsible for implementing the policy measures concerning its branch. For cross-cutting measures, parties responsible for implementation have been identified where possible.

### 7.2.1 Transport

In the effort sharing sector, the greatest potential for reducing emissions is in the area of transport. Therefore, the goal is to reduce transport emissions by approximately a half by 2030 compared to 2005 levels. Measures will be focused on road transport, which presents the greatest potential for emission reductions. However, when deciding on emission reduction measures, it is important to take into account any increases in costs they may cause, particularly in commercial transport, and to introduce measures to offset the increase, if necessary.

Measures to reduce transport emissions can be grouped in three categories, which will be discussed below. Measures included in the Energy and Climate Strategy will be listed in the body of the text and new measures put forward in this plan will be written in bold. The policies outlined in the strategy have been taken into account in estimates of total emission reductions.

## 1. REPLACING FOSSIL FUELS WITH RENEWABLE AND LOW EMISSION ALTERNATIVES

According to the 2016 Energy and Climate Strategy, the physical share of biofuel energy content in all fuels sold for road transport will be increased to 30% by 2030. The purchases of electric, hydrogen-powered and gas-powered vehicles will be promoted so that the share of new technologies in the vehicle fleet can be brought up to a level that is adequate for creating a well-functioning market. By 2030, the goal is to have, in total, a minimum of 250,000 electric vehicles (fully electric vehicles, hydrogen-powered vehicles and rechargeable hybrids) and at least 50,000 gas-powered vehicles. The distribution station network for new fuels and the network of recharging points needed for electric vehicles will be built in Finland mainly on market terms. In the long term, the electrification of the car fleet is a precondition for focusing the use of biofuels on heavy vehicle traffic, shipping and aviation in particular, because, unlike in road transport, no energy-efficient alternative power sources are in sight in these sectors.

- **An appropriation of 3 million euros is reserved in the central government budget for 2018 for promoting the infrastructure for electric vehicles and use of biogas in transportation, and an appropriation of 1.5 million euros is reserved for promoting the infrastructure for electric vehicles in residence houses.**
- **Nordic cooperation will be enhanced to reduce transport emissions. Common Nordic target indicators will be developed for different emission reduction measures in the transport sector.**

*Emission reductions potential* (*all measures combined*): 1.5 Mt $CO_2$ in 2030, taking into account improvements in the energy efficiency of the transport system and vehicles and the decrease in fuel consumption.

## 2. IMPROVING THE ENERGY EFFICIENCY OF VEHICLES

According to the 2016 Energy and Climate Strategy, the energy efficiency of vehicles will be improved by influencing at EU level the drafting of binding $CO_2$ threshold values applicable to car manufacturers. The aim is that the specific consumption and emissions of new cars and vans will be reduced by approximately 30% from their 2020 levels by 2030. Moreover, Finland will participate in the preparation and introduction of binding threshold values for heavy-duty vehicles in the EU. The replacement rate of the vehicle fleet in Finland will be considerably sped up.

- **Low emission modes of transport, such as electric or gas-powered cars as well as the conversion of old cars into vehicles powered by ethanol or gas, will be promoted. An appropriation of 6 million euros is reserved for the purpose in the central government budget for 2018.**

- **A Green Deal model will be developed for car dealers, directing them to present low emission vehicle alternatives to customers.**
- **The availability and effectiveness of advisory services for public procurement in the field of energy efficient transport and vehicles will be ensured. Joint municipal authorities and other public-sector organisations will be encouraged to introduce various financial incentives to increase the share of alternative technologies in procurement.**

*Emission reductions potential* (*all measures combined*): car emissions will reduce by approximately 0.6 Mt $CO_2$ by 2030 without changes to taxation.

### 3. IMPROVING THE ENERGY EFFICIENCY OF THE TRANSPORT SYSTEM

According to the 2016 Energy and Climate Strategy, the current self-service market will be replaced by a service market in the transport sector. By promoting the 'Mobility as a Service' model, the aim is to reduce the number of solo car journeys and to halt the increase in the transport performance of cars in urban areas regardless of a growing population. In terms of walking and cycling, the target is to increase the number of these journeys by 30% by 2030.

According to the strategy, a legislative reform related to the transport market will be implemented (Act on Transport Services), transport and land use will be coordinated, the conditions for walking, cycling and public transport will be promoted, especially in urban areas, and efforts will be made to prepare for changes in mobility habits through land use planning and parking norms. The automation of transport and different remote practices will also be promoted.

In addition:

- **The State will participate in the coordination of transport and land use in urban regions and in measures concerning the transport system, for example through agreements on land use, housing and transport (MAL). The aim is to ensure that projects promoting walking, cycling and public transport will be prioritised in urban transport planning and project funding.**
- **An appropriation of 3.5 million euros is reserved in the central governmental budget for 2018 for promoting digitalisation and services in large city regions' public transport development.**
- **An appropriation of 2 million euros is reserved in the central governmental budget for 2018 to increase contractual rail transport services.**
- **The location of jobs and services in growing urban regions will be steered towards regional centres, subcentres and public transport nodes with a high service level.**

- **Infill construction, the creation of locations that are good for the urban structure and the use of such locations for new construction will be promoted in urban areas.**
- **The joint programme of the State and urban regions for the promotion of walking and cycling will be implemented in 2018–2022.**
- **Park-and-ride facilities for bicycles will be developed in transport nodes.**
- **Station areas will be developed through market experiments and urban development pilots.**
- **The introduction of congestion charges based on emissions will be examined.**

In terms of community structure and land use[19], the most significant solutions to reduce transport emissions are related to urban development: the community structure and functionality of urban regions, coordination of land use and transport, creating favourable conditions for the production of renewable energy and enabling a low emission lifestyle. This will require existing steering instruments to be more efficiently targeted at mitigating climate change and reducing greenhouse gas emissions.

Measures to develop community structure can be implemented for example through municipal land policy and land use planning and by coordinating land use, housing, transport, services and economic activities. The development of community structure is closely connected to the promotion of walking, cycling and public transport, and the related development measures often partly overlap.

The shares of different modes of transport, transport performances and thereby also emissions can be influenced through planning efforts that ensure coordination between land use and the transport system. Ways to reduce emissions include the on-going reform of the Land Use and Building Act, reforming the national land use guidelines as well as continuing and further developing the agreement-based urban policy (agreements on land use, housing and transport). In future, needs and objectives related to climate change must be taken into account in all these activities.

Experiments and pilots promoting a low carbon lifestyle, such as the project on station areas as a platform for urban development and market experiments (*Asemanseudut kaupunkikehittämisen ja markkinakokeilujen alustana*), can also be employed to create a concrete environment that will foster a change in mobility habits and the use of new approaches in urban development.

19 The connection between emission reductions and community structure and land use is discussed in more detail in the sector-specific plan prepared by the Ministry of the Environment and in the Energy and Climate Strategy.

*Emission reductions potential* (*all measures combined*): emissions can be reduced by up to approximately 1 Mt $CO_2$ by 2030 if the increase in car transport performance can be maintained close to zero.

➲ **To ensure a transition towards low carbon transport, steps will be taken to prepare for increasing the financial steering of $CO_2$ emissions from transport already during the present term of government.**

Transport taxation is a cost-effective tool for influencing emission trends in the sector. At this point, however, no estimates can be given on how such steering would impact emission reductions.

### 7.2.2 Agriculture

In agriculture, greenhouse gas emissions originate from diffuse biological emission sources. This makes their mitigation more challenging than in many other sectors. Organic soils present the greatest potential for cutting emission from arable land. These types of soil are common in Finland, and emissions from their cultivation and clearance are manifold compared to emissions from mineral soil.

When designing measures to reduce agricultural greenhouse gas emissions, the importance of food production for the whole society should be borne in mind, ensuring that proposed measures will not compromise national food security. The aim of Finnish agricultural and food policy is to ensure national food security and high-quality nutrition for all people living in Finland.

In the agricultural sector, additional emission reduction measures mainly concern limiting emissions from organic soils. Organic agricultural soils include many kinds of fields, and it will be a challenge to design cost-effective emission reduction measures that will be appropriate to the region in question as well as sustainable and acceptable in the long term. Because the demand for food will grow, future efforts must focus particularly on improving the efficiency of production, i.e. reducing emissions per litre or kilogram of products produced.

➲ **Growing crops in organic soils for several years with zero tillage.**

The implementation of the existing measure '*perennial environmental grasslands on peat or mull soil*' will be continued, and efforts will be made to enhance its implementation during the next EU programming period starting in 2021. This will enable Finland to consider introducing a separate 'climate compensation' and expanding its scope from perennial grasslands to other plants. Achieving sizeable growth in the area of land covered by

the measure would require increasing the level of payments. Adaptation to the measure would benefit, for example, from increased biogasification of grass and manure and more wide-spread cultivation of reed canary grass for use in energy production or as bedding.

During the next EU programming period, it must be ensured that long-term crop grasslands that are renewed at least every five years will not become permanent grasslands. Various crops can be freely cultivated in areas classified as perennial grasslands, but an excessive reduction in the total area of permanent grasslands at national level may require producers to restore the same or corresponding area as grassland. This risk may limit free production and cause problems particularly for farms that are switching from grass-dominated production to other forms of cultivation.

The measure must be compatible with the EU's Common Agricultural Policy and its aid schemes and comply with EU State aid rules. Agricultural policy falls within the jurisdiction of common EU policies, and EU funding should be available for the measure, as it contributes to attaining common targets.

Finland should influence EU-level policies, ensuring that possibilities are created for resorting to national measures in which regional special features can be better accounted for. The aim should be at creating development-oriented rather than restrictive measures.

*Emission reductions 2030*: 0.07 Mt $CO_2$ equivalent in the effort sharing sector and 0.32 Mt $CO_2$ equivalent in the LULUCF sector.[20]

- **Planting forest in areas with organic soil.**
- **Planting wetland forest in areas with organic soil.**

According to the Energy and Climate Strategy, the possibilities for afforestation in treeless areas will be investigated. Projects have been launched to increase the efficiency of production in a sustainable manner and to optimise the use of arable land. The starting point is that the production capacity of Finnish agriculture will not decrease when the efficiency of production is increased in a sustainable manner, even though some of the land under cultivation would be used to create nature value or environmental benefits. Some of the less productive parcels could also be afforested in a controlled manner. This would help slow down the loss of forest area in Finland.

20 In the effort sharing sector, agricultural emissions include $N_2O$ and $CH_4$ emissions. $CO_2$ emissions are included in the LULUCF sector

The option of planting wetland forest has involved assessing the emission reductions and costs generated by blocking the drains of cultivated peatland and planting the land with downy birch or alder trees. Downy birch and alder will grow even in wet peatland, and raising the water level will deliver substantial savings in greenhouse gas emissions.

Both measures employ similar steering instruments: the inclusion of the afforestation measure in the Rural Development Programme for Mainland Finland should be considered when preparing the next programming period that will start in 2021. If forest measures are to be promoted with public funding before the next programming period, this should be done with national funds alone. No funding has been currently reserved for these measures.

As regards the environmental status of rural areas, planting forests on arable land may also have negative effects in Finland. Land used for forestry covers 72% of Finland's land area, while arable land accounts for 7%. In a country dominated by forests, open fields play a key role in enriching the landscape and opening up views. Agricultural areas are also important for species living in open areas. Many species use fields and their borders as their primary habitats, breeding grounds, places of refuge or feeding areas. The more extensive afforestation of fields would reduce their habitats. Thus, the measure may be incompatible with Finland's strategy and action plan for the conservation and sustainable use of biodiversity.

If afforested, fields would be permanently removed from agricultural use and would no longer be entitled to aid for agriculture. This may lead to a direct and potentially substantial decrease in farmers' income. Decades later, however, the forest would become a source of revenue for its owner.

*Emission reductions from the afforestation of organic soils 2030*: 0.23 Mt $CO_2$ equivalent in the effort sharing sector and 0.26 Mt $CO_2$ equivalent in the LULUCF sector.

*Emission reductions from planting wetland forest on organic soils 2030*: 0.01 Mt $CO_2$ equivalent in the effort sharing sector and 0.13 Mt $CO_2$ equivalent in the LULUCF sector.

**➲ Raising the water table through controlled subsurface drainage.**

In controlled subsurface drainage, drainage water is held in the drain network with control wells dug in fields or control dams placed in ditches, allowing the water table to be raised in fields. In organic agricultural land, raising the level of groundwater will slow down the decomposition of peat and thus reduce emissions.

The controlled subsurface drainage measure will be continued and efforts will be made to enhance its efficiency during the next EU programming period starting in 2021. The meas-

ure is included in the current rural development programme (building and implementing the control system). Both investment support and management payments (part of environment payments) are employed.

During the new programming period, funding for the implementation and management of controlled subsurface drainage would be based on the land area required.

*Emission reductions 2030*: 0.14 Mt $CO_2$ equivalent in the effort sharing sector and 0.43 Mt $CO_2$ equivalent in the LULUCF sector.

**Promoting biogas production.**

The promotion of biogas production will be continued and efforts will be made to enhance its efficiency during the next EU programming period starting in 2021. Investment support for biogas plants operated on farms and by rural enterprises will be developed so as to minimise the number of those falling between two stools.[21]

A plan for promoting the introduction of biogas in agricultural machinery will be drawn up in 2017. Possibilities and options for supporting the acquisition of biogas equipment for tractors will also be examined.[22] Moreover, Finland will try to remove restrictions on granting support to biogas plants by influencing EU State aid rules.

*Emission reductions 2030*: 0.36 Mt $CO_2$ equivalent in the effort sharing sector, of which 0.05 Mt $CO_2$ equivalent in the agricultural sector and a total of 0.31 Mt $CO_2$ equivalent from transport, heating and machinery emissions.

**Promoting the increased sequestration and storage of carbon in soil and the implementation of the 4per1000 initiative through research projects and experiments.**

The goal of the international '4per1000' initiative[23] is to demonstrate the role that the agricultural sector can play in promoting the transition towards carbon neutral economy in the long term. The aims of its first operational programme include developing and rolling

21 Measures, support alternatives and the profitability of biogas have been analysed in the report Hajautetun uusiutuvan energiantuotannon potentiaali, kannattavuus ja tulevaisuuden näkymät Suomessa [The potential of distributed energy production in Finland] (Publications of the Government's analysis, assessment and research activities 5/2017) prepared by Pöyry Oy in connection with the Energy and Climate Strategy. The report is available on the website of the Ministry of Employment and the Economy: www.tem.fi/strategia2016

22 The question will be discussed in the section on measures to reduce emissions from machinery.

23 The initiative has been presented in section 1.2 'Other international initiatives'.

out public steering instruments to support the initiative. Finland participates in the initiative and its decision-making body.

In Finland, the issue has been recognised and measures to increase carbon sequestration and storage in soils have been included in the Rural Development Programme for Mainland Finland 2014–2020 (e.g. recycling of nutrients and organic matter, plant cover on arable land in winter and environment management grasslands). There are also several on-going research and development projects concerning soil carbon, e.g. MAHTAVA – Modelling the carbon sequestration potential of soil amendments and Oranki – The role of organic matter in soil productivity.

In the long term, it will be important to find more practical measures to increase carbon sequestration in agricultural land. In the future, when more information will be available on carbon sequestration and storage, concrete action can be supported with various public measures. The theme could be emphasised more, for example, in agricultural aid schemes towards the end of the 2020s. At present, research projects that provide more information on the most efficient ways to increase carbon sequestration in soils play a key role. It is too early to define new steering measures, but experiments supporting research can be launched quickly.

In addition to practical measures and research, efforts are needed to find and develop ways to include the impacts of agricultural measures that increase the soil carbon stock in greenhouse gas reports and make them more visible.

### Food consumption, food waste and nutrition recommendations

Food causes a quarter of the climate impacts of Finnish consumption. Sustainable food choices can influence the greenhouse gas emissions originating from food consumption. Some of these impacts take place in the effort sharing sector (agriculture). It is important to make it as easy as possible for consumers to choose ingredients and meals that have a minimal impact on the climate. Ingredient choices are the main element determining the environmental footprint of consumers' food consumption: processing, transport and packaging have a more limited effect.

In June 2016, the Government adopted a resolution on sustainable public procurement in food products and catering services. The Government aims to ensure that only sustainably and responsibly produced food and catering services will be purchased in public procurement. In the resolution, the Government outlines that central government food purchases will emphasise environmentally good farming practices, animal health and welfare and food safety. In practice, the resolution will entail an increase in the share of domestic food served in institutional kitchens in the public sector.

- **Reducing food waste:**
  - **– Halving the amount of food waste in institutional kitchens by 2030.**
  - **– Encouraging various actors in the sector (e.g. commerce, industry and restaurants) to make voluntary commitments.**
  - **– Improving the system for measuring and monitoring food waste.**

Discarding edible food is a major economic and ecological burden that also reduces food security. MTT Agrifood Research Finland[24] has estimated the whole Finnish food chain to produce a total of 400–500 million kilograms of food waste a year. Food waste refers to discarded food and ingredients that could have been eaten if they had been stored or prepared differently at some point along the chain. Food waste is generated at each stage of the food chain. In terms of volume, it can be divided as follows: primary production 12%, industry 20%, commerce 18%, food and catering services 20% and households 30%. In relation to food flows in different parts of the food chain, by far the greatest amount of food waste is generated in restaurants, where approximately 20% of all food becomes waste (from preparation, serving and plate waste).

Food waste occurs at all stages of the food chain and, thus, its causes also vary. Emphasis should be on preventing food waste, because avoiding waste in the first place is more economical than treating it later. Measuring the current amount of food waste is a vital step to be able to set sensible targets for its reduction and evaluate possible initiatives. Food wastage could be better managed by improving food waste monitoring and statistics. Preventing and reducing food waste throughout the food chain will require research, quality management and foresight. The side-streams of primary production and food processing should be primarily used as food, secondarily as products with high added value and, as a last resort, in energy production. Food waste can also be reduced by providing more information and advice on and raising awareness of the impacts of food wastage and ways to reduce it.

UN Member States have adopted Sustainable Development Goals (SDGs) and a 2030 Agenda for Sustainable Development, which entered into force at the beginning of 2016. The SDG on consumption and production includes the target of halving global food waste at the retail and consumer levels and reducing food losses along production and supply chains, including post-harvest losses, by 2030. As a member of the UN, Finland is also committed to this goal.

- **Following nutrition recommendations:**
  - **– Providing guidance to institutional kitchens.**
  - **– Guiding by information on nutrition recommendations.**

24 Currently Natural Resources Institute Finland (Luke).

The National Nutrition Council has published the Finnish Nutrition Recommendations 2014[25]. Their objective is a health-promoting diet that is as environmentally sustainable as possible. The recommendations encourage people to eat more vegetables, in particular legumes. If meals were compiled emphasising plant products (vegetables, root vegetables, cereal, legumes, berries and fruit) and the food chain would implement those improvements that are already accessible, the climate impact of dietary choices would decrease by 20% during this decade.

Public food purchases are worth EUR 350 million each year. Their procurement takes place at regional level, which means that the goal of purchasing sustainably produced Finnish foodstuffs must be included in the municipal strategies as well. In summer 2016, the Government adopted a resolution on public procurement in food products and catering services. The public procurement of foodstuffs and catering services should aim for high quality and overall economic sustainability. This can be achieved by purchasing foodstuffs that have been produced with environmentally sound farming and production methods, promoting animal welfare and food safety. Moreover, procurement criteria concerning the nutritional quality of food must be taken into account. More efforts should be made to ensure that food choices meet several objectives simultaneously, for example by being healthy, safe and environmentally friendly.

## Measures to reduce agricultural emissions in the LULUCF sector as outlined in the Energy and Climate Strategy

The greenhouse gas emissions from agricultural land and the related emissions savings discussed in this section are covered by the LULUCF sector and thus by the policies and measures outlined in the Energy and Climate Strategy. These policies are nonetheless linked to agricultural emissions in the effort sharing sector and, through the flexibility opportunities provided by sinks, to the entire effort sharing sector.

Agricultural land, or arable land and grassland, are a net source of greenhouse gas emissions in Finland (under the current reporting system more than 7.5 Mt $CO_2$ equivalent annually). According to a monitoring study[26], the carbon stock in Finnish croplands has, on average, decreased and the amount of organic matter in soil reduced in a nearly linear fashion from 1974 to 2009. By means of good farming practices, the decrease of the carbon stock may be slowed down and, in some cases, the carbon stock may even be replenished by increasing carbon input into soil. The greatest potential for reducing emissions is in peatlands, and the greatest potential for increasing the carbon stock in mineral soil.

25 https://www.evira.fi/en/foodstuff/healthy-diet/nutrition-recommendations-for-all/adults2/

26 VALSE monitoring (national monitoring of the chemical status of arable land)
http://radar.luke.fi/catalog/search/resource/details.page?uuid={D10F22AE-A215-47A9-8D4C-FE2F78F98C67}

These developments and measures are discussed in more detail in the sector-specific plan concerning agriculture.

A significant source of emissions in the land use sector is the clearance of forest for other land use purposes, mainly as a result of civil works and clearing land for cultivation. The annual emissions from these activities are approximately 3.5 Mt $CO_2$ equivalent. According to the Energy and Climate Strategy, measures will be specified and implemented for reducing deforestation, especially in connection with civil engineering and transport sector construction (e.g. through land use planning) and as a result of clearing land for cultivation.

Over the years, the use of peatland for cultivation has increased for multiple reasons. One of these has been that livestock farms have required more land for spreading manure (Environmental Protection Act) and growing forage as they have expanded their operations. The growing costs of buying and renting arable land has also lead to farmers clearing more of their own land. The clearance of land for cultivation has been restricted with national measures, for example, by making cleared land ineligible for LFA aid and agri-environmental payments since 2004.

The Energy and Climate Strategy also states that techniques for measuring carbon sequestration and storage in arable land as well as cultivation methods that help to increase the carbon sink will be developed. According to the strategy, a pilot project will be launched with the aim of increasing the carbon sink of farms. Finland has joined the 4per1000 initiative that was launched in connection with the Paris Climate Change Conference and aims to increase the quantity of carbon contained in soils by 4‰ each year. The sequestration of atmospheric carbon in soils will contribute to limiting the temperature increase to 1.5–2 °C. It will also increase the productivity of soil and improve food security.

Measures implemented under the Rural Development Programme for Mainland Finland currently seek to slow down the decrease of soil carbon and to increase the soil carbon stock. These measures are discussed in the sector-specific plan on agriculture and, in terms of emission reductions in agriculture, in section 6.3.

The Energy and Climate Strategy also states that the impacts of the greening payments, cross-compliance conditions and environment payments of the EU's Common Agricultural Policy on soil carbon stocks in Finland will be examined, and proposals on how farmers can be encouraged in connection with the CAP reform to improve soil condition, including building up the soil carbon stocks and reducing the speed at which the carbon stocks are depleted.

Direct aid, fully funded by the EU under the CAP, is now associated with agri-environmental requirements, and 30% of direct payments have been linked to greening payments.

Farmers must comply with three greening measures on their eligible hectares. Greening payment measures that affect the soil include the requirements of perennial grassland, diversification of cultivation and partly also ecological focus areas. Other measures that fall within the scope of CAP cross-compliance conditions and impact the soil include the prohibition of burning stubble and the requirement of plant cover in fallow land. A number of research projects related to the carbon sinks of agricultural land and the impact of these measures are currently under way.

### 7.2.3 Building-specific heating

➲ **Introducing an obligation to blend light fuel oil used for heating with 10% of bioliquid and frontloading its implementation.**

The oil sector will be required to blend the heating oil on sale with a biocomponent. The share will increase up to 10% by 2030. The increase in the biocomponent share will be frontloaded to the first years of the period. The obligation will be laid down by law. The introduction of the blending obligation involves certain issues concerning technical and economic aspects, EU legislation and availability, and they must be solved when preparing the legislation needed to implement the measure.

The blending obligation will cut the $CO_2$ emissions of buildings with oil heating so that calculated emissions will decrease in proportion to the share of the biocomponent. The use of bio fuel oil will support the target of halving the use of oil and the commitment to provide incentives for replacing imported oil in heating by emission-free, renewable alternatives, as enshrined in the Government Programme.

*Emission reductions 2030*: 0.2 Mt $CO_2$ (all oil used for heating)

➲ **Phasing out oil heating in central government premises by 2025 and encouraging all public-sector operators to do the same.**

In this context, public-sector operators refer to the State and municipalities. The climate change policy plan cannot impose binding requirements on municipalities, but they can be encouraged to take action alongside the State. Municipalities are responsible for more than 90% of the oil use in public buildings. It is important that the State sets an example and encourages the municipal sector to shift from oil to other heating solutions. This could be done, for example, by establishing a programme to promote the cause. Replacing oil heating with geothermal heating has proven to be a cost-effective solution in numerous municipalities participating in the HINKU Forum, a network that supports municipalities in achieving carbon neutrality. Networks of municipalities can also promote measures for example by helping individual municipalities calculate their costs.

*Emission reductions*: For State properties 0.013 Mt $CO_2$ and in total up to 0.13 Mt $CO_2$ if the whole public sector, including municipalities, phases out oil heating.

**Improving energy efficiency and promoting the use of renewable energy in the existing building stock.**

As a steering instrument, the implementation of voluntary energy efficiency agreements will be continued and developed. Guidance by information will be provided on the energy-efficient use of buildings and a good indoor climate. The Ministry of the Environment will continue to participate in the energy efficiency agreement for the property sector, the oil sector energy efficiency agreement Höylä IV and the Kutteri energy efficiency agreement for the bioenergy sector. Experiments with, and the development of funding mechanisms needed for energy efficiency projects will be continued.

Guidance by information on the energy-efficient use of buildings and a good indoor climate will be conducted in collaboration with Motiva and other relevant actors in the field. Consumers will have access to domestic help credit for renovations to improve the energy efficiency of their dwellings and for the installation costs of renewable energy sources and heat pumps. At the beginning of 2017, the domestic help credit was increased to 50% of work costs.

**In order to increase the steering effect, taxation of heating fuels will be amended as agreed in the August 2017 governmental budget session.**

The transfer to heat pumps and heating solutions based on renewable energy can also be promoted by reforming the taxation of energy. The competitiveness of alternative heating solutions, such as heat pumps, can be improved by raising the carbon dioxide component of the energy tax on heating fuels. The measure will also intensify the impact of guidance by information as referred to in the previous section.

**Promoting the clean combustion of pellets and firewood.**

The clean combustion of wood will be promoted by improving technology and equipment and by raising public awareness of different wood burning techniques. Steering instruments will include an information campaign on cleaner ways to burn wood and instruments to improve the technical features of equipment and devices, such as drawing up a product standard. Fireplace manufacturers will be encouraged to place better products on the market, for example through ecolabelling.

In addition to its impact on the climate, the measure will improve public health by reducing fine particulate emissions and their (annually significant) adverse effects on health.

The measure aims to improve the efficiency of equipment and burning techniques and reduce the harmful emissions they produce.

*Emission reductions*: Clean combustion of wood will influence, in particular, fine particulate matter and black carbon emissions. Black carbon is a short-lived pollutant with significant warming potential and its warming effect is emphasized in the Arctic region and accelerates melting. In addition, black carbon has a connection to major health hazards such as mortality and cardiovascular disease. Finland has committed to reducing its black carbon emissions by joining the international coalition CCAC[27].

### 7.2.4 Waste management

The ban on landfilling organic waste, which entered into force in 2016, will significantly reduce the importance of landfills as a key source of greenhouse gas emissions in the waste management sector. Only waste that meets the criteria established in the Government Decree on Landfills will be accepted for disposal at landfills. In future, it will be important to supervise compliance with the landfilling restriction and develop new recycling options to replace landfilling.

Even though the recycling rate will increase, the capacity of existing waste incineration plants will be needed to recover energy from organic waste that cannot be recycled. The possibility of including this capacity in the ETS will be examined. This would mean that $CO^2$ emissions from waste incineration would be covered by price control.

➲ **The inclusion of waste incineration emissions in the ETS will be examined, taking into account its effects on achieving waste management targets.**

*Emission reductions*: If waste incineration is included in the ETS, emissions from the effort sharing sector will reduce by up to 0.6 Mt $CO_2$. It may increase the costs of waste incineration, which may promote recycling and the reuse of waste as material.

➲ **Overseeing and monitoring the implementation of the Government Decree on Landfills.**

According to the Government Decree on Landfills, the restriction on the share of organic matter in construction and demolition waste will become stricter as of 1 January 2020. Compliance with this restriction must be monitored and overseen. Moreover, the development of new waste treatment methods should be promoted where possible.

27 For more information on the CCAC, please see section 1.2. '*Other international initiatives*'.

*Emission reductions 2030*: The measure will be necessary to achieve the emission reductions included in the baseline scenario.

### 7.2.5 F-gases

Regulation on F-gases will steer emissions to the level of 0.8 Mt $CO_2$ equivalent by 2030 and further to 0.3 Mt $CO_2$ equivalent by 2040. Improvements in expertise, technology and public procurement are estimated to deliver additional savings of 0.3 Mt $CO_2$ equivalent by 2030. The emission reductions estimate concerns the following set of measures:

- **Avoiding appliances containing F-gases in public procurement.**

The steering instrument will be a set of criteria on alternatives for HFCs in public procurement (project underway).

- **Promoting the introduction of alternative technologies and enhancing the recovery of F-gases through education and information activities.**

Education and training will be reformed by including in existing degrees in the refrigerant sector the skills and competence required for technologies using 'natural refrigerants'. Educational institutions in the field would be supported in purchasing the equipment they need. Education and training for new entrants in the field and further education and training for qualified professionals will accelerate the transition towards alternative technologies by providing more information on new technologies and teaching professionals to use them safely. The Finnish National Agency for Education will be responsible for defining qualification requirements.

Consumer awareness of the importance of capturing F-gases and the appropriate ways to do it will be raised through information activities by public authorities and the industry. The industry will be encouraged to implement voluntary measures, such as attaching labels to equipment and devices in connection with sales and/or installation to remind users that the capture of F-gases must be undertaken by a qualified professional.

- **Exploring and demonstrating alternative technologies suited to local conditions.**

The development of technological alternatives to F-gases and their suitability for local conditions will be promoted with research projects in certain sectors of application with domestic equipment production or expertise. Potential sectors would include small cooling appliances in shops, heat pumps, air conditioning appliances in buildings or district cooling.

*Emission reductions 2030*: 0.3 Mt $CO_2$ equivalent (all measures combined)

### 7.2.6 Machinery

According to the Energy and Climate Strategy, an obligation to blend light fuel oil used in machinery with 10% of bioliquids will be introduced and the wider use of gas-powered machinery will be promoted. The blending obligation would also apply to the use of bioliquids in the oil heating of buildings.

- **Introducing an obligation to blend light fuel oil used in machinery with bioliquids. The blending ratio will be gradually increased to 10% in 2030, frontloading the increase.**

*Emissions reductions* delivered by the measure will amount to 0.2 Mt $CO_2$ in 2030.

The climate change policy plan also identifies the following forward-looking measures that will deliver additional emission reductions in the machinery sector in the coming years.

- **Promoting the use of biogas in machinery.**

The Ministry of Agriculture and Forestry has decided to expand the scope of agricultural investment support by allowing support for environmental investments to be granted for purchasing the equipment needed to fuel a tractor with biogas.

- **Participating in the development of $CO_2$-related regulation on machinery at EU level.**

Reforming the Machinery Directive will be on the European Commission's agenda in the near future, launching discussions on the regulation of CO2 emissions.

- **In order to increase the steering effect, taxation of heating fuels will be amended as agreed in the August 2017 governmental budget session.**

The taxes on heating fuels also apply to machinery, which uses light fuel oil.

- **Increasing the share of energy-efficient and low emission machinery through public procurement (equipment and services).**

The energy efficiency and low emissions of machinery can be taken into account when purchasing equipment and services, and public procurement can be used as an instrument to increase the share of low emission machinery. Machinery will be included in the development of advisory services concerning sustainable and innovative public procurement. Key activities include the creation of criteria for procurement.

- **Promoting the energy-efficient use of machinery through guidance by information.**

Energy efficiency can be promoted by providing training and other forms of guidance by information to machinery operators, for example, through Motiva and the energy-related advisory services provided for farms. In addition to energy savings, energy-efficient machines will also save costs. Gathering and communicating best practices are considered reasonable measures also among stakeholders.

➲ **Building a stronger knowledge base on reducing $CO_2$ emissions from machinery.**

Analyses will be launched to support the development of and other work on a national inventory and scenarios concerning greenhouse gas emissions from machinery and efforts to influence policies at EU level. The functioning of the network of experts and other operators in the field of machinery will also be ensured.

*Emission reductions 2030*: The total impact of these measures is estimated at 0.15–0.35 Mt $CO_2$.

### 7.2.7 Other sectors

Energy aid will continue to be an important tool for supporting the introduction of new energy technology and increasing the use of renewable energy and energy efficiency. Energy aid is an integral part of the framework formed by energy efficiency agreements and energy audits.

Other measures will include:

- ➲ **Promoting the replacement of fuel oil-fired boilers with boilers fired with solid fuel.**
- ➲ **Enhancing the efficiency of energy audits in accordance with the policies proposed in the Energy and Climate Strategy.**
- ➲ **In order to increase the steering effect, taxation of heating fuels will be amended as agreed in the August 2017 governmental budget session.**

## 7.3 Policy scenario (WAM)

The emission reduction measures identified in section 7.2 constitute the policy scenario (WAM). Table 5 includes a summary of their estimated sector-specific emission reductions in 2030. This section will examine the adequacy of these measures in relation to the binding emission reduction target and any uncertainties associated with them. No detailed information on the policy measures and their implementation is available at this stage; thus, the following analyses are based on assumptions about the timing and effectiveness of the implementation of these measures. The starting point of our analysis is the option that

the measures listed in Table 5 will begin to deliver emission reductions already in 2021 and their impact will increase in a linear manner until 2030.

**Table 4. Estimated sector-specific emission reductions.**

| Sector | Estimated emission reductions 2030 (Mt $CO_2$e/year) |
|---|---|
| **Transport, total** | **3.1** |
| • Renewable / low emission fuels and power sources | 1.5 |
| • Energy efficiency of vehicles | 0.6 |
| • Energy efficiency of the transport system | 1 |
| **Increased use of biogas** | **0.5** |
| **Agriculture** | **0.3** |
| **Building-specific heating, total** | **0.2** |
| • Blending obligation | 0.1 |
| • Phasing out oil in the public sector | 0.1 |
| **Industrial oil use** | **0.1** |
| **Waste management** | **0.6** |
| **F-gases** | **0.3** |
| **Machinery, total** | **0.5** |
| • Blending obligation | 0.2 |
| • Other measures | 0.3 |
| **Total** | **5.6** |

### 7.3.1 Adequacy of measures

According to the European Commission's proposal, Finland's emission reduction target for 2030 would be 20.6 Mt $CO_2$ equivalent (see section 5.1). The emission reduction target will follow a linear trajectory. According to the proposal, the trajectory will start in 2020 at the level of the average emissions for 2016–2018. In the baseline scenario, Finland will fall short of the 2030 target by 5.8 Mt $CO_2$ equivalent. When taking into account the total emission reductions delivered in 2030 by the measures listed in Table 5 and the one-off flexibility (0.7 Mt $CO_2$e/year), Finland will exceed the 2030 target by approximately 0.4 Mt $CO_2$ equivalent (see Figure 15).

However, the emission reduction target can be seen as a cumulative target for the period 2021–2030, because the Effort Sharing Regulation would determine annual emission reduction targets for each Member State, allowing countries whose emissions remain below their targets to save their excess emission units for later years. Therefore, in terms of target attainment, it is also relevant to examine the accumulation of emission units instead of focusing merely on individual years. In the period 2021–2030, the cumulative gap between the baseline scenario and the trajectory proposed by the European Commission will amount to 26.2 Mt $CO_2$ equivalent.

Assuming that the measures listed in Table 5 will immediately begin to deliver emission reductions in 2021 and that their impact will increase until 2030 following a linear path, there will be a cumulative surplus of emission units throughout the period 2021–2030. The surplus will continue to increase until 2030, reaching a level of approximately 11.2 Mt $CO_2$ equivalent.

These estimates are based on numerous assumptions, and the actual emission trend may differ from the one presented in Figure 15. Key uncertainties have been examined in a sensitivity analysis.

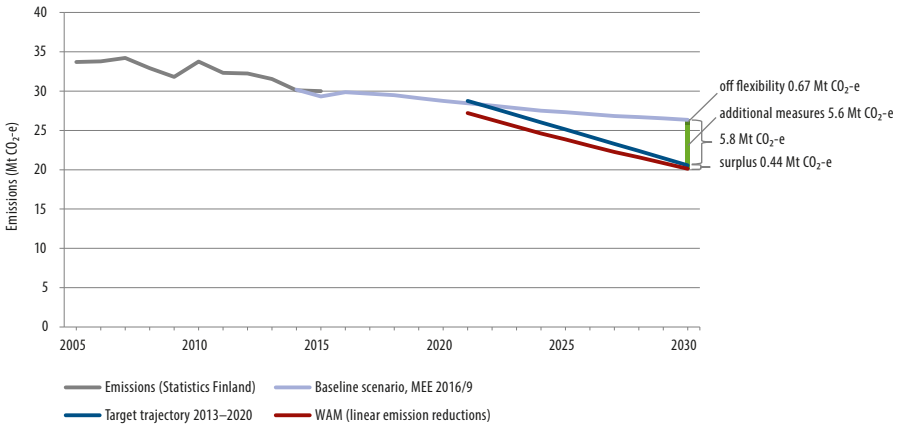


**Figure 15. Target trajectory, baseline scenario and the policy scenario based on emission reduction measures (WAM) assuming that emission reductions are delivered in a linear manner during the period 2021–2030.**

### 7.3.2 Sensitivity analysis

There are certain uncertainties surrounding the implementation of policy measures and the emission reductions they will deliver. No timetable has yet been determined for the implementation of the measures. Thus, there is a risk that at least some of their implementation will not begin in 2021. Moreover, there are uncertainties regarding their estimated emission reductions in 2030, and it is possible that not all emission reductions included in Table 5 will be realised in full. The effects of these uncertainties have been assessed by analysing the accumulation of emissions units in the following five scenarios:

**Linear + waste incineration transferred to ETS in full from 2021:** Like above, but waste incineration will be transferred to the ETS sector right away in 2021.

**Linear + waste incineration transferred to ETS in full from 2021 + frontloading the blending obligation:** Like above, but the blending obligation concerning the fuel oil used in heating and machinery is assumed to be frontloaded so that it will be 5% in 2021 and 10% already in 2023. In 2022, the compulsory blending ratio will be 7.5%.

**Shortfall in emission reductions + 50% of waste incineration transferred to ETS:** Emission reduction measures (excl. the blending obligation concerning light fuel oil and the inclusion of waste incineration in the ETS) will not begin to deliver emission reductions until 2023, continuing a linear increase towards the 2030 emission reduction level, which is assumed to be only 75% of the savings estimated in Table 5. The blending obligation concerning light fuel oil will be introduced in 2023, and the blending ratio will show a linear increase in 2023–2030, reaching 10% in 2030. Waste incineration will be included in the ETS sector only in part: only 50% of its emissions will be covered by the ETS sector. For these plants, the transfer is expected to take place in 2021.

**Shortfall in emission reductions + waste incineration not transferred to ETS:** Like above, but waste incineration cannot be transferred from the effort sharing sector to the ETS sector in full or in part, and the emission reductions from waste management will not be delivered.

Table 5 indicates the cumulative surpluses or deficits in emission units according to the baseline scenario and different scenarios with policy measures. The results show that the effectiveness of policy measures and the timing of their implementation will have a great impact on the accumulation of emission units. Under the assumptions made here, the accumulation will vary from a surplus of 15.1 Mt $CO_2$ equivalent to a deficit of 2.0 Mt $CO_2$ equivalent. The results also indicate that frontloading the blending obligation will have an impact of approximately 1.4 Mt $CO_2$ equivalent, which is relatively small compared to the overall variation between different scenarios.

**Table 5. Cumulative surplus (+) or deficit (-) in units in the efforts sharing sector in the period 2021–2030.**

| | Cumulative surplus/deficit* (Mt $CO_2e$) |
|---|---|
| **Baseline scenario** | -19.4 |
| **Linear** | 11.2 |
| **Linear + waste incineration transferred to ETS in full from 2021** | 13.7 |
| **Linear + waste incineration transferred to ETS in full from 2021 + frontloading the blending obligation** | 15.1 |
| **Shortfall in emission reductions + 50% of waste incineration transferred to ETS** | 0.8 |
| **Shortfall in emission reductions + waste incineration not transferred to ETS** | -2.0 |

*The figures are based on the assumption that the one-off flexibility will be used in full (cumulative impact 6.7 Mt $CO_2e$).

Table 6 examines the cumulative emission reductions achieved during the period 2021–2030 in each sector according to the scenarios *linear + waste incineration transferred to ETS in full from 2021 + frontloading the blending obligation and shortfall in emission reductions + waste incineration not transferred to ETS*, which constitute the two extremes of the sensitivity analysis. The results show that particularly the realisation of emission reductions in the transport sector and the transfer of waste incineration from the effort sharing sector to the ETS sector play a key role in achieving the emission target. Failure to transfer waste incineration under the scope of the ETS and shortfalls in emission reductions will have a total cumulative impact of 12.9 Mt $CO_2$ equivalent. This accounts for the majority of the cumulative difference of 17.1 Mt $CO_2$ equivalent between emission reductions in the scenarios examined. Therefore, it will be vital to implement emission reduction measures as soon as possible and at the latest during the early years of the period 2021–2030, particularly in the transport sector. The Ministry of Transport and Communications appointed a parliamentary working group on 8 February 2017 to assess the financing of the transport network taking into account, for example, emission reduction targets. By 18 August 2017, the working group will give an interim report on proposals concerning emission reductions. The group's emission reduction proposals will be closely connected to the climate change policy plan and the ways to further specify its policy measures.

**Table 6. Cumulative emission reductions delivered by the proposed measures during the period 2021–2030 in the sensitivity scenarios linear + waste incineration transferred to ETS in full from 2021 + frontloading the blending obligation and shortfall in emission reductions + waste incineration not transferred to ETS.**

| | Cumulative emission reductions (Mt $CO_2$e) 2021–2030 | | |
|---|---|---|---|
| | Linear + waste incineration transferred to ETS in full from 2021 + frontloading the blending obligation | Shortfall in emission reductions + waste incineration not transferred to ETS | Difference |
| Transport | 18.8 | 11.5 | 7.2 |
| Agriculture | 2.8 | 1.7 | 1.1 |
| Building-specific heating | 2.0 | 1.2 | 0.9 |
| Industrial oil use | 0.3 | 0.2 | 0.1 |
| Waste management | 5.7 | 0.0 | 5.7 |
| F-gases | 1.7 | 1.0 | 0.6 |
| Machinery | 3.3 | 1.8 | 1.5 |
| **Total** | **34.5** | **17.4** | **17.1** |

Because of the risks associated with emission reduction measures, a sufficient number of different measures should be determined in order to achieve the emission target. In addition to the risks associated with the timing and effectiveness of policy measures, there are certain uncertainties about future EU legislation. For example, no final decision has yet been made on the target trajectory and the flexibility mechanisms available. The target trajectory will, in particular, have a great impact on Finland's cumulative emission reduction target. The cumulative impact of the options put forward during the EU-level drafting process varies from an additional burden of 14 Mt $CO_2$ equivalent to a target that would be 4.6 Mt $CO_2$ equivalent easier than the one currently proposed. Moreover, the analyses described above build on the baseline scenario, which also involves uncertainties. It should also be noted that some of the measures may partially overlap or have mutual effects, meaning that they may not necessarily deliver the estimated emission reductions in full. As noted in section 5.2, in order to manage the numerous uncertainties, Finland must be prepared to complement banking and borrowing with other flexibility mechanisms allowed by the Effort Sharing Regulation.

Considering the significant uncertainty associated with the estimates, the starting point is that the contents of the measures proposed here and the details of their implementation can be further specified in future medium-term climate change policy plans. According to the Climate Change Act, the climate change policy plan must be amended if annual monitoring reveals a need to adopt new additional measures to reduce emissions.

# 8 Climate policy in everyday life – emission trends from the perspective of consumption

## 8.1 Food, housing and mobility

In addition to a shift towards sustainable energy production, measures are needed to moderate energy demand. Changing consumption habits and reducing demand are part of this trend. These measures will impact both the ETS and effort sharing sectors. They also help respond to the challenges of increasingly scarce resources.

Many of the ways to reduce emissions in the effort sharing sector, as set out in this climate change policy plan, are directly or indirectly connected to consumption-related measures. The majority of transport emission reductions are achieved by using low carbon power sources or by other technological means. At the same time, people will also need to change their habits and choices. They should increasingly often choose walking, cycling, public transport or carpooling and favour cleaner vehicles.

Property owners' decisions play a key role in phasing out oil heating. Greenhouse gas emissions from housing can also be cut by climate-smart housing and renovations that improve energy efficiency. Consumers also play a role in the highly technical chain of measures to reduce F-gas emissions.

In the effort sharing sector, measures concerning agriculture focus on emissions from livestock production and soil, but consumer action, such as shifting to a diet rich in fruits and vegetables and reducing food waste, may also have an impact on emission trends in the agricultural sector.

Emissions from the effort sharing sector are calculated based on where they are generated: at national level and in the sector where they are emitted. A consumption-based calculation model reveals lifecycle emissions as well as the carbon footprint of consumption

of domestic and imported products and materials. Of all consumption-based emissions in Finland, 75% are from food, housing and passenger transport.

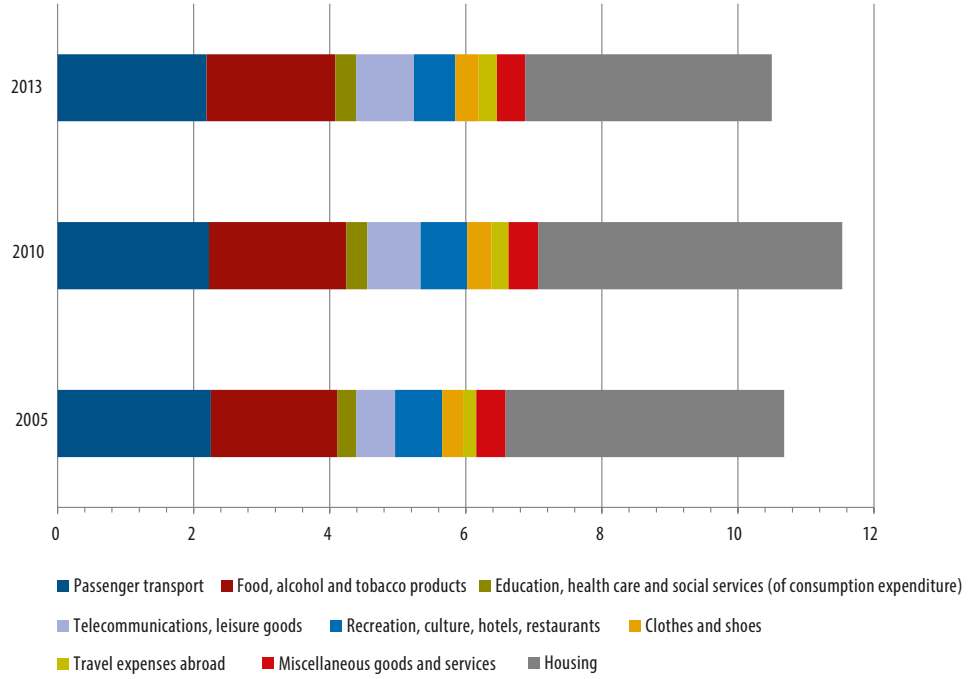


**Figure 16. Consumption-related greenhouse gas emissions in Finland in 2005, 2010 and 2013 ($tCO_2$/person in both the effort sharing and ETS sector) (ENVIMAT data).**

The single largest source of consumption-related emissions is housing, in which emissions are generated, for example, by heating and the use of electrical appliances. Housing is followed by food consumption and transport. Because emissions from housing and mobility will decrease, for example through the transition towards a low carbon energy system, food consumption will account for an increasingly large share of greenhouse gas emissions.

## 8.2 Towards sustainable consumption

Sustainability is a consumption trend that supports climate-friendly choices. There is increasing interest in foods rich in fruits and vegetables, and the food industry has begun developing new products to replace meat. However, when looking at the entire population, Finnish people eat clearly more meat than dietary guidelines recommend. Few people choose products solely on the basis of environmental or climate criteria. Low carbon solutions should be suitable for the good daily life of a diverse range of consumers and households – and different budgets.

Many low carbon choices concerning housing, mobility and food have positive side-effects. At home, most people can implement measures that improve energy efficiency and save money. Smart burning of wood will prevent black carbon emissions as well as air quality problems and health issues. Walking and cycling instead of taking the car will improve physical fitness, lift spirits and cut petrol costs. Reducing food waste will cut costs and reduce emissions from food production. Following the Finnish Nutrition Recommendations will promote health and reduce the climate impact of food.

On average, people are relatively slow to take action on their own initiative. Thus, the living environment plays an obvious role in consumers' choices. Choices that are sustainable in terms of the climate and promote well-being are easier to make when the immediate environment supports the use of public transport and safe cycling or when a restaurant or shop offers healthy and low carbon food. The way environments develop depends on decisions taken by numerous actors and the overall development of society. The market needs technology and expert services that facilitate the transition towards low carbon choices or new technologies.

Technological advances enable consumers to take a more active role as energy producers and players in climate action. In EU energy and climate policy[28], consumers are envisaged better possibilities to compare energy sources and prices as well as produce or sell their own electricity. The EU wants consumers to respond to changes in energy prices and thus become more involved in the energy system. The increasing use of air source heat pumps and the active public online discussions that have contributed to it are an example of energy citizenship in Finland. Consumer acting as player on energy markets is a fairly new phenomenon, but energy utilities, among others, are looking for new operating models for issues that interest their customers and for comprehensive guidance and cooperation.

## 8.3 Policy measures in steering consumption

In Finland, the perspective of consumption has been integrated into energy policy in the Energy and Climate Strategy and in strategies concerning sustainable consumption and production. However, most of the financial steering measures set out in the '*More from Less – Wisely*', a 2013 government resolution building on the latest *Programme to Promote Sustainable Consumption and Production*, are still waiting to be implemented. For example, financial steering and financing models have not been developed for renovations that improve energy efficiency, and the possibility of making the costs of energy audits, property condition assessments and surveys, and renovation planning eligible for domestic

28 https://ec.europa.eu/energy/en/news/commission-proposes-new-rules-consumer-centred-clean-energy-transition

help credit has not been examined. To eliminate environmentally harmful subsidies, mileage allowance has been reduced by 2 cents per kilometre, but no action has been taken regarding other subsidies or tax reliefs associated with similar problems.

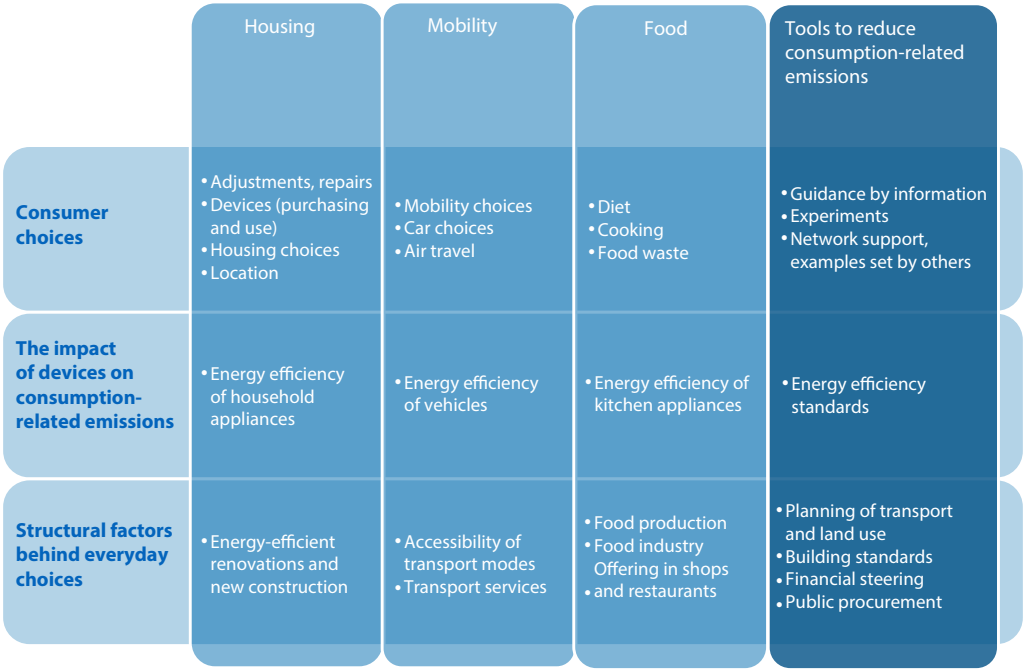


**Figure 17. Consumption and consumer choices can be influenced through various measures and their combinations.**

Cutting lifecycle emissions from housing, mobility and food requires diverse steering instruments. Steering is the most effective when it is done through a package of instruments targeting various actors with both 'hard' steering instruments, such as financial steering, and 'soft' instruments, such as guidance by information (see Figure 17).

Within society, different decisions that influence the behaviour of consumers are constantly made. At their best, they promote climate-friendly consumption. On the other hand, consumption is associated with a 'rebound effect' suggesting that any money saved will be spent on other goods and services, which may result in even greater emissions than those generated by the original use.

Calculators for measuring the emissions of one's own lifestyle have become more common in recent years. The Climatediet carbon footprint calculator developed by the Finnish Environment Institute (SYKE) helps consumers choose their preferred methods to adjust their consumption. The 'quick diet' gives consumers tips on how to cut their greenhouse gas

emissions by a fifth through simple choices accessible to many. The more thorough 'lifestyle change' option enables consumers to halve their annual carbon footprints. The Climate Pledge campaign[29] builds on the calculator[30] developed by the Finnish Environment Institute and has attracted international interest. The Commitment2050 tool[31] supports organisations and private individuals in their efforts to achieve a carbon neutral society.

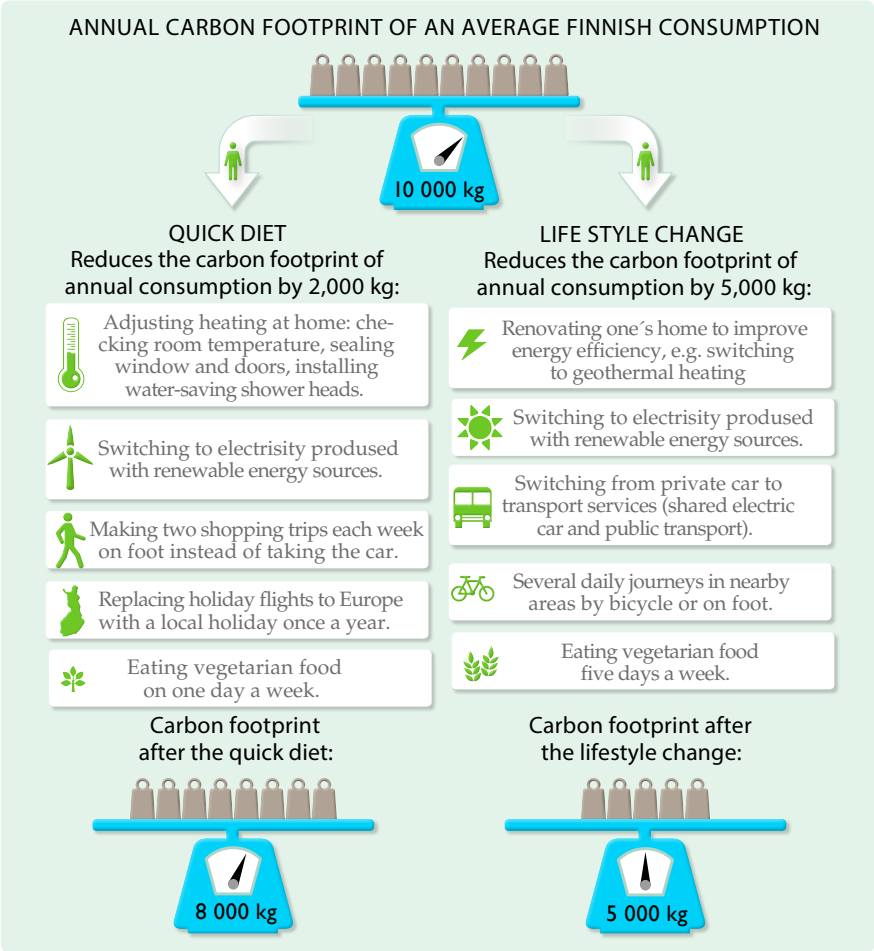


**Figure 18. Finnish consumers can cut their emissions by a fifth through simple measures that are accessible to most people. Halving emissions will require using these tools more frequently and making a few larger changes. (Source: SYKE )**

29 http://myrskyvaroitus.fi/ilmastolupaus/

30 https://www.ilmastodieetti.fi/

31 https://sitoumus2050.fi/

Activating the public will require the dissemination of information, capacity building and discussions about values. Climate education should be provided at all levels of the education system[32], and climate-related communications should be targeted at a wide range of target groups, especially at young people.

Consumers are given energy advice also in a web portal launched in 2013 and by regional advisers. The aim is to ensure that all people in Finland have equal access to energy advisory service free of charge. However, general guidance alone is insufficient, because there is an increasing demand for expert knowledge for example when consumers are making decisions about housing, renovations or investments. Hardware shops are an example of 'gatekeepers' whose work may make a significant contribution to promoting the energy efficiency of buildings.

Efforts to influence consumption will employ the whole arsenal of steering instruments available: norms, financial instruments and guidance by information. Existing instruments must be further developed, and new tools, especially cost-effective ones, will also be needed. In addition to the consumption-related measures in different sectors discussed above, the following measures are proposed:

- **Encouraging consumers to reduce their carbon footprint on average by 50% by 2030.**

Guidance by norms, advice and financial instruments must be complemented with more active consumer engagement and peer learning. For instance, local experiments and pilots as well as sustainable operating models can increase the effectiveness and acceptability of climate action. Consumers will also play a more prominent role in developing solutions.

- **Energy efficiency of buildings (emphasis on the ETS sector)::**
  - **Tools will be developed to support methodical building management in housing companies.**
  - **Past experiences will be drawn on, and funding mechanisms will be developed for energy investments.**

Experiences gained from innovative funding models (e.g. ESCO model and joint procurement) will be drawn on, and best practices will be established together with stakeholders to encourage the planning and implementation of energy investments. Novel experiments will be carried out, emphasising the active role of consumers.

32 The Finnish Climate Panel's report 1/2015 *Suomessa tarvitaan lisää ilmastokasvatusta*: http://www.ilmastopaneeli.fi/uploads/selvitykset_lausunnot/Ilmastokasvatuksen%20raportti%20%209.6.2015.pdf

# 9 The role of municipalities and regions in planning emission development trends in the effort sharing sector

## 9.1 Municipal and regional climate policy: contents and impacts

Municipalities make decisions that have a significant impact on the development of emissions at national level. These include decisions on energy production and use, transport planning, land use, services, industrial policy and procurement. Actions taken by municipalities have a broad scope and concern emissions from both the ETS and effort sharing sector.

More than a half of the population in Finland lives in municipalities that are actively engaged in climate action. Most of them have drawn up climate strategies, and many have joined energy efficiency agreements for municipalities. Municipal energy efficiency agreements provide municipalities with valuable support for moving towards sustainable energy solutions. Municipal climate networks encourage ambitious emission reduction targets, enhance cooperation and peer learning and foster a positive 'envy for neighbours' that acts as a source of motivation and a driving force of change. Figure 19 illustrates the package of climate measures implemented by the City of Helsinki. The programmes and measures focus on different targets, such as reducing emissions from the city organisation and cutting transport emissions.

Climate action must support a municipality's goals of promoting the economic vitality of the municipality and ensuring a good everyday life for its residents. Integrating climate issues in the municipal strategy will help ensure that decision-makers are committed to the cause and that various sectors participate in the efforts.

In pursuit of carbon neutrality, municipalities' goal-oriented climate action carries more weight than the size of a municipality might suggest. Many pioneering Finnish municipalities have linked ambitious climate targets to economic and employment objectives

and also promote climate action through packages of measures connected to resource efficiency and circular economy. This helps in engaging different kinds of businesses and organisations in developing sustainable solutions.

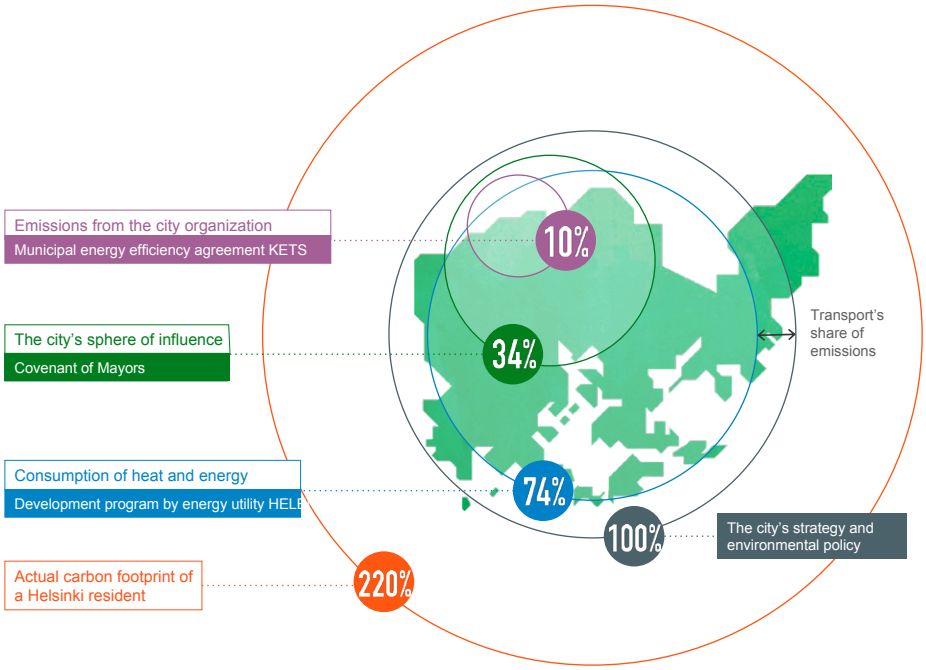


**Figure 19. The City of Helsinki implements climate measures to reduce greenhouse gas emissions caused directly by the municipality's own actions and activities and, more broadly, emissions produced in the city. In Helsinki, transport is the largest source of emissions in the effort sharing sector (Helsinki's Climate Roadmap).**

Municipal residents also play a key role in achieving local climate targets. Municipalities can influence as well as communicate and cooperate with residents in climate matters in a range of environments and contexts, such as schools, public food and catering services, transport matters, building control, recycling and waste management, health care and inclusive planning. Municipalities are aware of this, but further efforts should be made to involve municipal residents in climate action.

## 9.2 Importance of municipal and regional action in achieving targets in the effort sharing sector

There are great differences between municipalities and their greenhouse gas levels and profiles. The same applies to the emission reduction methods at their disposal. Achieving ambitious municipality-specific emission reduction targets (e.g. achieving carbon neutrality) typically requires major changes in both the effort sharing and ETS sector. For example, the HINKU network supporting carbon neutrality and the FISU network of sustainable municipalities provide municipalities with expert support for drawing up their own emission reduction plans or roadmaps.

In the HINKU municipalities that have set themselves ambitious emission targets, the ETS sector accounts for the largest share of total emissions in cities with the largest populations. On the other hand, in smaller municipalities the largest share of emissions originates from agriculture and road transport, leaving municipalities with least possibilities of influencing their emissions.

Feasible and economically profitable emission reduction measures mainly concern electricity and fossil fuels. Measures to reduce the consumption of electricity deliver emission reductions in the ETS sector. Measures to reduce oil consumption in building-specific heating, (small-scale) industry and machinery fall within the scope of the effort sharing sector, which also includes the small-scale production of district heat.

Small municipal power plants also present an interesting opportunity for reducing emissions in the effort sharing sector, for example by replacing oil with wood-based energy sources. In the HINKU network, these projects and the shift from oil to geothermal heating have in recent years progressed in many small municipalities because they are cost-effective.

Improving energy efficiency is a measure that has a wide impact and opens up opportunities for all municipalities. Systematic and well-planned efforts in this field have delivered relatively significant savings in many municipalities. Municipal energy efficiency agreements are widely used. Together with municipal climate networks, they support municipalities in their efforts.

Finland continues to become increasingly urban. Statistics Finland has estimated that the Finnish population will increase by 300,000 people in 2013–2030, with the growth focusing on larger cities. For example, the population of the Helsinki Metropolitan Area would grow by 18%. The population of Finnish cities will grow by 20,000 people a year.

In large cities, the per capita emissions from the effort sharing sector are smaller than in other municipalities because large cities can utilise district heating and public transport (see Table 7). Transport emission decrease when the share of bicycle and pedestrian traffic

and public transport increases and the per capita traffic performance decreases. The inclusion of district heating in statistics also plays a role, because emissions from large district heating plants are covered by the ETS. According to an estimate by the VTT, emissions from the effort sharing sector will decrease by 2030 as a consequence of domestic migration by approximately 1.5%, i.e. 250 kt $CO_2$[33].

**Table 7. Finnish emissions from the effort sharing sector in total and per capita in 2010–2013 (Source: VTT 245/2015).**

| | Emissions from the effort sharing sector (Mt $CO_2$e) | | | | Emissions per capita, average 2010–2013 (t $CO_2$e per capita) | | |
|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | Total | Transport + building-specific heating + waste | Other sectors |
| Helsinki metropolitan area | 3.6 | 3.4 | 3.2 | 3.3 | 3.1 | 1.9 | 1.2 |
| Other large cities | 7.3 | 7.0 | 6.9 | 6.7 | 4.5 | 2.7 | 1.8 |
| Small cities | 12.0 | 11.6 | 11.7 | 11.1 | 6.5 | 3.8 | 2.7 |
| Rural areas | 10.9 | 10.3 | 10.4 | 10.4 | 10.9 | 5.3 | 5.6 |
| **Total** | **33.8** | **32.3** | **32.2** | **31.5** | **6.0** | **3.4** | **2.6** |

Cities provide a natural setting for developing new tools and methods, such as smart and energy-efficient solutions in the fields of transport and construction. Measures implemented at municipal level are also sensible from the perspective of the national economy: increasing urbanisation will in any case require smart and cost-effective solutions.

Low carbon transport solutions are also important in small municipalities and sparsely populated areas. Collaborative development of mobility services within travel-to-work areas and innovative organisation of various transport services provided by municipalities support smooth journeys and the attainment of climate targets. Agriculture has so far received limited attention in municipal climate strategies. The transition towards low carbon agriculture is supported in Southwest Finland through the Nutrient Neutral Municipality (RANKU) project that aims to promote nutrient recycling and utilisation.

More information is needed on the lifecycle costs of projects to promote emission and energy savings. Estimates will support the advancement of cost-effective projects in municipalities.

33 VTT has assessed the development of emissions from the effort sharing sector in Finnish mu-nicipalities. To ensure comparability, the analysis was done with consistent emission calculation methods. Estimates of current emissions are based on municipality-specific statistics compiled by Statistics Finland. The scenarios are based on VTT's data concerning the transport sector, data from VTT's database on buildings in municipalities and VTT's database on municipality-specific data on power plants. Municipality-specific data on other sectors were not available, and their emissions were assumed to follow the same trends in all municipalities (Lindroos & Ekholm, 2015).

Municipality Finance Plc (MuniFin) grants loans to energy-efficient investments by municipalities and their majority-owned companies.[34] Funding is granted on the basis of the lifecycle energy savings delivered by projects. Funding has been granted to energy-efficient schools, multi-purpose buildings, waste water treatment plants and public transport investments.

The Finnish Environment Institute and KL-Kuntahankinnat Oy, a company supporting regional and local governments in public procurement, organised a joint procurement and competitive tendering process for purchasing solar power plants. It lowered the threshold for making energy-saving investments in turnkey solar panel solutions. In joint procurements, individual municipalities are saved from the trouble of organising their own competitive tendering processes and can get products at lower prices. Based on a survey, municipalities would also be interested in joint purchases of LED lights and electric cars.

Municipalities have identified certain development needs concerning basic and further education and training on energy use and energy-related procurement. There is a constant need for energy guidance and advisory services also at local level.

The Paris Agreement brought expectations for municipal climate action to the fore in a new way. There is an increased interest in learning to better understand the role and emission reduction potential of municipalities. Considering this, it will be increasingly important to support efforts to improve assessments on the effectiveness of measures implemented by municipalities. The impacts of reducing greenhouse gas emissions and saving energy should be made more visible in municipal decision making.

Finnish regional governments have drawn up climate strategies based on the policies defined in the 2008 Energy and Climate Strategy, and themes associated with a low carbon future are discussed in many regional strategies. In the regional government reform, it will be important to ensure that the implementation of regional climate change adaptation and mitigation activities will continue and that climate policy will be high on the agenda in the joint discussions between the State and regions. Regional governments implement climate policy through regional land use planning, the planning of transport systems, regional programmes, marine spatial planning, ERDF funding and regional cooperation.

34 https://www.kuntarahoitus.fi/ajankohtaista/uutiset/2016/10/04/suomen-ensimmainen-vihrea-bondi-vauhdittaa-kuntien

## 9.3 Municipal and regional measures

Finnish climate networks have diversified and expanded in recent years.[35] The Cities for Climate Protection is a pioneering campaign for climate-friendly municipalities, and the HINKU network has in ten years expanded from a community of six small cities aiming for carbon neutrality into a network of 35 municipalities with 0.7 million residents. The cities in the FISU network combine climate action with measures promoting circular economy and sustainable consumption, and the six largest and growing cities in Finland have formed a network for sustainable urban development.

- **Involving more municipalities in goal-oriented climate action: an appropriation of 1 million euros is reserved in the central governmental budget for 2018 speed up climate action in municipalities and regions.**
- **Implementing the tools developed by municipal networks:**
  - **Efforts will be supported with emission targets and roadmaps.**
  - **Decision-making will be supported by estimating the costs of measures.**
  - **Joint procurement (e.g. the joint procurement of solar panels for municipalities).**
  - **Municipalities participating in networks will help and motivate each other to achieve progress**
- **Ensuring that impartial regional energy advisory services are available in municipalities for various groups of consumers and businesses, and employing the solutions developed in collaboration among different actors.**

Increasing energy efficiency will require constant improvements, and it must be supported with practical advice. Many municipalities need information about costs and other aspects to support their energy solutions, and companies and municipal residents need energy advisory services regarding a range of solutions.

- **Encouraging public-sector operators to set their own goals supporting the State's target of reducing emissions by 39% by 2030:**
  - **Cars used in the public sector will emit on average less than 100 g/km of $CO_2$ by 2025.**
  - **Cities will be encouraged to set goals to increase walking and cycling.**
  - **All public-sector operators will be encouraged to phase out oil heating in their buildings by 2025.**
- **Encouraging regional governments to ensure that 25% of ERDF funding is allocated to low carbon projects.**

35 The sector-specific plan by the Ministry of the Environment includes a description of Finland's climate networks.

Some regional governments are actively using the project funding granted by the European Regional Development Fund to promote the low carbon economy. During the programming period lasting until 2020, the aim is to establish new operating methods and models, promote multi-sectoral expertise and create jobs with the help of new business opportunities.

**Ensuring interaction between the national and regional level in climate policy matters.**

The tasks and duties of regional governments and municipalities are changing. Interaction and negotiations between the national and local level cover many topics into which low carbon approaches can easily be integrated. The flow of information between different levels of administration will be ensured for example once the national climate targets included in the EU 2030 legislation have been confirmed.

# 10 Public procurement

Public procurement can be used as a strategic tool to promote climate change mitigation and various other societal objectives. Some EUR 35 billion are used each year for public procurement, constituting on average 16% of GDP. Two thirds of public procurement take place in the municipal sector.

According to studies conducted in the EU on actual procurements, greenhouse gas emissions can be cut by up to 25% by carefully planning purchases, setting strict criteria and engaging in market dialogue. In Finland, environmental considerations are integrated into procurement planning on average in 40% of cases. However, actual procurements are not comprehensively monitored and their climate impacts remain unknown.

According to the Government Programme, the public sector will be encouraged to introduce carbon-neutral energy solutions. Moreover, the goal is to increase the demand for cleantech products and services by leveraging the 5% target for innovative procurement established in the Government Programme. The Government also aims to develop low-carbon transport and energy systems (e.g. geothermal energy), smart grids, material- and energy-efficient construction of infrastructure and sustainable housing solutions in collaboration with municipalities, companies and research institutes. The plan is to use these outcomes in creating new business and as domestic references in efforts to promote exports of clean solutions.

Led by the Ministry of Employment and the Economy, Finnish ministries signed in June 2016 growth agreements between the State and the municipalities in the Helsinki Metropolitan Area and the urban regions of Joensuu, Lappeenranta and Imatra, Tampere, Turku, and Vaasa. The agreements cover key policies for strategic development. One of the themes involves promoting innovative and sustainable procurement.

In Finland, efforts have been made to mitigate the climate impacts of public procurement through government resolutions[36] (2009 and 2013) setting objectives for certain procurements that are significant in terms of volume and impact. They concern the fields of construction, electricity purchases, waste management, transport services, food and catering services as well as energy-related products and services. Among other things, the resolutions recommend purchasing responsibly produced organic food that complies with dietary guidelines and vegetarian food or seasonal food.

Moreover, the Act on Consideration for the Energy and Environmental Impact of Vehicles in Public Procurement (1509/2011) requires public contracting entities to take energy efficiency and environmental impacts into consideration in the procurement of vehicles and passenger transport services. The Energy Efficiency Directive requires the central government to only purchase energy-efficient products, services and buildings. The Ministry of the Environment is currently drafting guidelines on environmental assessment criteria for green public building projects.

Despite great expectations, the State and municipalities have not implemented a great deal of innovative and sustainable public procurements. Separate reports have been drawn up in Finland on the targeting of public procurement and, for example, the attainment of objectives set in government resolutions.

According to the reports, obstacles to sustainable procurement include the lack of strategic vision and objectives concerning environmentally sustainable procurement, uncertainty about potential risks (e.g. market law and financial risks) and lack of expertise.

Projects have been launched to promote sustainable procurement. These include Motiva's advice and consultancy service for sustainable public procurement[37], the Smart Procurement programme[38] run by Tekes, the Finnish Funding Agency for Innovation, and the Cleantech Procurement Folder[39]. However, these activities lack a systematic development approach. For example, Motiva's advisory services have given some consideration to public sector transport and vehicle purchases, but efforts in this subsector could be stepped up.

Public procurement is also supported in Finland through aid for audits and investments. Moreover, in the Esco financing model municipalities and cities can achieve emission and cost savings without initial investments. In the model, an external energy expert implements investments and measures to save energy and covers their costs with the savings

36 http://valtioneuvosto.fi/paatokset/periaatepaatokset/voimassa-olevat

37 http://www.motivanhankintapalvelu.fi/

38 https://www.tekes.fi/ohjelmat-ja-palvelut/ohjelmat-ja-verkostot/huippuostajat/

39 https://wwwp5.ymparisto.fi/hankintamappi/aloitus.aspx

they generate. The joint solar panel purchases and financing model of the HINKU municipalities are good examples of innovative approaches to financing.

The Helsinki Regional Transport Authority (HSL) has introduced a model that enables it to flexibly and cost-effectively compensate its transport operators for measures that reduce $CO_2$ and local emissions. The model constitutes an environmental bonus that can be used to compensate transport operators for emission reduction measures that exceed their contractual obligations. In 2016, HSL reserved EUR 1.25 million for the environmental bonus model.

The initiative shown by pioneering municipalities should be used in planning and piloting targeted measures. HINKU and FISU municipalities form a potential group of municipalities for testing the introduction of sustainable solutions and goal-oriented approaches also in public procurement.

- **Piloting a 'Green Deal' model between ministries and pioneering municipalities:**
  - **Municipalities will set ambitious sustainable development and innovation targets for public procurement. The State will target financial incentives to encourage, for example, procurement planning and the assumption of risks.**
- **Enhancing and developing a one-stop-shop model to stimulate sustainable and innovative procurement:**
  - **The model will cover advisory services, peer support for contracting entities, shifting from procurement costs to lifecycle costs and integrating environmental considerations into public procurement.**

The steering of public procurement in the effort sharing sector is particularly important, for example, in the fields of machinery, food and catering services, refrigeration equipment, replacing oil heating as well as transport and the related services. An example of the Green Deal model has been discussed in connection with measures concerning transport.

# 11 Technology, expertise and educational needs

## 11.1 Cleantech revolution[40]

### Digitisation, automation and electrification will transform transport

Transport can be reformed by three technological megatrends: digitisation, automation and electrification. Digital interaction may partially replace physical mobility through teleworking and services. Its impacts on traffic performance may nonetheless remain limited, because it will also enable people to live further away from jobs and services. A key element of behavioural changes is moving from private car ownership to purchasing transport services and shifting from the use of separate modes of transport for different legs of a journey to seamless travel chains regardless of the transport mode used (MaaS, Mobility as a Service).

Seamless travel chains may include cars, but carpooling will be easier and cars can be shared, owned either by a company or private individuals. In the long term, automation may enable all people in a car to be passengers, which will make it easier to consider mobility as a service. However, numerous technical and legal issues still remain to be solved before automation can become widespread.

The supply of electric vehicles has grown rapidly over the past few years as batteries have improved, the capacity of the infrastructure for charging electric vehicles has increased and vehicle prices have come down. Electrical power can also be generated from hydrogen with fuel cells, and many vehicle manufacturers believe hydrogen-powered vehicles to become more common in the long term. Electricity and hydrogen can be produced in multiple ways, which makes them all the more attractive as sources of power. Electrification also concerns bicycles and other light electric vehicles, which may reduce the need

40 The transformation of the energy technology sector has been discussed in more detail in the Energy and Climate Strategy (Appendix 1).

for cars for short journeys. Biofuels are a solution that can be implemented in the short term, but there are no sustainable methods for producing enough energy to fully meet the global energy demand in transport. Therefore, biofuels should be targeted particularly at heavy vehicles, which hold less potential for electrification. Alternative raw materials, such as algae, are being studied, and they could provide new sustainable solutions.

Nevertheless, technological megatrends will not eliminate or reduce the importance of traditional questions in the field of transport. In urban and transport planning, the promotion of mixed and efficient land use, walking, cycling and public transport will remain the most important objective. Active walking and cycling are extremely important for public health. The importance of increasing the attractiveness of public transport, on the other hand, will be emphasised as cars become more automatic, because our road capacity will not be sufficient to meet the demand if masses of public transport passengers become passengers in private cars even though automation will increase the capacity of roads.

### Digitisation opens up new opportunities for the energy performance of buildings

In future, buildings and other infrastructure will become more and more integrated into the multi-directional energy network of the entire city. Digitisation will enable increasingly cost-effective smart solutions that can help reduce energy consumption and steer the timing of peak loads without compromising indoor conditions. Smart solutions will also help raise user awareness of their energy consumption and emissions, even in real time.

Smart systems will also enable energy use to be more carefully adjusted to demand. According to studies, predictive and optimising energy management systems can already cut energy consumption by 10–30%. Moreover, smart systems enable active participation in demand response, allowing peak loads to be reduced by up to 40–65% at the system level. Costs are also estimated to decrease by 30%. So far, demand response has mainly been used in industry and commercial buildings. Few service providers offer the possibility for residential buildings, even though residential buildings account for approximately 30% of electricity consumption and some 21% of $CO_2$ emissions in industrialised countries.

Lower sensor prices and the Internet of Things (IoT), in particular, will help equip the old building stock more cost-effectively with new technology that will reduce energy consumption without end users having to compromise their comfort of living.

So far, compatibility and interface issues between different systems have caused problems, leading always to tailored solutions. Therefore, particular emphasis should be given to open interfaces. At the same time, a sufficiently high level of data security must be ensured. Predictive and cognitive systems have already shown great potential with respect to energy and peak loads and improving the resilience of the entire energy system.

## 11.2 Expertise and educational and training needs

Expertise, education and training influence all aspects of climate policy planning in many ways. Knowledge of environmental and climate matters is so closely connected to the fundamentals of all fields that they should be mainstreamed in the contents of all educational fields. The forerunners of efforts to combat climate change are those who produce new information and knowledge: the highest level of research and education in universities. The creation of jobs within vocational education and training will largely depend on whether we are able to generate high-level expertise that will enable us to create new technology associated with the fight against climate change for foreign and domestic markets. Technological solutions based on high-level expertise also form the foundation for combating climate change. In this context, research and innovation appropriations also play a key role.

It is important to provide workers with the vocational further education and training that they will need for climate solutions whose implementation requires expertise. Long-term education and training – and their development – will also be needed to ensure in the long run that the workforce has the skills needed to guarantee the functioning and competitiveness of the society. In addition to practical measures, public awareness and attitudes play a key role in how consumption and ultimately greenhouse gas emissions will be taken into account in practice.

Of all levels of education, vocational education and training has the closest connection to business and industry and the society as a whole, and the skills needs of the labour market are first reflected in vocational education and training.[41] It is important to try to predict educational and training needs. The educational administration carries out foresight activities to produce information about the quantitative need for vocational education and training based on long-term employment projections.[42]

From the perspective of societal planning and management, higher education institutions – universities and universities of applied sciences – form a central part of the education system. Universities take climate change considerations into account in the education they provide in different fields, so the climate change perspective is integrated in the university education provided in Finland.[43] The quality and quantity of climate-related education and training and thereby climate expertise can be increased by investing in expand-

41 Lehtonen, Anna and Cantell, Hannele, Ilmastokasvatus osaamisen ja vastuullisen kansalaisuuden perustana, Finnish Climate Panel, Report 1/2015

42 For example, a background report on future skills needs in the energy sector, Ope-tushallituksen energia-alan tulevaisuuden osaamistarpeiden ennakoinnin Energia-alan taustaselvitys, Finnish National Agency for Education, 3 June 2016.

43 Liljeström, Emma and Monni, Suvi, Ilmastoalan yliopisto-opetuksen nykytila Suo-messa, Benviroc oy, 2015.

ing the provision of climate education and training in higher education institutions and in cooperation among the institutions. This would also cover teacher education and thereby the important aspect of general education. In this respect, progress has been achieved in recent years: for example, the Teacher's Climate Guide[44] was published in 2016.

Climate-related expertise must be ensured and the related educational and training needs taken into account in all relevant economic branches and sectors of society. These branches and sectors include, transport, agriculture, energy supply, building, water supply and waste management. Similarly, access to further education and training and the availability of future experts must be ensured in all sectors, for the State, municipalities and industry alike. Ensuring a sufficient knowledge base for climate planning concerns all policy sectors.

The following targeted educational and training needs have been identified in connection with this climate change policy plan: experts in the capture of F-gases, drivers of non-road mobile machinery and training for chimney sweeps on raising public awareness of ways to ensure clean combustion in fireplaces.

44 http://openilmasto-opas.fi/

# 12 Links between climate policy and air pollution control

## 12.1 Air pollution and climate change

Climate policy and air pollution control are connected in several ways. The burning of fossil fuels and biomass releases emissions that affect both global warming and air quality. These synergies should be taken into account when planning air pollution control policies, assessing the impacts of emission reduction measures and calculating costs.

The most important short-lived climate pollutants (SLCPs), causing climate change are black carbon, tropospheric ozone and methane. Some SLCPs are also air pollutants. In terms of climate policy, methane is the second most important gas after carbon dioxide. Measures to reduce SLCPs impact relatively quickly compared to measures targeted at greenhouse gases that remain in the atmosphere for decades or even a century.

## 12.2 Key air pollutants in Finland

In Finland, poor air quality is harmful to human health and causes acidification, eutrophication and adverse effects on the built environment. The most harm is done by fine particulate matter (PM2.5), but respiratory particulate matter (PM10), nitrogen dioxide and ozone also have apparent adverse effects on human health.

Half of the concentrations of particulate matter in Finland are caused by long-range transboundary air pollution from other countries and the other half by domestic sources of pollution. In terms of exposure to fine particulate matter, the most significant sources include small-scale burning of wood (46%), transport exhaust gases (12%) and street dust (10%). The adverse effects of small-scale burning of wood are greatest in low-rise residential areas, while significantly fewer people are exposed in sparsely populated areas. The fine

particulate matter emitted in combustion processes, such as car exhaust gases and small-scale burning of wood, is considered particularly harmful. In future, the relative significance of small-scale burning of wood as an emission source will further increase as transport emissions will decrease.

Figure 20 illustrates the total emissions of fine particulate matter by emission source (kilotons/year) in Finland in 2015 and an emission projection for 2030 based on the WEM scenario included in the Energy and Climate Strategy.

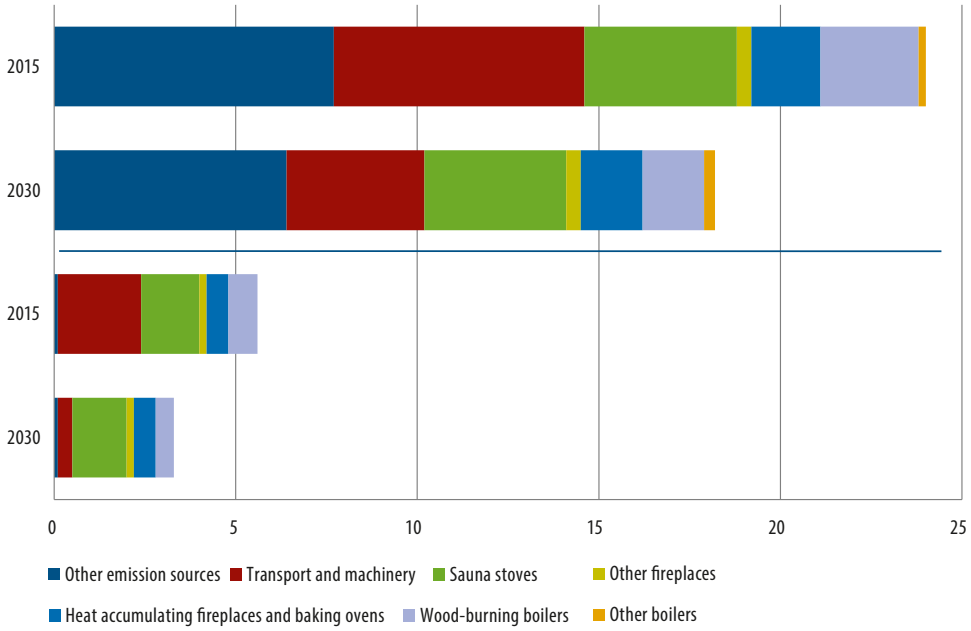


**Figure 20. Total emissions of fine particulate matter and black carbon in 2015 and 2030 by emission source (The black carbon emissions depicted by the lower set of columns are also included in the top columns illustrating total particulate matter emissions.) (Source: SYKE)**

In addition to small-scale burning of wood, the main sources of black carbon emissions in Finland include road transport and machinery. Emissions from these two sources will decrease as a result of developments in air pollution control legislation and technology. Future levels of particulate matter emissions will to a great extent depend on developments in the prevalence of small-scale burning of wood and the methods introduced to cut its emissions. In 2015, black carbon emissions were estimated at 5.6 kt/year, and they are expected to decrease to approximately 3 kt by 2030.

## 12.3 Legislation on air pollution control

Air pollution is regulated by the international UN Convention on Long-range Transboundary Air Pollution and the related protocols, most importantly the Gothenburg Protocol. The obligations under the Convention have been implemented at EU level by the National Emission Ceilings Directive (NECD). The NECD does not directly regulate emissions covered by climate policy, but its requirements concerning fine particulate matter will indirectly also reduce black carbon emissions. The Arctic Council's Ministerial meeting in May 2017 accepted a common emission target of 25–33 % by 2025 for black carbon. Attaining the target means new emission reduction efforts have to be taken also in Finland. Finland meets all of its international reduction targets concerning emissions into the air except for ammonium.

At EU level, air pollution control is also supported by the Industrial Emissions Directive and the Air Quality Directive, which set limit values, for example, for respiratory particulate matter, fine particulate matter and benzo[a]pyrene.

At local level, section 145 of the Environmental Protection Act (527/2014) requires municipalities to draw up a medium- or long-term air pollution control plan if the limit values laid down in the Government Decree on Air Quality (38/2011) have been exceeded or if there is a risk that they will be exceeded. In Finland, these limits have only been exceeded in Helsinki.

## 12.4 Assessment of the need to enhance regulation and the effectiveness of such measures

According to a 2015 estimate by the Finnish Environment Institute, the quantities of emissions caused by small-scale burning of wood vary greatly between different boilers and fireplaces. Compared to other fireplaces, old wood-burning boilers and sauna stoves emit considerably high levels of particulate matter and black carbon. Wood-burning boilers are being gradually replaced by other forms of heating, and in terms of particulate matter emissions new boilers will have to comply with the relatively strict EU Ecodesign Directive and its requirements on new fireplaces and boilers powered by solid fuel (entering into force in 2022 and 2020).

Sauna stoves, on the other hand, are excluded from the scope of regulation. Significant numbers of sauna stoves continue to be installed also in built-up areas, and there are no signs of their combustion technology becoming considerably greener. Eco-design requirements will cut emissions from other fireplaces than sauna stoves after 2020, even though the change achieved by replacing old fireplaces will be gradual and slow. The Finnish Envi-

ronment Institute estimates that by 2030 eco-design requirements will reduce particulate matter emissions by 6% and black carbon emissions by 4% of Finland's total emissions from small-scale burning of wood.

As emissions from other fireplaces decrease, sauna stoves will become increasingly important emission sources. Without new measures, they will account for approximately 50% of particulate matter and black carbon emissions caused by small-scale burning of wood in 2030. Because of the high initial level of emissions and the relatively short service life of sauna stoves, emissions could be significantly reduced if emission requirements were established for sauna stoves and low emission stoves became more common. Ecolabelling criteria have been established for sauna stoves, but so far no manufacturer has applied for a right to use the label. The introduction of ecolabelled sauna stoves on the market would be a major step towards greener wood-burning sauna stoves.[45]

Estimates of emissions caused by small-scale burning of wood are largely based on existing knowledge of the activity's scale and distribution among different fireplace types. The latest study on the topic concerns the heating season 2007/2008. However, the aim is to update the knowledge base through a new study conducted during the heating season 2016/2017. The new research project and the information generated will enable more accurate estimates of the emissions from small-scale burning of wood.

45 An on-going research project aims to expand the knowledge base on the matter.

# 13 Impacts of the medium-term policy plan

## 13.1 Impact assessment methodology

When the Climate Change Act was drafted, attention was given to the importance of impact assessments for analysing the future effectiveness of climate change policy plans and the related uncertainties (section 4.5 of the rationale for the Act). During the preparation of the medium-term climate change policy plan, impact assessments have been developed, performed and utilised in diverse ways, in accordance with the guidelines laid down in the Climate Change Act.

In sector-specific plans, existing impact assessments concerning individual measures and sectors were used. In addition to impacts on emissions, sector-specific plans also discuss other key aspects of the proposed additional measures, such as their acceptability and side effects, wherever possible.

In the context of the climate change policy plan, the assessments carried out on emission trends, economic impacts and the aspects covered by the Act on the assessment of the environmental impact of public authorities' plans and programmes (200/2005) are a continuation of the corresponding assessments included in the Energy and Climate Strategy. The assessments are based on the same scenarios and have been conducted by the same research group.

The economic impact of the climate change policy plan has been assessed on the basis of the energy system model (TIMES) and a model concerning overall economic balance (FINTAGE). Based on these model calculations, the impacts of the proposed measures on key indicators of the Finnish national economy have been assessed. Impacts have been assessed with and without measures to balance the Budget.

To support analyses on the cost-effectiveness of measures in the effort sharing sector, new methodology was developed and used for the measure-by-measure examination. It also helped to sketch a cost curve for the measures included in the plan, illustrating the affordability of measures in terms of cost-effectiveness.

A separate assessment was conducted to examine how consumption-related measures will impact emissions. A gender impact assessment was also carried out on the climate change policy plan. The gender impact assessment was the first conducted in Finland in the field of climate policy. It is a preliminary assessment and provides input for implementation planning and further work on gender impact assessments. Key development needs have also been identified in other areas.

## 13.2 Economic impact

### 13.2.1 Emission reduction costs in the effort sharing sector

This medium-term climate change policy plan has examined additional measures (WAM) which will enable the 2030 emission target to be achieved in the effort sharing sector. Similar measures have also been analysed in the National Energy and Climate Strategy[46]. In the strategy, VTT has assessed the reductions in greenhouse gas emissions achieved with the policy measures using the TIMES-VTT model[47]. The estimates take into account the proposed flexibility mechanism of allowing Finland to use each year approximately 2 percentage points of emission units from the ETS sector to achieve its emission target in the effort sharing sector. This would mean that in 2030 Finland's emissions would have to be 37% below the 2005 the levels.

Figure 21 illustrates how the measures examined in this plan will impact emissions in the effort sharing sector and the average costs of emission reductions. The cost estimate takes into account the interdependencies between the measures and their sensitivity to two external uncertainty factors: the market price of oil and the purchase cost of electric vehicles in 2030.

The figure includes the following measures:

- Transferring the emissions from waste incineration to the ETS sectors.
- Reducing F-gas emissions.
- Improving the energy efficiency of transport combustion engines, increasing the market shares of electric and gas-powered vehicles and mitigating the increase in traffic performance.
- Introducing an obligation to blend oil used in building-specific heating with a 10% share of a biocomponent.

46 Government Report on the National Energy and Climate Strategy for 2030. http://urn.fi/URN:ISBN:978-952-327-199-9

47 Impact assessments of the Energy and Climate Strategy: The summary report. Prime Minister's Office: Publications of the Government's analysis, assessment and research activities 21/2017 (in Finnish). http://tietokayttoon.fi/documents/10616/3866814/21_Energia-+ja+ilmastostrategian+vaikutusarviot+Yhteenveto-raportti/40df1f5f-c99c-47d1-a929-a4c825f71547

- Introducing an obligation to blend oil used in machinery with a 10% share of a biocomponent.
- Introducing an obligation to blend road transport fuels with a 30% share of a biocomponent.
- Increasing biogas production.

The costs illustrated in Figure 21 include two ranges of uncertainty. The dark, narrower area describes the impact of whether the measures will be implemented in full or in part. The lighter area describes costs with respect to four different sensitivity factors:

- Market price of crude oil in 2030: USD 55/barrel or USD 110/barrel (in the baseline case USD 75/barrel).
- Purchase cost of a fully electric vehicle in 2030: EUR 0 or EUR 12,000 more than a corresponding petrol vehicle (in the baseline case approximately EUR 6,000).

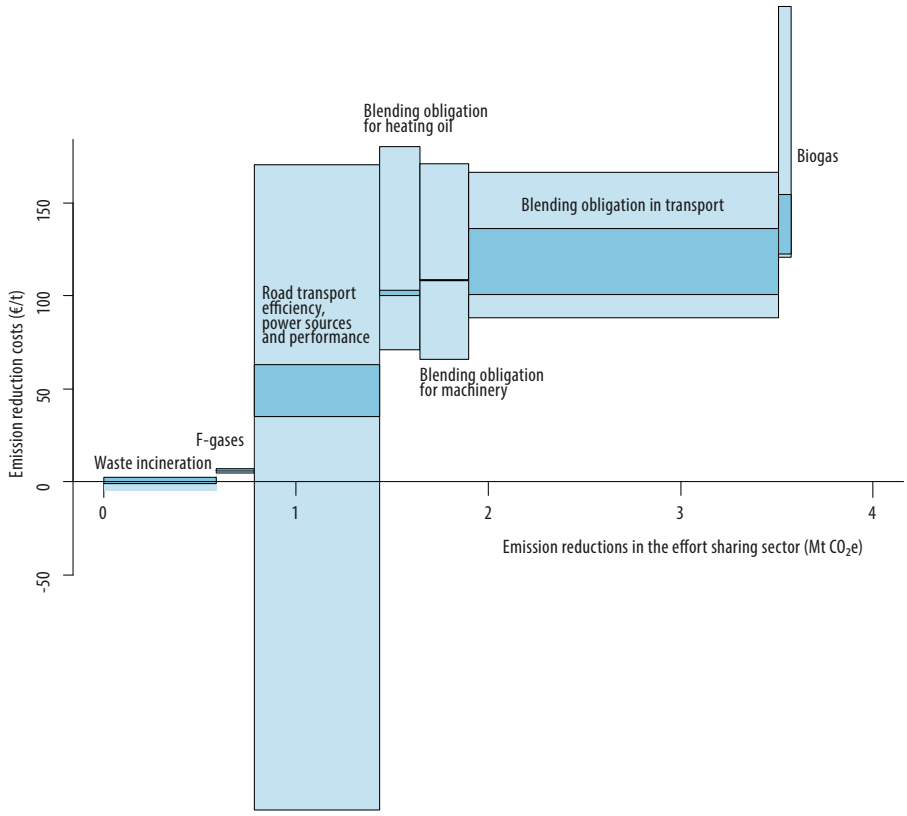


**Figure 21. The emission reductions achieved with the measures included in the climate change policy plan and their average costs as estimated with the TIMES-VTT model.**

Sensitivity factors mainly affect measures concerning oil imports and the use of energy in transport. High oil prices lower emission reduction costs, because reducing the use of oil will generate greater savings in the purchase costs of oil. Measures to reform transport, particularly developments in the market shares of alternative power sources, on the other hand, will lead to both the highest and lowest costs depending on the purchase cost of electric vehicles.

Based on the assumptions made, transferring waste incineration emissions from the effort sharing sector to the ETS would enable emission reductions in the effort sharing sector at very low costs. However, there is a certain level of uncertainty about the calculations on how these emission reductions will benefit achieving the target. In the baseline case, the average costs of measures concerning the transport system and alternative power sources are approximately EUR 50/t, but the estimates are highly uncertain, particularly because of developments in electric vehicle prices. Emission reductions delivered by obligations to blend oil and fuel with biofuels would be significantly more expensive, but the cost estimates are moderately influenced by factors such as crude oil prices.

Reductions in agricultural emissions play a very limited role in the measures examined, because the TIMES-VTT model focuses on modelling the energy system. However, the impact assessment concerning the Energy and Climate strategy estimates that an additional 0.3 Mt $CO_2$ of emissions could be saved in agriculture with the relatively low cost of less than EUR 50/t.

This assessment concerns the direct emission reduction costs of the proposed measures. However, when assessing measures, the objectives of other policies; such as energy, industrial, and technology policies, must be taken into account. Because of these other objectives, the climate policy measures selected may partly differ from the order supported by the cost curve presented here.

### Uncertainties and risks associated with costs

In the scenarios, the greatest potential for reductions is in transport emissions. However, these reductions involve several major uncertainties. Energy sources used in transport will diversify towards the 2030s, and different sources will compete with each other. Because new technologies are yet to be fully developed, it is too early to say for sure which of them will be the most advantageous, in terms of costs, properties, and impacts on emissions.

There are two alternatives to sourcing advanced biofuels: domestic production and imports. The first option may be based on domestic or imported raw material, or a combination thereof. From the perspective of costs, the order of superiority among different alternatives will depend on the profitability of biorefineries compared to the price of imported fuels. From a wider perspective, it is also possible to take into account other aspects like the promotion

of domestic technological development, security of supply, trade balance and employment issues. These have been examined in the assessment of national economic costs.

The profitability of biorefineries will depend first and foremost on their investment costs and the efficiency of their conversion processes. Based on the assumptions made here regarding these aspects, it would be more advantageous to import biofuels than produce them in Finland, taking into account the fact that this would enable the wood biomass used in refineries to be used for other purposes, such as electricity and heat generation. The investment cost (approx. EUR 5 million/kt) used in the scenarios is based on an estimate by Pöyry[48] and is higher than, for example, VTT's earlier estimates[49]. However, it is always difficult to estimate the actual investment costs of new technology concepts. The same also applies to estimating the price of biofuel imports. Moreover, imported biofuels would have to meet the sustainability criteria established by the EU.

The uncertainty surrounding the costs of electric vehicles is linked, in particular, to the development of battery prices, because batteries are the most important component affecting the difference between the costs of electric vehicles and internal combustion engine vehicles. In the baseline scenario of this assessment, the purchase cost of electric vehicles will remain approximately EUR 6,000 higher than that of petrol vehicles in 2030, unless electric vehicles become significantly more common without policy measures. In the cost-effective scenario, in which the purchase costs of electric vehicles will decrease to the level of petrol vehicles by 2030, the market share of fully electric vehicles will be approximately a fourth of the car market. If battery prices will not continue to develop according to the current trend and electric vehicles would remain approximately EUR 12,000 more expensive than petrol cars, getting 200,000 electric vehicles on the market would lead to significant additional costs of approximately EUR 140 million per year in 2030.

Due to the considerable uncertainties associated with the development of the costs of different power sources, it will be advisable to diversify the associated risks by investing in several options and adjusting the strategy over time based on future information and knowledge. On one hand, the Energy and Climate Strategy includes the objective of increasing the use of advanced biofuels for transport, electricity and gas, which is desirable from the perspective of diversification. On the other hand, the strategy's quantitative targets of a 30% share of biofuel components, 250,000 electric vehicles and 50,000 gas-powered vehicles are a cost risk if they are to be met at any cost. Thus, from the risk management perspective, the implementation of the strategy should also include the possibility of revising the targets in the light of possible changes in the operating environment.

48 Pöyry Management Consulting Oy, Cost-effective use of forest biomass, publications of the Government's analysis, assessment and research activities 23/2017.

49 Hannula I. & Kurkela, E. 2013. Liquid Transportation Fuels via Large-Scale Fluid-ised-bed Gasification of Lignocellulosic Biomass. VTT Technology 91. http://www.vtt.fi/inf/pdf/technology/2013/t91.pdf

### 13.2.2 Impacts of the climate change policy plan on the national economy

This section will assess how the medium-term climate change policy plan will affect the national economy. Its aim is, firstly, to analyse what kinds of immediate impacts the measures included in the plan will have on the national economy without efforts to balance the Budget and, secondly, how balancing the Budget with various tax solutions will affect the overall costs of the plan.

Impacts of the WAM scenario of the Energy and Climate Strategy and the climate change policy plan on the national economy

The impacts of energy and climate policy measures on the Finnish national economy have been assessed in a project of the Government's analysis, assessment and research activities (VN-TEAS) titled KEIJU (Sustainable energy and climate policy and the role of renewables in Finland), in which the national economy is described through a calculated balance model. The model describes the economy from the perspective of decisions made by households, companies and the public sector. The impact assessment of the measures implemented in the WAM scenario compares the impacts of policy measures to the WEM scenario, in which the future is analysed in terms of our current understanding of how the global market and our domestic economy will develop.

In the assessment of impacts on the national economy, the WAM scenario is based on the following assumptions:

- The energy system will follow the scenario estimated with the TIMES model.
- Biofuel production will follow the estimate produced using the TIMES model.
- The transport sector will develop in accordance with the estimate produced by the Ministry of Transport and Communications on transport performance and vehicle fleet trends.
- Financial steering will have no net effect on the Budget.

In the WAM scenario, reductions in greenhouse gas emissions will mainly be achieved through measures concerning the energy system and the effort sharing sector. The WAM scenario will have a relatively small impact on the use of financial steering instruments, because the impacts of emissions trading have already been taken into account in the WEM scenario. However, the structure of both production and consumption will change in the WAM scenario, which will have an impact on the budgetary position of the public sector. In addition, the support required by biorefineries will increase central government expenditure, while the growing share of biofuels and a transport performance that will increase more slowly than in the WEM scenario will reduce the fuel tax accrual. It was assumed that budget neutrality will be achieved by a small increase in commodity taxes (for example, through value added tax).

**Table 8. Impacts on the national economy (difference between WAM and WEM scenarios)**

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

In Table 8, the Budget has been balanced by increasing the value-added tax (VAT). The following analysis will also allow other balancing methods, and it will describe the climate measures in more detail.

## Assessment of the medium-term climate policy plan's impact on well-being and efficiency

In this climate change policy plan, assessments of individual measures will be based on the same WAM and WEM scenarios as the assessment of impacts on the national economy, but here the aim is to 'isolate' climate measures' direct impacts on the national economy from the additional impacts caused when the changes in tax revenue resulting from the measures are balanced in the Budget. Separating direct impacts from the budget-adjusted impacts corresponds to a 'first-best' situation, in which the Budget will not affect policy making. The separation will also make it possible to analyse which balancing measures will cause the least cost burden.

Figure 22 illustrates how much the national economy, investments, private consumption, exports, imports and employment will decrease compared to the corresponding level in the final year.

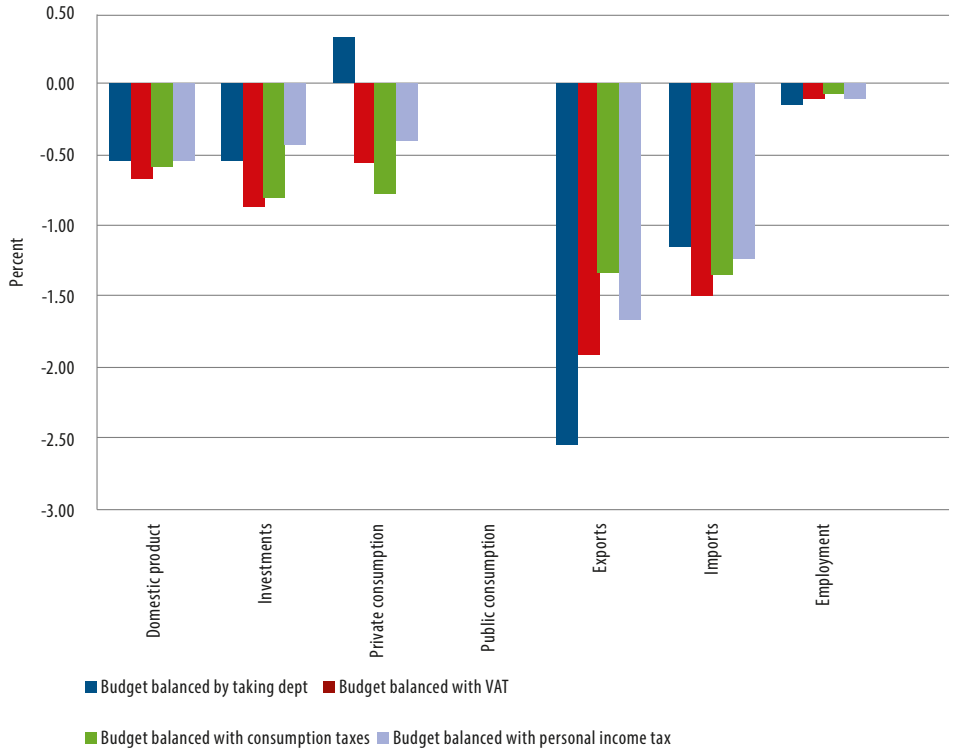


**Figure 22. Impacts of the medium-term climate change policy plan on the national economy when the Budget is balanced with alternative tax instruments.**

The first observation to be made from Figure 22 is that, in all cases examined, medium-term climate policy concerning the effort sharing sector will have a minimal impact on the growth of domestic product: only 0.51–0.6% of the 2030 growth level (29%) will be lost. With respect to the growth of domestic product, the immediate cost of the climate change policy plan is almost identical to the model balanced with earned income tax and they result in the smallest loss of domestic product compared to the WEM scenario. Impacts on private consumption and exports are greater. In brief, the direct (non-balanced) impact of climate measures will be that, unlike in other options, private consumption will increase because the policy will involve distributing subsidies. On the other hand, the reduction in exports will be the largest, because resources will be targeted at meeting domestic demand. This is because the model does not include an underused 'free' capital stock of resources that could serve both sectors.

The figure shows that the options in which public finances will be balanced will have the greatest impacts on investments, consumption and exports, while differences will be small in terms of domestic product and employment. Overall, the option involving earned income taxation fares best in terms of most components, and increasing VAT would lead to the poorest outcome in terms of most components. In the model, consumption taxes

refer to, for example, increases in fuel prices. This option would result in the second-best outcome. If increasing VAT is a politically difficult decision, the use of energy taxation would help balance the Budget and would be compatible with the objectives of the climate change policy plan.

### Direct and indirect annual costs of the medium-term climate change policy plan

The climate change policy plan will lead to an average annual budget deficit of EUR 230 million. It will be caused by three main elements: investment aid to biofuel plants, aid for the promotion of electric vehicles and a gradual decrease in fuel tax accrual. The calculated figure describes the average direct annual impacts of the medium-term climate policy plan, because in this section the Budget has not been balanced to meet the need for tax revenue.

Balancing the Budget will increase the costs of implementing the climate change policy plan because additional tax revenue will be needed. The simplest but slightly overestimating method is to multiply the budget deficit by the marginal costs of tax collection. Using the one-off flexibility will reduce the revenue form emission allowance auctions, and this loss has been taken into account in the calculations. A summary of these data is included in Table 9.

**Table 9. Average annual costs of the medium-term climate change policy plan.**

| | Annual budget deficit | VAT | Consumption tax | Earned income tax |
|---|---|---|---|---|
| Marginal cost of collecting tax revenue | 0.88 | 1.54 | 1.74 | 1.43 |
| Budget deficit (EUR mill.) | 230 | 0 | 0 | 0 |
| Average annual cost | 202 | 354 | 400 | 329 |

Table 9 shows that average annual costs will increase in accordance with the marginal cost coefficient. Based on the assumptions made, the maximum cost burden will be on average EUR 400 million a year. The figure does not include estimated improvements in environmental quality or the possible positive innovations made as a result of the solutions (which would reduce costs). Thus, the figure is an overestimate.

## 13.3 Impacts on human health and the environment

### Environmental impact assessment of the medium-term climate change policy plan (environmental impact of public authorities' plans and programmes)

If implemented, the policies and measures outlined in the medium-term climate change policy plan (hereinafter 'the plan') will have both positive and negative impacts on the

environment and society, as referred to in the Act on the assessment of the environmental impact of public authorities' plans and programmes (200/2005). Positive impacts mean consequences that promote the achievement of societal objectives set in other contexts, whereas negative impacts mean consequences that hamper the achievement of objectives other than climate targets. In addition to greenhouse gas emissions, the policies will affect areas such as air pollution, human health, natural resources use, biodiversity, water systems and human living conditions. Some of the impacts will be felt in Finland also in the ETS sector and the LULUCF sector or even outside the Finnish borders.

It is estimated that in the effort sharing sector the desired cut in greenhouse gas emissions by 2030 will be achieved, in particular, by replacing fossil fuels in transport, building-specific heating and machinery with renewable energy and electricity and by reducing energy use and increasing its efficiency particularly in transport. Other objectives include cutting agricultural emissions from organic soil, preventing methane emissions from landfills by prohibiting the landfilling of organic waste and increasing the efficiency of the recovery of landfill gas, and reducing F-gas emissions by introducing alternative technologies and reducing leakage. Changing the calculation method will transform waste incineration emissions from the effort sharing sector to the ETS sector.

There are great differences between the policies and measures proposed in the plan. Some of the policies are still mere goals without concrete measures. Their environmental impacts may vary in nature and intensity, depending on the selected steering instruments and their implementation, the impacts of other policies and other societal developments. Therefore, only indicative estimates can be given of the environmental impact of the policies and measures. The following section will examine how the policies and measures will affect greenhouse gas emissions in the ETS sector and outside the Finnish borders as well as other key impacts on the environment, human health and living conditions.

### Impacts in the effort sharing sector and outside the Finnish borders

If implemented, the measures outlined in this plan will partly affect the EU ETS sector. Transferring waste incineration emissions under the scope of the ETS and, for example, electric vehicles and other measures that will increase the consumption of electricity from the grid will hike up the price of and demand for emission allowances required for the production of electricity with fossil fuels. Measures to cut emissions from production plants covered by the ETS, on the other hand, will reduce the demand for and prices of emission allowances. These measures include improving the efficiency of energy use. In the ETS sector, total emissions depend on the number of emission allowances available. Measures targeted at emissions governed by the ETS will not directly change the total emissions covered by emissions trading but will affect the demand for emission allowances. However, they may indirectly influence the development of emissions in non-ETS sectors and

outside the EU, and they may also have an impact on future policy decision concerning the ETS.

If reducing the use of fossil fuels in Finland will contribute to a global decrease in their use, emissions from the production, transport and refining of fossil fuels will also decrease. These emissions have typically been estimated to account for 5–20% of the emissions from the combustion of fossil fuels. Emissions from biofuels and their raw materials imported into Finland are mainly produced outside the Finnish borders. The quantity of these emissions is highly dependent on the raw materials and production processes used.

### Impact of increasing the production of biofuels

In the Energy and Climate Strategy, the policies to promote the increased use of renewable energy focus, in particular, on bioenergy used in transport, buildings and machinery. Approximately a half of the increase in the share of bioenergy is based on the use of wood-based fuels, which can be produced from forest chips and the by-products of the forest industry.

In the Energy and Climate Strategy, the domestic production capacity of new sustainable biofuels is estimated to increase by 600 ktoe by 2030. The use of biofuels will be increased in transport, buildings and machinery by means of distribution obligations. According to the Energy and Climate Strategy, the additional production of biofuels could be based on several different technologies, and the raw materials would mainly consist of different wastes and residues as well as lignocellulose from forestry and forest industry. It could also be partly based on imported raw materials. The scale of the impacts of biofuel production will be highly dependent on the raw materials used and the total resources, such as energy, materials and production land, needed for their production. In so far as they can be produced from waste and other industrial residues, the production of biofuels will generally have very little impact on emissions and sinks compared to the lifecycle emissions of fossil fuels. However, the availability of waste and industrial residues is limited.

Alternative scenarios for the acquisition of advanced transport biofuels (see e.g. report by Pöyry, p. 85), and the option of relying on domestic additional production of transport biofuels, were considered in connection with the Energy and Climate Strategy. Scenarios for the use of wood in Finland until 2030 were also analysed. Impacts on the carbon sink and biodiversity of forests were also assessed on the basis of roundwood removal scenarios. The development of the forest carbon sink is crucially linked to the development of annual roundwood removal figures. In light of the scenario calculations, roundwood will continue to be used in Finland mainly in forest industry, not the production of biofuels. If the fellings of roundwood were increased to 79 million $m^3$/year and forest chip use would amount to 15 million $m^3$ annually, the carbon sink would be reduced to 13.5 Mt

$CO_2$ equivalents by 2030. The reference level set for Finland in the Kyoto Protocol for the period 2013–2020 (approx. 20 Mt $CO_2$ equivalents per year) would be achieved again relatively soon, in 2035–2044. The significance of the sink impact for meeting the EU 2030 target will depend on the details of the calculation rules to be agreed upon within the EU. Together with the general goal of increasing harvesting volumes, the increased use of biofuels may undermine forest biodiversity and cause harmful impacts on water bodies. A central conclusion of the scenario exercise carried out by the Natural Resources Centre Finland and the Finnish Environment Institute was that fellings of roundwood can be increased to an annual level of 79 million $m^3$ while still safeguarding forest biodiversity. This will require a more intensive use of the existing nature management methods for biodiversity enhancement in commercial forests.

### Impacts of measures in the agricultural sector

In farming, increasing grass cover on organic soils will reduce $CO_2$ emissions from the degradation of peat in the LULUCF sector and also the transport of suspended solids and nitrogen into water systems. While the carbon sink can be increased by reforesting fields, reforestation will also reduce habitats for open area species and change the landscape. Increasing biogas production from biowaste will decrease emissions from degradation and increase nutrient recycling, which will reduce emissions by restricting the need to manufacture new fertilisers. In farming, biogas production may indirectly reduce land clearing and the consequent emissions into air and water bodies.

### Impact on material efficiency and the depletion of mineral resources

In terms of material efficiency and the depletion of mineral resources, the plan will have limited impacts and they will not concern key sectors or product flows. Overall improvements in material efficiency would require separate measures affecting the use of natural resources and its efficiency. The increase in bioenergy production will be partly based on growth in pulp and paper industry production, which may be reflected in the quantities of basic chemicals used. However, these aspects will not have a significant impact at national level. The majority of measures will encourage the rapid renewal of technologies, such as speeding up the vehicle fleet replacement rate. This will increase the production of machines and electronics, which will accelerate the depletion of mineral resources. In the measures proposed, efforts to increase recycling mainly concern construction, and they have not been specifically targeted at highly valuable natural resources.

### Impacts on air quality, human health and living conditions

The majority of the negative health impacts of air pollution are caused by fine particulate matter. Its main domestic sources are small-scale burning of wood, road transport and ma-

chinery. In the field of road transport, emissions of fine particulate matter include both exhaust gas emissions and street dust. In addition to the primary particulate matter of these 'local emissions', long-range transboundary air pollution from other European countries and secondary particulate matter in gas emissions from domestic sources have a significant impact on concentrations in the air we breathe.

In Finland, air pollution emissions are estimated to reduce by 2030 from the current level as a result of existing or future EU legislation that will especially limit exhaust emissions from transport and emissions from combustion plants. The policies defined in this plan will have a limited impact on these developments.

Currently, the highest level of emission-related mortalities in Finland are caused by long-term exposure to fine particulate matter originating from the small-scale burning of wood, transport as well as regional and long-range air pollution. The decrease in transport performance due to more efficient transport and changes in the use of different mobility modes and the increase in the use of electric and gas-powered vehicles instead of internal combustion engine cars will, however, slightly improve air quality in urban areas, where large numbers of people are exposed to emissions. The impact on air quality in cities will ultimately depend on trends in vehicle performance and their geographical distribution. In absolute terms, exposure to street dust and its adverse effects on health may slightly increase from current levels as a result of population growth and internal migration.

Small-scale burning of wood in fireplaces and sauna stoves is a key issue for air quality. Small-scale burning emits fine particles that have negative health impacts as well as black coal and methane that cause global warming. Because small-scale burning of wood is an important source of fine particulate matter and it is not restricted with separate measures, the total domestic emissions of fine particulate matter and the associated health risks will remain high until 2030 and likely also thereafter, if significant technological improvements are not achieved in the small-scale burning. These emissions can be influenced, for example, by means of technical standards, innovations, awareness raising and instructions issued by municipalities.

Regulation of construction and land use will have a direct impact on living conditions. This plan seeks to propose measures that will create better preconditions for developing public transport, cycling and walking, reducing the transport performances of private cars in particular and improving the energy performance of buildings. Electric vehicles will reduce noise and air pollution, thereby promoting health and increasing comfort. Moreover, reduced transport performances will cut street dust emissions, and cycling and walking will increase people's physical activity, bringing diverse health benefits. At the same time, attention should be paid to the fact that the implementation of these policies may locally increase pressures on green spaces or exposure to noise and air pollution in areas with

a highly compact urban structure. Reductions in green spaces may undermine well-being and cities' resilience to climate change, increasing the possibility of damage caused by heat waves and floods. The significance of the impacts will to a great extent depend on the planning and practical implementation of measures and general technical development. For example, while some of the current indoor air problems may be solved in connection with renovations that improve energy efficiency, it is necessary to ensure the repairs do not create new indoor air quality risks.

The targets for reducing emissions by 2030 are so demanding that climate change mitigation measures may also have major impacts on people's living conditions, including effects that may widen income gaps if there is a major increase in energy prices. The Transport Code (HE 161/2016 vp) may significantly change the way transport services are provided and used. The sharing economy, in particular, will entail a major sociocultural change that needs to be understood in order to promote the shared use of, for example, different kinds of vehicles and spaces. The society holds great potential for shared use of assets if individuals experience a high level of communality and mutual trust. A change in values, with private car ownership becoming less desirable, will also have a similar effect. By contrast, a lack of trust and an emphasis on personal freedom of choice may maintain and even strengthen the status of private cars. Different population groups may have very different capabilities of participating in the sharing economy or utilising, for example, the digital shift in transport services.

Combined with other national and international developments, the policies may also have a direct impact on living conditions. Income gaps, for example, may become more significant if there is a major increase in energy prices and energy-saving investments are costly.

## 13.4 Impacts on security

The security of the society is closely connected to questions concerning security of supply and energy self-sufficiency. Energy is a multifaceted variable in the global security environment and a precondition for vital activities. The security of the society depends on, for example, self-sufficiency in energy procurement, contingency obligations in terms of security of supply, the scale of electricity and fuel imports and the ability to diversify or change supply routes, the energy infrastructure enabled by a wide fuel mix, availability of technology and expertise in crisis situations, the society's dependence on electricity and sufficient reserve production capacity, and sufficient possibilities to supply electricity to the main grid from abroad.

In terms of the security of the society, it is important to ensure that aspects associated with security of supply and needs in exceptional situations are taken into account in the policy of phasing out the use of coal for energy, as outlined in the Energy and Climate Strategy.

Halving the use of imported oil will be achieved mainly through energy efficiency measures in the transport sector and by increasing the obligation to distribute biofuels. The policy will strengthen the security of the society, especially if biofuels are manufactured in Finland from domestic energy sources. To ensure the security of supply, preparations should be made for the emergency stockpiling of biofuels, which is currently not supported by existing legislation. In this respect, important considerations include the long-term storage life of biofuels. Higher biofuel distribution obligations may pose a challenge for the Defence Administration.

Increasing the share of wood-based energy production will improve Finland's self-sufficiency in energy production, if the raw material comes from domestic sources. In terms of energy production, it will be important to ensure that production plants are able to use various energy sources (incl. fossil and renewable sources).

A low-emission transport system will require fossil fuels to be replaced with renewable ones or fuels with lower emissions than current fuels. An energy efficient transport system would enhance the security of the society. If the transport system will become automated and increasingly reliant on electric systems, it must also be ensured that the system will function in the event of different disruptions.

## 13.5 The role of consumer choices in achieving the plan's objectives

In future, consumers will play an increasingly important role in achieving emission reductions. The changes this will entail in people's lives will concern various choices regarding housing, mobility and food. While technological advances and the introduction of new steering mechanisms may enable energy savings without consumers taking on an active role, many of the policies included in this plan will require them to change their behaviour, particularly in the field of transport and mobility. Consumer behaviour will ultimately determine whether objectives are achieved. For example, geographical choices regarding housing will affect mobility needs. Similarly, mobility choices between private car use, public transport, cycling and walking will affect the development of transport performance. Moreover, willingness to buy electric and gas-powered vehicles will have a key impact on their proliferation.

Through their choices, consumers can have an even greater impact on the development emissions than envisaged in the plan. These emission reductions will concern both the effort sharing and the ETS sector. If consumers decide to, for example, replace oil heating with heat pumps, electricity or district heating, carry out renovations to improve energy

efficiency, otherwise invest in reducing the need for heating or choose less emission-intensive building materials to a greater extent than assumed in the plan, emissions from the effort sharing sector may decrease faster than expected. By reducing food waste and moving towards a diet containing more fruits and vegetables, consumers can also have an indirect impact on the demand for agricultural products and thereby emissions. Eating more fruits and vegetables would also be beneficial to health. Overall, consumers' willingness to purchase various goods and services and recycle materials will have a key impact on consumption, thereby enhancing our ability to reduce emissions. However, changes in domestic demand may alter the relationship between exports and imports. Therefore, their impacts may not necessarily be directly reflected in the effort sharing sector in Finland.

## 13.6 Gender impact assessment

The purpose of gender impact assessments is to examine how decisions and measures will affect men and women and gender equality. The objective is to ensure that decisions and measures are non-discriminatory and promote equality between men and women.

The medium-term climate change policy plan covers several areas that may influence gender equality. The impacts of the objectives set in the plan may not necessarily be gender-neutral: for example, there may be differences in how women and men participate in decisions concerning the objectives, how they act as consumers and in their daily life, what they consider important and how different objectives will influence them. Because the Finnish labour market is highly gender-segregated, the objectives of the plan may also have different impacts on male- and female-dominated sectors.

The most significant results of the gender impact assessment of the climate change policy plan concern the implementation of the plan. Key implementation issues were identified in the assessment.[50] These included, in particular, urban transport planning and questions concerning the steering of consumption, such as experimentations and guidance by information. In terms of heating and other technical instruments, gender may have an impact on how well guidance by information will work, and information campaigns should pay attention to, for example, the roles in which women and men of different ages are portrayed. Promoting the use of public transport will require changing people's behaviour, which may be particularly challenging among men. On the other hand, the experienced safety or unsafety of public transport may influence women's interest in using public

50 The assessment was supported by a workshop of which report and ??????

transport. When considering means to encourage consumers to reduce their carbon footprints, it may be useful to analyse the differences in the eating habits of women and men.

Certain information needs were also identified in the gender impact assessment. Such assessments require statistics broken down by gender in order to determine whether the situations of men and women truly differ.

The policy measures included in the climate change policy plan are general goals, and their gender impacts depend on the implementation of more concrete measures. Thus, gender impacts should also be taken into account in the implementation of the climate change policy plan by formally including gender impact assessment in the guidance and monitoring of its implementation. Based on the assessment, it is also advisable to compare the climate change policy plan to the gender equality objectives of public-sector actors to ensure that the plan is consistent with general equality objectives.

# 14 Stakeholder participation in drawing up the plan and the acceptability of measures

## 14.1 Measures to encourage stakeholder participation in drawing up the plan

When the climate change policy plan was prepared, several stakeholder consultations and workshops were organised. The workshops provided a forum for hearing stakeholders' proposals for measures, identifying best practices and surveying the acceptability of the planned measures. There were two public stakeholder seminars open to all: one in February 2016, when the planning began, and one in November 2016, when the package of measures had largely been determined. Moreover, smaller events were held in late summer and early autumn of 2016 for stakeholders in the transport and agricultural sector and for municipal and regional actors. Internal workshops within the administration were also organised to get expert comments on the sector-specific plans. In February 2017, an open workshop was held on the gender impacts of the plan. Participants included gender equality experts and experts from the fields covered by the plan.

During summer 2016, anyone could openly comment on the measures planned by public servants for the Energy and Climate Strategy prepared by the Ministry of Employment and the Economy and the climate change policy plan prepared under the leadership of the Ministry of the Environment on the website energiajailmasto.fi. The background report to the Energy and Climate Strategy includes a summary of the results and comments gathered through the website.

Comments on the whole climate change policy plan could be submitted when the plan was circulated for comments in May 2017. A total of 84 comments were received during the consultation round, many of them focusing on transport-related measures. Other sector-specific measures, consumption-related measures and the climate action of municipal-

ities and regions also drew interest. All comments are public and available on the website lausuntopalvelu.fi[51]. Moreover, a public summary of the comments is available on the website of the climate change policy plan. The opportunity to submit opinions, as laid down by the Climate Change Act, enables all citizens and stakeholders to participate in the preparation of climate change policy plans before they are submitted to Parliament in the form of reports. All opinions submitted have been taken into account when finalising the plans.

In addition to these measures, information on progress in preparing the climate change policy plan has been provided, for instance, on the plan's website and through reports in the media. On the website, updates on progress were given in a blog, and the material of all stakeholder events has been published on the website.

## 14.2 Remarks on the acceptability of the measures

The comments received at stakeholder events, through the online survey and during the consultation round have been examined from two viewpoints: (1) how various organisations and the public view the proposed emission reduction measures, i.e. how well they are accepted and what level of support can be expected for them, and (2) whether the comments include proposals that could be used later to further improve the emission reduction measures and their implementation. The importance of public and stakeholder acceptance for the implementation of the plan was recognised when the plan was being prepared.

The proposed emission reduction measures were mainly met with a positive response at the stakeholder events and during the consultation round. However, some of them sparked discussion and gave rise to concerns, for example, about whether risks and costs have been taken sufficiently into account. Efforts have been and will be made to take these concerns into account in this plan and the future implementation of the policies. Some people also called for more ambitious goals or other measures than those proposed in the plan.

Particularly the opinions received when the plan was circulated for comments included numerous concrete proposals that support the implementation of policies and the planning of their implementation. Both the consultation round and stakeholder events provided a great deal of information for the preparation process on matters that must be taken into account in the implementation of climate policy and on stakeholders' commitment to the implementation of climate policy and cooperation with the central government.

51 https://www.lausuntopalvelu.fi/FI/Proposal/Participation?proposalId=1b0a7aa7-8081-4c5f-b59d-db2dd856ac4e

# 15 Monitoring the implementation of the climate change policy plan

## 15.1 Overview

According to the Climate Change Act, the Government shall monitor the implementation of the climate change policy plans to a sufficient degree. If the monitoring reveals that the policy measures defined in the plans are insufficient to achieve the goals set, Government decides on the necessary additional measures.

The uncertainty factors associated with the preparation of the climate change policy plan have been discussed in previous sections. The policies and the package of measures outlined in the plan may need to be reviewed and the necessary corrective action taken, for example, when details of the pending initiatives on EU climate and energy legislation become clearer. This may entail changes to some of the estimates and assessments presented in this plan.

The effectiveness of policy measures and the possible introduction of new measures will be continuously examined and explored as part of the planning system for climate change policy. The aim will be to promote the introduction of new cost-effective measures.

➲ **It is proposed that a research project will be launched as part of the Government's analysis, assessment and research activities to further develop the impact assessments of climate and energy policy. The results of the project could be used, for example, when preparing the next climate change policy plan.**

## 15.2 Annual climate change reports

Each calendar year, the Government shall provide to Parliament an annual climate change report containing information on emission trends, the achievement of emissions reduction targets and the additional measures required to reach these targets. Monitoring will also cover aspects relating to the achievement of carbon neutrality. Moreover, monitoring information will be used in the implementation of the Agenda 2030.

Every other year, the report will include monitoring information on the implementation of policy measures. Parliament will also be provided with information on climate change adaptation at least once per electoral term.

## 15.3 Other monitoring activities

### Monitoring of environmental impacts

The plan consists of various policies and measures. When implemented, they may interact. Moreover, the Energy and Climate Strategy outlines various policies which are related to the policies and measures of the medium-term climate change policy plan and may affect same objects and areas. There are various uncertainties about the assessment of impacts, and some of them result from uncertainties regarding the implementation of policies and measures. The reliability of future impact assessments can be improved by appropriately monitoring the impacts that have been realised. In practice, this will require systematic monitoring and evaluation to find answers to the following questions:

1. Have the policies and measures been implemented in the form and scope envisaged in the plan? How much resources have been used to implement them?
2. Will the policies and measures change practices and structures that generate greenhouse gas emissions in any way (are there recognisable changes in practices, are they expanding/decreasing in some respect)?
3. Can something be learned from the implementation of policies and measures in order to enhance those parts of the activity that can be assumed to cut greenhouse gas emissions?
4. Can any changes be observed in absolute greenhouse gas emissions, sinks, the specific emissions of systems or indirect emissions? Is the intended emission trend accelerating or levelling out?
5. Can any changes be observed in other potential environmental impacts associated with the policies and measures (use of natural resources, environmental pollution/protection, biodiversity, human

health, living conditions)? Do the changes correspond to those anticipated in terms of effect and scale?
6. What other factors will influence the implementation of the policies and measures and their potential to change practices and structures?

Monitoring is especially meant to encourage a learning process that will help to identify and take into account the positive and negative feedback loops between different factors and the connections between different environmental impacts. This will enable monitoring to also support stronger synergies and reduce adverse effects.

Monitoring must also take into account that, like in other fields, the challenges and opportunities in the mitigation of climate change continuously evolve because of different external circumstances. Technical and social innovations may affect the significance of different policies and measures and their potential to deliver the desired changes in structures and practices. Trends may change quickly, for example, if new technological solutions become widespread faster than expected or if general political and economic circumstances change significantly. Therefore, it will be important to monitor how the anticipated impacts (and those not yet anticipated) develop in order to gain a better understanding of actual developments and to identify critical elements that could justify changing or specifying the policies. This will require establishing representative monitoring parameters for different sectors and consistently gathering information on them during the implementation of policies, as described above. The results gathered with the monitoring parameters must also be evaluated regularly and in a sufficiently comprehensive manner.

### Monitoring of gender impacts

The main gender impacts of the plan will be associated to measures implemented at local level. Therefore, a tool is being developed particularly for local operators to help them assess the potential gender impacts caused by the implementation of the plan. It will be important to continue improving the assessment of gender impacts in connection with the preparation and implementation of future climate change policy plans.

Provisions on the medium-term climate policy plan have been laid down in the Climate Change Act (609/2015). The plan sets the emissions reduction target for greenhouse gases to 2030 and specifies the actions to be taken to ensure that the targets are reached and that they are compatible with the long-term climate change objective.

The plan applies to the non-emissions trading sectors, i.e. the so-called effort sharing sector. This comprises transport, agriculture, the individual heating of buildings, waste management and F-gas emissions. Together with the Energy and Climate Strategy completed at the end of 2016, the plan implements the climate and energy policy objectives set in the Government Programme. The plan further specifies and supplements the emissions reduction actions set out in the Energy and Climate Strategy. Linkages and cross-cutting themes between the sectors are also examined, including the role of consumption and work on climate change issues done locally. The preparation of the plan was based on the same baseline scenario as was used for the Energy and Climate Strategy.

The actions included in the baseline scenario are not sufficient to achieve the reductions needed by 2030. The medium-term plan assesses what kind of measures should be taken to reduce the gap, also taking account of the factors of uncertainty we are aware of. The emissions reduction measures included in the plan also support the attainment of the long-term emissions reduction objective, i.e. the objective set to 2050.

Ympäristöministeriö
Miljöministeriet
Ministry of the Environment

**ISBN 978-952-11-4751-7 (printed)**
**ISBN 978-952-11-4752-4 (PDF)**
**ISSN 1796-1696 (print)**
**ISSN 1796-170X (online)**