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Government Report on the Climate Plan for the Land Use Sector

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Abstract

During 2021–2022, the Ministry of Agriculture and Forestry prepared a comprehensive Climate Plan for the Land Use Sector, which will be one of the key elements of the planning system under the revised Climate Change Act. The plan is part of the implementation of the Programme of Prime Minister Sanna Marin's Government. In line with the UN Framework Convention on Climate Change and the Paris Climate Change Agreement, the land use sector comprises land use, land use change and forestry.

The purpose of the plan is to promote the reduction of emissions from land use, forestry and agriculture, strengthening of removals by carbon sinks and adaptation to climate change, in accordance with the Sustainable Development Goals. The annual net impact that the additional measures in the land use sector aim for is at least three million tonnes carbon dioxide equivalent by 2035. The Climate Plan for the Land Use Sector contributes to the achievement of the national target of carbon neutrality by 2035 and of the climate objectives of the EU.

The plan sets down the measures targeted to land use changes, carbon dioxide emissions from agricultural lands and long-lived wood products, and several cross-cutting measures. The key principle in the preparation was to reach the climate targets in a way that is as cost-effective, fair and just as possible. Links to the Medium-term Climate Change Policy Plan and Climate and Energy Strategy were taken into account in the process.

Keywords	plans, carbon neutrality, emissions, climate policy, land use		
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Kuvailulehti

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Valtioneuvoston selonteko maankäyttösektorin ilmastosuunnitelmasta

Maa- ja metsätalousministeriön julkaisuja 2023:12

Julkaisija	Maa- ja metsätalousministeriö		
Yhteisötekijä	Maa- ja metsätalousministeriö		
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Tiivistelmä

Maa- ja metsätalousministeriö on valmistellut vuosien 2021–2022 aikana kokonaisvaltaisen maankäyttösektorin ilmastosuunnitelman, josta tulee osa uudistetun ilmastolain mukaista suunnittelujärjestelmää. Suunnitelma on osa pääministeri Marinin hallitusohjelman toimeenpanoa. Maankäyttösektorilla viitataan YK:n ilmastosopimuksen ja Pariisin sopimuksen tarkastelujen mukaisesti maankäyttöön, maankäytön muutokseen ja metsätalouteen.

Suunnitelman päämääränä on kestävän kehityksen tavoitteiden mukaisesti edistää maankäytön, metsätalouden ja maatalouden päästöjen vähentämistä, nielujen aikaansaamien poistumien vahvistamista sekä sopeutumista ilmastonmuutokseen. Maankäyttösektorilla toteutettavien lisätoimien tavoiteltu vuosittainen nettovaikutus on vähintään kolme miljoonaa hiilidioksidiekvivalenttitonnia vuoteen 2035 mennessä. Maankäyttösektorin ilmastosuunnitelma edistää osaltaan kansallisen hiilineutraaliustavoitteen saavuttamista vuoteen 2035 mennessä sekä EU:n ilmastotavoitteiden saavuttamista.

Suunnitelma kattaa maankäytön muutoksiin, maatalousmaiden hiilidioksidipäästöihin, metsiin ja pitkäikäisiin puutuotteisiin kohdentuvat toimenpiteet sekä useita erilaisia poikkileikkaavia toimenpiteitä. Valmistelussa lähtökohtana on ollut saavuttaa ilmastotavoitteet mahdollisimman kustannustehokkaalla ja oikeudenmukaisella tavalla. Yhtymäkohdat keskipitkän aikavälin ilmastopolitiikan suunnitelmaan ja ilmasto- ja energiastrategiaan on huomioitu suunnitelman valmistelussa.

Asiasanat	suunnitelmat, hiilineutraalius, päästöt, ilmastopolitiikka, maankäyttö		
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Presentationsblad

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Statsrådets redogörelse om en klimatplan för markanvändningssektorn

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Jord- och skogsbruksministeriet har under 2021–2022 berett en övergripande klimatplan för markanvändningssektorn. Den ska bli en del av planeringssystemet enligt den reviderade klimatlagen. Planen ingår i genomförandet av regeringsprogrammet för statsminister Sanna Marins regering. Med markanvändningssektorn avses markanvändning, förändrad markanvändning och skogsbruk i enlighet med FN:s klimatkonvention och klimatavtalet från Paris.

Det övergripande målet är att i enlighet med målen för hållbar utveckling främja att utsläppen minskar inom markanvändningen, skogsbruket och jordbruket, att upptaget av koldioxid i kolsänkor stärks och att det görs anpassningar till klimatförändringar. De ytterligare åtgärder som ska genomföras på markanvändningssektorn ska ge en årlig nettoeffekt på minst 3 miljoner ton koldioxidekvivalenter före 2035. Klimatplanen för markanvändningssektorn bidrar till att målet om klimatneutralitet kan nås senast 2035 och att EU:s klimatmål kan nås.

I planen ingår åtgärder som omfattar förändrad markanvändning, koldioxidutsläpp från jordbruksmark, skogar och långlivade träprodukter samt flera olika tvärsektoriella åtgärder. Utgångspunkten vid beredningen var att uppnå klimatmålen på ett så kostnadseffektivt och rättvist sätt som möjligt. Planen har beröringspunkter med den klimatpolitiska planen på medellång sikt och med klimat- och energistrategin, vilket har beaktats vid beredningen.

Nyckelord	planer, kolneutralitet, utsläpp, klimatpolitik, markanvändning		
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Contents

1 Introduction

The Climate Plan for the Land Use Sector (MISU) is the first climate plan that comprises the entire land use sector, that is, agricultural land, forestry and other land use. The purpose is, in accordance with the EU's Sustainable Development Goals, to promote to the transition in land use, forestry and agriculture towards climate resilience, i.e., reducing emissions, strengthening removals by carbon sinks and adapting to climate change. The plan establishes the climate policy measures that contribute to reaching the climate objectives set for the land use sector (LULUCF sector). The Climate Plan for the Land Use Sector will contribute to Finland's target to achieve carbon neutrality by 2035.

The annual net impact aimed for by the additional measures in the land use sector is at least three million tonnes of carbon dioxide equivalent by 2035 (million tonnes of CO_2-eq.). The target is based on the roadmap, published by the Government at its climate meeting in Vuosaari, Helsinki, on 3 February 2020, to reach the Climate Neutral Finland target by 2035. The Climate Plan for the Land Use Sector will also contribute to the implementation of other significant objectives, including the 29 per cent greenhouse gas emission reduction target set by the Government in December 2021 for agriculture (-4.6 million tonnes of carbon dioxide equivalent), compared to 2019, by 2035.

The key principle in the preparation of the Climate Plan for the Land Use Sector was to reach the climate objectives, set in the Government Programme, in a way that is as cost-effective, fair and just as possible. The plan has been prepared in line with the same principles required by the Climate Change Act (609/2015) in the preparation of the Medium-term Climate Change Policy Plan. Some of the impacts of the measures included in the plan will only be visible in the longer term. Therefore, the impacts of the measures will be reviewed not only by 2035, but based on scenarios, also by 2040. In long-term reviews, the uncertainties of impacts may become high. Even though the preparation and launch of measures in the land use sector will take a few years, the aim is to assess, in connection with the preparation, the impacts in the shorter term, that is, by 2030.

The Climate Plan for the Land Use Sector will be one of the key elements of the climate policy planning system under the revised Climate Change Act (423/2022). The government proposal (Government Proposal 27/2022) for the new Climate Change Act was approved on 10 June 2022 and the Act entered into force on 1 July 2022. The plan has points in common particularly concerning the agricultural sector with the Medium-term

Climate Change Policy Plan, and concerning the energy sector, particularly the use of biomass in energy production, with the Climate and Energy Strategy. Therefore, the background calculations used in the preparation of the Climate and Energy Strategy and the Medium-term Climate Change Policy Plan have been taken into account in the preparation of this plan.

Interaction with various stakeholders and actors played a key role in the preparation of the plan. The feedback received from the interactive events was utilised in the specification of the measures, in prioritisation, definition of information requirements, and impact assessment.

The preparation of the plan was supported by a working group appointed by the Ministry of Agriculture and Forestry in February 2021, consisting of public officials from key ministries and expert members of the Finnish Climate Change Panel. The working group's extended term lasted until the end of May 2022. A broad-based combined climate measure monitoring group for the land use sector, appointed by the Ministry of Agriculture and Forestry, served as the stakeholder forum for the Climate Plan for the Land Use Sector. The monitoring group received regular reports on the preparation of the plan during 2021–2022, and preliminary proposals for measures were also discussed at monitoring group meetings. The working group's preliminary proposal for the plan was presented at the Climate Policy Roundtable meeting, chaired by Prime Minister Sanna Marin, in March 2022. The plan was circulated for comments between 14 March–18 May 2022.

The government proposal for the new Climate Change Act (Government Proposal 27/2022), submitted to Parliament in March 2022, will influence the contents and preparation processes of future climate policy plans. The Climate Plan for the Land Use Sector has been prepared to meet the requirements under the new Climate Change Act as far as possible. In July 2021, the European Commission released their proposal for amending the legislation in the land use sector[1]. According to the legislative proposal, the share allocated to Finland of the European Union's shared carbon sink target will be -17.8 million tonnes of carbon dioxide equivalent in 2030. According to the proposals included in the European Commission's climate package, the current Regulation governing the land use sector would remain almost unchanged in the period 2021–2025, but for the

1 The European Commission's proposal of 14 July 2021 to amend Regulations (EU) 2018/841 as regards the scope, simplifying the compliance rules, setting out the targets of the Member States for 2030 and committing to the collective achievement of climate neutrality by 2035 in the land use, forestry and agriculture sector, and (EU) 2018/1999 as regards improvement in monitoring, reporting, tracking of progress and review. The Proposal is available on the EUR-Lex-website.

next five-year period, the calculation and accounting system would change markedly. The Commission has also proposed that from 2031 onwards, the effort sharing sector's agricultural emissions and land use sector's emissions and removals would be combined.

2 Preparation of the Climate Plan for the Land Use Sector

In addition to the preparation of the Climate Plan for the Land Use Sector, the Programme of Prime Minister Sanna Marin's Government contains more specific themes for targeting of the sector's climate action. This provided the basis for the Climate Plan for the Land Use Sector and the measures it contains. Diverse input data has been broadly utilised in the preparation of the plan (Figure 1).

For the purpose of Government Programme implementation, the Natural Resources Institute Finland was requested to prepare a **report on the emissions reduction possibilities of climate measures in the land use sector** (Lehtonen et al., 2021). The project prepared preliminary climatic effect assessments for, among others, afforestation, aftercare of peat production areas, peat and mineral soil field management, preventing deforestation, fertilisation, emissions from soil, and sinks in peatland forests and coniferous forests, wood products and decaying wood as carbon sinks, and wetlands.

The project HIISI, Carbon neutral Finland 2035 – impact assessments of climate and energy policies and measures, launched in order to reach the Government's objective 'Climate Neutral Finland 2035', defined also for the land use sector the development of emissions and removals by 2035 (baseline scenario) and conducted a preliminary assessment of the impacts of specified additional measures on the development of emissions and removals (policy scenario).

Even though the HIISI project mainly served the research and analysis needs of the National Climate and Energy Strategy and the preparation of the Medium-term Climate Change Policy Plan, it also provided a base for the Climate Plan for the Land Use Sector, particularly with regard to measures on agricultural lands and through the link to the climate and energy strategy. In the selection and preparation of the measures included in the Climate Plan for the Land Use Sector, one aim was to ensure that the proposed measures do not conflict with the climate and energy strategy and that they contribute to supporting the policies in the Medium-term Climate Change Policy Plan.

The cost impacts and effectiveness of additional measures used in the HIISI project were re-evaluated in the preparation of the Climate Plan for the Land Use Sector. Therefore, during the preparation of the Climate Plan for the Land Use Sector, certain parts of the HIISI project's policy scenario were changed and a policy scenario for the Climate Plan for the Land Use Sector was prepared.

Sector-specific low-carbon roadmaps, prepared in cooperation with operators in the sector in line with the Government Programme, are among the key materials used in the preparation of the Climate Plan for the Land Use Sector. The roadmaps have also been key material for the HIISI project. The most significant roadmaps for the land use sector included the agriculture roadmap (Lehtonen et al., 2020) and the forest management scenarios prepared for Finnish Forest Industries(Hynynen et al., 2020) alongside the roadmaps for the forest, energy, sawmill and food industries[2].

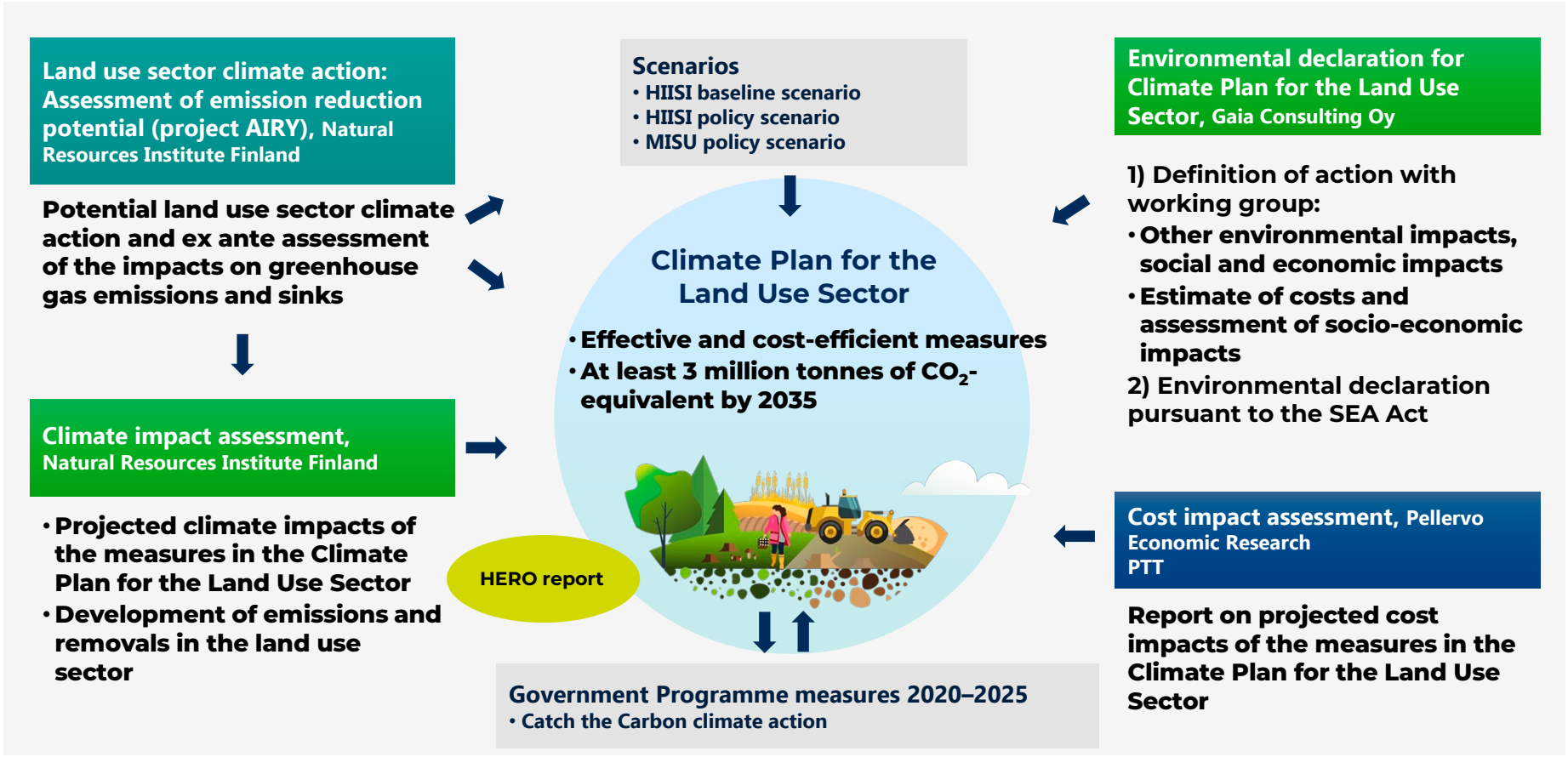
For the purpose of preparing the Climate Plan for the Land Use Sector, **a project for impact assessment and preparation of an environmental report was implemented in accordance with the Act on the Assessment of the Effects of Certain Plans and Programmes on the Environment (the SEA Act)** (Laine et al., 2022). The project was implemented by Gaia Consulting Oy and Pellervo Economic Research PTT ry. The project was launched at the very beginning of plan preparation, because the aim was to gain an overview of the impacts of the measures apart from climatic effects as part of the specification of measures and implementation. In addition, in connection with the SEA project, PTT was commissioned to prepare a **report on the assessment of the cost impacts of measures under the Climate Plan for the Land Use Sector** to assess the costs and cost effects of possible climate-related mesures in the land use sector (Laturi et al., 2022). The report was used in the prioritisation of the measures.

Because the Climate Plan for the Land Use Sector was prepared for the very first time, measures were reviewed on a broad scale. Assessment of the plan's impacts was based on scenarios, the projections according to the current measures (baseline scenario) and additional measures (policy scenario) of the HIISI project. As an additional analysis, a so-called "Hypercarbon" scenario was prepared, the aim being to include in the additional measures of the policy scenario measures that were estimated to have positive climatic effects. Because the climatic effects of the "Hypercarbon" scenario could not be assessed using the methodology used in the HIISI project, a final assessment of the "Hypercarbon" scenario was not possible. However, in the SEA project, assessment of other impacts was conducted for the "Hypercarbon" measures. Some measures of the "Hypercarbon" scenario were also selected as actual measures for the plan. The fact that certain measures were still being specified while the plan was prepared made the assessment of measures difficult in the SEA project.

2 Further information on the roadmaps is available on the website of the Ministry of Economic Affairs and Employment.

To clarify the measures to promote and support the prevention of deforestation, highlighted in the Government Programme, the Natural Resources Institute Finland was commissioned to prepare a report called **Harmful climate impact of deforestation and policy instruments for mitigating deforestation in Finland**, analysing the introduction of a land use change fee and other possible policy instruments and their impacts (Assmuth et al., 2022).

Figure 1. Input data of the Climate Plan for the Land Use Sector and projects supporting preparation.



The feasibility and acceptability of measures in the Climate Plan for the Land Use Sector were discussed in **interactive events**[3]. In autumn 2021, the interactive events were targeted at regional actors, and a broad range of various measures possibly included in the plan were discussed in the events. In the events arranged in early 2022, the discussion was based on measures that had been tentatively prioritised, and the aim was to gain feedback on how interesting the measures were, about the effectiveness of the planned policy instruments, and any bottlenecks involved. Young people and landowners were the specific target group of the interactive events in the autumn and spring.

The purpose of the interactive events was to form an understanding of the feasibility of the measures, the practical viewpoints for their implementation and the acceptability of the measures from the perspective of the actors concerned, and landowners. At the interactive events, the aim was not to find a shared view, but to introduce various viewpoints to the preparation process. The interest and acceptability of various climate action measures have also been analysed in studies (incl. Horne et al., 2020). At the events, the aim was to identify possible climate measures in addition to the ones already identified, and to collect information and viewpoints from the regional starting points of climate action.

Experts from the Natural Resources Institute Finland assisted the working group and the ministry as the work progressed, producing complementary assessments of the climatic effects of individual measures. The assessments are based on previous reports and studies. Furthermore, experts from the Natural Resources Institute Finland updated the impacts of measures proposed in the draft plan in the policy scenario of the Climate Plan for the Land Use Sector.

2.1 Round of comments

The draft Climate Plan for the Land Use Sector was circulated for comments between 14 April–18 May 2022 in the Lausuntopalvelu.fi online service. A total of 108 comments were provided during that period by key ministries, trade and professional organisations, interest groups, research institutions, government agencies and institutions, companies, environmental organisations and a few private individuals. Statement providers agreed on the necessity of the Climate Plan for the Land Use Sector. The overview is that the plan has comprehensively identified various measures to promote carbon sequestration in the

3 Summaries of the interactive events arranged in autumn 2021 and spring 2022, and abstracts of individual events are available on the website of the Ministry of Agriculture and Forestry.

land use sector and in general, the measures are feasible. The statements indicate that it is crucial to focus on preventing deforestation and peatland measures and to maintain and strengthen the vitality and growth of forests. In the feedback, emphasis on the permanence of measures and impacts was considered important.

The statements highlighted the importance of implementing measures in the land use sector broadly and proactively, and the feedback emphasised the fact that in comparison with the measures of the effort sharing sector, the measures are inexpensive per tonne of carbon. Some feedback providers proposed that the target level in the plan, of annual net impact at three million tonnes of carbon dioxide equivalent by 2035, could be more ambitious, particularly due to uncertainty factors in land use sector carbon sequestration and on the other hand, uncertainties relating to measures proposed by the parties themselves. Based on the feedback in the statements, the additionality of the actions was considered somewhat unclear, and overlaps with the CAP plan, the Medium-term Climate Change Policy Plan and the HERO Program for climate action and farm economy should be more clearly highlighted.

The statements also emphasised the need to coordinate the climate and diversity impacts and the expected higher consideration of diversity and environmental impacts. The fact that consideration of diversity was the starting point of the plan was considered good. Some measures, such as forest fertilisation, gave cause for concern regarding the impacts on diversity and the environment, and whether these would be identified. Climate action with an impact on diversity included lengthening of circulation times, lowering the intensity of thinning, conservation of forests and recording the sustainable maximum level of felling in the plan. The feedback emphasised the fact that climate action in the land use sector should not have negative impacts on diversity or nature, and this should be the main starting point of the plan.

Climate action in the land use sector was found to involve several uncertainty factors related to natural processes, which makes the impact assessment of measures difficult. Moreover, the statements paid attention to the major role of guidance by information in the implementation and emphasised the role of education and communication, and sufficient resource allocation to those as a prerequisite for the achievement of objectives. Likewise, clarification of responsibilities was expected, as were stronger policy instruments to enhance the efficiency of implementing the measures in specific cases. It was pointed out that as to forests, the sink impact is based on guidance by information instead of added economic policy instruments or regulation.

Most of the respondents regarded the plan as effective and feasible according to current knowledge, and on the basis of the scenarios. It is recommended that broad-based and proactive action be taken. Due to the uncertainties, the need for research and

development of monitoring is emphasised. The ongoing Catch the Carbon research and innovation programme and development projects were commended and hoped that they would continue as tools that provide and implement information. Further development of the greenhouse gas inventory should also be invested in.

The statements emphasised the fact that sufficient resources must be allocated to implementation and monitoring in order to produce impacts. Regions must be closely involved in planning and implementation.

The changed situation in the world, and its effects, were particularly reflected in the feedback comments as emphasis on the importance of security of supply and energy and food security. Most respondents paid attention to the impacts that Russia's invasion of Ukraine has on timber imports, and, correspondingly, felling volumes at home. Causes of concern include higher felling volumes and lower carbon sequestration. The situation also influences the scenarios presented in connection with the draft plan, as they include import of round timber. The changed global situation was also expected to affect the supply of fertilisers and stump treatment chemicals, and thus, at least in the short term, implementation of the plan.

As to the fairness of the measures proposed in the draft plan, attention was paid to intergenerational justice, differences between regions and the need to observe these, global justice and the rights of entrepreneurs. The obligation to participate in climate action was regarded as just on one hand, while other statements emphasised that the measures should not incur costs for entrepreneurs, but be motivating by nature. Respondents' opinions were clearly divided between obligatory measures versus guidance by information.

As to individual measures, afforestation was remarked on most, and, in particular, the preparation of a land use change fee, the carbon market, long-lived wood products, afforestation, fertilisation of forests on mineral soils and the use of peatlands. New measures were also proposed, including land use planning, forest management measures and conservation. The climate benefits of forest tree improvement and the need to identify these better were highlighted in many statements. As to long-lived wood products, the entire value chain, that is, the carbon handprint of products, should be reviewed.

The plan was specified on the basis of the comments, regarding the background, and descriptions of the changes in the operating environment resulting from Russia's invasion of Ukraine, and of basic and human rights were added, the descriptions of individual measures were specified and information on the published flash estimate of greenhouse gas inventory was added. The respondents provided plenty of input for

further work on the Climate Plan for the Land Use Sector, prepared for the first time, and its implementation. The proposals will be utilised in the planning and implementation of measures.

2.2 Starting points

The emissions and removals of the land use sector are calculated in six land use categories that cover Finland's land area and inland waters. The land use categories are forest land, cropland, grasslands, wetlands, settlements and other land. The classification used corresponds to the land use classification of Finland's national greenhouse gas inventory system, described, for example, in the report Development of emissions and sinks in the agricultural and LULUCF sectors until 2050 (Aakkula et al., 2019).

The greenhouse gas inventory is based on the reporting guidelines of the Intergovernmental Panel on Climate Change (IPCC), the reporting practices of the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, and the reporting guidelines of the European Union's climate legislation. In Finland, the Natural Resources Institute Finland delivers greenhouse gas reporting data for agriculture and the land use sector to Statistics Finland for inclusion in the national reporting system.

According to the IPCC's reporting guidelines, the emissions of agricultural land (cropland and grassland) are reported both for the agricultural sector and the land use sector. In the land use sector, greenhouse gas emissions and removals consist of changes in carbon stocks (living biomass, dead biomass and soil) (CO_2), and in the agricultural sector, nitrous oxide emissions from agricultural land from inorganic and organic fertilisers, organic soil farming and decomposition of organic matter on mineral soils, and minor emissions from liming (CO_2), use of urea as fertiliser (CO_2) and burning of agricultural residues (CH_4, N_2O).

According to the IPCC's calculation rules, in connection with biomass harvesting (including stemwood, felling residue), emissions are calculated in the land use sector as decrease in carbon stock (greenhouse gas emission), and when this transfers to wood product carbon stock, it forms an increase of stock. This means that, in connection with the burning of wood, emissions are not calculated for the second time as emissions from the energy sector. This helps avoid calculating the same emissions twice. The impacts of the use of biomass in energy production are also regulated by the Renewable Energy Directive (REDII, see chapter 4.2).

According to IPCC reporting guidelines, anthropogenic emissions, that is, emissions resulting from human activity, are included in the reports. In Finland, all forests are included in emission calculations, because they are considered to be under the influence

of human activity. Therefore, nature reserves are also included in the reports, even though they are not subjected to actual forest management measures. Natural mires, that is, mires that have not been drained, are excluded from management measures and thus also from calculations and reports.

2.3 Land Use Sector in the Government Programme

According to Prime Minister Sanna Marin's Government Programme, Inclusive and competent Finland – a socially, economically and ecologically sustainable society (PMO, 2019), Finland's aim is to be carbon neutral by 2035 and carbon negative soon after that. According to the Government Programme, this will be achieved by accelerating emissions reduction measures and strengthening carbon sinks. The Government Programme also states that the emissions reduction measures will be carried out in a way that is fair from a social and regional perspective and that involves all sectors of society.

According to the Government Programme, as part of planning for the climate and energy policy system, the Government will create a comprehensive climate programme for the land use sector (currently, a climate plan). The purpose of the programme is to identify means to decrease emissions from the land use sector and strengthen Finland's carbon sinks in the long and short term. The goal is to increase Finland's net carbon sink. Policies on carbon sinks will be added to the Climate Change Act and Finland's strategy towards carbon neutrality. The development of carbon sinks and the effectiveness of the related measures will be assessed as part of the annual reporting required by the Climate Change Act. The measures of the Climate Plan for the Land Use Sector will be assessed from the perspective of efficiency and cost-effectiveness.

In the Government Programme, measures in the land use sector include safeguarding the management, growth capacity and health of forests, advancing afforestation, reducing deforestation, means to reduce the emissions of swamps and peatlands, climate-sustainable management of swamp forests and reducing the emissions and strengthening the carbon sequestration properties of agricultural land. Guidance instruments and incentives for strengthening the carbon sinks and stores of forests and soil will be developed.

The annual net impacts that the additional measures in the land use sector aim for were specified at the ruling parties' Vuosaari climate meeting on 3 February 2020 as at least three million tonnes of carbon dioxide equivalent annually by 2035. Additional measures to reach this target are decided on in the land use sector plan. These additional measures will be carried out proactively so that the land use sector's flexibility for the effort sharing sector (0.45 million tonnes of carbon dioxide equivalent) is available.

2.4 Concepts and distinctive features of the land use sector

Carbon dioxide equivalent

The emissions of various greenhouse gas emissions are rendered commensurable so that their climatic effects can be compared and summed up. Carbon dioxide equivalent is used as the common measure for greenhouse gas emissions. Carbon dioxide emissions as such are calculated as carbon dioxide equivalent emissions, but the emissions of other greenhouse gases are multiplied by coefficients that describe the global warming potential of the compound in question in comparison with carbon dioxide.

Permanence of sinks

Carbon circulates in nature between the atmosphere, waterways and the soil. Plants capture carbon from the atmosphere in photosynthesis and transform it into biomass. Decomposition of biomass releases carbon back into the atmosphere or into waterways. Carbon is stored in vegetation and soil for a short and long term. The carbon stock serves as a carbon sink when it binds more carbon than it releases into the atmosphere. The permanence of sinks causes uncertainty in reaching climate objectives, because carbon stocks may be converted from a net sink to a net emission source. Carbon dioxide can be released fairly quickly into the atmosphere due to anthropogenic or natural causes, for example due to forest damage. Therefore, it is important to preserve and increase ecosystems' long-term carbon stocks, such as peat in mires.

Saturation

The greenhouse gas balance of a carbon stock in a land area may, at some stage, be close to zero or become a net emission source. In that case, the carbon stock in question releases more carbon than it binds. In many ecosystems, the growth of carbon stock may continue for a very long time. Due to the impact of climate change, both carbon sequestration and release processes may be accelerated.

Heterogeneity

Forests and fields, their soil in particular, are heterogeneous, which means that the conditions between areas and inside areas may vary a lot, and thus the impacts of measures vary considerably. The differences between areas should be identified when measures are planned and implemented. Various methods, such as laser scanning or other remote sensing methods, can be used to improve site-specific data and thus enhance

the targeting of measures according to the properties of each area, for example by precision farming. The uncertainty caused by heterogeneity must be taken into account in monitoring.

Cyclicity

The emissions and removals of land use may be repeated in regular cycles, for example as consequence of natural disasters, wood harvesting or tree cultivation systems. The cycles may be problematic and challenging in terms of setting goals for climate change mitigation or reaching of these goals.

Lagging effects

Particularly as regards forest stand and the soil, such as wetlands and peatlands, the impacts of measures may become visible after a long time. Therefore, impacts must be considered both in the short and long term.

Substitution

Substitution effects refer to emissions that have not been formed owing to the use of products, raw materials or services that generate lower emissions. These may include the use of wood or other plant biomass instead of a product with higher emissions.

Variation caused by markets

Economic trends influence the demand and production of goods. This means that the global demand for products influences raw material prices and thus the supply of products.

Carbon leakage

Carbon leakage describes the situation in which emission limitations implemented in a certain area or country increase emissions at another location. The development of environment-friendly technology and internationally agreed comparable targets and compatible emission calculation methods improve the transparency of carbon leakage.

Emissions originating from agriculture

Greenhouse gases generated by agriculture are reported for several reporting sectors (Figure 2):

- Agriculture belongs to the effort sharing sector in which methane, nitrous oxide and carbon dioxide emissions are reported as emissions from the agricultural sector, mainly originating from the digestion of production animals, manure precessing, soil of agricultural land and liming. In addition, minor emissions are generated by the use of urea as fertiliser and burning of plant residue in the fields.
- Carbon dioxide emissions from cropland and grassland are reported for the land use sector.
- In addition, energy-related emissions from agriculture, that is, the emissions of agricultural machines, property-specific heating and use of fuel in production buildings, are reported for the effort sharing sector's energy sector.

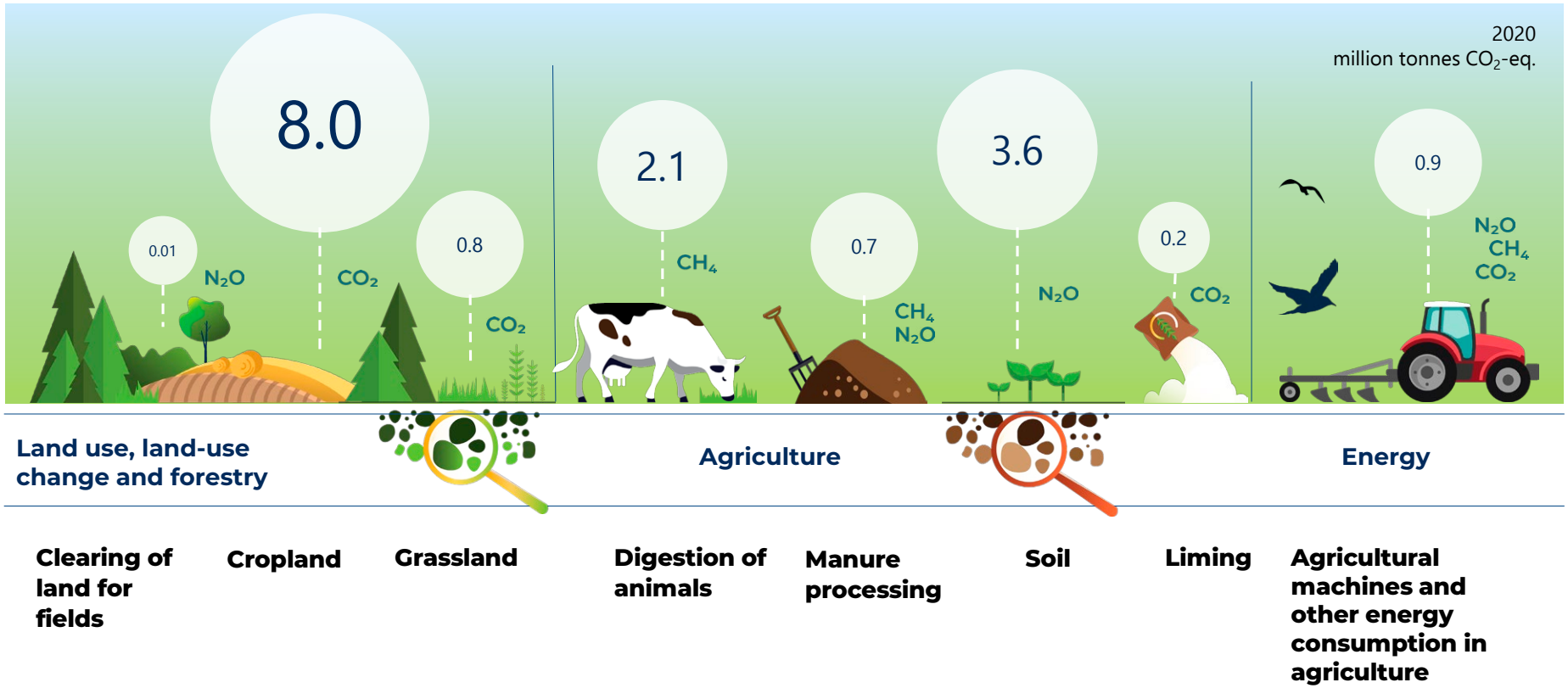
The emissions generated in the effort sharing sector of agriculture are analysed in the Medium-term Climate Change Policy Plan. Measures carried out in the effort sharing sector to reduce greenhouse gas emissions from agriculture also influence the land use sector. The texts in the Medium-term Climate Change Policy Plan on agriculture strive to reveal the impacts in both sectors.

Approximately three quarters of the overall emissions from agriculture are related to soil, including both carbon dioxide emissions in the land use sector and nitrous oxide emissions in the agricultural sector, whereas approximately three quarters of emissions from soil relate to organic soils. Studies show that most significant, fastest reductions requiring a relatively small area for implementation could be achieved by changing farming practices on peatland fields and mitigating deforestation.

In the effort sharing sector, emission reduction measures are more difficult to find in agriculture without cutting down production of animal origin, because the measures involve methane and nitrous oxide emissions from the digestion of production animals, manure processing and the soil of agricultural land. In this, the challenges include the efficiency of measures, their impact on animal welfare (for example the use of additives in fodder) and supervision.

In 2021, the total number of agricultural and horticultural businesses in Finland was 44,700 (Natural Resources Institute, 2021a). In sum, agriculture involves a set of fragmented, biological emission sources that are more challenging to manage than emissions in many other sectors.

Figure 2. Greenhouse gas emissions from agriculture are reported for the land use sector, effort sharing sector and effort sharing sector's energy sector. Carbon dioxide emissions of cropland also include carbon dioxide emissions from the clearing of land. Source: Statistics Finland 2022.



Uncertainties in reporting and development efforts

The reporting of land use sector climatic effects involves various uncertainties. Annual and seasonal variation in conditions may be relatively sharp and have significant impacts on the net balance of carbon stock emissions and removals.

Greenhouse gas inventories report emissions and removals for a period in history, for example from 1990 to the present day. Time series are a key element of the inventory and provide information of emissions in history, and development trends. The Climate Agreement encourages parties to improve the methods for assessing emissions and removals. However, national governments must apply the methods and materials (for example emission factors) consistently when reporting time series data. This means that if a country changes or improves its methodology in a certain year or develops its materials, the greenhouse gas estimate representing the time series in history, reported for the year in question, should be calculated in full using the new methods and materials in order to follow reduction measures and action at the national level. Recalculation may result in major changes in the reported emissions and removals, which means that the historic emissions and removals for the land use sector may change.

Uncertainties are analysed in further detail in Chapter 8.4, Uncertainties.

3 International and national operating environment

3.1 International operating environment

At the international level, the most important climate policies were defined in the UN Framework Convention on Climate Change (UNFCCC) that entered into force in 1994, in the Kyoto Protocol and the Paris Agreement. All UN member states, including Finland and the European Union, are parties to the UNFCCC. The Convention obliges parties to prepare, execute and update plans to mitigate climate change and promote adaptation, and to report data on greenhouse gas emissions and sinks. The parties are furthermore required to promote the conservation and enhancement of carbon stocks and sinks.

The UNFCCC (UN, 1992) does not include quantitative emission reduction obligations, but the Kyoto Protocol that supplements it (UN, 1997) sets legally binding obligations on industrialised countries to reduce greenhouse gas emissions. The Kyoto Protocol was adopted in December 1997 and entered into force in February 2005. In the first commitment period from 2008 to 2012, the total emission reduction target for industrialised countries was 5.2 per cent compared to 1990 levels. The European Union's commitment was eight per cent.

In December 2012 in Doha, the parties to the Kyoto Protocol agreed on a second commitment period for 2013–2020. Soon after that, the focus of international climate policy transferred to preparing the Paris Agreement that guides climate policy more broadly and with a more long-term approach than the Kyoto Protocol. The geographic coverage of the Kyoto Protocol's second commitment period remained clearly below that of the first commitment period. In the end, the Doha Amendment was adopted by a sufficient number of parties as late as in October 2020, and it entered into force on the last day of December in 2020. The EU's emission reduction target for the second commitment period, 2013–2020, was 20 per cent compared to 1990 levels. The EU, its Member States and Iceland have a common emission reduction commitment. The impact of land use sector measures, that is, afforestation and reforestation, forest destruction and forest

management measures was taken into account in the commitment. The utilisation of forest management measures to achieve the target was taken into account to a limited extent.[4]

The Paris Agreement (UN, 2015a) was adopted in December 2015 at the 2015 United Nations Climate Change Conference (COP 21) in Paris and entered into force in November 2016. By April 2021, the Agreement had been ratified by 191 parties and covered 97 per cent of global greenhouse gas emissions. The Agreement applies to the post-2020 period and remains in force until further notice.

At the Glasgow Conference of the Parties to UNFCCC in November 2021, the parties agreed, for example, on specifying rules of Article 6 on market mechanisms and uniform and transparent reporting of climate action and emissions reporting.

The target recorded in the Paris Agreement is to limit the rise of global average temperature to clearly below two degrees Celsius, and striving to limit the rise of average temperature to 1.5 degrees Celsius in comparison with the pre-industrial age. A further objective is to strengthen the ability of the parties to adapt to climate change and foster climate resilience and to direct financial flows towards low-carbon development. In order to achieve the temperature goal, global greenhouse gas emissions will need to be brought downwards as soon as possible and quickly reduced thereafter so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.

Key elements of the Paris Agreement include the obligation of the parties to prepare so-called Nationally Determined Contributions (NDCs) that represent the commitments of each country to reduce greenhouse gas emissions and adapt to climate change and communicate their planned climate action. The NDCs must be made stricter at least at five-year intervals and they must correspond to the highest possible target level of the party. 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.

According to the NDC Synthesis Report, published in September 2021 by the UNFCCC Secretariat (UN, 2021), so far, 113 countries have reported new commitments that will, if implemented, reduce emissions by an estimated 12 per cent in 2010–2030. By the end

4 Further details on the target of the Kyoto Protocol's second commitment period and achieving it are available for example in Finland's greenhouse gas emissions 1990–2020. Statistics Finland 2021.

of the Glasgow Climate Change Conference, the number of countries had increased to 124. Moreover, 70 countries have reported that their aim is to achieve carbon neutrality by approximately mid-century, which would result in higher emission reductions of approximately 26 per cent. Certain major economies have set later carbon neutrality targets, for example China and Russia by 2060 and India by 2070. Before more specific estimates are available, of the new commitments given during the Glasgow conference, the current NDC commitments of a total of 193 parties will result in a rise in the average global temperature by around 2.8 degrees Celsius by the end of this century (range 2.2–3.4 degrees Celsius). The parties' commitments, and how they correspond to the Paris Agreement goals for limiting the rise in temperature, will be re-evaluated as soon as in 2022. However, according to a study published in April 2022, it has been estimated that if the 154 NDC commitments, given or updated by the Glasgow Climate Change Conference, and 76 long-term commitments are implemented in full, it would be possible to limit the rise in average temperature to below two degrees Celsius (Meinshausen et al., 2022).

In addition to the UN Convention on Climate Change and the Paris Agreement, Finland is committed to several other international agreements and commitments that are closely linked to the Climate Plan for the Land Use Sector. The Convention on Biological Diversity (CBD) obligates to the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from biodiversity. The UN Convention to Combat Desertification (UNCCD) has become an agreement on soil management and conservation. The United Nations Forum on Forests (UNFF) and the associated UN Forest Instrument, which is not legally binding, promote the sustainable management, use and conservation of forests.

The "4 per 1000" Initiative

Launched in connection with the Paris Climate Conference in December 2015, the aim of the International "4 per 1000" Initiative is to increase the amount of carbon in the soil (The International "4 per 1000" Initiative; UN 2015b). The initiative aims to increase the quantity of carbon contained in soils by four per cent each year. Storage of carbon from the atmosphere in the soil supports the goal of halting the global rise in temperature at 1.5–2 degrees Celsius. It will also increase the productivity of soil and improve food security.

A total of 39 countries and hundreds of organisations have committed to the "4 per 1000" Initiative. Finland, one of the first countries to sign this initiative, is committed to promoting the initiative also in accordance with Prime Minister Sanna Marin's Government Programme. The initiative includes the joint action plan of government agencies and various stakeholders to increase the amount of carbon in the soil and a programme for international research and scientific cooperation.

The national potential of carbon sequestration is studied and developed further in several projects ongoing within the framework of the Catch the Carbon research and innovation programme.

Forest commitment / Glasgow 2021

The Leaders' Declaration on Forests and Land Use of the Glasgow Climate Change Conference emphasises the significance of forests, biodiversity and sustainable land use in achieving sustainable development goals, balancing emissions and sinks, and adapting to climate change. The Declaration commits signatories to work in order to halt deforestation and reverse the development, and prevent the degradation of land area quality by 2030.

Agriculture Innovation Mission for Climate

The Glasgow Climate Change Conference launched the Agriculture Innovation Mission for Climate (AIM for Climate) at the initiative of the United States and the United Arab Emirates, and Finland joined the initiative. The initiative aims at increasing and accelerating innovations that support international climate goals in research and development in the agricultural sector and food systems. Participants are committed to increasing investment to promote innovations in agriculture and to preparing a monitoring system for these. Funding can be targeted at the home country, or international cooperation. Projects within the Catch the Carbon research and innovation programme that promote climate efforts in agriculture within the land use sector's climate measures form part of Finland's input to further the AIM for Climate initiative in 2021–2025.

3.2 Operating environment of agriculture

The Nordic climate is the leading factor that influences agricultural production conditions in Finland. The length of the growing season varies between 110 and 180 days. The grazing season lasts a maximum of 120 days on average (Figure 3). In the northern parts of the country, the effective temperature sum is 500, and in the southernmost part of the country, 1,400 degrees Celsius. This amounts to a significant natural constraint in contrast with comparable agricultural production areas in the EU. In Finland, crop production costs are high and yields are exceptionally small compared to the southern EU production areas due to our northern production conditions. In Finnish conditions, the cultivation of winter cereals and oleaginous plants is not possible as extensively as in more southern parts of Europe, and the length of the growing season and cold winters restrict the cultivation of various plant species and varieties. Finland's freshwater resources are among the most

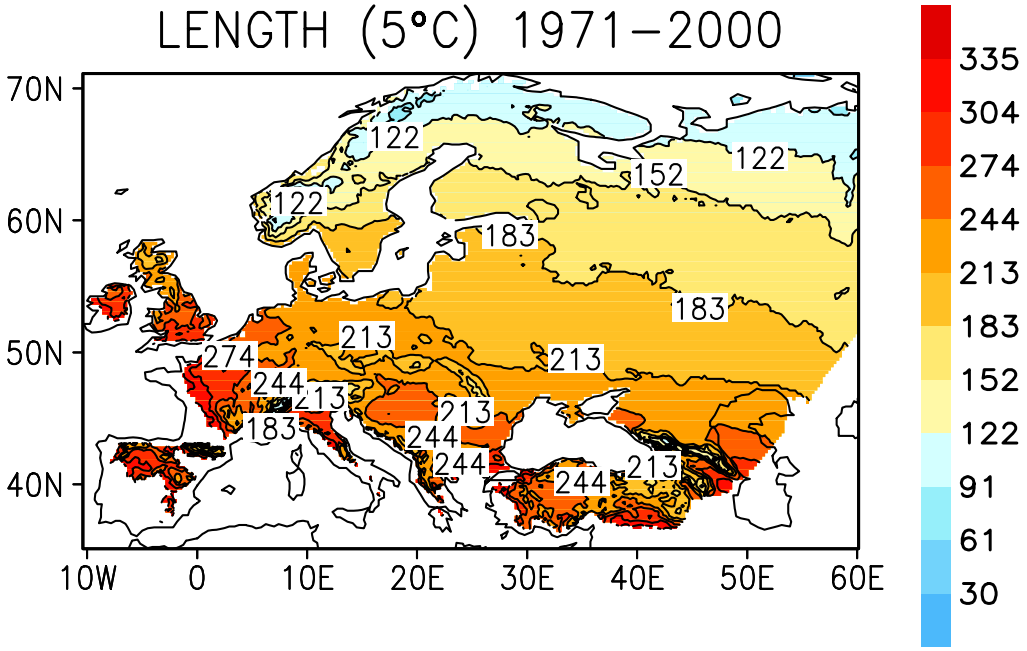
abundant in Europe in relation to the population. Measured by several indicators, soil quality is among the cleanest in Europe and in global comparison, air quality is among the purest.

The long winter season, the freezing of the ground and the soil types in arable land affect the water economy and cultivation method of agricultural areas. Cultivation requires efficient drainage of fields. Of the cultivated fields, some 60 per cent have subsurface drainage and some 25 per cent have ditch drainage. Cultivation without drainage is only possible on about 15 per cent of the field area. The need for the restoration of ditches and subsurface drains also brings continuous additional costs.

Several weather factors and their timing during the year must be taken into account in adapting agriculture to future climate conditions. Climate change may raise the average temperatures in Finland by up to six degrees by the end of this century. Winters will warm up in Finland more than summers. Extreme weather conditions become more frequent and periods of drought become longer. Very dry summers may occur in the future up to 2–3 years each decade. A warmer climate is also estimated to lead to higher precipitation, more intense rainstorms and more frequent wet growing seasons in Finland. In relative terms, the change in rainfall will be higher in winter than in summer, and in the north more than in the south. The amount of precipitation may be sufficient, but rain will fall less frequently.

Therefore, agriculture should be prepared for both dry and wet periods, but also for cold conditions. At the same time, attention must be paid to the consequential impacts of weather conditions – impacts in the soil in particular, and the occurrence of plant pests and animal diseases. If we can prepare for risks, the longer growing season may benefit Finnish agriculture.

Figure 3. The average duration of the growing season in days, in the reference period 1971–2000, with daily average temperature above five degrees Celsius. Because the temperature stays above the limit of five degrees Celsius throughout the year in the south and west, the starting and ending times of the growing season could not be determined. Source: Ruosteenoja et al., 2016.



Agricultural land accounts for approximately seven per cent of Finland's land area. According to preliminary data in the Agricultural and Horticultural Enterprise Register, the number of agricultural and horticultural businesses in Finland totalled 44,700 in 2021(Natural Resources Institute (Luke), 2021a). The decline in the number of agricultural and horticultural enterprises continued as in previous years, and now the decline from 2020 came to more than 900 farms. This decline in the number of farms has not, however, affected production volume in any significant way. The fields of farms that have gone out of business have been transferred to continuing farms, and the unit size of animal farms has increased. Farms have also specialised and increased production volumes. For example, meat production has increased in the 21st century, despite the lower number of animal farms. Likewise, milk production has decreased by a few per cent only, even though the number of dairy farms is almost 50 per cent lower than ten years ago, and the number of dairy cows has decreased by over one quarter in the 2000s. (Latvala et al., 2021.)

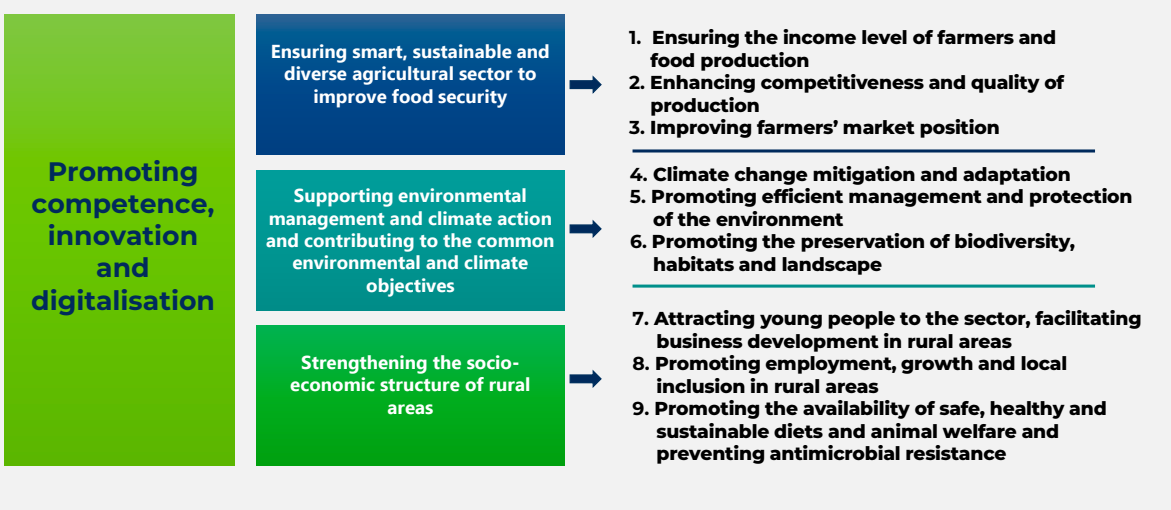
In 2021, some 2.3 million hectares of fields, of which rented area accounted for 850,000 hectares, were in use by agricultural and horticultural enterprises. The area of rented fields increased by slightly less than 77,000 hectares from the previous year. In ten years, the average area of farms has increased from 41 to 51 hectares. In the areas of Southwest Finland, North Ostrobothnia and Uusimaa Centres for Economic Development, Transport and the Environment, the average area is over 60 hectares.

Until now, very little agricultural land has gone out of use, and the fields of farms that have gone out of business have either been rented out or sold to other farms. At present, about 45 per cent of agricultural land in use is used for grass production or fallow land. If there is a significant decrease in livestock farming, grassland will become available for other uses. Future greenhouse gas emissions will be influenced in particular by which crops are chosen for these fields going forward, and the share of the fields that will be used, for example, for environmental management purposes. (Natural Resources Institute 2021a.)

The EU's common agricultural policy

Agricultural policy is one of the EU's common policies. At present, the EU's common agricultural policy (CAP) is being reformed for the next funding period 2023–2027. The EU's common agricultural policy implements nine objectives (Figure 4).

Figure 4. EU-level objectives for the EU's common agricultural policy (CAP).



The reform of the CAP puts particular emphasis on mitigating climate change and adapting to it, on animal welfare and on attracting new farmers to the industry. Other priorities include maintaining a viable income for farmers, developing rural areas and improving risk management.

Finland's draft CAP plan was submitted to the Commission in December 2021, and its implementation is due to start from the beginning of 2023. The measures of the current CAP will continue as usual during the transition period in 2021 and 2022. The EU's recovery funds are also available during this period.

In agriculture, emissions reduction measures have been taken mainly based on the methods provided by the CAP. It is not possible or appropriate to implement all climate change mitigation or adaptation measures in agriculture through the CAP, but national measures must be taken into use as well. It must be noted in the preparation of climate action in agriculture that the current reform of the CAP applies to the period 2023–2027, and another CAP will be prepared for the subsequent period.

National Climate Food Programme

In accordance with the Government Programme, the Ministry of Agriculture and Forestry has prepared a National Climate Food Programme, due for release in 2022, aiming at reducing the climate footprint of food that we consume and increasing understanding of food production. The aim of the Climate Food Programme is to support the transition of society towards a climate-sustainable food system, taking into account ecological, social, cultural and economic sustainability. The measures under the Climate Food Programme support the climate objectives of the land use sector and agricultural effort sharing sector. The measures will support the transition towards a diet focussing more on plant and fish products and promote, among others, the diversifying of farming, the creation of value chains for plant-based proteins of domestic origin, and climate resilience of public procurement of food, and prevent food waste.

3.3 Operating environment of forestry

Forest land covers for 86 per cent, or 26.2 million hectares, of Finland's land area, and forest land with a high growth potential for timber production accounts for more than three quarters of the total. In addition, one tenth of forest land is poorly productive forest land and 13 per cent is waste land that is almost or fully unforested. Forest roads and other service areas required for forestry account for one per cent of the total forest land area. Mires cover one third of forest land, while the rest is coniferous forest land, that is, mineral soil. Drainage covers 4.7 million hectares of Finland's current area of mires, totalling some

8.7 million hectares. The original total area of mires has been approximately 10.5 million hectares (Kaakinen et al, 2008). Mire and peat areas change constantly for example in peat production, where depleted areas transfer to the category of mineral soils.

More than half of the area of forest land is privately owned. Of forest land, 35 per cent is state-owned (about 20 per cent of the area used for forestry) and companies own seven per cent. The remaining six per cent is owned by municipalities, parishes and organisations.

Forest stand volume on forest land and poorly productive forest land totals 2,506 million cubic metres. One quarter of the volume is situated on mires, and the rest on mineral soils. Of forest stand volume, 89 per cent is situated on land used for wood production. Protected areas, among others, are excluded from wood production. In the past 50 years, forest stand volume has grown from 1.5 billion cubic metres to 2.5 billion cubic metres.

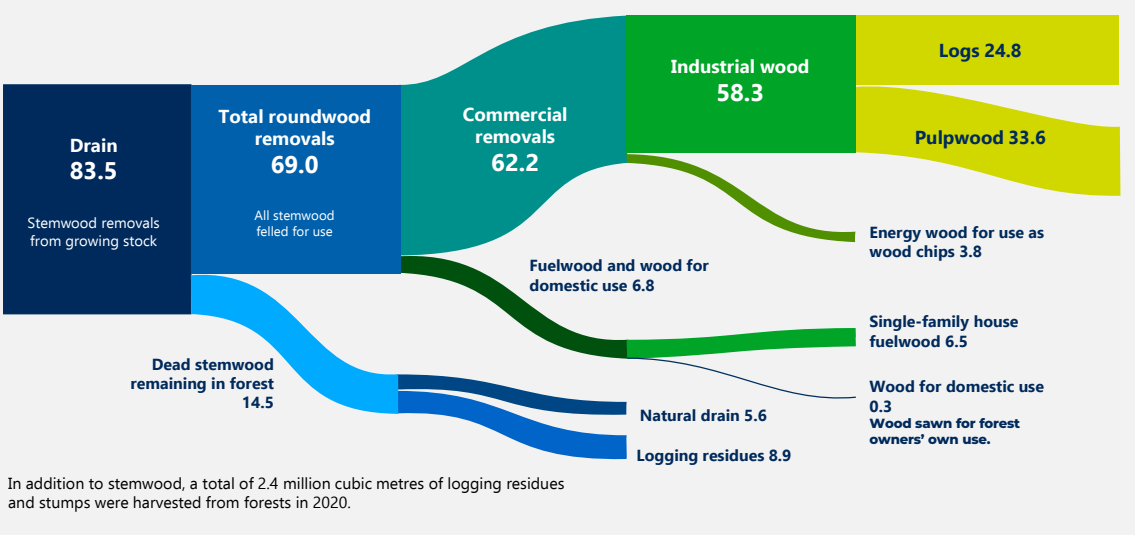
The average volume of forest stand on forest land is 122 cubic metres per hectare. In southern Finland, the average volume is 148 and in northern Finland, 90 cubic metres per hectare. The amount of deadwood on Finland's forest land totals 6.1 cubic metres per hectare. Of this, more than 70 per cent is lying deadwood and the rest is standing deadwood. In southern Finland, the amount of deadwood is 4.8 and in northern Finland, 7.7 cubic metres per hectare. (Natural Resources Institute (Luke), National Forest Inventory (NFI) 13.)

The annual growth of forest stand on forest land and poorly productive forest land has increased in Finland from 1990, from the annual level of 78 million cubic metres in NFI12 to 107.8 million cubic metres per year (Peltola et al., 2020). According to the most recent data available (NFI 13, 2021), the annual growth of forest stand totalled 103 million cubic metres. In comparison with the previous inventory, pine growth decreased but the growth of spruce has increased further. Factors having contributed to the increase in forest stand growth in the long term include forest management, the large share of young forests at a favourable growth stage, and mire drainage. Changes in the environment explain about 37 per cent of the increase in growth (Henttonen et al., 2017).

The total roundwood removals consist of merchantable timber for the forest industries (logs and pulpwood) and stemwood to be used for energy production (energy stemwood), of which households' firewood accounts for a major share. In 2020, the domestic roundwood removal volume totalled 69 million cubic metres (Figure 5). Of this, logs and pulpwood accounted for 85 per cent, that is, 58.7 million cubic metres. Of that, 58.3 million cubic metres were harvested for the forest industries and the export market, and 0.3 million cubic metres for domestic use by forest owners. 6.8 million cubic metres

were used in single-family houses as fuelwood or for domestic use, and 3.8 million cubic metres were felled for use as wood chips at heat and power plants. In addition, 2.4 million cubic metres of logging residues and stumps were harvested from forests in 2020.

Figure 5. Roundwood removals and felling of stemwood in 2020 (million cubic metres). Source: Natural Resources Institute Finland.



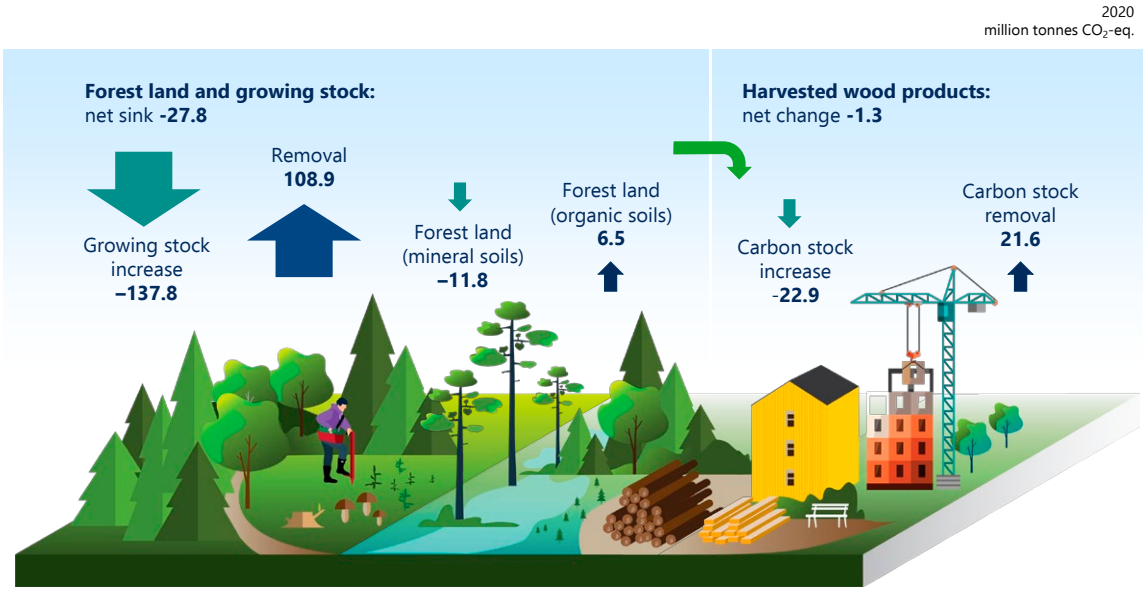
In the 2010s, more than 80 per cent of the raw material used by forest industries operating in Finland was harvested from privately-owned forests in Finland (Official Statistics of Finland: Commercial removals of wood). Forestry and related industries still play a very significant role in Finland's national economy, and in the regional economy specifically in Eastern and Central Finland. In 2020, private forest owners' gross stumpage earnings amounted to some EUR 1.8 billion and the operating profit was EUR 109 per hectare.

According to the Natural Resources Institute Finland (Official Statistics of Finland: Total roundwood removals and drain), the highest total roundwood removal volume that can be maintained in 2016–2025 throughout the country amounts to 80.5 million cubic metres of stemwood per year. Of this, on 74.6 million cubic metres are merchantable wood. In the calculation of the highest total roundwood removal volume that can be maintained, the factors taken into account include economic sustainability and sustainability of wood production, forest management recommendations and conservation decisions made, and restrictions to wood production resulting from other forms of forest use. In the period 2016–2020, the annual total roundwood removals of merchantable wood have been 63.4 million cubic metres on average (range in that period, 58.7–69.2 million cubic metres).

In 2016–2020, average felling exceeded the maximum total roundwood removal volume that can be maintained in a total of six regions in Southern and Central Finland. In South Karelia, this level was exceeded by 15 per cent, and in Kymenlaakso, by seven per cent. In the regions of Kanta-Häme, Pirkanmaa, Päijät-Häme and South Savo, the figures were between one and four per cent. (Natural Resources Institute (Luke), 2021b.)

In 2020, the forest stand and soil in forest sequestered a total of 27.8 million tonnes of carbon dioxide equivalent of carbon and wood products, including sawn timber and wood panels, sequestered carbon totalling 1.3 million tonnes of carbon dioxide equivalent (Figure 6).

Figure 6. Carbon balance of forest and wood products in 2020 (million tonnes of carbon dioxide equivalent). Source: Natural Resources Institute Finland/Statistics Finland 2022.



National Forest Strategy

The National Forest Strategy defines the objectives for Finland's forest policy, with emphasis on comprehensive sustainable development. The climate resilience of forests is one of the key objectives of the strategy. The purpose of forest policy is to steer the choices of forest owners, and the use of forests, to the desired direction for society. Increasingly often, international priorities influence the contents of national policy.

Forest policy steers felling and wood harvesting as well as forest and nature management. Traditionally, forest policy measures are divided into normative regulation, such as forest legislation, economic steering, such as the Temporary Act on the Financing of Sustainable

Forestry and taxation, and guidance by information, including forest management recommendations, advisory services for forest owners, and forest planning. As the priorities for forest use in society change, the aim is to steer forest owners and the use of forests by changing the aforementioned instruments.

Forest policy is under national control. The European Union does not have a common forest policy, but it influences the contents of forest policy through climate, environment and energy policy, among others. International conventions and agreements also steer our choices of policy related to the use of forests.

Incentive systems for forestry

The purpose of the Act on the Financing of Sustainable Forestry is to promote the economically, ecologically and socially sustainable management and use of forests (34/2015, section 1). State support can be granted to measures with long-term impacts on the growth and use of forests, the private economic benefits of which will be enjoyed after several decades. Work that can be eligible for public funding from the system under the Act includes the tending of seedling stands, tending of young stands and the related harvesting of small-diameter wood, remedial fertilisation, peatland forest management and the construction and improvement of forest roads. The public funding system also promotes nature management in commercial forests and encourages the preservation and restoration of forest habitats of special value (forest nature management and environmental aid agreements).

In 2021, public funding for wood production based on the Act on the Financing of Sustainable Forestry totalled around EUR 42 million, and for nature management and environmental aid agreements, around EUR 9.8 million. The current public funding system for sustainable forestry is temporary, valid until the end of 2023.

At present, the preparation for a new incentive scheme for forestry in underway (MoAF, 2011). On 11 September 2019, the Ministry of Agriculture and Forestry appointed a working group to carry out a preliminary study on the incentive scheme for forestry in the 2020s for the next funding period of the European Union. The aim was to prepare a sufficiently detailed study to serve as the basis for the actual government proposal. The proposals presented in the study include the measures for which the aid is to be granted, conditions for the aid and aid levels.

The working group assesses the impacts of the proposed measures to be supported on climate resilient wood production. The working group proposal corresponds to the entry in the Government Programme on forestry support system.

Recommendations for forestry and other guidance by information

Forest management recommendations are the guidelines on the principles and methods of forest management. Forest management recommendations provide forest owners with justified options for forestry practices. Professionals in the field utilise the recommendations in services offered for forest owners and in the practical implementation of forest management.

The purpose of forest management recommendations is to advise and motivate forest owners to manage their forests in line with their objectives, considering the various viewpoints of sustainability. Since the recommendations are not binding, compliance is optional. Despite their optional nature, the forest management recommendations are widely used in Finnish forestry, for example in the specification of thinning models in various calculation programmes.

Forest management recommendations are updated regularly to correspond to the latest information available and expectations targeted at forest management. The procedures are prepared taking into account legislative restrictions and the key requirements that forest certification systems place on forestry practices.

Forest certification

Forest owners may, should they wish, enter their forest areas into a forest certification scheme, where the criteria impose requirements on the use and management of forests that go beyond what is laid down by law. The certification of forests is a voluntary, market-driven system to verify compliance with these requirements. The certification systems currently in use in Finland are the Programme for the Endorsement of Forest Certification (PEFC) and the Forest Stewardship Council (FSC). Most of the commercial forest area in Finland, about 90 per cent, is certified under Finland's PEFC scheme, while about 10 per cent is currently certified under the FSC standard.

3.4 Changes in land use and other land use

Deforestation means the conversion of forest land for other forms of land use. In the 2010s, the total area of deforestation per year has averaged around 14,000 hectares, that is, less than 0.1 per cent of forest area (22.8 million hectares). However, in 2013–2019, deforestation has caused emissions of approximately 3.7 million tonnes of carbon dioxide equivalent every year, corresponding to around 6 per cent of Finland's overall emissions (Statistics Finland, 2021). Of the deforested area, around one half is associated with construction, and around one third with agriculture. Areas converted from forest land into cropland have caused approximately one half, and areas converted into settlements

around one fifth of the emissions from deforestation (Statistics Finland, 2021). Cropland's high relative share of emissions in comparison with cleared areas is caused by clearance of forest land on peat soil into fields. The surface area of land clearing has been less than 5,000 hectares annually, that is, 0.2 per cent of agricultural land in use (2.3 million hectares). Clearances on organic soils, and their soil emissions, have been the key source of emissions that has become increasingly significant for the past 20 years. As a whole, emissions from clearing of land for agricultural purposes are around three times higher than those from clearing for settlements, even though the cumulative surface area of land clearing for fields is only about one half. Because soil emissions are determined on the basis of cumulative surface area, emissions from land clearing for fields would not end immediately even if land clearing were immediately stopped completely.

The structural change in agriculture is the driver for land clearing, as increasing size of farms improves the profitability of operations. Farms centralise their operations as close to the central farm as possible to facilitate the efficient use of resources. Cattle farms that expand their production may also need more field area to produce green forage and to facilitate manure landspreading. Even if the total production of agriculture were not to increase, the larger size of individual farms results in clearing of additional cropland, if the existing fields cannot be utilised on the basis of farming agreements, renting or buying. In Finland, the method used to curb land clearing for fields has been to refrain from granting new payment entitlements to cleared parcels of land after 2004. However, it has been possible to transfer, buy or rent existing CAP payment entitlements that form the basis for direct payments for parcels cleared after 2004, but, as a rule, parcels cleared after 2004 are no longer eligible for payments. The eligibility of a parcel forms the basis for payment of environmental and compensatory allowances, organic production allowances and national per hectare aid.

The Natural Resources Institute Finland prepared a report called **Harmful climate impact of deforestation and policy instruments for mitigating deforestation in Finland**, analysing the introduction of a land use change fee and other possible policy instruments and their impacts (Assmuth et al., 2022). According to the report, the harmful climate impacts caused by deforestation can be internalised, that is, included in the land owner's decision-making by way of an economic policy instrument, such as a land use change fee. Such a fee can be considered to constitute a fair policy instrument because it would implement the generally accepted 'polluter pays' principle. Apart from the land use change fee, there are several other potential policy instruments to curb deforestation. According to the report, it would be most appropriate to apply a combination of several policy instruments to curb deforestation.

Various infrastructure projects, too, such as roads, power grids, wind power plants and mines often require clearing of forest. Correspondingly, the development of residential and commercial properties often causes deforestation, if it is not targeted at cropland or does not involve additional or complementary building. In the past decades, deforestation for settlements has primarily been caused by mines and other soil extraction areas, building of residential and holiday properties and traffic routes (Timonen, 2020). Infrastructure and building projects often involve significant benefits for society, so they cannot, and should not be completely avoided. According to national land use guidelines, the preservation of sufficiently coherent field and forest areas is important in terms of bioeconomy, security of supply, landscape and biodiversity, and well-functioning and sufficiently coherent areas for agriculture and forestry must be taken into account in land use.

Even though forests already account for a high share of Finland's total land area, there are still certain areas in Finland whose afforestation would be wise from the perspective of climate objectives. These include field parcels that are not farmed, with the exclusion of thick-peat fields, and cutaway peatlands no longer used for peat production, on which either no peat remains or the remaining layer of peat is thin. In spring 2020, in connection with the preparation of afforestation support, an estimate based on a geospatial data analysis was prepared on the potential of waste land in Finland. According to the report, the surface area of waste land areas suitable for afforestation was estimated as approximately 118,000 hectares. The estimate included field parcels excluded from agricultural use and former peat production areas. According to the estimate, afforestation potential is highest in the regions of Lapland, Kainuu, Ostrobothnia and North Karelia. Waste land mainly consists of fields no longer in use, and of these, around three quarters are situated on mineral soil and a quarter on peatland.

As peat-based waste land areas in particular are a source of greenhouse gas emissions, climate benefits could be achieved through afforestation of fields with a thin layer of peat and low in nutrients, and former peat production areas that have lost the layer of peat. The key point is to identify the sites suitable for afforestation. In the case of low-nutrient peatlands with a thick layer of peat, afforestation does not reduce net emissions in the medium term, and in some cases, not even in the long term. In such cases, a more favourable method than afforestation in terms of emissions is to channel water to the site to make it a wetland.

As part of the land use sector's set of measures, a new aid system has been prepared for the afforestation of waste land. Aid is granted, for example, to the afforestation of field parcels excluded from agricultural use and peat production areas no longer in use.

The Finnish Bioeconomy Strategy

The updated Finnish Bioeconomy Strategy was published on 1 April 2022. The strategy aims to increase the added value of the bioeconomy. Higher value added is sought, for example, by developing manufacturing methods and products, by increasing the value added and resource efficiency of production, and by utilising side streams and circular economy operating models. Bioeconomy plays a key role in supporting the green transition of society. Sustainable bioeconomy provides solutions to many issues concerning the climate and biodiversity. Bioeconomy supports Finland's goal of achieving carbon neutrality by 2035.

The sustainability and usability of biomasses is one of the prerequisites of sustainable bioeconomy. Impacts on the land use sector's objectives are indirect, as the strategy does not comment on the amount of biomass available. The impacts are reflected in the resource-efficient utilisation of our biomass resources and increasing the added value of the products and services based on them. Further impacts are achieved through land use planning and the promotion of long-lived wood products.

3.5 Climate risks and adaptation

In the 1960s, the rise in temperature in Finland was rapid, and the pace of change has varied from decade to decade between 0.2 and 0.4 degrees Celsius, roughly double in comparison with the global average. In Finland, climate change intensifies extreme weather phenomena, such as heatwaves, drought, storms and flooding. These may cause significant changes for example in food production and forestry. Various weather-related risks may also have a significant impact on the net balance of land use emissions and removals. In the future, it is possible that within a single year, these may exceed the impacts of use and management.

The impacts of a changing climate may affect the permanence of sinks. More frequent forest fires and insect damage may have far-reaching consequences on the preservation of trees and thereby the permanence of sinks. As under current circumstances, forest damage affects a few per cent of the forest area only, the damage should increase dramatically before the impacts would reach tens of millions of cubic metres and be of the same magnitude as annual felling volumes. From the perspective of ecosystems, intensive forestry will continue to be the most significant disruption. In agricultural land, too, the factor that influences carbon sequestration and carbon retention is the water balance of the soil, which is, in turn, significantly influenced by climate factors and weather conditions, including drought.

In the land use sector, climate change mitigation and adaptation measures are closely interlinked. Climate change mitigation measures can promote more efficient reduction, preparation and adaptation to the impacts of changing climate in the land use sector. For example, measures aiming at carbon sequestration that improve the condition of the soil can also contribute to the resilience of the soil in withstanding exceptional weather phenomena. At the same time, the use of renewable energy sources or biogas reduces farms' risk of power outages caused by storms. A healthy forest not only provides a carbon sink but is also more resistant to, for example, storm or insect damage. The traditional and current forestry practices have made forest structure more unvaried, and exposed to damage. Research has proven that forests with diverse species and several layers of canopy are more resilient to various disturbance agents than even-aged stands that consist of one species. Cultivation of spruce on sites not suitable for the species may pose a risk that can increase the risk of significant forest damage in this century.

The National Climate Change Adaptation Plan 2022, published in 2014 (MoAF, 2014) and in particular the Action Plan for the Adaptation to Climate Change of the Ministry of Agriculture and Forestry (MoAF, 2011) define measures to strengthen the assessment and management of climate risks in the land use sector. Preparation of the new National Climate Change Adaptation Plan in accordance with the new Climate Change Act is underway, and due for completion and submission to Parliament as a Government Report by the end of 2022. The plan extending to 2030 defines the goals for preparing and adaptation and the policy measures for their implementation. The plan will also include risk and vulnerability planning as well as branch-specific plans and possibly also cross-sectoral and regional analyses. The aim is to also develop a monitoring system to assess the progress and the effectiveness of measures. The Action Plan for the Adaptation to Climate Change of the Ministry of Agriculture and Forestry will also be published in 2022 and it will focus, in particular, on the administrative branch's measures by 2026 to manage climate risks in agriculture and forestry and adaptation.

3.6 Russia's invasion of Ukraine and its impacts on the operating environment

The increasingly tense geopolitical situation and Russia's military attack against Ukraine and the resulting sanctions have changed the operating environment that influences the land use sector as well. For now, the impacts are difficult to assess precisely, but key perspectives include:

- Service security and security of supply for food, water, energy and raw materials have become emphasised.

- Termination of the import of timber and forest chips from Russia increases the need for domestic production.
- The significance of the use of peat in energy production is temporarily more significant for security of supply.
- Increasing prices of energy, fertilisers and fodder undermine the profitability of agricultural production.
- The global food crisis is reflected both in production and higher food prices, even in Finland.
- Problems in the availability of natural gas and chemicals affect forestry and the forest industries.
- The poor availability of labour and seasonal labour in particular cause problems for agriculture, forestry and horticulture.
- Detachment from fossil energy imported from Russia may even accelerate the green transition.

The Ministerial Working Group on Preparedness has outlined various measures to reduce the harmful impacts and to strive, for example, to accelerate detachment from fossil energy and support the introduction of new technology.

4 National and international legislation

4.1 Key national legislation

The land use sector is not included in the **Climate Change Act** (609/2015) that entered into force in 2015. In line with Prime Minister Marin's Government Programme, the Climate Change Act was reformed so that Finland's national goal of carbon neutrality by 2035 can be achieved. The government proposal (Government Proposal 27/2022) for the new Climate Change Act (423/2022) was approved on 10 June 2022 and the Act entered into force on 1 July 2022. The Act lays down provisions on climate policy plans and the reform extended the Act to apply to the land use sector as well. The land use sector became a more integral part of the planning system under the Climate Change Act, and the Climate Plan for the Land Use Sector will be reported as part of the Annual Climate Report in the future. Carbon sinks and emissions from the land use sector fall within the scope of the Climate Change Act and the Act defines the target for strengthening the sinks. In all climate policy plans, the aim is to ensure sustainable development and a just transition. The Act also lays down provisions on the monitoring of the implementation of the plans, which means that the Government must follow the achievement of Finland's climate objectives and the need for additional measures.

In addition to the carbon neutrality target, the Act sets emission reduction targets for 2030, 2040 and 2050. These targets are -60 per cent by 2030, -80 per cent by 2040 and -90 per cent by 2050, the aim being, however, -95 per cent by 2050 compared to the 1990 level.

Under the new Climate Change Act, a Sámi Climate Change Council will be set up in Finland. The Council will be an independent expert body that produces information and gives opinions on climate change policy plans from the perspective of the Sámi people. The Act would also obligate the authorities to negotiate with the Sámi Parliament when drafting climate plans. In its budget session in September 2021, the Government decided that an obligation to draw up climate plans at the local, district or regional level will be included in the legislation. In addition, provisions on request for review would be included in the reform of the Act. The supplementary government proposal for the Climate Change Act should be issued in the autumn.

Fundamental rights refer to the rights of the individual laid down in the **Constitution**. Key provisions on fundamental rights in the Constitution regarding the preparation of the Climate Plan for the Land Use Sector include the provisions relating to equality,

the protection of private life, the protection of property, the status of the Sámi as an indigenous people, the right to work and the freedom to conduct business, and responsibility for the environment. In addition to the fundamental rights, the Constitution includes several provisions that must be taken into account in the implementation of land use sector policies. Human rights usually refer to the individual's (fundamental) rights, secured by international human rights documents. The content of Finland's system of fundamental rights is closely linked to the rights secured in international human rights conventions. In a well-established manner, different actors of the UN have recognised climate change as a fundamental threat to the implementation of various human rights. Warming of the global atmosphere over the limit set in the Paris Agreement will result in increasing drought, flooding, storms and heatwaves, and in the northern latitudes, decrease in the amount of snow and ice in particular. The consequences include weaker food security and biodiversity, and an increase in the number of uninhabitable regions, illnesses, forced migration and higher instability in societies. This will endanger human rights and cause harm to livelihoods worldwide. Safeguarding of fundamental and human rights in the short and long term requires effective climate action and energy policy measures. At the same time, these measures must be implemented observing the restrictions resulting from fundamental and human rights.

The Forest Act (1093/1996) applies to the management and utilisation of forests in areas classified as forestry land. The purpose of the Forest Act is to promote the economically, ecologically and socially sustainable management and utilisation of forests. The Forest Act imposes the minimum requirements for forest management and use. The Forest Act lays down minimum requirements on for example wood harvesting, forest regeneration and safeguarding the biodiversity of forests. In addition to the Forest Act, the Government Decree on the Sustainable Management and Use of Forests, issued under the Forest Act, regulates the use of forests.

The Act on the Financing of Sustainable Forestry promotes forest improvement and the management of forest ecosystems in privately owned forests and the use of energy wood. Further legislation governs trade in forest reproductive material, timber measurement and forestry organisations.

The Forest Damages Prevention Act lays down provisions on the prevention of damage caused by insects and fungi. The purpose of the Act is to ensure that forest management operations, wood harvesting and the storage of timber will not undermine the health status of forests. In practical terms, the Act strives to keep the populations of bark beetles that proliferate particularly in fresh coniferous roundwood with bark at sufficiently low levels to prevent severe damage. The 2021 amendments to the Act seek to enhance the possibilities of forest owners and operators to prepare for and prevent the risks caused by climate change.

The **Environmental Protection Act** (527/2014) regulates the siting of peat production. According to section 13 of the Act, the siting of peat production shall not lead to the deterioration of nationally or regionally significant natural values. One of the criteria for assessing significance is the extent to which the mire is in a natural state. Provisions on the significance of changes to the extent to which the mire is in a natural state are laid down in section 44 of the Environmental Protection Decree.

According to the **Water Act** (587/2011), ditch drainage, that is, digging a new ditch, is subject to a permit if it can cause environmental pollution in a water area or other detrimental consequences for water areas. Ditch drainage may cause environmental pollution in a water area, for example by increasing the nutrient input or causing acidification in the water area that receives the drainage water. Clouding or sediment transport in the drainage water are not considered to constitute environmental pollution. Only the impacts on water bodies are reviewed when granting the permit. Notification must be provided to the relevant Centre for Economic Development, Transport and the Environment (ELY Centre) of other than minor ditch drainage no later than 60 days in advance. The notification must include details of the channels to be cleaned out and dug, their location, and the environmental impacts of the ditch drainage.

Measures carried out by public authorities can direct and channel funds to economic activity – State Aid rules guide and restrict this. According to EU Treaties (TFEU, Article 107), state aid, as defined by the EU, is generally prohibited. However, **State Aid rules** establish procedures and exceptions under which the Commission may consider a state aid measure suitable for the internal market. These include aid of which the Commission has received separate notification and which the Commission decides to approve, and aid under the General Block Exemption Regulations and De Minimis Regulations that a Member State may execute without a separate decision on approval, provided that all terms and conditions laid down in EU regulations are met. State Aid rules administered by the Commission, reformed at regular intervals, define the terms and conditions of aid suitable for the internal market and thus largely the framework that sets the limits for supporting industries and companies through nationally financed state aid measures. Various industries, such as agriculture or forestry, may have partly or fully sector-specific State Aid rules that define the possible forms of aid.

On 7 January 2021, the Government issued a **decree land on subsidy and appropriation granted to climate action in the land use sector** (5/2021). The decree was issued on the basis of the Act on Discretionary Government Transfers and the EU's State Aid rules are taken into account. Pursuant to the decree, climate action in agriculture and forestry, changes in land use, and the implementation of the Climate Plan for the Land Use Sector

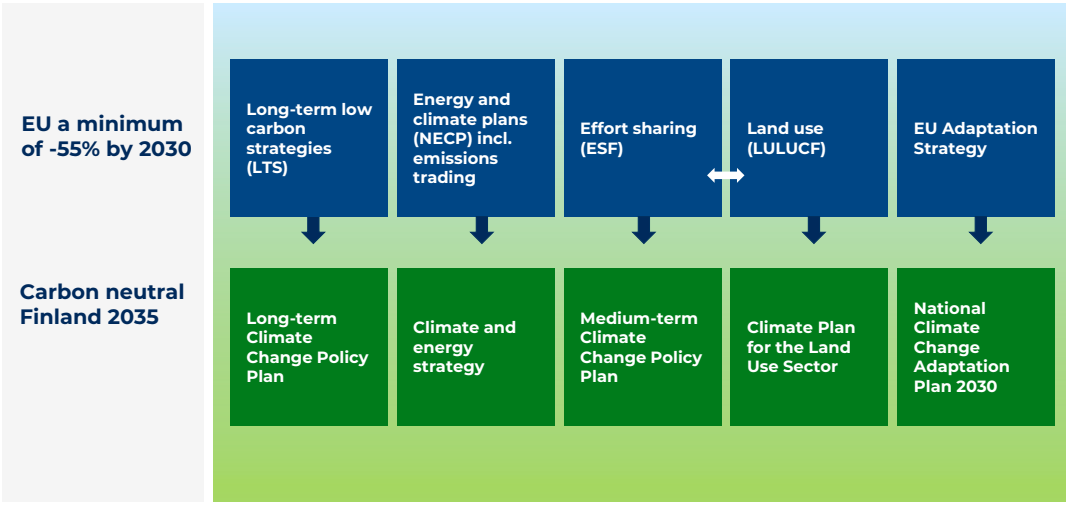
can be supported through diverse project activities. The decree regulates the use of the appropriation granted for climate policy in the land use sector. The decree entered into force on 13 January 2021 and will remain in force until 31 December 2025.

4.2 Key EU legislation and strategies

The European Union's climate policy guides the actions to mitigate climate change and adapt to it, both within the EU as a whole and in individual Member States. EU climate policy is based on the UN Convention on Climate Change, the supplementary Kyoto Protocol and the Paris Agreement on Climate Change.

EU climate policy focuses on emissions trading, national targets for sectors not subject to emissions trading (effort sharing), the land use sector (LULUCF sector) and the EU Adaptation Strategy (Figure 7).

Figure 7. Climate policy sectors and plans.



The EU is committed to reducing greenhouse gas emissions by at least 55 per cent compared to 1990 by 2030. This is also the commitment the EU has declared in line with the Paris Agreement to the Secretariat of the UN Framework Convention on Climate Change. Another aim for the EU is to make Europe the first climate-neutral continent by 2050.

The **European Green Deal,** published by the European Commission in December 2019, presents the means to achieve climate neutrality. The European Climate Law entered into force in summer 2021. With the passing of the Climate Change Law, the 2050 carbon neutrality target and the 2030 target of 55 per cent emission reductions became legally binding. In July 2021, the Commission published a large package of proposals for climate and energy legislation (the Fit for 55 package). By implementing this packet, the EU seeks to reduce emissions by at least 55 per cent by 2030. In autumn 2021, negotiations began between the European Parliament, European Commission and Member States on several different proposals, and they are still ongoing.

Regulation of the land use sector

Regulation (EU) 2018/841 on land use, land use change and forestry (LULUCF), adopted in 2018, defines accounting rules for how the sinks and emissions from land use, land use change and forest management are taken into account in the EU's climate targets for the period from 2021 to 2030. The Regulation regarding the land use sector (COM(2021) 554 final) is updated as part of the European Commission's package of proposals for climate and energy legislation, published in July 2021, aiming at ensuring Union-wide 55 per cent emission reduction by 2030. The legislative proposal is currently considered by the European Union's decision-making bodies[5].

At the EU level, the land use sector absorbs more greenhouse gas emissions than it produces. In the period 1990–2019, the removals achieved by carbon sinks have averaged six per cent (circa 300 million tonnes of carbon dioxide equivalent, including the UK) of the annual emissions from all other sectors. In the EU LULUCF sector, forests are by far the largest carbon sink, and most emissions result from deforestation, as forests are cleared to make way for infrastructure, including new roads and buildings, and for agricultural land (EEA 2021). There is major variation between the Member States in terms of the size of carbon sinks and the significance of land use categories.

5 In December 2019, the European Commission issued a communication on the European Green Deal that will make the European Union climate neutral by 2050. To increase climate ambition in the EU, the Commission presented in September 2020 the EU's 2030 Climate Target Plan on raising the 2030 emissions reduction target to at least 55 per cent below 1990 levels. In December 2020, the European Council adopted a general approach on the proposal for a European climate law that also included the reduction target for emissions by at least 55 per cent by 2030, in line with the Commission's proposal. In its 2021 work programme, the Commission presented the extensive Fit for 55 package, planned to be issued in June, which included updating the Regulation on the land use sector.

The current Regulation on the LULUCF sector obligates Member States to maintain calculated greenhouse gas emission removals according to the accounting rules defined in the Regulation at least at the calculated emission level in the period 2021–2030. In the period 2021–2025, comparison of removals in the commitment period against the specified reference level reveals whether forests act as a sink or source of emissions. The reference level of forests is the forecast for the commitment period concerning the removals or emissions trend of forest land and wood products, assuming that the Member State follows the same forest management practices as in the period 2000–2009.

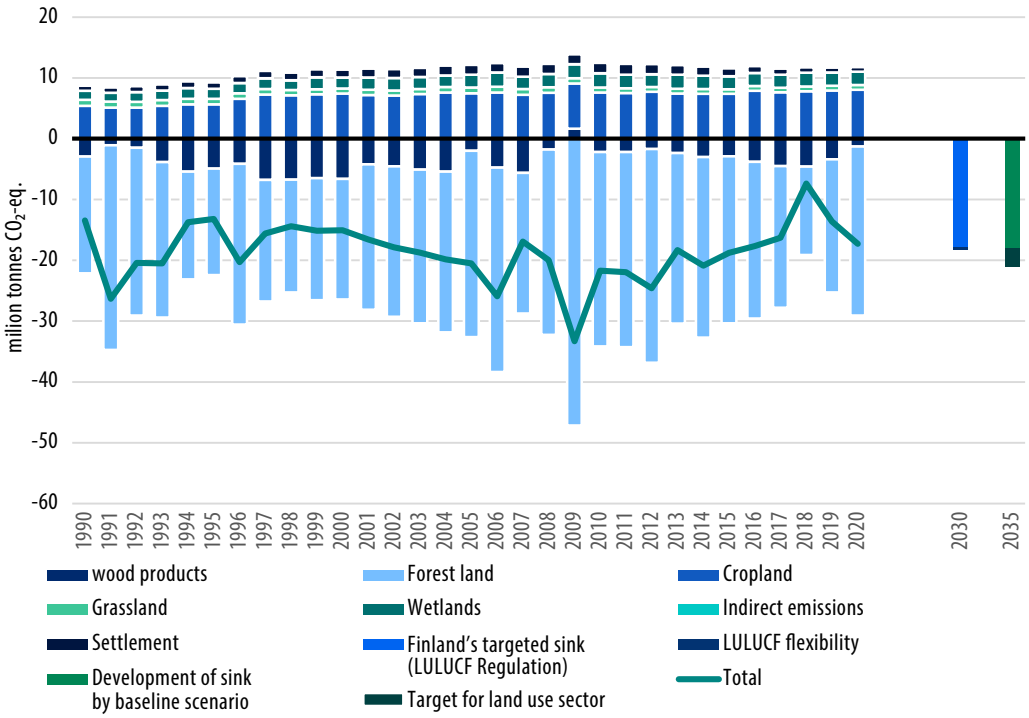
According to the proposals included in the European Commission's Fit for 55 climate package for the LULUCF sector, the current Regulation governing the sector would remain almost unchanged in the period 2021–2025, but for the next period, 2026–2030, the calculation and accounting system would change considerably. The EU level target for the LULUCF sector is a net sink of -310 million tonnes of carbon dioxide equivalent in 2030. The share prorated for Finland in the Regulation proposal is -17.8 million tonnes of carbon dioxide equivalent of the 2030 target. In addition, the Commission will issue an implementing regulation based on the proposal for the LULUCF sector in 2025 to establish the development path for annual targets for each Member State for 2026–2029, so that the target in the proposal can be reached in 2030. The flexibilities established in the Regulation apply to inter-sectoral flexibility within various sectors, and transfers of LULUCF sector emission units between Member States. In the new proposal for the LULUCF sector, some of the flexibilities will remain, but the Commission proposes new flexibility mechanisms as well.

For Finland, flexibility between the land use sector and effort sharing sector is important, whereby while the land use sector acts as a net sink, removals can be used to compensate emissions from the effort sharing sector by a maximum of 0.45 million tonnes of carbon dioxide equivalent per year in 2021–2030. In addition, a separate flexibility mechanism has been negotiated for Finland to compensate emissions caused by deforestation within the LULUCF sector at least in the period 2021–2025. Estimates indicate that the LULUCF sector accounting rules for 2021–2025 do not, in practical terms, facilitate any surplus and flexibility in the effort sharing sector. If the LULUCF sector becomes an emission source in the calculations, emissions may have to be compensated through additional emission reductions from the effort sharing sector. Emission units can also be obtained from Member States whose overall removals exceed overall emissions. To reach the 2030 target, this possible flexibility generated in the land use sector to reaching the target for the effort sharing sector was taken into account in the budget negotiations in autumn 2021. In the negotiations, it was assumed that the land use sector would compensate to the effort sharing sector the maximum amount (0.45 million tonnes of carbon dioxide equivalent per year) in 2030 (Figure 8). The success of this flexibility mechanism depends

on the EU Regulation on the LULUCF sector being negotiated, and the rules it includes, and on the measures in the Climate Plan for the Land Use Sector being implemented proactively.

A significant reform proposed by the Commission would be that from 2031 onwards, the emissions from agriculture that are currently reported for the effort sharing sector would also be included in the land use sector. This new, so-called AFOLU sector (agriculture, forestry and other land-use) should, as proposed by the Commission, be carbon neutral in 2035, and from then on, the aim is to be carbon negative. A more detailed legislative proposal on the AFOLU sector would be submitted in 2025. The impacts of the AFOLU sector in Finland's land use sector still remain unclear, because for now, it is not known whether AFOLU's carbon neutrality consists of national balances or whether the emissions and removals of the AFOLU sector will be analysed at the EU level, which would mean that the carbon sink of forest-rich countries would play a significant role in balancing the emissions of agricultural countries. Land use sector greenhouse gas balance development in 1990–2019 and the targets set for the land use sector are shown in Figure 8.

Figure 8. Change in the land use sector greenhouse gas balance and future targets.



The Renewable Energy Directive (RED II; 2018/2001) includes binding EU level sustainability criteria for transport biofuels, bioliquids and fixed and gaseous biomass fuels used for power and heat generation. The aim of the sustainability criteria is to ensure that the increasing use of bioenergy generates considerable greenhouse gas emission reductions compared with the use of fossil fuels. A further aim for the sustainability criteria is to ensure ecological sustainability. As part of the Fit for 55 climate package, the Commission also issued a proposal to amend the Renewable Energy Directive that includes new obligations regarding sustainability criteria.

Effort sharing legislation

The EU decision on effort sharing (406/2009) establishes emission reduction obligations for non-emissions trading sectors, with the exception of the land use sector. Key sectors covered by the effort sharing decision include transport, heating of buildings, agriculture, waste management, off-road vehicles and other machinery and fluorinated greenhouse gases (F-gases).

The EU's common emission reduction objective for the effort sharing sector is divided between Member States mainly on the basis of gross domestic product. In addition, national targets have, for some countries, been proportioned on the basis of cost efficiency and fairness. The European Commission's climate package, published in July 2021, proposes stricter targets for both the overall target of the effort sharing sector and the obligations of each Member State. The EU wide emission reduction target would become stricter in 2005–2030: from 30 per cent to 40 per cent. Member States' current individual emission reduction obligations vary between zero and 40 per cent, but according to the Commission's proposal, in the future they would vary between 10 and 50 per cent. According to the proposal, Finland's emission reduction obligation would rise from the current 39 per cent to 50 per cent for the effort sharing sector.

According to the Effort Sharing Regulation (ESR), emissions must be cut annually following a linear reduction trajectory according to emission allocations defined at annual level during the 2021–2030 period (Effort Sharing Regulation 2018/842).

Member States have various flexibility mechanisms at their disposal to facilitate meeting the targets. Between 2021 and 2030, Member States can use temporal flexibilities, which means that they can bank and borrow emissions between individual years. Temporal flexibilities facilitate the banking of extra units for the coming years and borrowing from the following year, based on certain terms. Member States may also buy and sell emission units between themselves. This means that if necessary, emission units can be obtained from other Member States to cover the emission reduction obligation. From 2021 onwards, it is not possible to utilise international emission units obtained from non-EU

countries. In addition, for 2021–2030, two new flexibilities are available: a limited amount of emission allowances can be transferred from emissions trading to cover emissions in the effort sharing sector using a one-off flexibility mechanism, and on certain terms, and to a highly limited degree, possible surplus units from the land use sector can be utilised to meet the effort sharing sector obligation.

In the climate package, the Commission has proposed that the current flexibilities be retained. The country-specific flexibility used in the land use sector at present is limited to two five-year periods. To use the flexibility to meet the effort sharing sector obligation requires that the obligation specified for the land use sector is exceeded. According to the proposed Regulation, unlike before, all land use categories of the land use sector can be used in the future in the calculation of the exceeding of obligation that entitles to flexibility.

A new flexibility method proposed by the Commission is an optional EU level reserve based on the possible surplus from the land use sector generated at EU level, and its use to achieve the targets of the effort sharing sector, provided that certain criteria are met. Joining this scheme would be optional for Member States.

Emissions trading

The emission reduction targets of the EU, both to 2020 and to 2030, are divided between the sectors covered by the emissions trading system of the EU and effort sharing on the national level in sectors not covered by the ETS. Operations covered by the ETS include large industrial plants and electricity and heat production. For example, forest industry companies and food industry companies are covered by the ETS. The reduction target set by the EU for the emissions trading sector is 43 per cent compared to 2005 by 2030. According to the proposal issued by the Commission in July 2021, the new target for the emissions trading sector would be 61 per cent by 2030. Moreover, the Commission proposes that emissions trading should be enhanced and expanded into new sectors.

Regulation on the Governance of the Energy Union

The Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action was adopted in December 2018. The governance mechanism of the Energy Union is a system for monitoring the Energy Union's targets and achievement of the emission reduction targets. The Energy Union covers five dimensions: energy security, an internal energy market, energy efficiency, decarbonisation, and research, innovation and competitiveness. National Energy and Climate Plans (NECP) and Long Term Strategies (LTS) are key elements of the governance mechanism. The National Energy and Climate Plan includes the land use sector's greenhouse gas emissions and removals as part of

the decarbonisation set of measures, and the plan reports on the land use sector's target for 2030, on the planned policy measures to reach the targets, and their impacts. In the National Long Term Strategy (LTS), the development of land use sector removals forms part of the low emission scenarios in the strategy.

The Regulation on Governance includes provisions for the monitoring of both the energy sector and greenhouse gas emissions. Member States had to submit their NECP plans by the end of 2019 and from then on, an updated or new plan at five-year intervals. In the NECP plans, Member States describe their contribution to achieving the EU's common energy and climate targets for 2030. Reports on the implementation of the national plan must be submitted to the Commission every second year from 2023 onwards. The contents of Finland's 2019 NECP plan (Ministry of Economic Affairs and Employment, 2019) are based on the most recent national energy and climate strategy of 2016 and the Medium-term Climate Change Policy Plan of 2017. The NECP plan includes the energy and climate policy entries in Prime Minister Sanna Marin's Government Programme.

According to the Regulation on Governance, the Long Term Strategies until 2050 must cover the overall reductions of greenhouse gases and the removals achieved by sinks, and their increase. Emission reductions and removals must be analysed in different sectors, including energy production, industry, the construction sector, agriculture, waste management and the land use sector.

Further Long Term Strategy contents established in the Regulation on Governance include expected progress in the transfer to low-carbon economy, greenhouse gas intensity, research, development and innovation strategies and links to other national long term plans. Finland submitted its national strategy in April 2020 (Ministry of Economic Affairs and Employment, 2020).

EU Adaptation Strategy

The European Commission adopted its new EU strategy on adaptation to climate change (COM(2021) 82 final) on 24 February 2021, as part of the European Green Deal action plan. The Strategy updated the previous EU Adaptation Strategy, adopted in 2013. The Strategy highlights adaptation to climate change alongside mitigation as a key element in the action to make Europe climate resilient by 2050. The Strategy aims at making adaptation smarter, swifter and more systemic, accelerating the adaptation efforts and the introduction of solutions, and stepping up international action on climate resilience. The measures proposed to achieving the objectives include nature-based solutions regarding forests and agricultural land, including the carbon removal certification network, integrating adaptation with the outlines concerning afforestation and forest management

practices, expanding the offering of plant propagating material, including revision of the Directive on their trade, and further development of the EU criteria for sustainable economic activities.

In addition, key legislation includes EU legislation on plant health, based on the EU Regulation (2016/2031) on protective measures against plant pests.

4.3 Other EU legislation and strategies under preparation, with an impact on land use

The aim of the **EU Biodiversity Strategy** is to halt the loss of biodiversity and reverse the negative trend in biodiversity by 2030. The Member States are committed to 17 key targets to achieve this ambition. According to the key target concerning the network of nature protection areas, the Member States must increase the surface area protected so that a minimum of 30 per cent of the EU's land area and 30 per cent of the EU's sea area are covered by legal protection. At least a third of the EU's protected areas, including all remaining primary and old-growth forests, must be strictly protected. Furthermore, more effective management of all protected areas is required. The remaining fourteen targets are related to improving the state of habitats in and outside protected areas.

Coordinated by the Ministry of the Environment, two commitments related to the key targets, as required by the Commission, will be prepared during 2022. The first commitment concerns how the Member States will promote the common EU target to protect 30 per cent of the land and sea area and to designate 10 per cent of this to strict protection. This includes the strict protection of the remaining primary and old-growth forests. The second commitment concerns actions by the Member States to ensure the conservation status of species and habitats in the annexes to the Habitats and Birds Directives and, in addition to this, actions by which the conservation status of 30 per cent of them will be improved. In Finland, an important principle in reaching the targets is that the actions must be voluntary. The Helmi Habitats Restoration Programme and Forest Biodiversity Programme for Southern Finland METSO also contribute to the targets.

The European Commission's legislative initiative on nature restoration was adopted on 22 June 2022.

These initiatives may have an impact on the type of land use that various areas in Finland are designated to at the national level, and the climate impact of the initiatives cannot be estimated at this stage.

On 15 December 2021, the Commission adopted a **Communication on Sustainable Carbon Cycles**, as part of the European Green Deal. The part of the Communication on Carbon Farming was also highlighted in the Commission's Farm to Fork Strategy, published in May 2020. According to the Communication, to achieve the climate objectives, sustainable carbon cycles must be established to facilitate adaptation to climate change. This requires three key actions: drastically reduce reliance on fossil carbon, recycle carbon from waste streams, from sustainable sources of biomass and directly from the atmosphere, and capture carbon from the atmosphere with biological or technological solutions. The focal points in the Communication include short-term action to upscale carbon farming as a business model incentivising practices in natural ecosystems that increase carbon sequestration. Carbon farming practices highlighted in the Communication include afforestation and reforestation that respect ecological principles favourable to biodiversity and enhance adaptation to climate change: agroforestry, use of catch crops and cover crops, reducing tillage, targeted conversion of cropland to fallow and permanent grassland, and restoration of peatlands and wetlands. The aim is to integrate carbon removals in EU climate policy architecture, and one of the methods to promote this would be to develop an EU standard for the monitoring, reporting and verification of greenhouse gas emissions and carbon removals at the farm and forest estate level.

By the end of 2022, as part of the Commission's initiative on sustainable carbon cycles, the Commission will issue a proposal on the **calculation and certification of carbon removals**. To meet the 2050 goal of EU carbon neutrality, each single tonne of carbon dioxide emitted into the atmosphere will have to be neutralised by a tonne of CO2 removed from the atmosphere. For this purpose, the Commission will propose the establishment of a regulatory framework, based on a legislative proposal, for the certification of carbon removals post-2030. The framework must include a sound and reliable definition of carbon removals providing guarantees in terms of environmental integrity. The certification framework development should ensure that the identified solutions unambiguously remove carbon from the atmosphere in a sustainable manner. Reliable monitoring, reporting and verification is required to ensure authenticity as well as to minimise the risk of fraud and errors. Therefore, certification would form the basis for market-based carbon removal solutions. Technical issues pose challenges to this certification. Re-emission of removed carbon dioxide is possible. Moreover, challenges in measurement result in uncertainty in the results. Existing certification frameworks for carbon farming deploy a wide variety of approaches to quantify the amount of carbon removals compared to current land use or the co-benefits of measures for biodiversity.

In November 2021, the European Commission published a **legislative proposal aimed at preventing the entry of certain products causing deforestation into the EU market, as well as developing deforestation-free production chains**. The proposed

new regulation applies to six product groups: soy, palm oil, coffee, cocoa, beef and wood, as well as products made of or containing these. In Finland, the impact would focus especially on cattle, that is, beef and leather. As to forests, the review would focus on forest conversion into agricultural land and forest degradation due to forest use after 31 December 2020. In recent years, 2,000–4,000 hectares of forest has been cleared in Finland annually to meet the needs of cattle farming.The regulation would not apply directly to milk production, but indirect impacts may arise. The preparation of the legislative proposal will continue throughout 2022, as a minimum.

On 17 November 2021, the Commission adopted the **EU Soil Strategy** (COM(2021) 699 final), part of the European Green Deal action plan. The Strategy updates the previous EU Soil Strategy of 2006. The Commission's main proposals include the objectives for soil by 2030 and 2050, and proposed actions to achieve climate neutrality and adapt to climate change, promote the sustainable use and management of soil, prevent biodiversity loss and desertification, reduce the harmful effects of harmful substances, increase soil research and develop monitoring of soil.

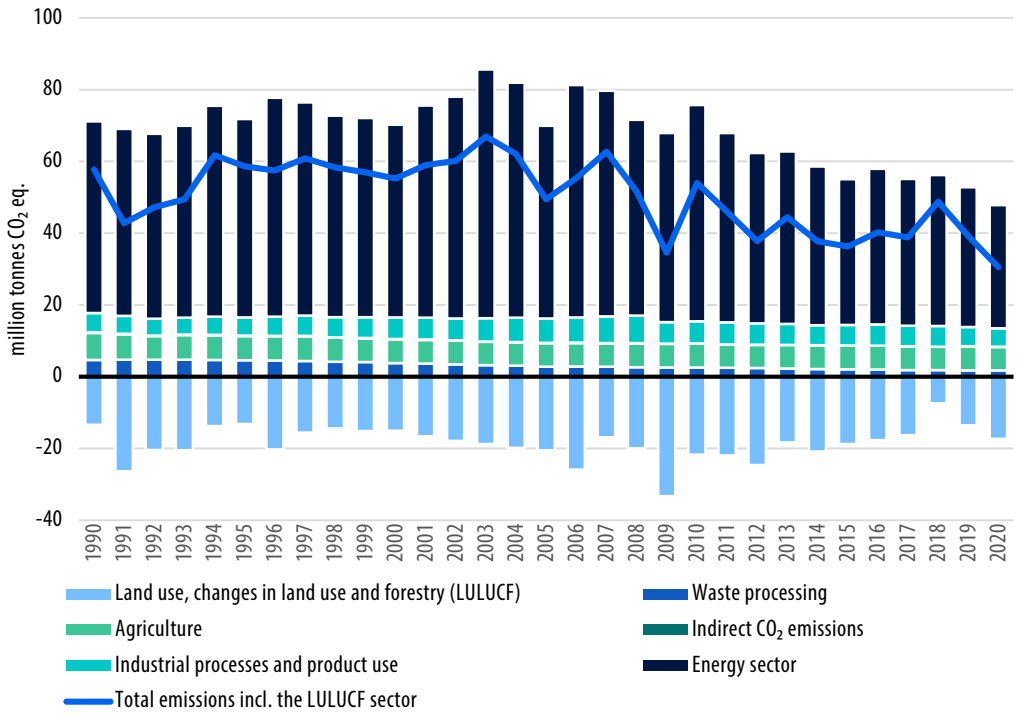
The EU's sustainable finance taxonomy regulation entered into force in summer 2020. Under the Regulation, the Commission adopted a delegated act in June 2021, approved by the EU Parliament and Member States. It establishes technical screening criteria for various measures, including criteria for forest use and management to curb climate change. The practical requirements for implementing the ambiguous criteria will be determined during 2022.

5 Development of emissions with existing measures

5.1 Development of greenhouse gas emissions of the effort sharing sector and emissions trading sector from 1990

In 2020, Finland's overall greenhouse gas emissions totalled 47.8 million tonnes of carbon dioxide equivalent (Statistics Finland, 2022), nine per cent less than in 2019 and 33 per cent less than in 1990 (Figure 9). Of the 2020 overall emissions, the energy sector accounted for 72 per cent, agriculture for 14 per cent, the industrial processes and product use sector for 11 per cent and waste processing for four per cent. The emissions and removals of the land use, land use change and forestry (LULUCF) sector are not included in the overall emissions. Considering the net sink of the land use sector, the emissions came to 30.5 million tonnes of carbon dioxide equivalent in 2020.

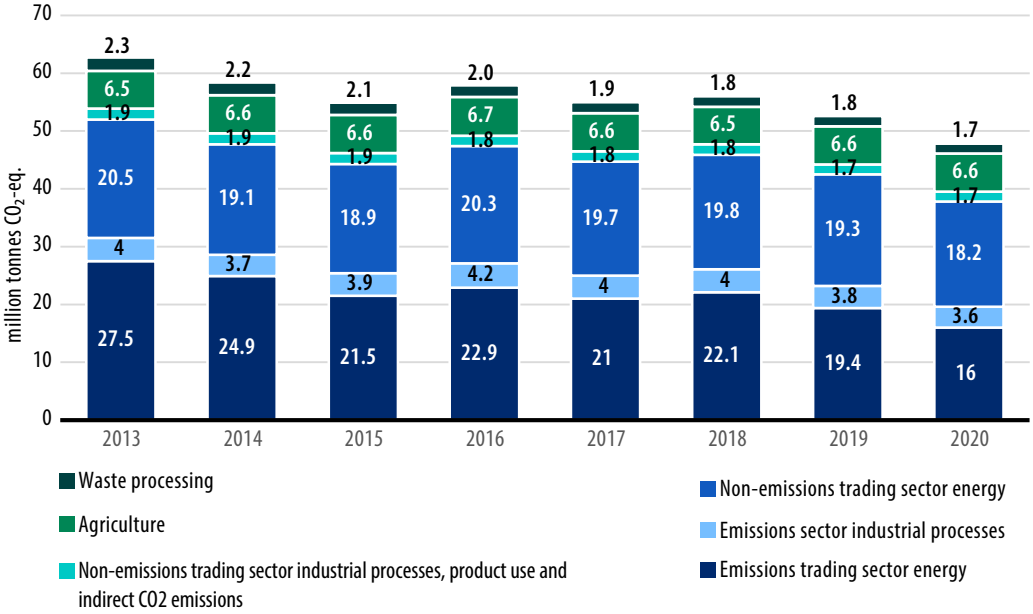
Figure 9. Finland's greenhouse gas emissions and removals by sector and the sum of all sectors, in which the net sink of the land use sector is deducted from the total emissions of other sectors. The sectors correspond to Finland's national Greenhouse Gas Inventory. The various sectors or parts of sectors are covered by the EU's emissions trading or effort sharing systems. Source: Statistics Finland 2022.



The EU's emissions trading and effort sharing systems cover different parts of the emissions from the energy sector and the industrial processes and product use sector. For example, large industrial plants and electricity and heat production are included in the emissions trading sector. Sectors not included in emissions trading, with the exception of the land use sector and domestic civil aviation, are included in the effort sharing sector. This includes emissions from other transport, heating of buildings, agriculture, waste management, off-road vehicles and other machinery and F-gases, and emissions from other energy use and industry excluded from emissions trading.

Of the 2020 overall emissions, 19.6 million tonnes of carbon dioxide equivalent came from the emissions trading sector and 28.1 million tonnes of carbon dioxide equivalent from the effort sharing sector (Figure 10) (Statistics Finland, 2022). Emissions of the effort sharing sector have reduced more slowly than those of the emissions trading sector. Effort sharing sector emissions reduced by four per cent from 2019 and by 10 per cent from 2013, whereas emissions of the emissions trading sector reduced by 16 per cent from the previous year, and 38 per cent from 2013.

Figure 10. Greenhouse gas emissions by sector, divided into emissions included in emissions trading and excluded from it, in 2013–2020. Source: Statistics Finland 2022.



In 2020, energy sector emissions were the lowest throughout the time series. In comparison with 2019, emissions reduced most in the energy industry, where the use of coal and peat in energy production in particular declined considerably due to, for

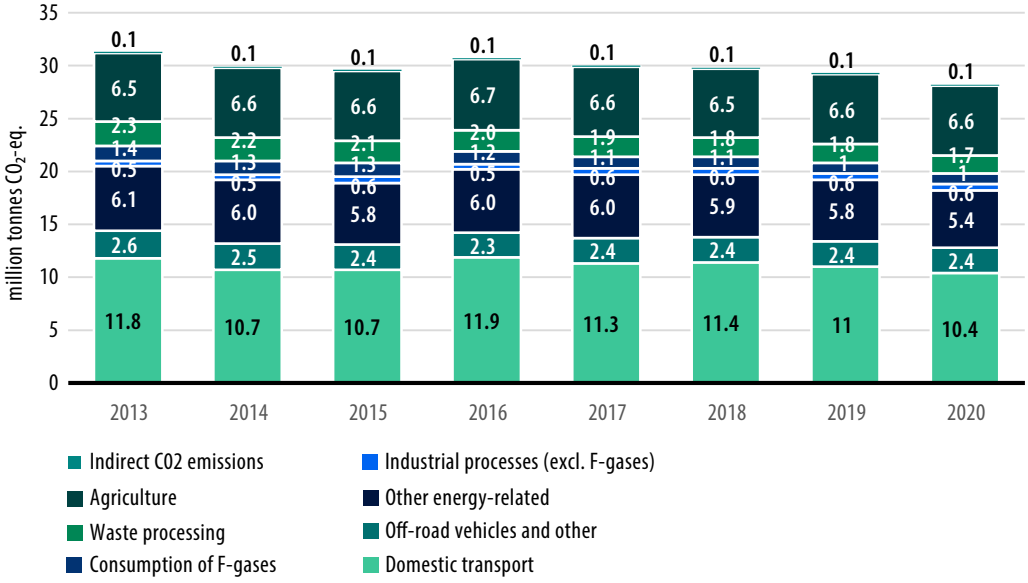
example, the warm winter and recent changes in the production structure of electricity (Statistics Finland, 2022). Emissions from domestic transport totalled 10.4 million tonnes of carbon dioxide equivalent in 2020 (Figure 11) and reduced by six per cent year-on-year primarily due to the lower road transport performance. Emissions from off-road vehicles and other machinery remained approximately unchanged (2.4 million tonnes of carbon dioxide equivalent). Energy sector emissions reduced by 18 per cent in the emissions trading sector and by six per cent in the effort sharing sector year-on-year.

Emissions from industrial processes and product use have reduced by five per cent from 1990. Emissions from industrial processes included in emissions trading reduced by six per cent and those included in the effort sharing sector, by three per cent from 2019. F-gas emissions reduced by three per cent year-on-year, totalling 1.0 million tonnes of carbon dioxide equivalent in 2020 (Figure 11). F-gas emissions increased markedly in the 1990s and 2000s, as F-gases replaced substances that cause ozone layer depletion and enhance global warming. The transfer to substances with a lower warming potential has contributed to the reduction of F-gas emissions in recent years.

Emissions from agriculture have reduced by 13 per cent from 1990, due to the decline in the use of commercial fertilisers and in the number of agricultural farms, larger farm size and reduction in the number of production animals (Statistics Finland, 2022). At the same time, the increase in land clearing for fields in the 2000s has caused a significant increase in emissions from organic cropland. Therefore, the agricultural sector's net emissions have remained approximately the same throughout the 2000s. Emissions reduced by less than one per cent year-on-year.

The waste sector's annual emissions have reduced by 63 per cent from 1990 and three per cent from 2019. The reasons for this include restricting the placement of biodegradable waste in landfills and increasing recovery of landfill gas (Statistics Finland, 2022).

Figure 11. GHG emissions in the effort sharing sector in 2013–2020. Source: Statistics Finland 2022.



5.2 Trend in emissions and removals in the land use sector

The land use, land-use change and forestry (LULUCF) sector is a net sink in Finland, that is, the amount of carbon dioxide sequestered in the sector exceeds the amount of carbon/carbon dioxide, methane and nitrous oxide emitted. In the land use sector, the sum of removals and emissions, i.e. the net sink, was -17.3 million tonnes of carbon dioxide equivalent in 2020, 27 per cent higher than the sink in 2019 (-13.6 million tonnes of carbon dioxide equivalent) (Figures 12 and 13).

Figure 12. Sums of emissions and removals by land use category, in the LULUCF sector in 1990–2020 (positive indicates net emission and negative indicates net removal). The sum of land use sector emissions and removals is indicated with a line. Source: Statistics Finland 2022.

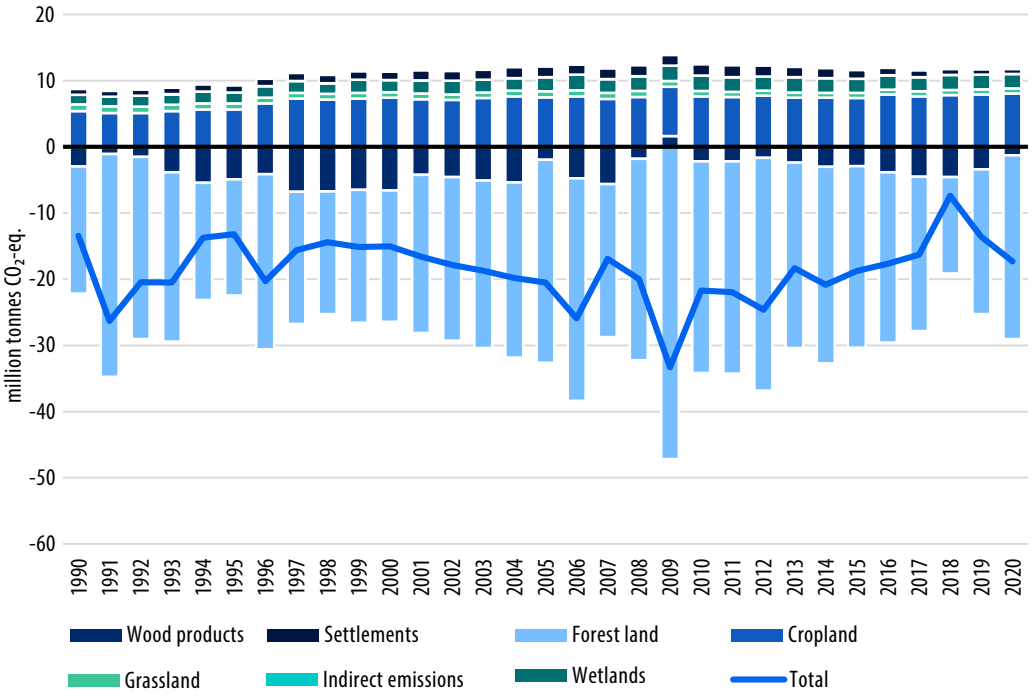
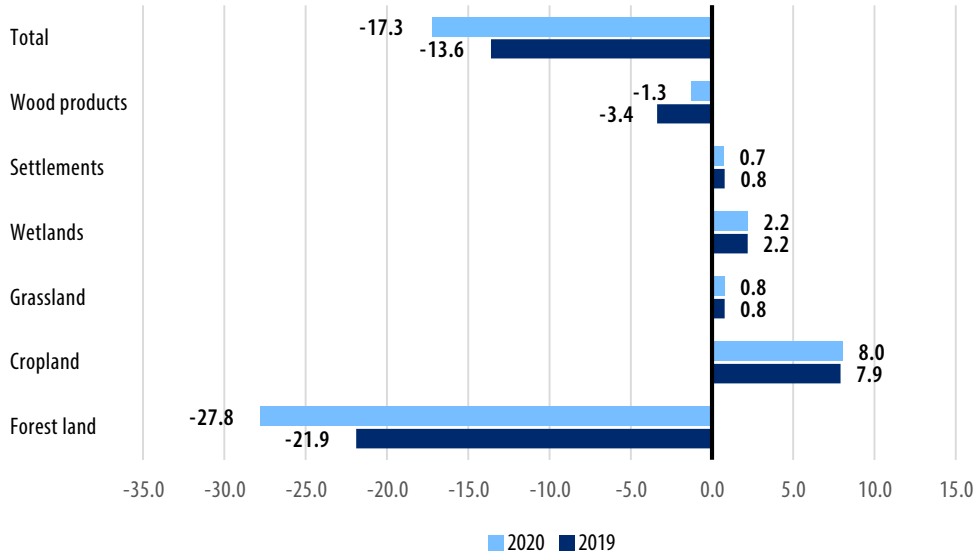


Figure 13. Land use sector emissions and removals by land use category in 2019 and 2020 (million tonnes of carbon dioxide equivalent). A positive figure indicates emissions and a negative figure indicates removal (sink). Source: Natural Resources Institute Finland 2022.



Forests are Finland's largest carbon sink. Forest stand growth binds more carbon than is released into the atmosphere as consequence of felling and natural drain. The size of the net sink of forests varies from year to year particularly due to felling, whereas factors that influence felling volumes include the market situation of forest industry products, and demand for wood. In 2020, the net sink of forests was approximately -27.8 million tonnes of carbon dioxide equivalent.

Emissions from cropland came to 8.0 million tonnes of carbon dioxide equivalent in 2020. Grasslands account for a minimal share of removals and emissions. Grasslands also include wooded pastures and natural meadows or pastures, wasteland in the middle of fields, ditches that are over three metres wide and other field fringe areas, reed canary grass fields and energy willow fields.

In 2020, the carbon sink of wood products was -1.3 million tonnes of carbon dioxide equivalent. In Finland, the calculation of changes in wood product carbon storage includes wood products manufactured in Finland from domestic wood, divided into mechanical wood processing products (sawn timber and wood panels), paper products (paper and paperboard) and exported products. The changes in wood product carbon stock are reported from 1990, including an estimate of wood products manufactured since 1900. The calculation method is largely based on the expected lifetime of wood products. For example, a drop in paper production can easily turn paper products into emissions (short half-life), as lower production volume than before cannot compensate the removal of old products.

According to the reporting guidelines of the Intergovernmental Panel on Climate Change (IPCC), wetlands include areas that are either covered by water or saturated with water at least for a period during the year, and that are not forest or agricultural land (cropland, grasslands). In Finland's national greenhouse gas reporting, wetlands include peat production areas and the mires or organic soil that are not forest or agricultural land, and inland waters (reservoirs and natural waters).

Even though the LULUCF sector has clearly been a carbon sink in Finland owing to forest stands, the sector also produces emissions (Figure 14). The highest emissions are reported from the soil of drained peatlands in forests and on cropland. In addition, smaller emissions are generated by treated wetlands, including peat production areas or unsuccessfully drained forest areas or drained forest areas without drainage repair, that have transformed into wetlands again. Forest fires, prescribed burning and restoration burning, and nitrogen fertilisation of forests generate minimal emissions. Figures 15 and 16 show the changes in various carbon stock.

Figure 14. The largest sinks and emission sources in the land use sector in 2020, million tonnes of carbon dioxide equivalent (the table shows all sinks and emission sources as well as total sums). Source: Statistics Finland 2022.

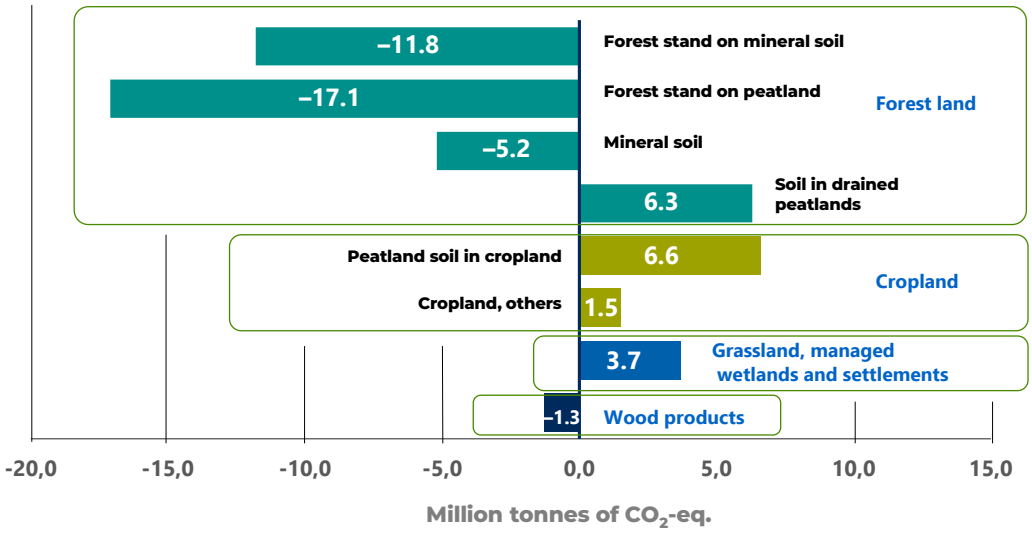


Figure 15. Changes in the carbon stocks of forest land (a negative figure indicates growth in carbon stocks, a positive figure a decrease), and greenhouse gas emissions from drainage, nitrogen fertilising, wildfires and nitrogen mineralisation as the organic material in soil decomposes, as well as the sum of all carbon stock changes and emissions in 1990–2020. Source: Statistics Finland/ Natural Resources Institute Finland 2022.

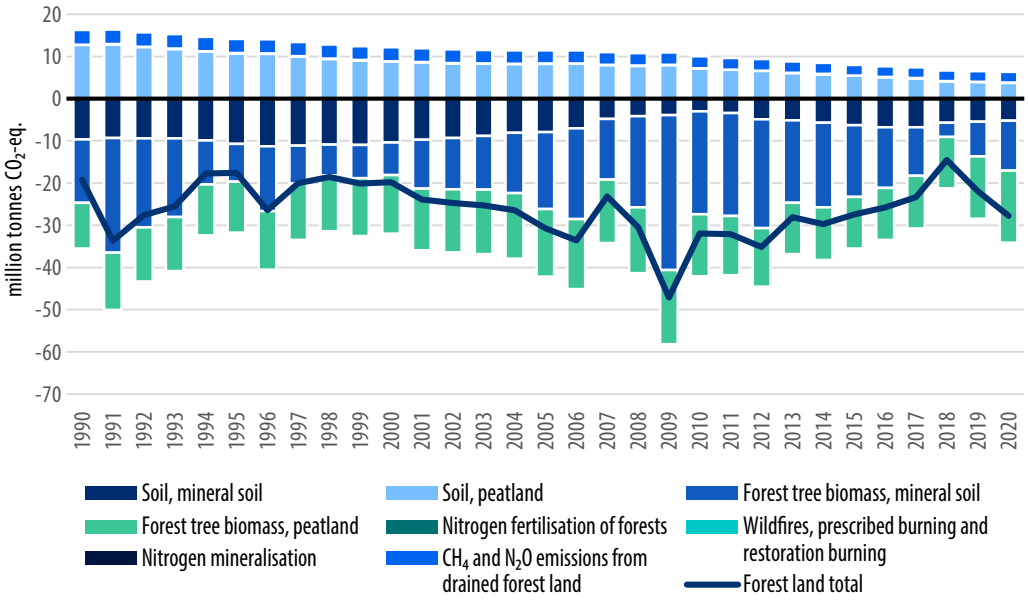
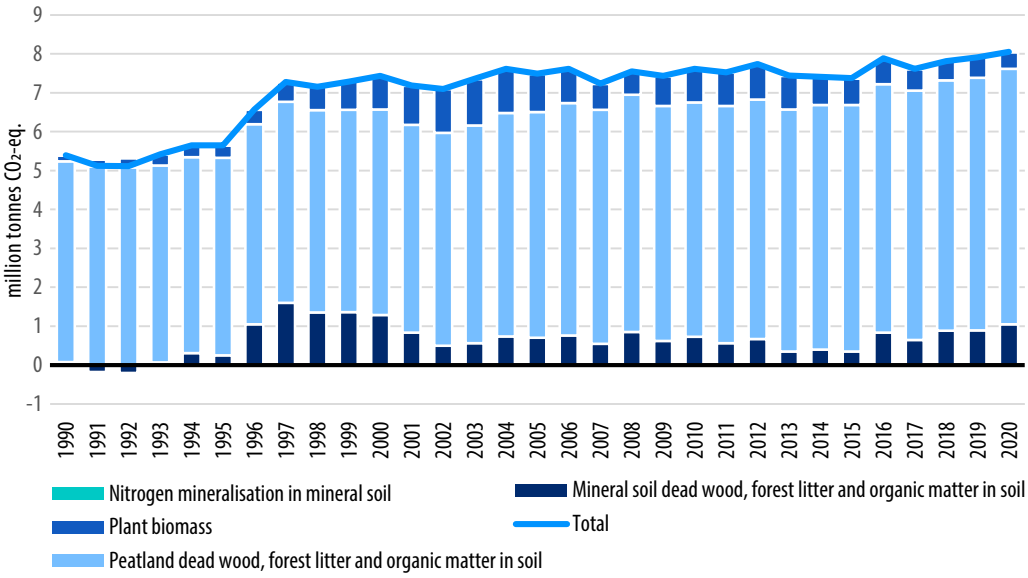


Figure 16. Changes in carbon stocks (a negative figure indicates growth in carbon stocks, a positive figure a decrease) in the cropland land-use category, and the overall emissions from cropland, calculated as a sum of changes in carbon stocks, in 1990–2020. The nitrous oxide emissions (N_2O) from agricultural land are reported for the effort sharing sector (with the exception of nitrous oxide emissions from the clearing of land), which is why they are not depicted in this figure. Source: Statistics Finland/Natural Resources Institute Finland 2022.



Flash estimate of greenhouse gas inventory 25 May 2022

On 25 May 2022, Statistics Finland published a flash estimate of national greenhouse gas emissions and removals for 2021. According to the estimate, the carbon sink of the land use sector became a net emission source for the first time in 2021. The land use sector has previously been a significant net sink in Finland, meaning that its emissions have been smaller than the removals. According to the flash estimate calculated by the Natural Resources Institute Finland and published by Statistics Finland, the 2021 net emissions of the land use sector were 2.1 million tonnes of carbon dioxide equivalent.

The sector's conversion from a net sink to a net emission source was caused in particular by the new estimate of forest stand growth and the extensive felling carried out. The new growth estimate, still a preliminary calculation, is based on the decrease in forest stand growth observed in the 13th national forest inventory.

The flash estimate indicates that the overall removal and drain of growing stock increased by nine per cent over the previous year, totalling 90.9 million cubic metres. Meanwhile, roundwood removals increased by ten per cent.

A total of 118 million tonnes of carbon dioxide equivalent were removed from the carbon stock of forest tree biomass, which is nine per cent more than in 2020. In 2021, the growth estimate for tree biomass was calculated as being 128 million tonnes of carbon dioxide. The estimate is approximately seven per cent lower than the growth reported in the past few years.

Forests remained a net sink, but the size did not offset the net emissions of other land use categories.

Methodological changes are being carried out in the land use sector's inventory. As a result, the figures in the 2020 greenhouse gas inventory and the 2021 flash estimate, for example, are not yet comparable. The growth of stands will be updated in the following publications for the inventory's entire time series, which will also lead to changes in the previous years' sinks. Updates will also be made to surface areas, which, in turn, will affect the calculation of emissions and removals.

5.3 Trend in emissions and removals with existing measures (baseline scenario)

In connection with the project "Hiilineutraali Suomi 2035 -ilmasto- ja energiapolitiikan toimet ja vaikutukset" (Carbon Neutral Finland 2035 – measures and impacts of the climate and energy policies) (HIISI), which was carried out to support the preparation of the climate and energy strategy and the medium-term climate policy plan, an assessment was made of the trends in the land use sector's different land use categories, based on the measures currently in place, as well as the impact on the sector's carbon sinks and stocks. The scenario calculation was based on the reporting and calculation methods used in the greenhouse gas inventory. A more detailed description of the scenario can be found in the HIISI report (see Maanavilja et al., 2021).

The estimates of forest development are based on projections of the forest industry's production trends, forest growth and roundwood felling volumes, all of which affect the development of forest carbon sinks. Projections of the forest industry's production and wood use in Finland up to 2035 are based on the baseline scenarios presented in the low carbon roadmaps of Finnish Forest Industries and the Finnish Sawmills Association, as well as the estimated development of forest industry production volumes, revised based on investment and disinvestment decisions made.

The forest industry's production projections were used to forecast roundwood removals up to 2035. The calculations were based on estimates of wood use in the forest industry and energy production. In the baseline scenario, annual roundwood removal is expected to increase to approximately 79 million cubic metres by 2035 and to remain at this level until 2045. This level is much the same as the annual target of 80 million cubic metres set for 2025 in the National Forest Strategy. In 2020, an annual total of 69 million cubic metres of roundwood was harvested. The maximum roundwood removal volume that can be maintained in terms of wood production is estimated to be an average of 86 million cubic metres per year in the three decades from 2016 to 2045.

The forest sector also plays a role in Finland's energy production. In the scenarios of the climate and energy strategy, the volume of forest chips, obtained as by-products of felling, is expected to increase to 16–17 million cubic metres annually. In recent years, an average of 7–8 million cubic metres of forest chips has been used annually in heat and power stations, which means that the scenarios expect consumption to double from the current volumes by 2035.

In the scenarios, the carbon sink of wood products was estimated based on the reporting rules for wood products currently in force. According to these rules, the trend in the carbon stock of wood products is calculated using the production volumes of wood

products made of domestic wood and the half-life value of carbon contained in the products. Based on the scenarios, the carbon sink of wood products is expected to amount to roughly 3.6 million tonnes of carbon dioxide equivalent in 2035.

The assumption in the baseline scenario, as well as in the scenario of the Climate Plan for the Land Use Sector, is that young stand management will be carried out whenever required. The HIISI calculations only include certain measures related to forest growth and carbon sink development, and no assumptions have been made about the increased use of forest reproductive material or earlier young stand management, for example. Climate change was not accounted for in the scenario. The weather data for 2020–2050 used in the calculations (for example, in the Yasso model) correspond to the average for the period 1990–2019.

According to the HIISI baseline scenario, a total of some 300,000 hectares of arable land will be freed from grain and grassland cultivation by 2040. Most of this will end up lying fallow, thus remaining under the scope of subsidies and considered agricultural land. As the number of farms decreases because of structural development (increasing size of farms and decreasing number of farms resulting from the pursuit of scale and specialisation benefits), some arable land will remain unused in different parts of Finland, despite aid to agriculture, and this will mainly be seen in areas of low productivity in central, eastern and northern parts of the country. The baseline scenario also includes the continued trend in agricultural policy, which directly or indirectly encourages grass-covered fields, meaning that field use will remain more or less unchanged in terms of grassland. The numbers of cattle will decline gradually, as the average yield per dairy cow continues to increase and the production volumes remain the same. In the baseline scenarios, field use and crop levels are expected to remain largely the same, and no significant changes are expected to occur in the carbon content and carbon sequestration of mineral soils.

The scenarios also include assumptions about the areas of land use change, including developments in grasslands and croplands, as well as settlements, changes in peat production areas and new land areas required by onshore wind and solar power stations. In the baseline scenario, the area of forest land decreases by approximately 66,000 hectares in 2021–2040. A more detailed description of expected developments in land use in Finland from 2010 to 2040 can be found in the HIISI report (see Maanavilja et al., 2021).

According to the baseline scenario, in 2035, the land use sector will be a net sink of approximately 18.0 million tonnes of carbon dioxide equivalent (Figure 17 and Table 1).

Figure 17. Emissions of the land use sector per emission category in the baseline scenario, million tonnes of carbon dioxide equivalent. The figures for 2015 and 2020 correspond to the values of the greenhouse gas inventory using the global warming potential values (GWPs) provided in the Fifth Assessment Report of the UN Intergovernmental Panel on Climate Change (AR5), while the figures for 2025–2050 come from the baseline scenario. Source: Natural Resources Institute Finland 2022.

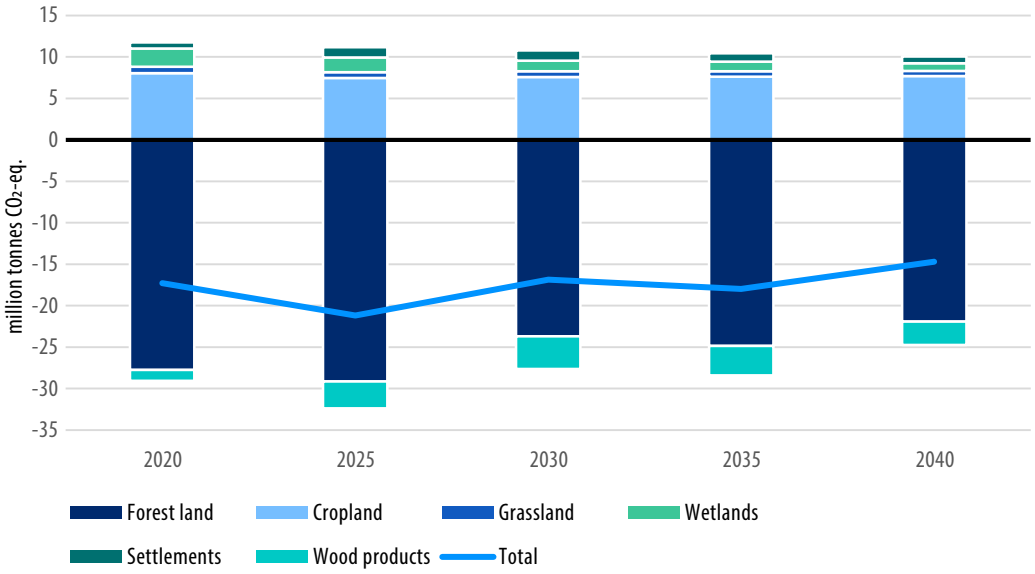


Table 1. Emissions of the land use sector per emission category in the baseline scenario, million tonnes of carbon dioxide equivalent. The figures for 2020 correspond to the values of the greenhouse gas inventory using the GWPs provided in AR5, while the figures for 2025–2040 come from the baseline scenario. Source: Natural Resources Institute Finland 2022.

Emission categories	2015	2020	2025	2030	2035	2040
Forest land	-27.55	-27.89	-29.17	-23.71	-24.85	-21.92
Cropland	7.38	8.05	7.47	7.58	7.61	7.67
Grassland	0.76	0.77	0.69	0.68	0.67	0.65
Wetlands	2.14	2.20	1.75	1.28	1.13	0.90
Settlements	1.29	0.73	1.27	1.23	1.00	0.82
Wood products	-2.91	-1.30	-3.22	-3.92	-3.56	-2.82
Total	**-18.89**	**-17.44**	**-21.20**	**-16.85**	**-18.00**	**-14.69**

6 Objectives of the Climate Plan for the Land Use Sector

6.1 Nationally determined target for the land use sector

The revised Climate Change Act defines a 2035 carbon neutrality target, as well as quantitative emissions reduction targets for the effort sharing and emissions trading sectors for 2030, 2040 and 2050. Removals by sinks are required to increase, and the targets concerning the land use sector are defined in the sector's climate plan, as specified in the Climate Change Act.

According to the roadmap for reaching the target of Climate Neutral Finland 2035, published at the Vuosaari climate meeting on 3 February 2020, the additional measures in the land use sector aim for an annual net impact of at least three million tonnes of carbon dioxide equivalent by 2035. Thus, the additional measures defined in the Climate Plan for the Land Use Sector also contribute to the achievement of Finland's climate neutrality target.

According to the "with existing measures" projection in the baseline scenario, the net sink of the land use sector will be -18.0 million tonnes of carbon dioxide equivalent in 2035. In other words, the combined net carbon sink of the baseline scenario for the land use sector and the defined additional measures will total at least -21 million tonnes of carbon dioxide equivalent. This corresponds to the emissions targets in the climate and energy strategy and the Medium-term Climate Change Policy Plan, which will help Finland reach the climate neutrality target specified in the Government Programme and draft Climate Change Act in 2035. Should any changes be made to the scenario's base data, greenhouse gas inventory methods, calculation models or premises, these would call for future revisions and updates to the scenario.

The draft Climate Change Act includes the goal of continuing to increase removals by sinks after 2035. In addition to the measures adopted in the land use sector, this is promoted by what are known as technological sinks, which may be in use in the 2030s.

The Climate Plan for the Land Use Sector also strives to promote other sustainable development objectives, and the goal has been to coordinate it with other plans, programmes and strategies to achieve a harmonised system. The plan is linked to, for example, the climate and energy strategy, Medium-term Climate Change Policy Plan,

National Climate Change Adaptation Plan, biodiversity strategy, national forest strategy, Climate Food Programme, water control in agriculture and forestry, bioeconomy strategy and the programme for climate action and farm economy.

The emissions reduction target in agriculture and the programme for climate action and farm economy

On 16 December 2021, the Government agreed a 29 per cent reduction target for agricultural greenhouse gas emissions by 2035 (-4.6 million tonnes of carbon dioxide equivalent), compared to 2019 (when emissions totalled 16 million tonnes of carbon dioxide equivalent). This includes the agricultural emissions in the effort sharing sector (totalling 6.6 million tonnes of carbon dioxide equivalent), emissions from machinery (approximately 0.9 million tonnes of carbon dioxide equivalent) and farmland emissions in the land use sector (approximately 8.61 million tonnes of carbon dioxide equivalent).

A considerable share of the reduction target for agricultural emissions is allocated to the land use sector, where the carbon dioxide emissions of farmland are reported. In this context, agricultural greenhouse gas emissions encompass agricultural greenhouse gas emissions in both the effort sharing sector and the land use sector. The impact of the national CAP actions in the 2023–2027 funding period, as well as market actions external to CAP have been taken into account in the emissions reduction target for agriculture. Moreover, CAP actions are assumed to continue and become more effective after 2027.

The programme for climate action and farm economy, drawn up in early 2022, determines how the 29 per cent emissions reduction target is to be achieved in agriculture, while ensuring that the finances of Finnish farms and the self-sufficiency of Finnish food production are not weakened but instead become stronger. The programme also specifies the policy instruments available to the authorities and support measures for the cooperation partners of farms.

7 Measures in the Climate Plan for the Land Use Sector

In accordance with the Sustainable Development Goals, the Climate Plan for the Land Use Sector aims to promote climate resilience in land use, forestry and agriculture, which means reducing emissions, strengthening removals by carbon sinks and adapting to climate change. Impact and cost-effectiveness were key considerations when defining and selecting measures for the plan. In the efforts to ensure the climate resilience of agriculture and forestry, attention will be paid to the various dimensions of sustainability. Under Article 2 of the UN Framework Convention on Climate Change, efforts to mitigate climate change must be pursued in a way that does not threaten food production, and nationally, attention will be paid to ensuring that climate action does not weaken the profitability of farms. Likewise, the national Climate Change Act requires that measures are prepared without undermining food security.

The maintenance and promotion of biodiversity is another important consideration. Measures to mitigate climate change and their implementation should not weaken biodiversity. When choosing measures, the emphasis should be on those that promote climate change mitigation and adaptation, as well as biodiversity.

In both agriculture and forestry, it is important to ensure the good growth potential of fields and forests, as biomass with a high yield and good growth contributes to increasing carbon stocks. Good soil condition and appropriate water resources management promote carbon sequestration and can help curb the release of carbon from the soil. In forestry, it is also important to prevent forest damages and pests to ensure that forests remain healthy and capable of growing. This means, for example, ensuring forest regeneration, choosing appropriate tree species for each site, and ensuring that forests are not thinned too much or harvested too young. In continuous cover forestry, felling must be carried out so that a tree structure suitable for this particular forest management approach is retained on the site.

Since climate change also increases and changes the climate risks in agriculture and forestry, both climate change mitigation and adaptation measures are required. Plant breeding and the preservation of genetic resources, for example, can be used to maintain species suited to the changing climate. In forests, the preparedness for climate change impacts can be boosted by increasing the share of broadleaved trees and mixed forests.

This also has a positive impact on biodiversity. As climate change progresses, the resilience of forests should be improved by increasing biodiversity, as well as by making forests structurally more versatile, both at the level of individual stands and areas. This reduces the risk of a single destructive agent causing widespread damage. Meanwhile, it is important to keep in mind that disturbances belong to the natural dynamics of ecosystems, and that processes necessary for maintaining biodiversity, such as the formation of decaying wood, should be promoted.

Climate actions in land use, forestry and agriculture rely on individual people and organisations. Metsähallitus manages around 35 per cent of Finland's productive forest land (around 20 per cent of the forests used for forestry). Private forest owners hold approximately 52 per cent of productive forest land. The remaining six per cent is owned by municipalities, parishes and societies. Most of the state-owned land is located in northern Finland (Vaahtera et al., 2021). The acceptability, effectiveness and implementation of climate actions can be promoted by enabling land owners to pursue climate actions that support their values and goals for their land assets, including financial profitability.

The best available knowledge and expertise have been used in the planning and implementation of measures. The current package of measures for the land use sector emphasises the accumulation of a knowledge base, experiences and competence. For example, considerable uncertainties surround the effectiveness of the greenhouse gas inventory data and different measures. The Climate Plan for the Land Use Sector will require the development of monitoring. New information and knowledge will guide the further planning, implementation and monitoring of measures.

Russia's attack on Ukraine has highlighted in a new and serious way matters related to preparedness and contingency planning and to the safeguarding of security of supply. **When planning the Climate Plan for the Land Use Sector and the related measures, one of the goals was to prepare for changing circumstances and contribute to national security of supply.** This means that the measures presented in the plan and their scope will not significantly undermine the achievement of these social goals.

7.1 Climate actions in state owned forests

Description of measure: Implementation of the owner policy of state owned enterprise (Metsähallitus) and the instructions concerning Metsähallitus's business operations.

Policy instrument: Owner policy of Metsähallitus and instructions concerning Metsähallitus's business operations.

Timeline: 2020–2035

Surface area/amount: In 2021, the carbon sink of trees in multifunctional forests is calculated to be -8.6 million tonnes of carbon dioxide equivalent, and the carbon stock of state-owned forest stands is estimated to total 184 million tonnes of carbon.

Resources: In accordance with the owner policy of Metsähallitus and the instructions concerning Metsähallitus's business operations.

Climate impact: The projected impact of the measures outlined in the owner policy of Metsähallitus on the land use sector in 2030 is 0.4 million tonnes of carbon dioxide equivalent annually and in 2035, approximately 0.7–0.9 million tonnes of carbon dioxide equivalent annually.

Responsible parties: Ministry of Agriculture and Forestry and Metsähallitus.

7.2 Prevention of deforestation

7.2.1 Preventing the conversion of forests into fields

Description of measure: The Good Agricultural and Environmental Conditions (GAECs) are standards in the EU's common agricultural policy, with the GAEC 2 calling for the protection of wetland and peatland as of 2024/2025.

In November 2021, the European Commission published a legislative proposal aimed at preventing the entry of certain products causing deforestation into the EU market, as well as developing deforestation-free production chains. The proposed new regulation applies to six product groups: soy, palm oil, coffee, cocoa, beef and wood, as well as products made of or containing these. In Finland, fields are being cleared for agricultural products, including for cattle raising, and the impact in Finland would therefore focus especially on cattle, that is, beef and leather. Cattle, including meat and leather, raised in a cleared area would not be accepted on the market. The regulation would not apply directly to milk production, but indirect impacts may arise. The preparation of the legislative proposal will continue throughout 2022, as a minimum.

Policy instrument: The EU's common agricultural policy and the enforcement of the EU's deforestation legislation.

Timeline: CAP period 2023–2027; the review of the EU's deforestation legislation will focus on forest conversion into fields and forest degradation due to forest use after 31 December 2020.

Surface area/amount: According to the draft CAP plan, clearing will be reduced by an annual 900 hectares in peatland and by an annual 800 hectares in mineral soils, compared to the current state. The impacts of the EU's legislative proposal addressing deforestation will target land cleared for cattle raising needs. In Finland, 2,000–4,000 hectares of forest has been cleared annually for these needs. The total area covered by these measures reducing deforestation is estimated at 1,700–1,900 hectares.

Resources: CAP, market-based measures arising from the EU's deforestation legislation, and guidance by information.

Climate impact: The aggregate climate impact of the measures reducing deforestation is projected to total an annual 0.5 million tonnes of carbon dioxide equivalent in 2035.

Responsible parties: Ministry of Agriculture and Forestry, Finnish Food Authority, Centres for Economic Development, Transport and the Environment, and guidance.

7.2.2 Developing the structure of arable land

Description of measure: One of the measures in Prime Minister Sanna Marin's Government Programme involves carrying out a development programme on the structure of arable land to facilitate processes and boost the development of the structure of holdings. The Ministry of Agriculture and Forestry is drawing up such a programme, the aim being to prepare and implement measures related to the structure of holdings that will improve the competitiveness of agricultural production, while also addressing the impacts on the environment, water bodies, climate and biodiversity.

Policy instrument: In Finland, the need to clear land for fields will be reduced, for example by improving the structure of holdings through land consolidation and by developing the state's land acquisition in connection with land consolidation, as well as by increasing nutrient recycling. The structure of Finnish field holdings is not favourable, as the average size of field plots is small, and the plots are often dispersed and far away from central farm operations. In connection with land consolidation, the use of fields can also be adjusted and made more climate-friendly in terms of emissions.

Timeline: From 2023 onwards.

Surface area/amount: Approximately 10,000 hectares per year (implementation of land consolidation).

Resources: Existing resources, no need for additional resources.

Climate impact: Land consolidation can help reduce the need for clearing land for cultivation, thus contributing to a reduction in emissions from the land use sector. Moreover, the measures can contribute to reducing agricultural emissions in the effort sharing sector and transport-related greenhouse gas emissions.

Responsible parties: Ministry of Agriculture and Forestry and National Land Survey of Finland.

7.2.3 Preventing the clearing of forests for settlements

Description of measure: Forest clearing for settlements will be reduced through land use guidance, land use planning and by developing impact assessment. A tool will be developed to help land use planners assess the climate impacts of land use changes.

Policy instrument: Guidance by information.

Timeline: The measure will be specified from 2022 onwards.

Surface area/amount: No estimate at this point.

Resources: Existing resources.

Climate impact: No estimate as yet.

Responsible parties: Ministry of the Environment, other ministries, Centres for Economic Development, Transport and the Environment, and other participants.

7.2.4 A land use change fee for all land use or an authorisation requirement for clearing

Description of measure: Continue preparations for the introduction of a land use change fee, assess the impact of measures introduced to reduce land use change (including the EU's deforestation regulation), and based on the assessment, decide on the introduction of a land use change fee and any other necessary policy instruments (such as a notification procedure or authorisation procedure).

Policy instrument: Preparations, assessment, decision on introduction and legislation, if required.

Timeline: The preparatory work for legislation on a land use change fee concerning construction and land clearing and aimed at minimising deforestation and climate emissions will be launched in September 2022, coordinated by the Ministry of Agriculture and Forestry and the Ministry of the Environment. A cross-sectoral working group will submit its draft legislative proposal for comments by the first week of April 2023 (beginning on Monday, 3 April). The working group will carry out adequate preparations so that the proposal for a land use change fee encompassing construction and land clearing can be submitted to Parliament in the 2023 autumn session.

Surface area/amount: No estimate as yet.

Resources: Existing resources during preparations.

Climate impact: No estimate as yet.

Responsible parties: Ministries (Ministry of the Environment, Ministry of Agriculture and Forestry, Ministry of Economic Affairs and Employment, Ministry of Transport and Communications, Ministry of Justice and Ministry of Finance).

7.3 Afforestation of waste land and low-yield fields

7.3.1 Fixed-term afforestation support for waste land

Description of measure: The new aid system for the afforestation of waste land took effect in early 2021, and the fixed-term system will be in force until the end of 2023. The system will be assessed, and decisions on its continuation and upgrading will be made in 2023.

Policy instrument: Aid (act on the fixed-term aid for afforestation 1114/2020).

Timeline: 2021–2023 period, continuation from 2024 onwards, based on the assessment made.

Surface area: The goal in 2021–2023 is to afforest 3,000–4,000 hectares annually.

Resources: Resources in line with the funding policies, especially in keeping with the appropriations in the General Government Fiscal Plan and the Budget.

Climate impact: Assuming that the afforestation of waste land in Finland covered an annual 3,000 hectares over a period of 15 years from 2021 onwards, totalling 45,000 hectares, greenhouse gas emissions would decrease by an annual average of 0.1 million tonnes of carbon dioxide equivalent by 2035 compared to previous land use. Examined over a period of 45 years, greenhouse gas emissions would decrease by an annual average of 0.2 million tonnes of carbon dioxide equivalent by 2065.

Responsible parties: The Ministry of Agriculture and Forestry is in charge of preparations and guidance, and implementation is handled by the Finnish Forest Centre and Centres for Economic Development, Transport and the Environment.

7.3.2 Afforestation of low-yield fields suitable for afforestation

Description of measure: A separate system for the afforestation of low-yield mineral soil and (shallow) peatland fields suitable for afforestation.

Policy instrument: National aid for afforestation (not included in the CAP plan) for low-yield and shallow peatland fields will be prepared in 2023.

Timeline: Preparation in 2023 and implementation in 2024–2028.

Surface area/amount: Fields with a shallow peat layer and widely cultivated peatland fields suitable for afforestation cover an area of 6,000 hectares in southern Finland and 3,000 hectares in northern Finland.

Resources: Preparation in 2023 and EUR 2 million for implementation in 2024, EUR 4 million in 2025 and EUR 6 million in the period 2026–2028.

Climate impact: Only a minor increase will be achieved in the carbon stock of trees by 2035, but emissions from soil will decrease. The overall impact is estimated at approximately 0.1 million tonnes of carbon dioxide equivalent.

Responsible parties: Ministry of Agriculture and Forestry.

7.4 Climate-resilient use of peatland fields

The emissions from peatland fields vary depending on how the field is used and what the level of water is. Emissions are described in Table 2. In the CAP plan, peatland means land in which organic matter accounts for at least 40 per cent of the topsoil. Several studies are under way to gain more details about fields of different types of soil. The climate resilience of peatland cultivation can be influenced through cultivation methods and especially through the regulation of groundwater level. The terminology for cultivation with raised water level has not yet been standardised.

Measures will be carried out primarily through the national strategic plan for the EU's common agricultural policy in the period 2023–2027.

Table 2. The emissions from peatland fields for different uses and water levels. Sources: IPCC 2014, 2013. The category "Abandoned" according to Maljanen et al. 2010. Emissions of methane and nitrous oxide have been converted into carbon dioxide equivalents in the HIISI project, using the GWP values from the IPCC fifth assessment report: CH_4 28, N_2O 265. The emissions factors are largely based on studies conducted in Finland and the other Nordic countries.

Field use	CO_2, tn/ha LULUCF	CH_4, tn CO_2-eq/ ha LULUCF	N_2O, tn CO_2-eq/ha Agricultural sector	Total tn CO_2-eq/ha
Annual crop (grain)	29	-	5	34
Perennial (grassland)	21	-	4	25
Abandoned field	13	-	2	15
Paludiculture, groundwater level -30 cm	13	1	1	15
Climate wetlands, groundwater level -5 – -10 cm	-2	5	-	3

7.4.1 Raising the water level in peatland fields to prevent the decomposition of peat

Measure: In peatland fields, the water level can be raised with the help of controlled subsurface drainage or impoundment. In the CAP measures, the raising of peatland groundwater levels is supported through investment aid for controlled subsurface drainage and agri-environmental compensation for the management of runoff water.

No aid is granted separately for impoundment. Controlled subsurface drainage will be promoted by supporting investments in all parcels for which the method is suitable. The use of regulation systems constructed for parcels on acid sulphate soil and peatland will be promoted in the management commitment related to agri-environmental compensation: controlled subsurface drainage can be used to raise the groundwater level and help prevent the decomposition of peat and thus greenhouse gas emissions, as well as reduce acidic water emissions from acid sulphate soils formed during the early stages of the Baltic Sea.

Policy instrument: CAP investment and management aid for controlled subsurface drainage.

Timeline: The policy instrument is already in use, and its continued use in 2023–2027 has been proposed.

Surface area/amount: The surface areas are presented below for each individual measure.

Resources: CAP, investment aid for the establishment of controlled subsurface drainage equals 40 per cent of the costs eligible for aid, and the management aid for controlled subsurface drainage amounts to EUR 77 per hectare annually.

Climate impact: The climate impacts are presented below for each individual measure. The climate impact depends on the field's cultivation history and on the field's use after the water level is raised (see Table 2).

Responsible parties: Ministry of Agriculture and Forestry, Finnish Food Authority and Centres for Economic Development, Transport and the Environment.

7.4.1.1 Grassland farming on peatland, raised groundwater level of -30 cm

Description of measure: Fields with a raised groundwater level are used for perennial grassland farming, without tillage.

Policy instrument: CAP investment and management aid for controlled subsurface drainage, and aid related to crop plants in 2023–2027.

Timeline: From the beginning of 2023.

Surface area/amount: The goal is 20,000 hectares by 2030 and 32,500 hectares by 2035.

Resources: CAP enables this type of cultivation.

Climate impact: The emissions reduction depends on the cultivation history of the field. The emission factor is 15 tonnes of carbon dioxide equivalent per hectare per year. The projected annual emissions reduction is 0.31 million tonnes of carbon dioxide equivalent in 2030 and 0.21 million tonnes of carbon dioxide equivalent in 2035.

Responsible parties: Ministry of Agriculture and Forestry, Finnish Food Authority, Centres for Economic Development, Transport and the Environment, and guidance.

7.4.1.2 Cultivation of peat soils with raised water level (reed canary grass etc.) -30 cm

Description of measure: Fields with a raised groundwater level are used for the cultivation of other plants that produce biomass (e.g. reed canary grass).

Policy instrument: CAP investment and management aid for controlled subsurface drainage, aid related to crop plants in 2023–2027 and the creation of a value chain.

Timeline: From the beginning of 2023.

Surface area/amount: 5,000 hectares by 2030 and approximately 10,000 hectares by 2035.

Resources: CAP

Climate impact: The climate impact is affected by the field's use prior to this measure. The emission factor is 15 tonnes of carbon dioxide equivalent per hectare per year. The projected annual emissions reduction is 0.05 million tonnes of carbon dioxide equivalent in 2030 and 0.09 million tonnes of carbon dioxide equivalent in 2035.

Additional information: A value chain and markets must be created to reach the goal.

Responsible parties: Ministry of Agriculture and Forestry, Finnish Food Authority, Centres for Economic Development, Transport and the Environment, guidance and development projects.

7.4.1.3 Cultivation of peat soils with raised water level -5 – -10 cm (cattail, sundew etc.)

Description of measure: Fields with a raised groundwater level are used for the cultivation of plants suitable for this approach.

Policy instrument: CAP investment and management aid for controlled subsurface drainage in 2023–2027 and the creation of a value chain.

Timeline: Trials will be carried out in the 2023–2027 CAP period.

Surface area/amount: 2,500 hectares by 2030 and 5,000 hectares by 2035.

Resources: CAP

Climate impact: The climate impact is affected by the field's use prior to this measure. The emission factor is three tonnes of carbon dioxide equivalent per hectare per year. The projected annual emissions reduction is 0.05 million tonnes of carbon dioxide equivalent in 2030 and 0.09 million tonnes of carbon dioxide equivalent in 2035.

Additional information: A value chain and markets must be created to reach the goal.

Responsible parties: Ministry of Agriculture and Forestry, Finnish Food Authority, Centres for Economic Development, Transport and the Environment, guidance and development projects.

7.4.2 Climate wetland on peatland field

Description of measure: Wetland investments and management (CAP measures). The measure is a non-productive wetland investment that promotes water protection, the biodiversity of agricultural environments, greenhouse gas mitigation and climate change adaptation. The wetland investment involves the establishment, in accordance with the principles of natural modification of water bodies, of wetlands, chains of small wetlands, wetland-like flood areas and plains, two-stage water channels, as well as naturally meandering channels in their natural locations, in readily flooding fields and on drainage terraces. A wetland is an area, part of which is permanently covered, that retains sediment and nutrients, provides a habitat for biota or diversifies the farming landscape. A wetland investment can also involve the establishment of a two-stage water channel without an actual wetland. A wetland investment can also be used to convert cultivated peatland fields into wetlands or bog-like areas, called climate wetlands. A land area made into a wetland will no longer be considered agricultural land.

Policy instrument: CAP aid for non-productive investments and wetland management agreements.

Timeline: The policy instrument is already in use, and its continued use in 2023–2027 has been proposed.

Surface area/amount: 4,000 hectares in 2030 and 7,500 hectares in 2035 (the CAP target of 400 wetlands (currently 136 wetlands) corresponds to approximately 1,500 hectares by 2027).

Resources: CAP. Average investment aid estimated at EUR 37,500 per investment. Wetland management aid EUR 500 per year per hectare.

Climate impact: The size of the emissions reduction will be influenced by, for example, the area's use prior to the establishment of the climate wetland (see Table 2). The projected annual emissions reduction is 0.07 million tonnes of carbon dioxide equivalent in 2030 and 0.13 million tonnes of carbon dioxide equivalent in 2035.

Responsible parties: Ministry of Agriculture and Forestry, Finnish Food Authority, Centres for Economic Development, Transport and the Environment, and guidance.

7.4.3 Grassland on peat fields

Description of measure: Change the prevailing cultivation practice. In the measure concerning perennial grassland on peat fields, tillage is not used for grassland renewal during the commitment period. Annual plant protection is also prohibited. Renewal without tillage and patch sowing are allowed. Fertilisation is allowed. The harvesting of vegetation is required.

Policy instrument: CAP aid related to crops and guidance.

Timeline: 2023–2027.

Surface area/amount: 40,000 hectares per year as of 2025.

Resources: EUR 100 per hectare per year (EUR 4 million per year).

Climate impact: The projected annual emissions reduction is 0.08 million tonnes of carbon dioxide equivalent in 2030 and 0.08 million tonnes of carbon dioxide equivalent in 2035.

Responsible parties: Ministry of Agriculture and Forestry, Finnish Food Authority, Centres for Economic Development, Transport and the Environment, and guidance providers.

7.4.4 Wetting low-yield, thick-peat fields and cut-over peatlands to establish climate wetlands

Description of measure: An alternative for sites unfit for afforestation. Low-yield, thick-peat fields or cut-over peatlands will be identified using geospatial methods, and measures will be targeted based on more detailed assessments conducted in connection with land consolidation or plans for the after-use of cut-over peatlands.

Policy instrument: A measure or package of measures will be prepared to compensate land owners for maintaining soil carbon stocks as an ecosystem service. The areas will not be on agricultural land. Possibly an invitation to tender, land acquisition or carbon offsetting site.

Timeline: A tentative proposal for the plan will be prepared in 2022, and it will be used as the basis for further preparations and launch of operations. According to a preliminary estimate, part of the EUR 30 million appropriations for paludiculture included in the security of supply package in spring 2022 (for the period 2023–2025) will be allocated to this measure. From 2026 onward, the annual funding need for this measure is expected to be EUR 20 million.

Surface area/amount: 30,000 hectares of low-yield, thick-peat fields or cut-over peatlands will be withdrawn from production and wetted to establish wetlands.

Resources: Budget funding. In spring 2022, a total of EUR 30 million was allocated to paludiculture as part of the security of supply package. Part of this appropriation will be allocated to this measure. Funding is allocated to the period 2023–2025. From 2026 onward, the annual funding need is EUR 20 million.

Climate impact: The projected emissions reduction is 0.175 million tonnes of carbon dioxide equivalent by 2030 and 0.175 million tonnes of carbon dioxide equivalent by 2035.

Responsible parties: Ministry of Agriculture and Forestry.

7.4.5 Preparing a roadmap for the use of peatland fields

Description of measure: To make climate-smart use of peatland fields, the individual properties of such fields must be identified and this information must be used to choose the appropriate forms of use for each site. Peatland fields can be roughly divided into thick-peat and shallow-peat fields. Thick-peat fields offer more cost-effective emissions reductions, because if drained, their emissions would continue longer. Shallow-peat fields

gradually turn into mineral soil, and the shallower peat layer thus forms a lower emissions potential. Based on their origins, peatland fields can be divided into nutrient-rich and nutrient-poor fields. The smart use of fields is dictated by the thickness and nutrient content of the peat layer. It would be important to at least impose crop restrictions on thick-peat, low-yield fields and wet them to ensure that the carbon sequestered in the peat remains in the soil. Projects in the Catch the Carbon programme produce information about the location of peatland fields, and a parcel-specific identification of peatland fields as well as data about the thickness of the peat layer are being developed. Nutrient content must be added to the attributes of peat parcels to facilitate the selection of suitable further uses. Based on parcel-specific information, recommendations can be made for different types of peat parcels and incentive schemes can be developed to promote the appropriate use of peatland fields. The climate and environment plan of farms, included in the CAP environmental measures, is well suited to this purpose.

Policy instrument: Parcel-specific soil information will be produced, indicating peatlands, as well as their thickness and nutrient content. This will be used as the basis for a project in which peat parcels are identified and classified based on their properties and the use of parcels is appropriately allocated with the help of administrative measures. CAP, information guidance and a funding system encouraging the wetting of thick-peat, low-yield parcels are used as policy instruments.

Timeline: Parcel-specific peat data for agricultural land will be completed by 2025 (MaaTu project and other projects in the Catch the Carbon information programme). The data must be complemented in terms of nutrient content (MaaTu follow-up project). A project will be launched to classify parcels and steer their use.

Surface area/amount: Owing to the nature of the measure, the surface area cannot be defined.

Resources: The measure will be funded by the existing Catch the Carbon resources allocated in the Government Programme.

Climate impact: Cannot be estimated as yet.

Responsible parties: Ministry of Agriculture and Forestry, Ministry of Economic Affairs and Employment, Ministry of the Environment, Finnish Food Authority, Geological Survey of Finland, Natural Resources Institute Finland and Finnish Meteorological Institute.

7.5 Climate-resilient management and use of peatland forests

7.5.1 Comprehensive planning of peatland forest management (avoiding drainage repair)

Description of measure: Concerning peatland forests, drainage repair will be avoided in mires and bogs.

Policy instrument: Incentive scheme, guidance and training.

Timeline: From 2023 onwards.

Surface area/amount: This measure would leave 13,000 hectares of such peatland forests undrained by 2035. This measure would reduce drainage repair by 1,000 hectares in mires and bogs in connection with thinning.

Resources: Resources in line with the funding policies, especially in keeping with the appropriations in the General Government Fiscal Plan and the Budget.

Climate impact: An annual reduction of 1,000 hectares would result in an estimated climate impact of 0.05 million tonnes of carbon dioxide equivalent by 2035 (a highly tentative estimate, which is why it has not been included in the summary of individual measures).

Responsible parties: The Ministry of Agriculture and Forestry, Ministry of the Environment, Finnish Forest Centre and Centres for Economic Development, Transport and the Environment.

7.5.2 Comprehensive planning of peatland forest management (continuous cover forestry in mires)

Description of measure: In mires, 30 per cent of felling is carried out using continuous cover forestry methods (a range of felling methods that take the site's properties into consideration).

Policy instrument: Incentive scheme, training and guidance.

Timeline: From 2023 onwards.

Surface area/amount: 6,000 hectares per year. Continuous cover forestry would be adopted on 78,000 hectares of mires and bogs by 2035.

Resources: Resources in line with the funding policies, especially in keeping with the appropriations in the General Government Fiscal Plan and the Budget.

Climate impact: The estimated climate impact is 0.21 million tonnes of carbon dioxide equivalent by 2035.

Responsible parties: The Ministry of Agriculture and Forestry, Ministry of the Environment, Finnish Forest Centre and Centres for Economic Development, Transport and the Environment.

7.5.3 Promoting ash fertilisation in peatland forests

Description of measure: Drained peatlands are fertilised with wood ash fertiliser generated as a side stream in combustion plants. Since in peatlands, tree growth is often restricted by the lack of potassium, phosphorus or boron, ash fertilising helps cure any deficiency.

Policy instrument: Incentive scheme, guidance and training.

Timeline: 2020–2028.

Surface area/amount: In 2019, ash fertilisation was carried out over a total of 11,000 hectares per year. The target will be raised by 26,000 hectares per year to 37,000 hectares per year. In 2035, the increase in the overall area fertilised so far would thus equal 390,000 hectares.

Resources: Resources in line with the funding policies, especially in keeping with the appropriations in the General Government Fiscal Plan and the Budget. The need for appropriations is estimated to total EUR 4,625,000 annually. The amount of subsidies will be assessed in connection with the preparation of the incentive scheme for forestry.

Climate impact: As an additional measure in the land use sector, the sought addition to surface area (26,000 hectares per year) is estimated to have a net impact of 0.4 million tonnes of carbon dioxide equivalent in 2035.

Responsible parties: Ministry of Agriculture and Forestry and Finnish Forest Centre.

7.6 Catchment area planning

Description of measure: Methods and tools will be developed for the planning of catchment areas to support the implementation of climate-resilient projects and water protection. The successful practices related to negotiations with land owners will be implemented more efficiently and any development needs will be determined. Syntheses will be compiled of pilot and development projects to provide information about the methods, benefits and impacts of catchment area planning and natural water control, and these will be communicated actively. Experiences from the projects, such as the duties of drainage host and catchment officer, will be tested and implemented more extensively. The role of the water authorities (Centres for Economic Development, Transport and the Environment, Regional State Administrative Agencies, municipalities) in promoting water control in individual catchment areas will be strengthened.

Policy instrument: Development projects, guidance and training.

Timeline: Preparation and planning in 2023–2024, followed by implementation.

Surface area/amount: Plans at the level of catchment area will be implemented in agriculture and forestry over an area of 100,000 hectares, in accordance with river basin management plans.

Resources: Resources specified in the Government Programme and other existing resources, including Catch the Carbon resources; additional resources may be required for implementation.

Climate impact: A measure directly and indirectly supporting the planning and implementation of climate actions in agriculture and forestry.

Responsible parties: The Ministry of Agriculture and Forestry, Ministry of the Environment, Centres for Economic Development, Transport and the Environment, Finnish Forest Centre and operators in the field.

7.7 Promoting markets and incentives related to carbon sequestration and storage and the reduction of emissions

Description of measure: The emergence of voluntary carbon markets will be promoted with development projects and pilot projects linked to the land use sector and agriculture.

Policy instrument: The development of rules for the carbon market will be promoted, methods and solution models applicable to the carbon market will be piloted through practical experimental projects. Measures for developing the EU carbon markets will be monitored and addressed.

Timeline: A set of pilot projects will be prepared in 2022 and implemented in 2022–2024.

Surface area/amount: No estimate.

Resources: Resources available to the ministries, including the existing Catch the Carbon resources in the Government Programme.

Climate impact: The goal is a significant reduction in emissions and an increase in sinks.

Responsible parties: Ministry of Agriculture and Forestry, Ministry of the Environment, Ministry of Economic Affairs and Employment, Ministry of Finance and operators in the field.

7.8 Catch the Carbon research and innovation programme

Description of measure: Implementation of the Catch the Carbon research and innovation programme will be continued in 2025–2027, taking the needs of the changing operating environment into consideration (security of supply, economy, adaptation). The impact and knowledge base of climate actions in the land use sector involve greater uncertainties than in other sectors. The research and innovation programmes emphasises the continuity and renewal of climate research in the land use sector by supporting the participation of early-career researchers. This measure is in line with the four per cent target for research, development and innovation funding.

Policy instrument: A research programme funding projects.

Timeline: 2020–2027.

Surface area/amount: No estimate.

Resources: The programme will be funded under the current Government Programme until 2024. The programme's continuation is estimated to require EUR 4.5 million in funding in 2025 and 2026.

Climate impact: Research has a significant indirect impact on the achievement of Finland's carbon neutrality target and competitiveness obtained through clean solutions.

Additional information: An overall assessment of the research and innovation programme will be carried out in 2024, and it will be used as the basis for examining further research needs in the land use sector and drawing up a plan on any further measures.

7.9 Experiments and implementation (Catch the Carbon development projects)

Description of measure: Practical experiments and development measures putting scientific results into practice will be carried out. The projects promote emissions reduction, carbon sequestration and storage, climate change adaptation and the development of carbon markets in the land use sector. They continue and add to the overall system of the Catch the Carbon and other development projects. In addition to climate and environmental impacts, the projects focus on strengthening biodiversity, water resources management, economic, social and regional sustainability, food security and security of supply. The information produced in the projects and the implementation of good practices support competence and anticipation, as well as the acceptability of the targets set in the Climate Plan for the Land Use Sector and their implementation on farms and in forests across Finland.

Policy instrument: Subsidies for funding the projects.

Timeline: 2020–2028.

Surface area/amount: To be estimated in 2022/2023.

Resources: Development projects will be funded under the current Government Programme until at least 2023. Activities after this are estimated to require EUR 2 million in funding in 2024 and EUR 4 million from 2025 onward.

Climate impact: To be estimated in 2022/2023.

Additional information: Plans are to extend funding for development projects as part of the implementation of the Climate Plan. The administration of project applications would be transferred from the Ministry of Agriculture and Forestry to Centres for Economic Development, Transport and the Environment.

7.10 Other measures promoting carbon sequestration and storage

7.10.1 Promoting carbon sequestration and carbon stocks in fields

Description of measure: In the CAP 2023–2027 funding period, actions related to carbon farming have been planned for conditionality requirements, as well as agri-environmental compensation and eco-scheme measures. Conditionality, which will replace the cross-compliance system, includes the requirement for permanent grassland, the requirement for arable stubble or vegetation cover on fallow land, the requirement of lighter tillage related to wintertime land cover and the prohibition of burning arable stubble. The following measures promoting carbon sequestration have been planned for the eco-scheme: wintertime vegetation cover, nature protection grasslands and green manure fields. In agri-environmental compensation, carbon farming is promoted, for example by catch crops, soil-improving and remediation crops and the voluntary protection of horticultural plants, as well by an emphasis on the circular economy. CAP carbon farming, catch crops, crop rotation, soil-improving crops, increase in organic matter, wintertime vegetation cover, minimum tillage and so on.

Policy instrument: CAP, guidance (Neuvo 2030), farm-specific environmental plans and guidance by information.

Timeline: An ongoing measure, CAP in 2023–2027.

Surface area/amount: 1.5 million hectares.

Resources: CAP, guidance and development projects.

Climate impact: Will reduce emissions and reinforce stocks, but no quantitative estimate can be given at this stage. The carbon sequestration of mineral soils and the permanence of carbon stocks involve many uncertainties. A great deal of research to specify climate impacts is under way.

Additional information: The measure can be implemented regardless of the soil type, but in mineral soils, it sequesters carbon and in peatlands, it maintains carbon stocks.

7.10.2 Promoting the fertilisation of mineral soil forests

Description of measure: In coniferous forests, nitrogen is the nutrient that most restricts growth, and especially spruce and pine forests benefit from nitrogen fertilisation. The use of nutritional complements can further improve the fertilising impact of nitrogen. Nitrogen fertilisation can be carried out several times during the rotation period without undermining the fertilising impact. In guidance, attention is paid not only to climate impacts, but also to biodiversity and the impacts on water bodies.

Policy instrument: Guidance by information and monitoring, including impacts.

Timeline: An ongoing measure.

Surface area/amount: In 2019, nitrogen fertilisation was carried out over a total of 26,000 hectares per year. The target will be raised by 24,000 hectares per year to 50,000 hectares per year. In 2035, the increase in the overall area fertilised so far would thus equal 360,000 hectares.

Resources: Funded by the operators, market-based.

Climate impact: The projected annual impact of this measure is approximately 0.46 million tonnes of carbon dioxide equivalent in 2030 and approximately 0.28 million tonnes of carbon dioxide equivalent in 2035.

Responsible parties: Ministry of Agriculture and Forestry and other operators.

7.10.3 Promoting rapid and efficient forest renewal

Description of measure: Forests should be renewed immediately after regeneration felling. Sometimes, renewal measures are neglected or, in the case of poor natural renewal conditions, young stands are left to grow on their own. Stands that are renewed efficiently and without undue delay grow into carbon-sequestering forests much faster. Cultivated stands that are actively renewed usually become established more quickly than called for by the minimum requirements. Bred forest reproductive material (seeds and seedlings) can be used to further accelerate the establishment of stands, but bred seeds and seedlings can also be used to speed up forest growth, that is, carbon sequestration, throughout the forest's growth period. As well as this, breeding can be used to improve the quality and health of growing stock, as well as its adaptation to climate change.

Policy instrument: Guidance by information. Information about the climate and financial benefits of fast and high-quality forest renewal, as well as the use of bred forest reproductive material will be distributed to forest owners. Forest owners are encouraged to renew their forests actively and determinedly. The programme for forest tree breeding (Metsänjalostus 2050) and the programme for the establishment of seed orchards will be implemented. A new programme for the establishment of seed orchards will be prepared.

Timeline: An ongoing measure.

Surface area/amount: No estimates are available. The goal for bred forest reproductive material is that all the seeds required for sowing spruce, pine and silver birch in tree nurseries, as well as half the pine and silver birch seeds required for sowing in forests are produced in seed orchards.

Resources: Existing resources. The Finnish Forest Centre, Natural Resources Institute Finland, Ministry of Agriculture and Forestry, Tapio and Siemen Forelia Oy.

Climate impact: The knowledge base on climate impacts will expand.

Additional information: Delays in renewal measures weaken the final results of renewal and also reduce the future financial yield from forests. The breeding of forest species produces supreme specimens for forest cultivation. Safeguarding the diversity of origin is an essential part of breeding.

7.10.4 Increasing the carbon stock of decaying wood in commercial forests due to biodiversity and climate considerations by leaving retention trees in place

Description of measure: Forest owners will be encouraged to increase the amount of decaying wood in commercial forests due to biodiversity and climate considerations. The amount of decaying wood can be influenced through active measures, such as leaving retention trees in place during various felling operations or by not harvesting damaged trees.

Policy instrument: Advice and guidance by information.

Timeline: An ongoing measure.

Surface area/amount: Potential sites (felling sites) where retention trees can be made cover approximately 500,000 hectares per year, assuming that felling volumes remain at the level of 2019 and that no new retention trees are made in first thinning or when removing hold-overs.

Resources: Voluntary expense for forest owners. Resources for guidance.

Climate impact: The climate impact of this measure has been estimated from the perspective of retention trees. The impact of additional retention trees on the carbon stock is in the range of 0–0.3 million tonnes of carbon dioxide equivalent per year, depending on the number of retention trees left in place. It should be noted that this addition to stocks must be reviewed annually. The estimate is imprecise due to uncertainties about the surface area over which the measure will be carried out, as well as the conversion factor used and the indirect market impacts, including risks of carbon leakage.

Responsible parties: The Ministry of Agriculture and Forestry, Finnish Forest Centre, operators in the field and land owners.

7.10.5 Climate-resilient continued use of cut-over peatlands

Description of measure: Knowledge about the alternative uses of cut-over peatlands will be increased and relevant methods will be developed.

Policy instruments: Guidance by information and development activities.

- Knowledge about alternative uses for areas that will no longer be used for peat extraction, especially about their climate and environmental impacts, will be increased.
- Climate-resilient production methods and crops for the cultivation of biomass in former peat extraction areas, as well as new business models will be developed.
- An information package on the continued use of peat extraction areas will be prepared for land owners, providing information about the impacts and profitability of the alternatives, as well as the related permit procedures and available incentives.
- The legal and administrative procedures for the after-care and continued use of areas no longer used for peat extraction will be developed, focusing especially on the cultivation and harvesting methods for sphagnum moss.
- New growth and bedding mediums will be developed as replacements for horticultural and bedding peat.

Timeline: 2022–2025.

Surface area: Owing to the nature of the measure, the surface area cannot be defined.

Resources: Catch the Carbon funding. Funding for the measures of the working group on peat.

Climate impact: Has not been determined due to the nature of the measure.

Responsible parties: Ministry of Agriculture and Forestry, Ministry of the Environment, Ministry of Economic Affairs and Employment.

7.10.6 Promoting carbon stocks in long-lived wood products and structures

Description of measure: The promotion of wood construction will continue, coordinated by the Ministry of the Environment, with targets and measures supporting the achievement of the overall objectives defined for all ministries.

Policy instrument: The Government's measures aimed at promoting wood construction focus on increasing the share of public wood construction, expanding competence through research and development, enhancing legislation and practices in the field, as well as improving product development and productivity in the material value chains by:

- Promoting the use of wood in infrastructure construction
- Promoting the use of wood in tourism construction and structures related to outdoor activities and exercise facilities
- Promoting the use of wooden elements in farm structures through promotional projects run by the Agricultural Fund for Rural Development and with the help of business support
- Promoting the use of wood in furniture and surface materials
- Promoting the development of wood solutions in repair construction.
- Ensuring the compatibility of climate actions in different fields of construction

Calculation and assessment tools used for life cycle assessments and for assessing the amount of carbon sequestered in long-lived wood products and structures, the carbon footprint and carbon handprint, as well as substitution effects will continue to be developed, and their rapid deployment will be promoted, especially in public operators' construction and interior decoration projects.

Timeline: 2023–2025.

Surface area/amount: Due to the nature of the measure, no surface area has been defined.

Resources: Existing resources.

Climate impact: No estimates at this point.

Responsible parties: Ministry of the Environment, Ministry of Economic Affairs and Employment, Ministry of Agriculture and Forestry and other key ministries such as the Ministry of Education and Culture.

7.11 Other cross-cutting measures

7.11.1 Competence, training and guidance

Description of measure: A competence, training and guidance package related to the land use sector will be prepared and launched, and it will be coordinated with other training and guidance.

Policy instrument: Project activities and other guidance by information.

Timeline: 2022–2024.

Surface area/amount: No estimates are available.

Resources: Resources from the Government Programme's existing Catch the Carbon resources will be used for the preparation and launch. Implementation may require additional resources from various sources.

Climate impact: No estimate.

7.11.2 Communication and interaction

Description of measure: Communication and interaction activities of operators in the land use sector. The goal is to increase information about climate-resilient operating models in the land use sector and to promote their adoption.

Policy instrument: Project activities and other guidance by information.

Timeline: 2022–2024.

Surface area/amount: No estimate.

Resources: The existing Catch the Carbon resources allocated in the Government Programme.

Climate impact: No estimate.

7.11.3 EU and international cooperation

Description of measure: EU and international cooperation related to the land use sector will be prepared and launched.

Policy instrument: Project activities and other guidance by information.

Timeline: 2022–2024.

Surface area/amount: No estimate.

Resources: Existing Catch the Carbon resources specified in the Government Programme.

Climate impact: No estimate.

7.11.4 Development and adoption of technologies

Description of measure: The results of the Catch the Carbon development projects and the research and innovation programme will be put into practice to make use of site-specific information in decisions related to land use. The national bioeconomy strategy and its interconnections with the land use sector will be implemented.

Policy instrument: Project activities and other guidance by information.

Timeline: 2022–2024.

Surface area/amount: No estimate.

Resources: Existing Catch the Carbon resources specified in the Government Programme. Implementation may require additional resources from various sources.

Climate impact: No estimate.

7.11.5 Programme for climate action and farm economy (HERO programme)

Description of measure: The programme defines the measures for achieving a 29 per cent reduction in agricultural greenhouse gas emissions by 2035 while also strengthening the economy of farms.

Policy instrument:

Timeline: From 2022 onward.

Surface area/amount: No estimate.

Resources: To be defined in greater detail later.

Climate impact: No estimates for now.

Responsible parties: Ministry of Agriculture and Forestry, operators and the sector.

7.11.6 Low-carbon roadmaps of different sectors

Description of measure: The low-carbon roadmaps of different sectors specify the key measures with which the sectors can contribute to Finland achieving its carbon neutrality target. The key roadmaps for the land use sector include the roadmap for agriculture and the roadmaps prepared by the Finnish Food and Drink Industries' Federation, Finnish Grocery Trade Association, Finnish Forest Industries and Finnish Sawmills Association.

Policy instrument: Interaction.

Timeline: From 2020 onward.

Surface area/amount: No estimate.

Resources: –

Climate impact: –

Responsible parties: Operators (Central Union of Agricultural Producers and Forest Owners, Central Union of Swedish-speaking Agricultural Producers in Finland, Finnish Food and Drink Industries' Federation, Finnish Grocery Trade Association, Finnish Forest Industries, Finnish Sawmills Association).

7.11.7 Local and regional cooperation

Description of measure: Local and regional cooperation related to the land use sector will be prepared and launched. This can include cooperation with municipal operators, the promotion of green structures in the built environment and cooperation related to the implementation of regional forest programmes, for example.

Policy instrument: Project activities and other guidance by information.

Timeline: 2022–2024.

Surface area/amount: No estimate.

Resources: The existing Catch the Carbon resources allocated in the Government Programme and the resources outlined in the government proposal for the Climate Change Act (for 2022–2023). Implementation may require additional resources from various sources.

Climate impact: No estimate.

Responsible parties: Ministry of Agriculture and Forestry and Centres for Economic Development, Transport and the Environment (provided that the resources proposed in the Climate Change Act become available).

Additional information: To be specified in connection with the further revision of the Climate Change Act in autumn 2022.

7.11.8 Developing the greenhouse gas inventory and monitoring system (Catch the Carbon information programme)

Description of measure: The monitoring system and methods described in Chapter 9.2. will be developed and implemented. The greenhouse gas inventory and monitoring system will be developed to help verify and observe the impacts of the plan's mitigation measures and the needs of the information programme for the land use sector: the cost-effective procurement of data, development of data use and efficient data utilisation, including information systems, data products and services, and modelling. The need for scientific, accurate information and cost-effective methods for producing information is emphasised in climate impact calculations related to life-cycle assessments and the carbon markets.

Policy instrument: Performance guidance and project funding.

Timeline: 2020–2024. The programme's impact and any further needs concerning the development of methods and materials will be assessed in 2024.

Surface area/amount: Owing to the nature of the measure, the surface area cannot be defined.

Resources: Resources allocated in the Government Programme and Catch the Carbon funding during the development stage. Separate funding of EUR 0.5 million per year allocated to the Natural Resources Institute Finland in the Government Programme. The development of the monitoring system is estimated to require EUR 2 million in additional funding from 2024 onward.

Climate impact: No direct climate impact due to the nature of the measure.

Responsible parties: Ministry of Agriculture and Forestry.

7.12 Measures to be further developed and decided later

Once the measures in the Climate Plan for the Land Use Sector are underway, the experiences and research data accumulated from them will be used to further prepare and plan new sets of measures, such as the development of carbon handprint methods. As a potential later measure, surveys will be conducted to determine ways to encourage longer forest rotation periods in specific sites and the impacts of such efforts. Preparations will be carried out as part of the normal duties of public officials, and the plans will be presented in the mid-term review of the Climate Plan for the Land Use Sector. A review should also be carried out to determine how an assessment of technological sinks and potential promotion could be included in the preparation of a national climate policy.

8 Climate impacts and uncertainties of the measures in the Climate Plan for the Land Use Sector

8.1 Review of the impacts of individual measures

According to the guidelines issued by the ruling parties, the Climate Plan for the Land Use Sector lays out additional measures with a target annual net impact of at least three million tonnes of carbon dioxide equivalent by 2035. Table 3 lists the projected climate impacts of the measures in the Climate Plan for the Land Use Sector.

Table 3. The preliminary projections for the climate impacts of the measures in the Climate Plan for the Land Use Sector in 2030 and 2035 (million tonnes of carbon dioxide equivalent). Source: Natural Resources Institute Finland 2022.

Measure	Surface area	Climate impact in 2030	Climate impact in 2035
Metsähallitus's ownership policies		0.4 million tonnes CO_2-eq.	0.7–0.9 million tonnes CO_2-eq.
Preventing the conversion of forests into fields	approx. 1,700–1,900 ha annually		0.5 million tonnes CO_2-eq.
Fixed-term afforestation support for waste land	3,000 ha annually, of which 40 per cent targets peat extraction areas	0.09 million tonnes CO_2-eq.	0.11 million tonnes CO_2-eq.
Afforestation of low-yield fields suitable for afforestation	9,000 ha in 2024–2028	0.09 million tonnes CO_2-eq.	0.10 million tonnes CO_2-eq.
Grassland farming on peatland, raised groundwater level -30 cm	2030: 20,000 ha 2035: 32,500 ha	0.132 million tonnes CO_2-eq.	0.215 million tonnes CO_2-eq.
Cultivation of peat soils with raised water level -30 cm	2030: 5,000 ha 2035: 10,000 ha	0.046 million tonnes CO_2-eq.	0.093 million tonnes CO_2-eq.

Measure	Surface area	Climate impact in 2030	Climate impact in 2035
Cultivation of peat soils with raised water level -5 – -10 cm	2030: 2,500 ha 2035: 5,000 ha	0.046 million tonnes CO_2-eq.	0.092 million tonnes CO_2-eq.
Climate wetland on peatland fields	2030: 4,000 ha 2035: 7,500 ha	0.070 milliontonnes CO_2-eq.	0.132 million tonnes CO_2-eq.
Grasslands on peatland fields	2030: 40,000 ha 2035: 40,000 ha	0.081 million tonnes CO_2-eq.	0.081 million tonnes CO_2-eq.
Wetting low-yield, thick-peat fields to establish wetlands	2030: 10,000 ha 2035: 10,000 ha	0.175 million tonnes CO_2-eq.	0.175 million tonnes CO_2-eq.
Comprehensive planning of peatland forest management (avoiding drainage repair)	-	-	-
Comprehensive planning of peatland forest management (continuous cover forestry in mires)	6,000 ha annually	0.21 million tonnes CO_2-eq.	0.21 million tonnes CO_2-eq.
Promoting ash fertilisation in peatland forests	26,000 ha annually	0.18 million tonnes CO_2-eq.	0.40 million tonnes CO_2-eq.
Promoting the fertilisation of mineral soil forests	25,000 ha annually	0.46 million tonnes CO_2-eq.	0.28 million tonnes CO_2-eq.
Increasing the carbon stock of decaying wood in commercial forests due to biodiversity and climate considerations by leaving retention trees in place	-	-	-
Total		**1.98 million tonnes CO_2-eq**	**3.09–3.29 million tonnes CO_2-eq**

8.2 Trend in emissions and removals in the land use sector until 2035 (policy scenario of the Climate Plan for the Land Use Sector)

The scenario of additional measures in the Climate Plan for the Land Use Sector (MISU-WAM, with additional measures) was prepared on the basis of the baseline scenario of the project "Climate Neutral Finland 2035 – measures and impacts of the climate and energy policies" (HIISI-WEM, with existing measures) (Chapter 5.3, Maanavilja et al., 2021), and the impacts of the Climate Plan's measures were then added to the baseline scenario (Ollila et al., 2022). As in the HIISI scenarios, greenhouse gases have been converted into carbon dioxide equivalents using the GWP (Global Warming Potential) coefficients in the IPCC fifth assessment report, which are as follows: carbon dioxide (CO_2) 1, methane (CH_4) 28 and nitrous oxide (N_2O) 265 (IPCC AR5 WG1 Ch8, 2013). The measures included in the MISU policy scenario are listed in Table 3. In addition, "Promoting rapid and efficient forest renewal" was also added as a measure to the scenario.

The assumptions concerning forest development and the roundwood felling volumes are in line with the baseline scenario. Forest development also includes the climate actions of Metsähallitus (Chapter 7.1). The impact of additional measures in forests has been calculated following the same methods as in the HIISI scenarios. The emissions reduction impact of the afforestation of suitable low-yield fields was calculated using the same methods and coefficients as in the AIRY project (Lehtonen et al., 2021). The forest industry's production and consequently the carbon sink of wood products complies with the baseline scenario. The assumptions made in calculations are described in greater detail in Appendix 1.

The emissions reduction impact of measures carried out in the agriculture sector is calculated using the default coefficients of the IPCC (2014). As concerns agricultural measures, the assumption is that climate actions will take place within the cropland land-use category, meaning that they do not involve land use change. As a result, the emissions reduction impact of the conversion into climate wetlands is displayed only in the cropland land-use category, although the classification used in the greenhouse gas inventory would treat it as a land use change into wetland. No estimate has been calculated for the impact of promoting the carbon sequestration of mineral soil fields. The assumptions made in the calculations of different measures are described in greater detail in Appendix 1.

According to the policy scenario of the Climate Plan for the Land Use Sector, the land use sector will have a net sink of -22.7 million tonnes of carbon dioxide equivalent in 2035 (Figure 18, Table 4). The net sink will increase by a total of 4.7 million tonnes of carbon dioxide equivalent by 2035 compared to the baseline scenario, and will thus exceed the

plan's minimum target by 1.7 million tonnes of carbon dioxide equivalent (Figure 19). The net impact of additional measures carried out in the land use sector is estimated to be 4.2 million tonnes of carbon dioxide equivalent as early as 2030.

Forest land will account for 68 per cent and cropland for 32 per cent of the overall net impact in 2035. Due to the assumptions made in the scenario calculations, no changes will be seen in the net emissions from grasslands and wetlands compared to the baseline scenario. The net emissions and removals of settlements and wood products will also remain at the same level in the MISU policy scenario as in the baseline scenario. In the MISU policy scenario, deforestation emissions will decline by 0.5 million tonnes of carbon dioxide equivalent in 2035 compared to the baseline scenario, while the net emissions from afforestation will increase by 0.1 million tonnes of carbon dioxide equivalent following the afforestation of peatland.

Figure 18. Emissions of the land use sector per emission category in the MISU policy scenario, million tonnes of carbon dioxide equivalent. Source: Natural Resources Institute Finland 2022.

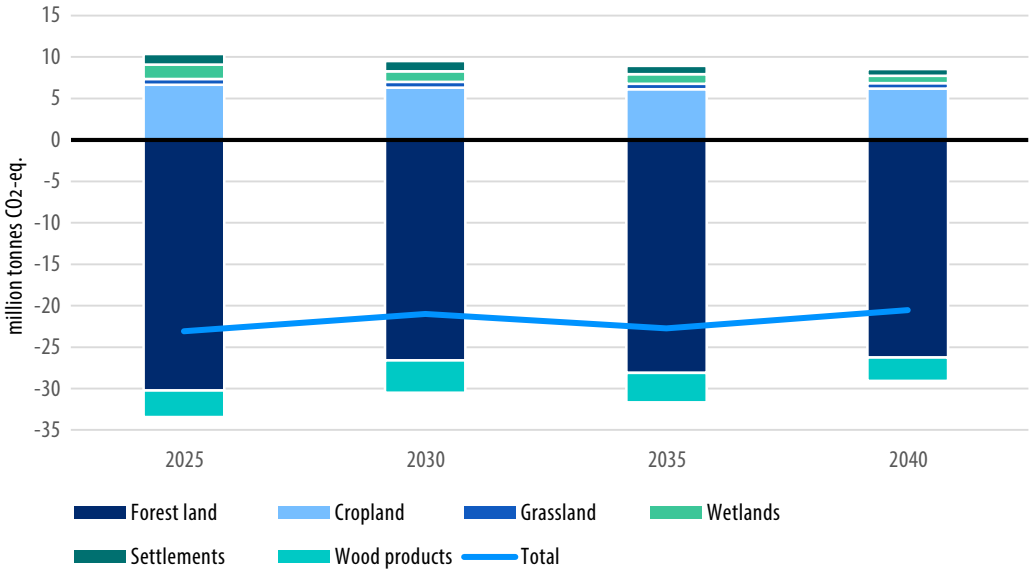
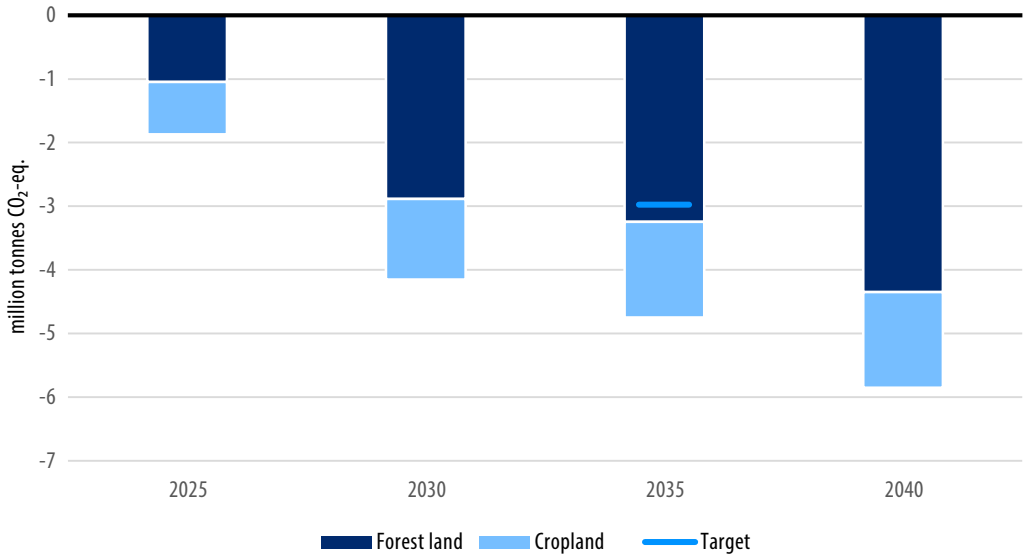


Table 4. Emissions of the land use sector per emission category in the MISU policy scenario, million tonnes of carbon dioxide equivalent. Source: Natural Resources Institute Finland 2022.

Emission category	2025	2030	2035	2040
Forest land	-30.21	-26.60	-28.10	-26.26
Cropland	6.65	6.32	6.11	6.17
Grassland	0.69	0.68	0.67	0.65
Wetlands	1.75	1.28	1.13	0.90
Settlements	1.27	1.23	1.00	0.82
Wood products	-3.22	-3.92	-3.56	-2.82
Total	**-23.07**	**-21.01**	**-22.75**	**-20.54**

Figure 19. The net impact of additional measures in the land use sector compared to the baseline scenario. Negative figures signify a growing sink, or declining emissions. Source: Natural Resources Institute Finland 2022.



8.3 Assessment of the environmental impacts of the Climate Plan for the Land Use Sector (SEA)

The measures in the Climate Plan for the Land Use Sector have direct or indirect impacts in and outside Finland, as referred to in the Act on the Assessment of the Effects of Certain Plans and Programmes on the Environment. The impacts of the plan's measures on the soil, groundwater, surface waters, air quality, utilisation of natural resources, biodiversity, landscape, recreational amenities and the health, living conditions and wellbeing of people were assessed in the environmental report on the Climate Plan for the Land Use Sector (Laine et al., 2022).

Soil

The soil impacts of the measures were generally assessed as positive or very positive. Many of the measures were assessed to reduce the need for tillage through restrictions or land use change, for example from agriculture to forestry, which increases soil cover especially in the long term. The only potential negative impacts assessed arose from an increase in wood products, should the measure considerably increase forest felling levels nationwide. In general, soil impacts are long-term impacts. However, considerable uncertainties surround the assessment of environmental impacts from both an environmental and a climate perspective related to, for example soil carbon stocks and potential nutrient leakage.

Groundwater

The assessment of groundwater impacts involved a great deal of uncertainty. The impacts of some of the measures are not precisely known and in some cases, the impacts depend on how the measure is implemented. A significant number of measures was assessed not to have impacts on the groundwater. Especially agricultural measures that increase grassland cultivation were expected to have positive impacts. The impacts come from a decline in the use of plant protection products and fertilisers, which reduces the risk of chemicals flowing into the groundwater. Based on the assessment, negative impacts may arise from a potential increase in the use of plant protection products and fertilisers. Overall, the precautionary principle should be adopted regarding groundwater impacts: groundwater contamination has long-term impacts that are very difficult to remedy. Local conditions should always be considered when implementing measures.

Surface water

The implementation of measures has various impacts on surface waters. In practice, they depend on local conditions and the conditions at the outset. Continuous cover forestry and a reduction in drainage repair in forestry were assessed to have extremely positive impacts, as they reduce nutrient leakage and maintain soil cover better than periodic cover forestry. Concerning agricultural measures, especially the reduction in land clearing was assessed to have positive impacts for these same reasons. Measures reducing tillage and increasing soil cover were generally considered to have a positive impact on surface waters. Nitrogen fertilisation of forests and an increase in long-lived wood products were assessed to have negative impacts because they increase the probability of nutrient runoff and the felling volumes at the national level. In many cases, wetland measures were assessed to have both negative and positive impacts. Uncertainties are due at least partly to the lack of available research data, and the results may change in the near future as more research related to paludiculture is completed. The regional and national impacts on surface waters may be significant. Any negative impacts from the measures would probably be of at least mid-term duration and quite permanent, but they can accumulate and cause extremely negative impacts locally. The abundance of scientific literature on surface-water impacts has enabled a comprehensive and reliable examination of the question. The assessment of impacts on water bodies generally includes uncertainties at the regional level, which is why the initial conditions and characteristics of the region should always be considered in operations.

Air quality

The impacts of the measures on air quality are generally speaking minor or impossible to assess. In many cases, the measures will be carried out far away from residential areas, and their intensity will be low or comparable to previous procedures, meaning that they will not have a considerable impact on air quality, with a few exceptions. However, the afforestation of fields was expected to have very positive impacts, as the measure reduces the dust formation due to tillage. The impacts of the measures would be temporary, except for the afforestation of fields. In general, the measures will not have a significant impact on air quality at the national level.

Utilisation of natural resources

The impacts on the utilisation of natural resources were assessed at a general level, since more detailed socio-economic assessments of individual measures will be conducted as part of the assessment prepared by Pellervo Economic Research PTT (Laturi et al., 2022). Overall, some of the measures will weaken the opportunities to utilise natural resources, because they aim to reduce the intensity of management methods used in agriculture and forestry or partly exclude natural resources from the scope of active utilisation. Exceptions

to this include fertilisation methods and the afforestation of waste land, which have positive impacts. These measures increase the surface area used for forestry, as well as the volume of growing stock in the areas of implementation. The duration of the impacts of measures depends on their permanence, which is difficult to assess based on existing information. Measures leading to land use change have long-term impacts. Regionally, the decrease in field surface areas may affect the operations of livestock farms but these are also influenced by the structure of parcels and farms. The assessment is indicative, and a more detailed assessment is presented elsewhere.

Biodiversity

Since the impacts of measures on biodiversity depend on local circumstances and initial conditions, the assessment has been made at a very general level. Especially some of the wetland measures, the increase in decaying wood and the decrease in land clearing were assessed to have a positive impact on biodiversity. Measures with negative impacts included those that actively increase the use of areas in near-natural state or that increase the chemicals load, for example through the use of fertilisers and plant protection products. One example of measures with negative impacts is the afforestation of waste land, should the waste land have come to include characteristics of (dry) meadows, in which case a land use change into a much more common commercial forest would considerably weaken these biotopes. If activities weaken biotopes such as these, the impacts on biodiversity are significant and long-lasting. However, many of the measures were generally considered to have positive impacts, as they often encourage the use of lighter methods in agriculture and forestry. The assessment of biodiversity is an extremely challenging task, as it should be carried out on many different levels (genetic, population, ecosystem, local, landscape etc.), and it is therefore difficult to draw clear-cut conclusions. When planning measures, increasing attention should be paid to landscape design and a comprehensive approach in which the cumulative impacts of different measures are assessed as a whole, not separately.

Recreational amenities

The measures mainly have positive impacts on the recreational amenities available on the basis of right of public access. In particular, an increase in forest surface area will improve the area's recreational amenities in the long term. Only measures that hamper passage or significantly hide the landscape without changing the land-use category were assessed to have negative impacts. In general, measures affecting agriculture were not considered to impact recreational amenities, as cropland is suitable for recreational use only to a limited extent and mainly in the winter. The impacts may be locally significant for residents in the

area if a landscape is closed off or nearby forests change due to the measures. However, right of public access is a yielding right and cannot be cited to demand a land owner to limit legal activities, such as forest felling or forestry work.

Human health, living conditions and wellbeing

The impacts of the measures were assessed to be mainly positive or insignificant, with the exception of a few measures that negatively change the landscape. The measures will mainly be implemented outside residential clusters. Therefore, measures such as forest fertilisation or the use of plant protection products are not expected to have much impact on people. However, especially changes in recreational amenities and the landscape have a bearing on the health, living conditions and wellbeing of people, so the conclusions in this respect are similar to those of the assessments of these aspects. The national and local level cannot be clearly assessed due to the complexity of the perspective. For example, people's experiences of wellbeing and living conditions vary greatly, in terms of land use, and it is thus impossible to draw clear conclusions on these topics.

Summary

In general, the measures in the Climate Plan for the Land Use Sector are assessed to have more positive than negative impacts on both the environment and people.

According to the assessment, the bulk of positive impacts target the soil – as many as half the measures were expected to have extremely positive soil impacts. In particular, measures reducing tillage such as increasing high thinning, reducing drainage repair in peatlands, and reducing land clearing generate positive soil impacts, because the reduce nutrient and mineral leakage from the soil. According to the assessment, the utilisation of natural resources was considered to generate the greatest negative impacts. Many of the measures aimed at increasing carbon sinks and stocks also have a reducing impact on clear cutting and the use of natural resources.

The measures with the most negative potential environmental impacts were the nitrogen fertilisation of coniferous forests and the use of long-lived wood products. However, the negative impacts can be prevented by carefully planning the implementation of measures and taking local conditions into account.

The precautionary principle should be followed when addressing the negative impacts on groundwater, as groundwater contamination has long-term impacts that are very difficult to remedy. Local conditions should always be considered when implementing measures. Impacts on surface waters must also be taken into consideration, and measures reducing tillage and increasing soil cover were generally considered to have a positive impact on

surface waters. In many cases, wetland measures were assessed to have both negative and positive impacts. Any negative impacts from the measures would probably be of at least mid-term duration and quite permanent. The negative impacts can accumulate and cause extremely negative impacts locally.

The impacts on biodiversity are mainly assessed to be positive, but, for example the nitrogen fertilisation of coniferous forests and afforestation of waste land may also have negative impacts on biodiversity. Biodiversity impacts are usually markedly local, but it is important to consider them when finalising the plan to promote and preserve diversity.

The measures were not found to have significant crosscutting impacts. However, a few examples were detected. As a positive example, fertilisation can increase mushroom and berry yields and thus have a positive impact on recreational amenities and the health, living conditions and wellbeing of people. As a negative example, impacts on surface waters (such as eutrophication) can negatively impact recreational amenities.

Assessment of cost impacts

In parallel with the strategic environmental assessment, Pellervo Economic Research PTT carried out a cost impact assessment of the measures in the Climate Plan for the Land Use Sector. The description and key results of the assessment are included in Appendix 2.

8.4 Uncertainties

The land use sector has several special characteristics that give rise to various uncertainties. These include:

- Natural processes affecting the land use sector, which vary depending on the conditions. Natural processes and their annual and local variations make it difficult to assess and report emission and removals. While some of the measures may cause a direct emission, it may take years for the positive impacts of actions that strengthen sinks to become fully visible.
- Climate change and its future impacts present uncertainties to the land use sector, encompassing land use, forestry and agriculture. Climate change is expected to increase rainfall, temperatures and extreme weather conditions in the near future.
- The measures in the land use sector are carried out over large areas. The emissions and removals are diffuse, which makes their assessment and monitoring considerably more difficult than for point sources of emissions.

- In the greenhouse gas inventory, uncertainties are greater in the land use sector than in the assessments of emissions from the energy sector, for example. Especially soil information contains a great deal of uncertainty.
- In the land use sector, fluctuation in forest felling in response to the market situation causes significant variation in the net sink of forests. This makes it difficult to plan measures and monitor their effectiveness.
- Uncertainties still surround calculation models and the knowledge base. In particular, future scenario reviews and modelling, the assessment of individual measures and the strengthening of their compliance with greenhouse gas reporting still involve significant development needs.
- The measures in the land use sector depend on the efforts of land owners and other operators. If the measures are not attractive to them, it is unlikely that the measures or the changes sought through them will be achieved.
- Social changes affect the future of the land use sector at large. For example, Russia's attack on Ukraine is expected to increase the use of domestic biomass, at least in the near future. The importance of domestic food production will be emphasised, as well. Different factors will engender changes in land use and thus in the trend of emissions and removals in the land use sector, at least in the coming years. A rapid detachment from fossil energy imported from Russia may, in fact, accelerate the green transition.
- A predictable and stable operating environment, including the predictability of national targets and regulation and those of the EU's environmental and climate policy, can help reduce uncertainties in the land use sector.

9 Implementation and monitoring

9.1 Implementation

The Climate Plan for the Land Use Sector specifies the climate policy measures that will help reach the climate objectives set for the land use sector. The plan will contribute to Finland's target of achieving carbon neutrality by 2035. The annual net impacts that the additional measures in the land use sector aim for is at least three million tonnes of carbon dioxide equivalent by 2035. These additional measures will be carried out proactively to ensure the availability of the land use sector's flexibility in the effort-sharing sector (0.45 million tonnes of carbon dioxide equivalent). In the implementation of the measures in the Climate Plan for the Land Use Sector, attention will be paid to fairness and justice between current and future generations, from a regional, national and global perspective.

Many of the measures in the Climate Plan for the Land Use Sector are already being implemented. Their implementation will continue in accordance with the current procedure, and they will be monitored and assessed, as well as expanded in the near future.

The implementation and monitoring of measures targeting agricultural land will be coordinated with, for example the measures included in the Medium-term Climate Change Policy Plan and the EU CAP. In turn, the implementation and monitoring of measures targeting forestry will be coordinated with, for example the national forest strategy and the forestry incentive scheme. The preparation of the new proposed measures will continue according to the timeline and descriptions presented in Chapter 7, and the measures will be implemented within the framework formed by the appropriations and labour units outlined in the general government fiscal plans and the Budget. Matters concerning funding needs will be handled as normal in procedures associated with the Budget and the general government fiscal plan, within the central government spending limits and coordinating them with other expenditure needs. A summary of the additional funding needs required by the Climate Plan for the Land Use Sector can be found in Table 5.

Table 5. The annual additional funding needs required by the Climate Plan for the Land Use Sector compared to the 2023–2026 General Government Fiscal Plan.

Measure	Implementation	The annual additional funding need compared to the 2023–2026 General Government Fiscal Plan
Afforestation of suitablelow-yield fields (7.3.2)	Preparation in 2023, implementation in 2024–2028	In 2024: EUR 2 millionIn 2025: EUR 4 millionFrom 2026 onwards: EUR 6 million
Catch the Carbon researchand innovation programme (7.8)	The three-year follow-up programme will be carried out in2025–2027, but funding is for 2025–2026	In 2025: EUR 4.5 millionIn 2026: EUR 4.5 million
Experiments and implementation (Catch the Carbon development projects) (7.9)	Subsidies to the projects will continue	In 2024: EUR 2 millionFrom 2025 onwards: EUR 4 million
Developing the greenhouse gas inventory and monitoring system (7.11.8)	Current activities will be assessed in 2023, and activities will be developed and boosted	From 2024 onwards: EUR 2 million
Raising the water level in peatland fields to prevent the decomposition of peat (7.4.1), climate wetland on peatland field (7.4.2), wetting low-yield, thick-peat fields and cut-over peatlands to establish climate wetlands (7.4.4)	CAP (2023–2027) and national funding (measures 7.4.1 and 7.4.2). The General Government Fiscal Plan includes EUR 30 million for paludiculture in 2023. The current GGFP does not include national additional funding for 2026–2028.	In 2026: EUR 14 million In 2027: EUR 15 million In 2028: EUR 15 million

The additional measures mentioned in Chapter 7, as well as any other other potential measures will continue to be addressed in future work. According to the government proposal for the Climate Change Act, the Climate Plan for the Land Use Sector requires permanent additional resources equivalent to at least three labour units in the Ministry of Agriculture and Forestry. Moreover, the Climate Plan for the Land Use Sector and the National Climate Change Adaptation Plan require additional resources at the Centres for Economic Development, Transport and the Environment. In addition, many other employees at the Ministry of Agriculture and Forestry and other ministries as well as experts and stakeholders in their administrative branches participate closely in the plan's implementation.

The goal is to assess the various measures according to the timeline presented in Chapter 7. The mid-term review of the Climate Plan for the Land Use Sector will be carried out in the following government term. At that point, previously launched measures can be retargeted and new measures can be initiated. A new climate plan for the land use sector is to be drawn up in accordance with the new Climate Change Act in the 2027–2031 parliamentary term.

9.2 Monitoring

The implementation of the Climate Plan for the Land Use Sector will be monitored annually. The purpose of monitoring is to assess the implementation and effectiveness of the measures. The results will be used to assess the adequacy of the measures in relation to the objectives and decide on any necessary additional measures.

The monitoring system will be developed in 2022–2024. It is envisaged to comprise the following packages:

- Monitoring of the progress of individual measures (realisation) and more detailed estimates of their climate impact.
- Information produced by the national greenhouse gas emissions inventory. The Natural Resources Institute Finland will produce the information about greenhouse gas emissions and removals and supply it to Statistics Finland, which in its role as the statistical authority makes it available for international and EU needs.
- Other follow-up indicators, marks and assessments, including information and assessments provided by different parties: the progress of Metsähallitus's activities, roadmap work of participants, assessment of project activities and so on.

9.2.1 Annual Climate Report

The monitoring of the Climate Plan for the Land Use Sector will be incorporated into the Annual Climate Report, submitted once every calendar year to Parliament, in accordance with the Climate Change Act. The Annual Climate Report helps keep Parliament up to date on the trend in emissions and removals, the achievement of emissions reduction targets and the additional measures required to achieve the targets. The Government is responsible for monitoring the achievement of climate policy plans, including the Climate Plan for the Land Use Sector. Based on the results of monitoring, the Government decides on any additional measures required to reach the targets. For the Annual Climate

Report, each ministry submits the information concerning their administrative branch to the Ministry of the Environment, which is in charge of compiling the report. Cooperation between the administrative branches has been good. Broad sectoral cooperation among the administrative branches and the use of a common knowledge base support reporting. In practice, the ministries responsible for the plans have carried out monitoring by conducting assessments of the realisation of the plans.

9.2.2 EU and international reporting

The information reported about the Climate Plan for the Land Use Sector and its progress is used, in as consistent a form as possible, when reporting it to the UN Framework Convention on Climate Change, other international treaties, conventions and organisations, as well as the EU for its reporting needs. The information provided to the UN Framework Convention on Climate Change comprises annual greenhouse gas inventory data and information from regularly conducted comprehensive country reports. EU reporting must comply with the needs and procedures defined in the Regulation on Governance of the Energy Union and Climate Action ((EU) 2018/1999), as well as the requirements of the regulation concerning the land use sector (COM(2021) 554 final).

Appendix 1. Assessment by the Natural Resources Institute Finland concerning the trend in emissions and removals achieved with the land use sector's policy measures up to 2035 (policy scenario for the Climate Plan for the Land use Sector)

The Natural Resources Institute Finland has calculated and drawn up scenarios concerning the land use sector to be used in the preparation of national climate plans. Scenarios concerning the land use sector were also drawn up for the climate and energy strategy and Medium-term Climate Change Policy Plan. The impact of current measures was depicted with the baseline scenario drawn up in the project "Hiilineutraali Suomi 2035 – ilmasto- ja energiapolitiikan toimet ja vaikutukset (HIISI)" (Carbon neutral Finland 2035 – measures and impacts of the climate and energy policies), and the impacts of selected policy measures were included in the policy scenario (Maanavilja et al., 2021). The land use sector's baseline scenario was also used as the baseline scenario in the Climate Plan for the Land Use Sector (MISU baseline scenario) (see Chapter 5.3). In addition, the Natural Resources Institute Finland drew up an updated policy scenario based on the policy measures in the land use sector's plan (MISU policy scenario) (see Chapter 8.2)) This Appendix describes the key assumptions and applications used in the calculations for the updated policy scenario.

General assumptions

Instead of producing annual time series of surface areas for different land-use categories, the surface areas used in the baseline and policy scenarios of the HIISI project were used, as applicable, in the MISU policy scenario calculations (Maanavilja et al., 2021). The surface areas of the measures in the Climate Plan for the Land Use Sector were also used. This means that the surface areas may include minor inaccuracies and the results are slightly more uncertain than those of, for example the HIISI scenarios.

Measures carried out on agricultural land affect the emissions of both the land use and agricultural sector. As the MISU policy scenario only applies to the land use sector, only the impacts that are felt in the sector have been taken into consideration.

Assumptions related to forests and afforestation

The baseline and policy scenarios drawn up in the HIISI project were used in the forest-related analyses carried out for the MISU policy scenario calculation. In the HIISI scenarios, felling was guided by the estimates of the forest industry's wood consumption and energy use of wood, which in turn were used to derive the target removals for the scenario calculations (Maanavilja et al., 2021). The target volumes for roundwood were the same in the baseline and policy scenarios, but small differences were noted in the estimates of energy use.

In the baseline scenario, the simulation of processing and development alternatives was based on the specifications of the MELA Tulospalvelu service (Maanavilja et al., 2021, Natural Resources Institute Finland, 2022). Additional measures in the policy scenario included increasing nitrogen fertilisation to 150,000 hectares annually, excluding bogs from drainage repair during thinning and carrying out high thinning in some of the last thinning operations of the rotation period (Maanavilja et al., 2021). The additional measures were based on the approaches to increasing forest growth and accounting for other forest uses included in the forest management scenario prepared for the climate roadmap of Finnish Forest Industries (Natural Resources Institute Finland, 2020). In both HIISI scenarios, young stand management was also assumed to be always carried out in accordance with forest management recommendations, and the potential impact of bred forest reproductive material was assumed to be included in the growth level used in the calculations (Maanavilja et al., 2021).

In the MISU policy scenario calculation, target removals were determined according to the baseline scenario, but the simulation of processing and development alternatives was mainly based on the additional measures defined in accordance with the policy scenario (see Maanavilja et al. 2021). In line with the policy scenario, the MISU policy scenario sought to reduce drainage repair by 1,000 hectares annually in mires and bogs (Chapter 7.5.1) and high thinning by 6,000 hectares annually in mires (Chapter 7.5.2). However, in the MISU policy scenario, the overall annually fertilised surface area totalled 117,000 hectares and the volume of retention trees left per hectare in regeneration felling was raised to seven cubic metres (Chapter 7.10.4), compared to the five cubic metres of retention trees left per hectare of regeneration felling in the policy scenario. In the calculations, forests were also assumed to be renewed without delay after regeneration felling (Chapter 7.10.3).

Concerning fertilisation, the MISU policy scenario included the climate plan's measures from 2021 onward aimed at promoting ash fertilisation in peatland forests by 37,000 hectares per year (Chapter 7.5.3) and nitrogen fertilisation in mineral soil forests by 50,000 hectares per year (Chapter 7.10.2), as well as increasing the fertilised area to 30,000 hectares annually, included in the climate actions of Metsähallitus (Chapter 7.1).

In the MISU policy scenario, more fertilisation was allocated to northern Finland than in the policy scenario. This was due to the increase in fertilisation of land belonging to Metsähallitus. In the policy scenario, fertilisation was not divided in advance between coniferous and peatland forests, but instead, fertilisation targeted sites indicated as being most profitable in the calculation (Maanavilja et al., 2021).

Changes in the carbon stock of trees on forest land (areas that had been forest land for more than 20 years) were calculated based on the data on differences per hectare in tree biomass stocks determined for 10-year periods, provided by MELA modelling, which were then multiplied by the forest surface area used in the scenario. The MELA results calculated for the nationally defined surface area of forest land and poorly productive forest land were thus scaled to correspond to the forest surface area used in the greenhouse gas inventory (Natural Resources Institute Finland, 2022). The soil calculation inputs for forest litter generated by living and naturally removed trees and by logging residue left in forests are the results of the MELA calculation.

The results of the policy scenario were used for the measures concerning the extension of afforestation support for waste land (Chapter 7.3.1) (Maanavilja et al., 2021). As for low-yield peatland fields suitable for afforestation (Chapter 7.3.2), a new calculation was prepared based on the method used in the ILMAVA project (Lehtonen et al., 2021). The results of the baseline scenario were used for wetlands, settlements and the afforestation of mineral soil fields.

Assumptions related to the mitigation of deforestation and agricultural land

In the calculations concerning the measure aimed at preventing land clearing (Chapter 7.2.1), the results of the baseline and policy scenarios were used as applicable, and the emissions reduction impact was calculated as the difference between the scenario results for the relevant years and separately for mineral soils and peatlands. Deforestation due to settlements (Chapter 7.2.3) is in line with the baseline scenario because no estimate is yet available for the surface area targeted by the measure that aims to prevent forest clearing for settlements. Forest clearing to establish wetland and grassland is in line with the baseline scenario.

The emissions reduction impact of measures planned for organic agricultural land depends on the cultivation history of the field. The emissions reduction calculations of the measures are mainly based on the emissions factors for different uses of peatland fields provided in the Wetlands Supplement (ICPP 2014) of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006) (Table 2). The emissions reduction was calculated for 2025, 2030 and 2035, by multiplying the difference in the emissions factors of the old and new uses by the planned surface area of implementation.

The surface areas of measures planned for peatland fields are based on the HIISI estimates, where applicable (Miettinen et al., 2022), as well as on the estimated availability of field parcels for raising water levels. When estimating the surface areas for implementing the measures required to raise the groundwater level, it was assumed that in 2035, 65,000 hectares of peatland fields would have adequate groundwater resources according to the DTW (Depth To Water) survey for raising the groundwater level high enough in order decelerate peat decomposition for either part of or the entire year (Kekkonen, 2022). The CAP measure concerning grassland on peat fields (Chapter 7.4.3) does not the require the groundwater level to be raised (Finland's CAP plan for 2023–2027, (2021)). The measure concerning perennial grassland on peat fields will be implemented over an area of 40,000 hectares. This will annually replace 10,000 hectares of land used for annual crops, as the measure will lead to additional grassland farming of 40,000 ha/4 = 10,000 ha compared to grassland farming where renewal is carried out every four years with nurse crops.

The assumption in the MISU policy scenario calculation is that field parcels used for grassland farming with a raised groundwater level (-30 cm) (Chapter 7.4.1.1) used to be perennial grassland. Prior to transitioning to the cultivation of reed canary grass and other similar plants with a raised groundwater level (-30 cm) (Chapter 7.4.1.2), one third of the parcels was assumed to have been used for the cultivation of annual crops and two thirds for perennial grassland farming. Prior to transitioning to the cultivation of cattail, sundew and other similar plants with a raised groundwater level (-5 – -10 cm) (Chapter 7.4.1.3), 10 per cent of the field parcels was assumed to have been used for the cultivation of annual crops and 90 per cent for perennial grassland farming. Cultivated peatland field parcels, converted into wetland (Chapter 7.4.2) were assumed to be perennial grasslands or nature management fields. Low-yield, thick-peat fields to be wetted (Chapter 7.4.4) were also assumed to be nature management fields.

Appendix 2. Measures assessed for the preparation of the Climate Plan for the Land Use Sector

The following summary table presents the assessments of each measure made in the survey "Maankäyttösektorin ilmasto-suunnitelman kustannusvaikutusten arviointi" (Assessment of the cost impacts of the Climate Plan for the Land Use Sector) (Laturi et al., 2022). The assessments concerned the effectiveness of the measures in relation to the climate target, the cost level of the emissions reductions or increases in carbon sinks achieved with the measures, and the acceptability of the measures (Table 9).

Climate effectiveness depicts the potential of a measure to achieve a net increase in carbon sinks amounting to three million tonnes of carbon dioxide equivalent, set as the target for the land use sector, by 2035. Climate effectiveness was assessed by comparing the impact that an individual measure has on the net sink of the land use sector in 2035 and the emissions reduction target. Climate effectiveness increases in line with the significance the measure is assessed to have in terms of its impact on reducing emissions from the land use sector or increasing sinks by 2035 and the greater the share of the land use sector's climate target the measure would cover, if implemented. Climate effectiveness depends on (1) the significance of the measure's climate impacts at the unit level, for example, how much the measure would reduce annual soil emissions or increase the carbon stock per hectare and (2) the scaling of the measure, for example, how large an area the measure would be implemented on.

Cost-effectiveness describes the cost to society of a reduction in emissions or increase in carbon sink amounting to one tonne of carbon dioxide equivalent that was achieved with the climate action. The price is determined based on the cost impacts of the climate action. In terms of cost impacts, attention has been paid to the impact that the measure has on the net income of a private land owner and the expenditure of the public sector. Some of the measures generate expenses to the private sector in the form of lost revenue while others increase revenue. The impacts of the measures on public sector expenditure also vary depending on whether the implementation of the measure increases or decreases public sector expenditure from the current level. Higher costs for the same climate impact signify poorer cost effectiveness and lower costs signify better cost effectiveness.

The assessment of **acceptability** is a synthesis of the following factors affecting the acceptability of climate measures: (1) The uncertainties related to the assessments of climate and cost impacts in research literature and previous surveys. Higher uncertainty

related to, for example, estimates of climate impact weaken acceptability. (2) Legitimacy from the land owner's perspective in the current operating environment. Significant costs or lost revenue that are not compensated in the current operating environment weaken the perceived legitimacy among land owners. Land owners also have different goals for their assets. In addition to based on profitability, land owners' attitudes to climate actions have been assessed based on the results of questionnaire surveys (TURVA and Metsänomistaja 2020). (3) The significance of the climate actions' direct impact on food and wood markets. (4) The markets' readiness to implement the measure.

The indicators used for the climate effectiveness, cost effectiveness and legitimacy of climate actions are presented in tables 6, 7 and 8.

Table 6. Indicators for the climate effectiveness of climate actions.

Climate impact	Impact on the net sink of the land use sector in 2035	Interpretation
Very good	more than 0.75 million tonnes CO_2-eq	Covers more than 25% of the climate target
Good	0.3–0.75 million tonnes CO_2-eq	Covers 10–25% of the climate target
Satisfactory	0.05–0.3 million tonnes CO_2-eq	Covers less than 10% of the climate target
No impact	-0.05–0.05 million tonnes CO_2-eq	No impact/minimal impact in relation to the climate target
Very bad	less than -0.05 million tonnes CO_2-eq	Negative climate impact
Unknown, impossible to estimate	-	-

Table 7. Indicators for the cost effectiveness of climate actions.

Cost effectiveness	Cost	The achievement ofclimate impacts...
Very good	less than €0 per tonne CO_2-eq	reduces/does not affect the net costs to society
Good	€0–10 per tonne CO_2-eq	generates small costs to society
Average	€10–50 per tonne CO_2-eq	generates average costs to society
Poor	€50–200 per tonne CO_2-eq	generates large costs to society
Very bad	more than €200 per tonne CO_2-eq	generates very large costs to society
Unknown, impossible to estimate	-	-

Table 8. Indicators for the legitimacy of climate actions.

Legitimacy	Interpretation
Very good	No significant uncertainty factors or factors weakening feasibility in the current operating environment
Good	Minor uncertainty factors or factors weakening feasibility in the current operating environment
Average	Some uncertainty factors or factors weakening feasibility in the current operating environment
Poor	Significant uncertainty factors or factors weakening feasibility in the current operating environment
Very bad	Very significant uncertainty factors or factors weakening feasibility in the current operating environment
Unknown, impossible to estimate	-

Table 9. Summary of results.

Climate action	Climateeffectiveness	Cost effectiveness	Legitimacy
Promoting ash fertilisation in peatland forests	Very good	Good	Very good
Promoting ash fertilisation in coniferous forests	Very good	Very good	Very good
30% of thinning in mires carried out as high thinning, followed by a transition to continuous cover forestry	Unknown, impossible to estimate	Unknown, impossible to estimate	Unknown, impossible to estimate
No drainage repair in connection with thinning carried out in mires or bogs	Satisfactory	Very good	Average
Considerably reduce clearing of peatland fields	Good	Very good	Good
Reduce clearing of mineral soil fields	Satisfactory	Very good	Good
Increase afforestation of abandoned peatland fields (“waste land”)	No impact	Unknown, impossible to estimate	Very good
Increase afforestation of abandoned mineral soil fields (“waste land”)	Satisfactory	Good	Very good
Increase afforestation of peatland fields (low-yield fields)	Satisfactory	Very good	Good
Increase afforestation of mineral soil fields	Satisfactory	Very good	Poor
Convert low-yield peatland fields into climate wetlands (water level -5 – -10 cm)	Satisfactory	Very good	Good
Convert low-yield peatland fields into water protection wetlands (agricultural wetlands)	No impact	Very bad	Very bad
Convert mineral soil fields into water protection wetlands (agricultural wetlands)	No impact	Very bad	Very bad
Increase grassland farming on peatland with raised water level	Good	Average	Poor

Climate action	Climateeffectiveness	Cost effectiveness	Legitimacy
Increase paludiculture on peatland (canary reed grass, common reed)	Satisfactory	Average	Very bad
Increase the use of catch crop	Good	Poor	Poor
Increase soil improvement and remediation crops	Good	Poor	Very bad
Increase grassland farming on peatland fields	Satisfactory	Good	Good
Increase the cultivation of green manure fields	Satisfactory	Poor	Poor
Increase the cultivation of biogas fields	Satisfactory	Poor	Poor
Increase the carbon stock of decaying wood in commercial forests	Satisfactory	Poor	Good
Transition moderately to continuous cover forestry also in growth sites other than mires	Unknown, impossible to estimate	Unknown, impossible to estimate	Unknown, impossible to estimate
Improve the assessment and management of forest damage risks	Unknown, impossible to estimate	Unknown, impossible to estimate	Unknown, impossible to estimate
Increase the rotation period in a targeted manner in (1) sites where biodiversity is expected to have a significant climate impact and in (2) sites with a large impact on carbon stocks and sequestration (old forests + soil impact)	Very good	Good	Average
Increase the use of long-lasting wood products	Unknown, impossible to estimate	Unknown, impossible to estimate	Good
Let forests grow denser (influence the degree of thinning)	Unknown, impossible to estimate	Good	Poor
Moderately increase the use of organic soil conditioners to increase the carbon stock of agricultural soil (including compost, biomass-derived black carbon and soil improvement fibres)	No impact	Very bad	Good

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