# National Forestry Accounting Plan
# 2021-2025
Estonia

# OVERVIEW

This National Forestry Accounting Plan (NFAP) has been prepared according to requirement by "LULUCF Regulation", *Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU*[1].

The LULUCF Regulation requires the EU Member States to submit their NFAPs, including a proposed forest reference level (FRL), to the Commission by 31st of December 2018 for the period from 2021 to 2025.

This Estonian National Forestry Accounting Plan for the period of 2021-2025 has been prepared in cooperation by Forest Department of the Ministry of the Environment and Estonian Environment Agency (EstEA).

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[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.156.01.0001.01.ENG&toc=OJ:L:2018:156:TOC

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# ACRONYMS

| | |
|---|---|
| BAU | Business As Usual |
| BAWS | Biomass Available for Wood Supply |
| C | Carbon |
| CCADP | Climate Change Adaptation Development Plan |
| $CO_2$ | Carbon dioxide |
| CP | Compliance period |
| EstEA | Estonian Environment Agency |
| EU | European Union |
| EFDP | Estonian Forestry Development Plan |
| FAWS | Forest Available for Wood Supply |
| FMP | Forest management practice |
| FRL | Forest Reference Level |
| GHG | Greenhouse gas |
| GHGI | Greenhouse gas inventory |
| HWP | Harvested Wood Product(s) |
| IPCC | Intergovernmental Panel on Climate Change |
| IPCC GL | IPCC Guidelines |
| IRW | Industrial roundwood |
| LULUCF | Land Use, Land Use Change and Forestry |
| MFL | Managed Forest Land |
| NA | Not Applicable |
| NCDP | Nature Conservation Development Plan |
| NDPES | National Development Plan of the Energy Sector |
| NFAP | National Forestry Accounting Plan |
| NFI | National forest inventory |
| NIR | National inventory report |
| RP | Reference period |
| SOM | Soil organic matter |
| SQC | Site quality class |
| t | Tonne |
| T1, T2, T2 | Tier 1, Tier 2, Tier 3 |
| UNFCCC | United Nations Framework Convention on Climate Change |

# 1. GENERAL INTRODUCTION

## 1.1 General description of the forest reference level for Estonia

According to the LULUCF regulation[2], Forest Reference Level (FRL) is an estimate, expressed in tonnes of $CO_2$ equivalent per year, of the average annual net emissions or removals resulting from managed forest land within the territory of an Estonia in the period of 2021 to 2025, based on the criteria set out in the Regulation.
The FRL for the period of 2021 to 2025 was calculated by Estonian Environment Agency. The data used for FRL calculations mostly originates from NFI (National Forest Inventory), FAOSTAT and Statistics Estonia.
For the calculation of FRL, all forest land is considered managed in Estonia – the whole forest land in Estonia is or has been covered with forest management plans. Protected forests are covered with the protection scheme. Managed forest land was distributed into 3 different strata: forest category, dominant tree species and site quality class. Forest reference level with and without HWP was calculated. FRL for Estonia for the period 2021-2025 has been estimated to -1.89 Mt $CO_2$ eq per year (Table 1.1).

**Table 1.1** Average annual carbon stock changes, other emissions and the resulting FRL for managed forest land in Estonia 2021-2025

| *[Mt $CO_2$ ]* | *2021-2025* |
|---|---|
| *Living biomass* | -0.60 |
| *Non-biomass pools* | -0.88 |
| *HWP* | -0.41 |
| | |
| *TOTAL without HWP* | **-1.48** |
| *TOTAL with HWP* | **-1.89** |

## 1.2 Consideration to the criteria as set in Annex IV of the LULUCF Regulation

Annex IV of the LULUCF Regulation lists the criteria a Member State's FRL determination has to be in accordance with.

Estonian FRL is consistent with the goal of achieving a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century, including enhancing the potential removals by ageing forest stocks that may otherwise show progressively declining sinks. The above-mentioned goal is in line with sustainable forest management practises in Estonia which are supported by long-term forest policies in order to meet future demands for energy and timber and to substitute fossil based energy production while maintaining biodiversity.

FRL ensures that the mere presence of carbon stocks is excluded from accounting. The same principle was affirmed in Decision 16/CMP.1 under the Kyoto protocol[3]. Its objective is related to enhancing the carbon stocks and the net carbon sinks where possible instead of just

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.156.01.0001.01.ENG&toc=OJ:L:2018:156:TOC
[3] FCCC/KP/CMP/2005/8/Add.3

preserving already existing carbon stocks. The FRL is calculated in order to support accounting for differences in net changes in forest carbon stocks.

Also, the FRL ensures a robust and credible accounting system which assures that emissions and removals resulting from biomass use are properly accounted for. FRL is consistent with national GHGI reporting system as all C stock changes on MFL are accounted for in LULUCF sector. All C pools are included in the calculation of FRL and in the reporting for Estonia.

A carbon pool of HWP is included in FRL calculations. FRL provides a comparison between assuming instantaneous oxidation and applying the first-order decay function and half-life values as presented in Chapter 4.1.

For calculation of FRL, a constant ratio between solid and energy use of forest biomass as documented in the period from 2000 to 2009 is assumed. Same share of HWP commodities as for the RP was used to determine the projections for the CP. This means continuing with the same share of energy vs non-energy use of wood as documented in the historical RP.

The calculated FRL is consistent with the objective of contributing to the conservation of biodiversity and the sustainable use of natural resources, as set out in the EU forest strategy, Estonia's national nature conservation and forest policies, and the EU biodiversity strategy. In the calculation of FRL for Estonia biodiversity objectives and restrictions for sustainable use of forest resources have been taken into account. Biodiversity and timber production among others are important components of sustainable forest management according to Estonian Forest Act. Forest biodiversity protection follows the principle to protect forests that have high conservation value.

The FRL is consistent with the national projections of anthropogenic GHG emissions by sources and removals by sinks reported under Regulation (EU) No 525/2013. Both, the FRL and the projections under regulation (EU) 525/2013 include the same C pools. The reporting under the named regulation is a business as usual projection which may deviate to some extent from the FRL because of assumptions made.

In addition, the FRL is consistent with GHGI and relevant historical data based on transparent, complete, consistent, comparable and accurate information. The model that is used to construct the FRL is able to reproduce historical data from the GHGI as the same data sources and similar methodology (same definitions of C pools, same guidelines, etc) has been used for calculating FRL.

# 2. PREAMBLE FOR THE FOREST REFERENCE LEVEL

For the calculation of FRL, Estonia has taken into account all requirements set out in LULUCF regulation and has also used suggestions in guidance document[4] shared by the European Commission on developing and reporting the FRL in accordance with the regulation. FRL for the period of 2021-2025 takes into account all relevant carbon pools and GHGs. Consistency between carbon pools have been demonstrated in chapter 2.2. General approach for estimating the forest reference level is based on forest management planning regulation and felling coupe calculations. Forest management practices for the reference period and documentation of data

[4] https://publications.europa.eu/en/publication-detail/-/publication/5ef89b70-8fba-11e8-8bc1-01aa75ed71a1/language-en

sources are described in chapter 3.1. Managed forest land was designated into three different strata: forest category, dominant tree species and site quality class (chapter 3.2.1). Modelling steps of the FRL are listed and described in chapter 3.3. Check list for the elaboration of Forest Reference Level is presented in Annex I.

## 2.1 Carbon pools and greenhouse gases included in the forest reference level

The same C pools and gases have been estimated in the managed forest land (Managed forest land) in GHGI category as were used in the construction of the FRL. In line with the LULUCF regulation, the following $CO_2$ pools are included in the calculation of forest reference level: above- and below-ground biomass, dead wood, mineral and organic soils (emissions from mineral soils and drained organic soils) and harvested wood products. Litter pool and all other additional pools will be added with the technical correction during the commitment period.

## 2.2 Demonstration of consistency between the carbon pools included in the forest reference level

All carbon pools are calculated corresponding to the IPCC GL and consistent with the GHGI[5] thus only a summary is provided in this document. Activity data is derived mostly from NFI but FAOSTAT and Statistics Estonia data is also used for HWP calculations.

For estimating carbon stock changes in living biomass and dead wood for the Managed forest land, the *Tier 2* approach and *Method 2* – the stock-difference method was applied. Stock-difference method for biomass also comprises carbon loss from biomass burning and natural disturbances.

Soil carbon estimates are calculated using the emission factors from Sweden[6] both for mineral and drained organic soils; this approach was suggested for Estonia by ERT[7]. Estonia is currently working on projects to provide country specific emission factors for soils.

The carbon estimate for HWP has been calculated using the production approach[8]. HWP calculations include following products: solid wood (sawnwood and wood panels), paper (paper and paperboard) and semi-chemical wood pulp. The changes in roundwood stocks and their carbon balance are not taken into account in the reporting. The CO2 emissions form HWP in solid waste disposal sites are also excluded from the calculations.

## 2.3 Description of the long-term forest strategy

Estonian Forest Policy was approved by the parliament in 1997[9]. Long-term forest strategy in Estonia is determined by different adopted national policies. One of the most important and direct forest strategy documents is Estonian Forestry Development Plan (EFDP) compiled for every 10 years. In addition to EFDP and other policies there are also Estonian Environmental

[5] https://www.envir.ee/sites/default/files/nir_est_1990-2016_15.01.18_submission.pdf
[6] Sweden NIR 2017, Annexes, Table A3:2.2, p. 106
[7] FCCC/ARR/2012, para. 94.
[8] 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Chapter 2.8. p. 2.109.
[9] https://www.riigiteataja.ee/akt/73663

Strategy 2030, Climate Change Adaptation Development Plan until 2030, National Development Plan of the Energy Sector until 2030, Nature Conservation Development Plan and Climate Policy until 2050 that play an important role in long-term forest strategy.

### 2.3.1 Overall description of the forests and forest management in Estonia and the adopted national policies

*Forests and forest management*

According to Estonian Forest Act[10] forest and forest land are being separated. Forest is an ecosystem that consists of forest land that is covered by vegetation and where living fauna is present. Forest land on the other hand, is land that meets at least one of the following requirements:

1) is registered in land cadastre as forest land;
2) has an area of 0.1 hectares of land, growing woody plants with a minimum height of 1.3 meters and the tree crown cover at least 30 per cent.

Forest land that is entered into land cadastre and where woody plants are not grown is forest land without forest. If forest land meets the criteria described in point 2, it is called forest land with forest.

GHGI definition of forest land differs from the one by Forest Act. Parameters for managed forest land according to the LULUCF regulation are shown in Table 2.1.

**Table 2.1**. Parameters for forest definition

| | |
|---|---|
| Minimum tree crown cover | 30% |
| Minimum land area | 0.5 ha |
| Minimum tree height | 2 m |

Based on the GHGI definition of forest land 2017 National Forest Inventory (NFI) data and information from Estonian Environment Agency, there were 2.35 million ha of forest land in in Estonia that made up to 51.9% of the whole terrestrial area. 2.2 million ha of the forest land was covered by forest. Total area of forest land has slowly increased in Estonia. 51% of the forest land belongs to the state and privately owned forests make up to 49%. There is 1.8 ha of forest land per capita in Estonia.

In recent years area of forest under protection has increased as well. In 2017 there was 13.1% of forest land that was strictly protected and 12.5% of forest land was determined as with management restrictions. Protected forests therefore form 25.6% of Estonian forest land. The share of forest land area that is strictly protected, has increased but the share of forest land area with management restrictions has decreased in this century.

After Estonia restored its independence land reform was initiated and after 25 years it is in final stages by 2017. Significant part of the land that had no owner was finally privatized or obtained by state.

There is a lot of mature forest stands in Estonia[11]. Approximately 39% of forest stands are more than 60 years old. The total area of Estonian forest stands is 2.2 million ha of which the biggest part – 551 800 ha – constitute of stands in age 41-60 years. The most common tree species in Estonian forests are pine, birch, spruce, grey alder, aspen and black alder. Based on expert

[10] https://www.riigiteataja.ee/en/eli/ee/528062018009/consolide/current
[11] https://www.keskkonnaagentuur.ee/et/uudised/eesti-metsad-2017

opinion by Environment Agency, the annual increment for the whole forest land was about 16.1 million $m^3$ in 2017. Felling rates in 2016 (NFI) and 2017 (expert evaluation) were 10.7 $m^3$ and 11 million $m^3$ per year accordingly[12].

### *Policies*

#### Estonian Forest Policy

Estonian Forestry is based on Estonian Forest Policy[13] (1997). According to Estonian Forest Policy, forestry development has two general objectives that are inseparable and come from each other. Those objectives are:

1) sustainable (steady, continuous and versatile) forestry which means maintenance and usage of forests and forest land in a way and pace that ensures their biological diversity, productivity, regeneration ability, viability and potential today and also in the future without damaging other ecosystems to fulfil ecological, economic and social functions on local, national and global level;
2) efficient management of forests which means economical production and usage of all forestry related goods in both short and long term perspective.

#### Estonian Forestry Development Plan

The most important long-term forest strategy document is Estonian Forestry Development Plan that is compiled in every 10 years. The valid EFDP was adopted by parliament in 2011. Its main goal is to ensure productivity, vitality and diverse and efficient use of forests. In order to achieve this goal several activities are determined. In the long term, it is determined, that wood is used as renewable natural resource in wood industry and energetics up to increment. Also, in order to maintain forest productivity, forest renewal activities will be carried out at least on half of the renewal cutting sites. And, in order to maintain good state of populations of endangered species and species most common for Estonia, at least 10% of the area of forest land has been taken under strict protection and representativeness of protected forests have been improved.

More precise activities and goals of EFDP until 2020 can be found in the document[14]. EFDP for the period of 2021-2030 will be compiled in 2019 and 2020.

#### Nature Conservation Development Plan until 2020

Nature Conservation Development Plan until *2020*[15] (NCDP 2020) was adopted in 2012. From the NCDP 2020 standpoint the most important principle is that wood is harvested in a way and extent that ensures biodiversity, productivity, regeneration ability, viability and potential of forests today and also in the future. In managed forests where are no nature conservation restrictions, key habitats where probability of appearance of endangered or rare forest species is high are protected according to Forest Act. In managed forests it is important to follow additional restrictions like leaving seed trees, dead and retention trees, avoiding monoculture stands, giving up forest fertilization, not using dangerous plant protection products (glyphosates) and avoiding construction of new drainage systems in order to support conservation of forest biota.

[12] Eesti Metsad 2017, https://www.envir.ee/sites/default/files/eesti_metsad_2017_v5_vaiksem_.pdf
[13] https://www.riigiteataja.ee/akt/73663
[14] Estonian Forestry Development Plan until 2020,
https://www.envir.ee/sites/default/files/elfinder/article_files/mak2020vastuvoetud.pdf
[15] https://www.cbd.int/doc/world/ee/ee-nbsap-v2-en.pdf

### Estonian Environmental Strategy 2030

Estonian Environmental Strategy 2030 describes forest related trends, objectives and measures in Estonia[16]. The document supports the conception of diverse use of forests that is emphasized in Forest Policy. Subchapter 5.1.4 "Forest" of the Environmental Strategy has an objective of balanced satisfaction of ecological, social, cultural and economic needs in the course of utilisation of forests in a long perspective (longer than the period of 25 years). Forests must offer economic benefits (timber, mushrooms, berries and other forest products) and socio-cultural benefits like recreation and hiking possibilities and cultural-historical sites (such as sites of ancient sacred groves, etc.). At the same time, the diversity, balance and regeneration capacity of forest ecosystems must be preserved. The strategy also supports the development of a system of incentives, benefits and regulations with a view to encouraging the management and sustainable utilisation of multifunctional forests.

### Climate Change Adaptation Development Plan until 2030

According to Climate Change Adaptation Development Plan until 2030[17] (CCADP 2030) the objective of forestry is to ensure sustainable forest management in changing climatic conditions. Due to higher temperatures and increased precipitation primary production of ecosystems are estimated to enhance in the future but at the same time degradation of organic matter and thus greenhouse gas emissions related to this process will also increase. Estonian winters are expected to be warmer due to climate change and soils would not freeze up which would make forest harvesting difficult and increases occurrence of winter storm damage in excessively moist forests with surface root systems. Climate change affects the spread and coherence of forest habitats, biological diversity, inter-species relationships and forest habitat types.

According to CCADP 2030, climate change may affect functioning of important bio-economy sectors in Estonia, including the forest sector through i.e. changes in species composition, production capacity and ecological status. CCADP 2030 emphasizes the need for increased investments in sustainable forest management and public awareness raising about the benefits of forests and wood, to secure viability of forests and its productive functions, long term use of wood and thus increased sequestration of CO2 by forests and storing in long term forest products.

### National Development Plan of the Energy Sector until 2030

National Development Plan of the Energy Sector until 2030 (NDPES 2030)[18] was approved by the Government in October 2017. The NDPES 2030 describes the objectives of Estonia's energy policy until 2030, the vision for the energy sector until 2050, as well as the overall and specific targets and actions to meet them.

According to NDPES 2030 wood including forestry and timber industry waste, makes a significant contribution to Estonia's fuel sector. Low-quality wood and timber waste are increasingly used in heat and electricity generation. Most of the wood used in Estonian energy sector comes from Estonian forests. Due to development of renewable energy, wood based fuels (pellets, wood chips etc) have become goods traded in world markets with price that forms in balance of demand and supply. The increased use of wood in the energy sector can have a

[16] Estonian Environmental Stragegy 2030,
https://www.envir.ee/sites/default/files/keskkonnastrateegia_inglisek.pdf
[17] Climate Change Adaptation Development Plan until 2030,
http://www.envir.ee/sites/default/files/national_adaptation_strategy.pdf
[18] https://www.mkm.ee/sites/default/files/ndpes_2030_eng.pdf

negative impact on the carbon sequestration capacity and greenhouse gas emissions, with the consequence of reducing Estonia's opportunities for meeting its international obligations and participating in the international market of greenhouse gas emissions.

**Climate Policy until 2050**

Climate Policy until 2050[19] was adopted by the parliament (Riigikogu) in April 2017. According to Climate Policy 2050, step by step wider introduction of domestic renewable energy sources in all sectors of final consumption is encouraged with a view to increasing the welfare of society and the need to ensure energy security and security of supply. Wide consumption of local bioenergy and other renewable energy resources are encouraged for production of electricity and heating energy as well as for transportation fuel.

Climate policy describes guidelines for forestry and land use sector. First guideline says that forest growth and the carbon sequestration capacity will be increased through productive and sustainable forest management, and the carbon stock of forests will be maintained in the longer perspective. The productivity of managed forest land will be mainly increased through improvement cutting, timely cutting of forest stands and fast renewal of forests with tree species appropriate for the habitat type. Flexible rotation ages considering the growth potential of forest stands will be implemented in managed forests, and the principles of sustainable forestry and the maintenance of biodiversity will be taken into account.

Also, timber use will be consistently enhanced and the carbon stock in wood products and buildings will be increased, thus replacing the use of non-renewable natural resources. The use and production of domestic wood products will be developed, e.g., the use of wood in construction will be increased.

Another guideline says that preservation of the current area under forest land will be facilitated, and in other categories of land use, techniques of increasing carbon sequestration and reducing emissions will be preferred. Trends in the land use sector will be monitored and considered in planning.

Also, it is determined that research, development and innovation fields that help to increase carbon sequestration and find alternative uses for wood will be preferred in the forestry and land use sector.

### 2.3.2 Description of future harvesting rates under different policy scenarios[20]

According to the LULUCF Regulation, a Member State has to submit information on how harvesting rates are expected to develop under different policy scenarios.

Taking into account existing measures and adopted policies that overlap the commitment period of NFAP (2021-2025) the following scenarios were analysed.

Future harvesting rates in Estonia depend on adopted and planned policies. The adopted policies that may have impact on felling rates up to 2030 are National Development Plan of the Energy Sector until 2030 (NDPES 2030) and Climate Policy until 2050. Also, the great impact on felling rates might be determined by Estonian Forestry Development Plan until 2030. The EFDP

[19] https://www.envir.ee/sites/default/files/low_carbon_strategy_until_2050.pdf

[20] The study is conducted on the bases of Estonian forest definition and not on the GHGI forest definition. Definitions are in 2.3.1.

2030 will be compiled in the next two years and therefore the impacts to felling rates are unknown at this time.

In the first half of 2018 a study about possible final felling areas was carried out by Estonian Environment Agency (EstEA) and commissioned by the Ministry of the Environment. The study serves as a basis for information both in compilation of Estonian Forestry Development Plan for the period of 2021 to 2030, and also provides valuable information for the compilation of the NFAP for the period of 2021 to 2025.

The study states that the age structure of managed forests of Estonia are dominated by mature stands (average age of stands is quite high compared to rotation age). Therefore, the forests' rejuvenation by final fellings is reasonable. The intensity of final fellings is a bases for different options to calculate optimum final felling area (allowable cut). It is assumed that felling according to allowable cut (considering final felling area by years and tree species) will avoid excessive variation in total felling volume.

Calculations in the study have been made for commercial forests and protection forests that all together are considered as forest available for wood supply (FAWS). Commercial forests are the ones where forest management is allowed according to Forest Act and other legal documents based on Forest Act. Final felling is allowed depending on the age of the stand, diameter and fullness of the stand. Age and diameter of the stand where final felling is allowed are described in Table 2.2 and Table 2.3. Protection forests are the ones where management activities are limited but not prohibited. Protected forests are left out of the calculations.

**Table 2.2.** Allowed final felling age (years) by site quality class and tree species

| **Species** | **Site quality class** | | | | | |
|---|---|---|---|---|---|---|
| | **1A** | **1** | **2** | **3** | **4** | **5; 5A** |
| Pine | 90 | 90 | 90 | 100 | 110 | 120 |
| Spruce | 60 | 70 | 80 | 90 | 90 | 90 |
| Birch | 60 | 60 | 70 | 70 | 70 | 70 |
| Aspen | 30 | 40 | 40 | 50 | 50 | - |
| Black Alder | 60 | 60 | 60 | 60 | 60 | 60 |
| Hard deciduous trees* | 90 | 90 | 100 | 110 | 120 | 130 |

*Oak, Ash, Maple, Elm

**Table 2.3.** Allowed final felling diameter (cm) by site quality class and tree species

| **Species** | **Site quality class** | | | | | |
|---|---|---|---|---|---|---|
| | **1A** | **1** | **2** | **3** | **4** | **5; 5A** |
| Pine | 28 | 28 | 28 | 28 | 28 | 28 |
| Spruce | 26 | 26 | 26 | 26 | 26 | 26 |
| Birch | 26 | 26 | 24 | 22 | 18 | 16 |
| Black Alder | 24 | 24 | 22 | 22 | 18 | 16 |
| Aspen | 20 | 20 | 18 | 18 | 18 | 18 |

The method of calculations has been used for calculation of allowable cutting level scenarios for the National Forestry Development Plan until 2020. Calculation rules of an allowable cut are described in the Forest Management Planning Regulation[21].

Three different optimum final felling scenarios were calculated.

- Scenario A is maximum allowable felling. In this case there is presumption that all stands that have reached the allowed felling age or diameter will be cut during the next ten years (maturity stand).
- Scenario B presents the BAU according to EFDP 2020. This scenario represents the optimum usage of forest resources taking into account the present age structure of stands today and during the next 40 years.
- Scenario C represents long term uniform final felling. In this case an average even annual final felling area is assumed during the whole rotation period.

According to the scenario A, average annual final felling for the period from 2021 to 2025 in FAWS could reach 19.8 million $m^3$. The same estimate for the scenario B is 11.8 million $m^3$ per year and for the scenario C it is 8.6 million $m^3$.

Scenario B is a compromise between the timely felling of mature stands and long term uniform wood harvest.

The study also provides information on how different final felling rates' scenarios affect forest growing stock and increment in a long run. Total growing stock figures include protected forests. The following Table 2.4 illustrates the named changes up to the year 2050.

**Table 2.4.** Changes in FAWS growing stock, total growing stock and increment (million $m^3$)

| Year | BAU-EFDP2020 (scenario B) | | | Maximum final felling (scenario A) | | | Uniform final felling (scenario C) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Growing stock (FAWS) | Total Growing stock | Increment | Growing stock (FAWS) | Total Growing stock | Increment | Growing stock (FAWS) | Total Growing stock | Increment |
| 2020 | 413.0 | 486.0 | 14.0 | 413.0 | 486.0 | 14.0 | 413.0 | 486.0 | 14.0 |
| 2030 | 354.0 | 435.9 | 12.0 | 289.1 | 371.0 | 10.4 | 389.8 | 471.7 | 12.8 |
| 2040 | 327.8 | 415.5 | 11.6 | 287.3 | 375.0 | 11.0 | 369.6 | 457.3 | 12.4 |
| 2050 | 311.4 | 405.5 | 11.7 | 290.0 | 384.1 | 11.8 | 352.4 | 446.5 | 12.3 |

According to the results of the calculations presented in Table 2.4, irrespective of forest felling scenarios, both growing stock of FAWS as well as annual increment are expected to decline in the next 30 years.

[21] https://www.riigiteataja.ee/akt/13124148?leiaKehtiv

# 3. DESCRIPTION OF THE MODELLING APPROACH

Activity data for FRL calculations mainly comes from NFI but information about HWP commodity production and foreign trade originates from FAOSTAT and Statistics Estonia.

All forest land is considered managed in Estonia – the whole forest land in Estonia is or has been covered with forest management plans. In addition, protected forests are covered with the protection scheme.

Estonia applies the same forest definition for FRL as is used for National Greenhouse Gas Inventory. The main parameters of forest definition are shown in Table 2.1. Method for calculation of FRL does not consider future climate effects.

## 3.1 Description of the general approach as applied for estimating the forest reference level

General approach for estimating the forest reference level is based on forest management planning regulation[22] and felling coupe calculations[23]. Similar methodology has been widely used to forecast allowable cutting limits, roundwood supply, future forest age- and volume structure, (forestry development plans[24], wood supply scenarios for forestry development pan[25], felling plans for state forests[26]) Estonian forests are mostly even-aged and predominant final felling type is clear felling in forest available for wood supply. Shelterwood cuttings are being used seldom.

Forest management regulation sets rotation ages according to dominant tree species and site quality classes.[27] Final fellings for the next period include stands which exceed rotation age during the planning period. Method of shifting the areas of age classes is used for modelling the future growing stock development. The growing stock volume is obtained multiplying the area in age class with average growing stock per hectare in relevant age class. The influence of intermediate fellings (cleanings, thinnings and sanitation fellings) is reflected in the average growing stock per hectare, thus those felling types are not separately considered in calculations. The management practise of intermediate fellings has not changed compared to RP. Intermediate fellings do not alter the age of stands and it is assumed that all stands in one age class reach next age class. The natural disturbances are also indirectly taken into account according to the same logic. This method ensures robust and credible accounting, to guarantee that emissions and removals resulting from biomass are properly accounted.

### 3.1.1 Management practices for reference period (RP)

Estonian management practices have been defined by limits set in Forest Act[28] and Forest management regulation. During the RP those limits were changed several times. Rotation ages differ a lot by dominant tree species and site quality classes. In addition to rotation ages there

[22] https://www.riigiteataja.ee/akt/13124148?leiaKehtiv
[23] https://www.riigiteataja.ee/aktilisa/1310/8201/8008/KKM_16012009_m2_Lisa18.pdf#
[24] https://www.envir.ee/sites/default/files/mak2020vastuvoetud.pdf
[25] https://www.envir.ee/sites/default/files/elfinder/article_files/puidupakkumine-arvutustearuanne.pdf
[26] https://www.rmk.ee/files/Metsavarude%20prognoos%202011_2040%20_kokkuv%C3%B5te.pdf
[27] https://www.riigiteataja.ee/akt/126022014016?leiaKehtiv
[28] https://www.riigiteataja.ee/akt/130122015032?leiaKehtiv

are several additional options for final fellings: final felling according to maturity diameter (by dominant tree species and site quality classes), final fellings by health reasons, clear fellings as a result of low stocking level. There are several additional requirements for final fellings: maximum felling area, recommendation to retain certain amount of deadwood, seed trees and retention trees for biodiversity reasons on the felling site.

Besides forest available for wood supply there are also strictly protected forest i.e. areas where fellings are prohibited. Protected areas are treated separately from forests available for wood supply.

As described above in forests available for wood supply there are several possibilities and restrictions for final fellings in Estonia. For modelling these are converted to one dimension – rotation age according to dominant tree species and site quality classes (SQC) as illustrated in Table 3.1.

**Table 3.1.** Rotation ages used in calculation of the RP intensity of final fellings

| Dominant species | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pine | | Spruce | | Birch | | Aspen | | Black Alder | | Grey alder | | Other | |
| SQC | Age | SQC | Age | SQC | Age | SQC | Age | SQC | Age | SQC | Age | SQC | Age |
| 1 | 90 | 1 | 80 | 1 | 60 | 1 | 35 | 1 | 60 | 1 | 30 | 1 | 80 |
| 2 | 90 | 2 | 80 | 2 | 70 | | | | | | | | |
| 3 | 100 | 3 | 90 | 3 | 70 | | | | | | | | |
| 4 | 115 | 4 | 90 | 4 | 70 | | | | | | | | |

Forest area in Estonia has a slightly growing trend in recent years. Forest area in CP is estimated considering areas of afforestation and reforestation entering in managed forest land in CP.

The growing stock change between 2020 and 2025 is modelled using management practices and harvesting intensity during RP. $CO_2$ stored in biomass is calculated from growing stock figures based on IPCC GL methodology[29].

$CO_2$ stored in soil and dead wood in CP is estimated by using average content per hectare in RP.

Reference level for HWP pool is based on the projected harvest level during the CP. Same fraction of harvest for the HWP commodity production as in RP is assumed. Same share of HWP commodities as for the RP is used to determine the projections for the CP. This means continuing with the same share of energy vs non-energy use of wood as documented in the historical RP.

## 3.2 Documentation of data sources as applied for estimating the forest reference level

The main data source for the FRL and GHGI is NFI. The Estonian NFI covers all land-use categories: forests and other wooded lands in all ownership groups, including protected areas. The first National Forest Inventory covering the whole country commenced in 1999. The main objective of the NFI is to provide the estimates about major characteristics of forests, but nowadays the NFI also gives information about subjects such as the distribution of land by land-use categories and the afforestation and growing stock of non-forest land etc.

[29] IPCC 2006, Vol 4 (AFOLU), Equation 2.8, p. 2.12.

Design of the Estonian NFI is a systematic sample without pre-stratification. The network of sample plots covers the whole country and is planned as a five-year cycle. The sampling grid is designed to meet the accuracy requirements at national level. The sampling intensity is the same throughout the whole country. The sample (cluster) distribution is based on a national 5-km x 5-km quadrangle grid. Point estimates of parameters are calculated using data from the sample plots and form the basis for inferences to the entire population. More detailed information about sampling scheme, design and density of sampling grid is described by Adermann (2010)[30] and additional information concerning GHGI is described in NIR[31]. Main characteristics of forest land according to NFI is presented in Table 3.2.

**Table 3.2.** Distribution of forest land area and growing stock by dominant tree species in 2017

| Dominant species | Area | | Growing stock | | |
|---|---|---|---|---|---|
| | | | total volume | | volume per ha |
| | 1000 ha | % | 1000 $m^3$ | % | $m^3$/ha |
| Pine | 739.3 | 31.4 | 173 658 | 36.0 | 235 |
| Spruce | 441.9 | 18.8 | 94 802 | 19.6 | 215 |
| Birch | 694.2 | 29.5 | 123 467 | 25.6 | 178 |
| Aspen | 145.1 | 6.2 | 33 799 | 7.0 | 233 |
| Black alder | 87.8 | 3.7 | 18 300 | 3.8 | 209 |
| Grey alder | 207.1 | 8.8 | 32 631 | 6.8 | 158 |
| Others | 38.9 | 1.7 | 5 859 | 1.2 | 150 |
| Total | 2 354.3 | 100.0 | 482 516 | 100.0 | 205 |

Information about HWP commodity production and foreign trade originates from FAOSTAT and Statistics Estonia.

### 3.2.1 Documentation of stratification of the managed forest land

Managed forest land is distributed into 3 different strata: forest category, dominant tree species and site quality class. Strata are divided into subcategories that are assembled in Table 3.6. Forest category contains three different subcategories: forest available for wood supply, strictly protected forests and forest land subject to privatisation. Dominant tree species are Scots pine (*Pinus sylvestris)*, Norway Spruce (*Picea Abies)*, Birch (*Betula spp)*, Aspen (*Populus tremula)*, Black alder (*Alnus glutinosa)*, Grey alder (*Alnus incana)* and other species. Site quality class indicates the productivity of habitat and is expressed as index for all forest subcompartments or sites[32].

[30] Adermann, V. (2010). Estonia. *In*: Tomppo, E., Gschwantner, T., Lawrence, M., McRoberts, R. (eds). National forest inventories: Pathways for common reporting. Dordrecht: Springer, pp. 171–184.
[31] Greenhouse gas emissions in Estonia 1990-2016 National Inventory report. (2018).
[32] Calculation rules for site quality classes are described in Forest Management Planning Regulation (Annex 10, https://www.riigiteataja.ee/aktilisa/1310/8201/8008/KKM_16012009_m2_Lisa10.pdf# ), for practical use the site quality class tables have been calculated (Annex 8 of regulation https://www.riigiteataja.ee/aktilisa/1310/8201/8008/KKM_16012009_m2_Lisa7.pdf# ). There are 7 site quality classes used in Estonia (1a, 1, 2, 3, 4, 5, 5a). Site quality class is calculated using average height and age of dominant tree species of stand.

Corresponding to GHGI Estonia is not divided into geographic regions because the area is relatively small and homogeneous in terms of ecological conditions.

*Strata: forest category (3):*

- Forest available for wood supply - management is allowed according to different legal acts (Forest Act, Forest Management Planning Regulation, Forest Management Regulations, Nature Conservation Act, Water Act etc);
- Strictly protected forests– forest management activities are prohibited. Includes following protected areas: strict nature reserves, special management zones, species protection site special management zones, habitat protection forests;
- Forest land subject to privatization (forest land without owner and management) – after Estonia restored its independence land reform took almost 25 years. Significant part of the land had no owner during the RP and thus no possibilities for management. Land reform is in final stages by 2017 and area of this strata in CP can be considered as zero. During the RP a significant part of land was outside management activities. It is reasonable to take it account as separate strata, not to unduly constrain future forest management intensity.

Average distribution of forest land by dominant species and forest category in RP is shown in Table 3.3 and in

Table 3**.4**.

*Strata: dominant tree species (7):*

There are six main dominant species in Estonia, other species are assembled to strata other species. Main dominant species are: Scots pine *Pinus sylvestris*, Norway Spruce *Picea Abies*, Birch *Betula spp*, Aspen *Populus tremula*, Black alder *Alnus glutinosa*, Grey alder *Alnus incana*.

**Table 3.3.** Average distribution of forest land area by dominant species and forest category in 2000-2009

| | Dominant species | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Forest category | Pine | Spruce | Birch | Aspen | Black Alder | Grey Alder | Other species | Total |
| Forest available for wood supply | 21.0% | 12.7% | 21.8% | 4.0% | 1.9% | 6.4% | 1.1% | 68.9% |
| Strictly protected forests | 3.8% | 0.7% | 1.9% | 0.3% | 0.3% | 0.1% | 0.2% | 7.2% |
| Forest land subject to privatization | 8.1% | 4.2% | 6.8% | 1.3% | 0.8% | 2.2% | 0.4% | 23.8% |
| Total | 32.9% | 17.6% | 30.6% | 5.6% | 3.0% | 8.7% | 1.6% | 100.0% |

**Table 3.4.** Average distribution of forest land area by dominant species and forest category in 2017

| Forest category | Dominant species | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Pine | Spruce | Birch | Aspen | Black Alder | Grey Alder | Other species | Total |
| Forest available for wood supply | 25.2% | 16.8% | 26.3% | 5.5% | 3.2% | 8.5% | 1.4% | 86.9% |
| Strictly protected forests | 6.2% | 2.0% | 3.2% | 0.6% | 0.6% | 0.3% | 0.2% | 13.1% |
| Forest land subject to privatization | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Total | 31.4% | 18.8% | 29.5% | 6.2% | 3.7% | 8.8% | 1.7% | 100.0% |

### *Strata: site quality class (4):*

Pine, spruce and birch stands are separated to four quality classes. Aspen, black alder, grey alder and others are in one quality class (see in Table 3.5). Quality classes are defined in Forest Management Planning Regulation[33]. National quality classes I and Ia are combined to class 1. National quality classes IV, V, and Va are combined to class 4.

**Table 3.5.** Distribution of forest land area by dominant tree species and forest categories in 2000-2009 and 2017

| | Site quality class | | | |
|---|---|---|---|---|
| **Pine forests 2000-2009** | 1 | 2 | 3 | 4 |
| Forest available for wood supply | 14% | 20% | 15% | 14% |
| Strictly protected forests | 1% | 2% | 3% | 6% |
| Forest land subject to privatization | 6% | 7% | 6% | 7% |
| | | | | |
| **Pine 2017** | | | | |
| Forest available for wood supply | 30% | 23% | 14% | 13% |
| Strictly protected forests | 3% | 4% | 4% | 8% |
| | | | | |
| **Spruce 2000-2009** | 1 | 2 | 3 | 4 |
| Forest available for wood supply | 41% | 23% | 7% | 1% |
| Strictly protected forests | 1% | 2% | 1% | 0% |
| Forest land subject to privatization | 14% | 6% | 2% | 1% |
| | | | | |
| **Spruce 2017** | | | | |
| Forest available for wood supply | 67% | 16% | 5% | 1% |
| Strictly protected forests | 8% | 2% | 1% | 0% |
| | | | | |
| **Birch 2000-2009** | 1 | 2 | 3 | 4 |
| Forest available for wood supply | 22% | 29% | 14% | 6% |
| Strictly protected forests | 1% | 2% | 2% | 1% |
| Forest land subject to privatization | 7% | 9% | 5% | 2% |

[33] https://www.riigiteataja.ee/akt/131082018008

| | | | | |
|---|---|---|---|---|
| **Birch 2017** | | | | |
| Forest available for wood supply | 44% | 30% | 11% | 4% |
| Strictly protected forests | 4% | 3% | 1% | 2% |

### 3.2.2 Documentation of sustainable forest management practices as applied in the estimation of the forest reference level

Fixed rotation ages for RP used in calculations are defined in Forest Management Regulation[34]. Actual final felling ages were compared to rotation ages occurred in RP to verify the compliance of rotation ages.

In case of pine, spruce and birch rotation age was calculated:

- for site quality class 1 as average of domestic site quality classes Ia and I;
- for site quality class 4 as average of domestic site quality classes IV, V and Va.

In case of aspen, black alder, grey alder and other stands weighted average rotation age over the site quality classes (SQC) were used.

**Table 3.6.** Managed forest land stratification and management practises in RP

| Strata by forest category | Strata by dominant species | Strata by site quality class | Final felling age | % of area of stand* | Distribution between site quality class |
|---|---|---|---|---|---|
| Forest available for wood supply | Pine | 1 | 90 | 100% | actual area of final fellings in pine stands is distributed between site quality classes by share of pine stands exceeding felling ages |
| | | 2 | 90 | 100% | |
| | | 3 | 100 | 100% | |
| | | 4 | 115 | 100% | |
| | Spruce | 1 | 80 | 100% | actual area of final fellings in spruce stands is distributed between site quality classes by share of spruce stands exceeding felling ages |
| | | 2 | 80 | 100% | |
| | | 3 | 90 | 100% | |
| | | 4 | 90 | 100% | |
| | Birch | 1 | 60 | 100% | actual area of final fellings in birch stands is distributed between site quality classes by share of birch stands exceeding felling ages |
| | | 2 | 70 | 100% | |
| | | 3 | 70 | 100% | |
| | | 4 | 70 | 100% | |
| | Aspen | NA | 35 | 100% | NA |
| | Black Alder | NA | 60 | 100% | NA |
| | Grey Alder | NA | 30 | 100% | NA |
| | Other species | NA | 80 | 100% | NA |
| Strictly protected forests | Pine | 1 | NA | NA | NA |
| | | 2 | NA | NA | |
| | | 3 | NA | NA | |

[34] https://www.riigiteataja.ee/akt/12771900

| Strata by forest category | Strata by dominant species | Strata by site quality class | Final felling age | % of area of stand* | Distribution between site quality class |
|---|---|---|---|---|---|
| | | 4 | NA | NA | |
| | Spruce | 1 | NA | NA | NA |
| | | 2 | NA | NA | |
| | | 3 | NA | NA | |
| | | 4 | NA | NA | |
| | Birch | 1 | NA | NA | NA |
| | | 2 | NA | NA | |
| | | 3 | NA | NA | |
| | | 4 | NA | NA | |
| | Aspen | NA | NA | NA | NA |
| | Black Alder | NA | NA | NA | NA |
| | Grey Alder | NA | NA | NA | NA |
| | Other species | NA | NA | NA | NA |
| Forest land subject to privatization (forest land with no ownership) | Pine | 1 | NA | NA | NA |
| | | 2 | NA | NA | |
| | | 3 | NA | NA | |
| | | 4 | NA | NA | |
| | Spruce | 1 | NA | NA | NA |
| | | 2 | NA | NA | |
| | | 3 | NA | NA | |
| | | 4 | NA | NA | |
| | Birch | 1 | NA | NA | NA |
| | | 2 | NA | NA | |
| | | 3 | NA | NA | |
| | | 4 | NA | NA | |
| | Aspen | NA | NA | NA | NA |
| | Black Alder | NA | NA | NA | NA |
| | Grey Alder | NA | NA | NA | NA |
| | Other species | NA | NA | NA | NA |

* 100% share has been used in calculation despite the fact that certain amount of seed and retention trees are retained on final felling sites. Remaining volume is accounted in the stocking per hectare in age classes.

## 3.3 Detailed description of the modelling framework as applied in the estimation of the forest reference level

Only data from years 2000-2009 are used for stratification the forest in RP. Pine, spruce and birch stands are stratified by four site quality classes and aspen, black alder, grey alder and others by 1 site quality class. In modelling the final fellings it is assumed that all trees in one stand are felled. This assumption has been made despite the fact that certain amount of seed and retention trees are retained on final felling sites. Remaining volume is accounted in the stocking per hectare in age classes.

Starting year for the projection of the FRL is 2017. Reasons for this are:

- best available activity data. NFI is constantly evolving and later years have better data;
- to avoid the possible significant impacts of management practises for FRL during the period of 2010-2020;
- land reform is in final stages by 2017 and did not occur linearly;
- fellings in RP differed a lot (max in 2001 12.4 mil $m^3$, min in 2008 4.6 mil $m^3$).

Modelling steps:

1. forest area in each management practise is divided into 5-year age classes;
2. calculation of forest available for final fellings in RP is carried out by dominant tree species. In case of pine, spruce and birch the area available for final fellings is calculated separately for four site quality classes. The results are summarized into one total area available for final fellings by dominant tree species. The calculation of final felling area is applied only in case of forest available for wood supply. Protected forests and forest land subject to privatization are modelled without fellings;
3. calculation of final felling intensity for RP by dominant tree species as a share of performed final fellings from total area available for final fellings (see Table 3.7) Volume of shelterwood fellings were transponded into area of clear fellings dividing volume of shelterwood fellings with volume per hectare of clear fellings (by dominant tree species). This approach has been considered appropriate as shelterwood fellings decrease average stocking level per ha of mature stands.
4. calculation of average annual area of final fellings by dominant tree species for the period of 2017-2020 multiplying the area available for final felling by final felling intensity in RP. In case of pine, spruce and birch stands the area of final fellings in site quality classes is calculated using the distribution of mature stands;
5. modelling forest age-structure for year 2021 based on data from 2017 according to intensity of fellings during RP. For projection of age-structure development the method of shifting the areas of age classes is used. In case of a clear felled areas the dominant tree species of cut stand was used in calculations so area of the dominant species stays the same;
6. calculation of growing stock volume for 2021 multiplying the area in age class with average growing stock per hectare in relevant age class;
7. calculation of average annual area of final fellings by dominant tree species for the period of 2021-2025 according to step 4;
8. modelling forest age-structure for year 2025 based on projected data from 2021 according to intensity of fellings during RP (see step 5);
9. calculation of growing stock volume for 2025 multiplying the area in age class with average growing stock per hectare in relevant age class (see step 6);
10. calculation of annual change of $CO_2$ in 2021-2025 stored in biomass is calculated from growing stock figures based on IPCC methodology.

The illustrating forest biomass scheme can be found in Annex II.

**Table 3.7**. Area of mature forest, area of final felling and intensity of final fellings in RP

| Dominant tree species | Area of mature forest (1000 ha/year) | Area of final fellings in RP (1000 ha/year) | Intensity of final fellings per year |
|---|---|---|---|
| Pine | 58.2 | 4.9 | 8.4% |
| Spruce | 44.8 | 5.5 | 12.3% |
| Birch | 74.4 | 4.3 | 5.8% |

| Dominant tree species | Area of mature forest (1000 ha/year) | Area of final fellings in RP (1000 ha/year) | Intensity of final fellings per year |
|---|---|---|---|
| Aspen | 60.4 | 2.0 | 3.2% |
| Black Alder | 11.9 | 0.5 | 4.0% |
| Grey Alder | 77.2 | 2.3 | 3.0% |
| Other species | 7.0 | 0.0 | 0.0% |
| Total | 333.9 | 19.4 | 5.8% |

Used method was controlled and calibrated using NFI data for 2012 and 2017. Using forest characteristics from year 2012 forest growing stock in 2017 was estimated (using actual final felling data from years 2012-2017). Estimated growing stock and real growing stock in 2017 differed only 0.7%.

$CO_2$ stored in soil and dead wood in CP is estimated by using average content per hectare in RP. Detailed description of the transparent, complete, consistent, comparable and accurate information about the methodology used for the calculations is provided in National Greenhouse Gas Inventory[35].

Emissions from the HWP are calculated according to the methodology provided in chapter 2.8 in 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol. Forestry data originates from National Forest Inventory (NFI), foreign trade data from Statistics Estonia and production data from FAOSTAT. Reference level in HWP pool is estimated consistently with estimated harvest level during the CP. The quantity of wood products is predicted according to the RP practices.

IPCC GL default conversion factors and half-lives were used to calculate Paper and paperboard and Solid wood removals with the Tier 2 method. Tier 3 method was used to calculate carbon stock and emission from Semi-chemical wood pulp with country specific C conversion factor (0.4275 kt C/m3).

Modelling steps:

1. calculation of harvest for years 2018-2025 using previously calculated final felling areas multiplying the area of final fellings of mature stands (calculated in steps 4 and 7 in biomass calculations) in 2017-2020 and 2021-2025 with the average growing stock volume of mature stands in 2017; the result will be multiplied with coefficient 0.95 which ensures that the retained biomass of seed trees and retention trees on final felling sites is properly accounted.
2. calculation of IRW (industrial roundwood) production for years 2018-2025 using average share of IRW from harvest in 2013-2017;
3. calculation of share of IRW used for the HWP commodity production by dividing each HWP commodity with total average IRW production in 2013-2017;
4. calculation of yearly HWP production in 2018-2025 multiplying projected IRW production by share of IRW used for the HWP commodity production in 2013-2017;
5. calculation of wood originating from deforestation in 2018-2025 by multiplying the average share of deforestation from total harvest in 2000-2017 with projected harvest in 2018-2025;

[35] Greenhouse gas emissions in Estonia 1990-2016 National Inventory report. (2018).

6. calculation of share of domestic IRW in RP according to equation 2.8.1[36];
7. calculation of share of domestically produced wood pulp in RP according to equation 2.8.2[37];
8. calculation of average annual $CO_2$ stock change in HWP for the period 2018-2025 according to IPCC GL[38] for annual carbon stock changes in HWP pool with the shares from steps 5, 6 and 7.

The illustrating HWP scheme can be found in Annex III.

### 3.3.1 Assumptions concerning the development on MFL area during CP

Area of land allocated to each stratum remains constant from starting year (2017) of the projection. Dynamic development of managed forest land is assumed. Estimation of area gains is based on the historical area of land classified as "afforested land" reported in NIRs. If area reached the end of 20-year transition period it's moved to MFL category. To estimate area losses average area of deforestation in 2000-2017 is used. This approach is used for its simplicity and transparency and thus it is easier to compare CP yearly emissions to FRL. After CP technical correction will be presented to remove any erroneous estimates of carbon development simply caused by differences between the assumed area development and the area development that actually took place during the CP.

# 4. FOREST REFERENCE LEVEL

## 4.1 Forest reference level and detailed description of the development of the carbon pools

The main driver behind the managed forest land carbon pool is harvest rate. From 1999 to 2004, the rate of logging was more than twice as high as in the previous 10 years and the harvest rate peaked in 2001, which can be explained by the outcome of land reform (active management by new owners on resituated and privatised forest land) and the economic boom taking place in the early 2000s.

In coming years forest growing stock reaches the peak and then begins to decrease (Table 3.2). Therefore, it is also expected that $CO_2$ sequestration from forest land is going to decline (Figure 4.1).

[36] 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Chapter 2.8.1.2, p. 2.115.
[37] 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Chapter 2.8.1.2, p. 2.115.
[38] 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Chapter 2.8, p. 2.109-2.134.

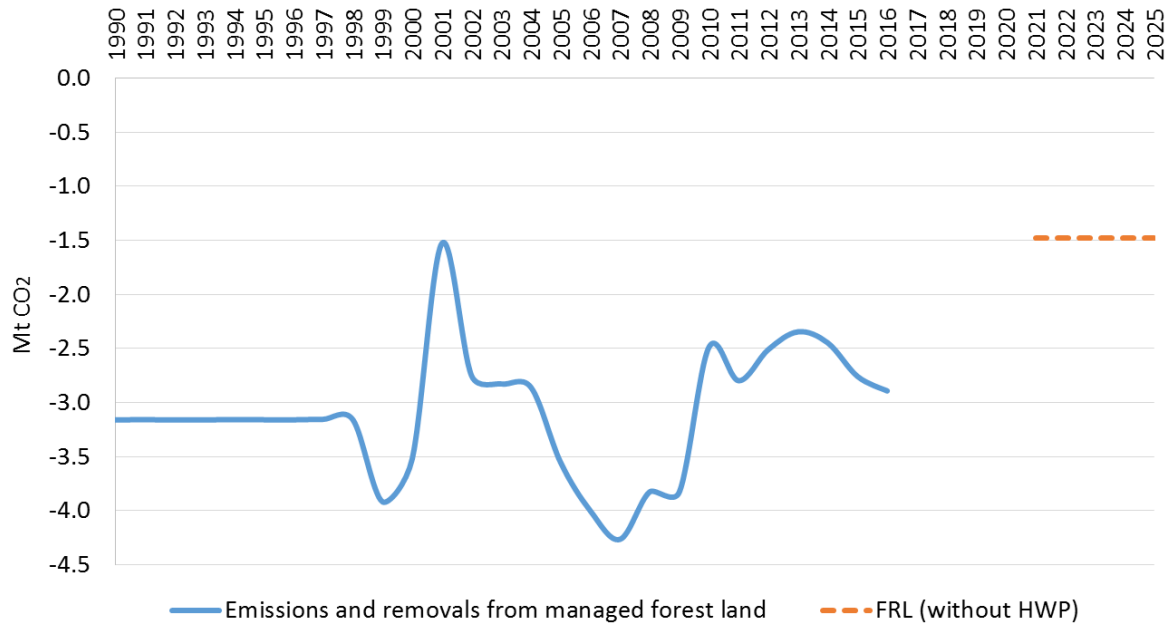



**Figure 4.1.** $CO_2$ emissions and removals from MFL and FRL without HWP

$CO_2$ stock in HWP is expected to grow. Reference level for HWP is strongly influenced by the share of domestic IRW in RP. In RP average annual fraction of feedstock for HWP production originating from domestic harvest[39] was 77%, in 2015-2017 the relevant share was 96%. It is projected that the production of HWP products will not increase in RP. Due to those reasons the reference level for HWP is also above the direction of trend (Figure 4.2).

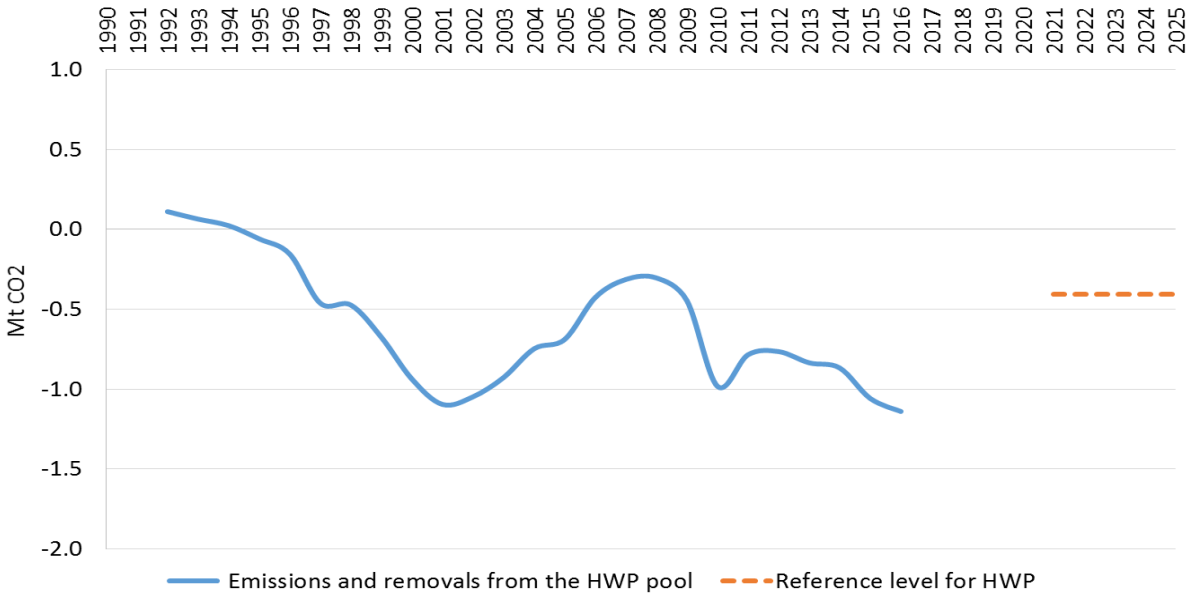



**Figure 4.2**. $CO_2$ emissions and removals from HWP pool and FRL for HWP

[39] 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Chapter 2.8.1.2, p. 2.115.

## 4.2 Consistency between the forest reference level and the latest national inventory report

Same methodology and emission factors are used for the calculation of FRL carbon pools as are used in the GHGI, maintaining consistency between those two documents. The only difference is that GHGI calculations are not stratified, but it does not affect the consistency.

## 4.3 Calculated carbon pools and greenhouse gases for the forest reference level

Estonia has proposed an FRL of -1.89 million tonnes of carbon dioxide equivalent (Mt $CO_2$ eq.) per year applying the first-order decay function for harvested wood products (HWP) and -1.48 Mt $CO_2$ eq. per year assuming instantaneous oxidation of HWP.

# Annex I

Check list for the elaboration of Forest Reference Level

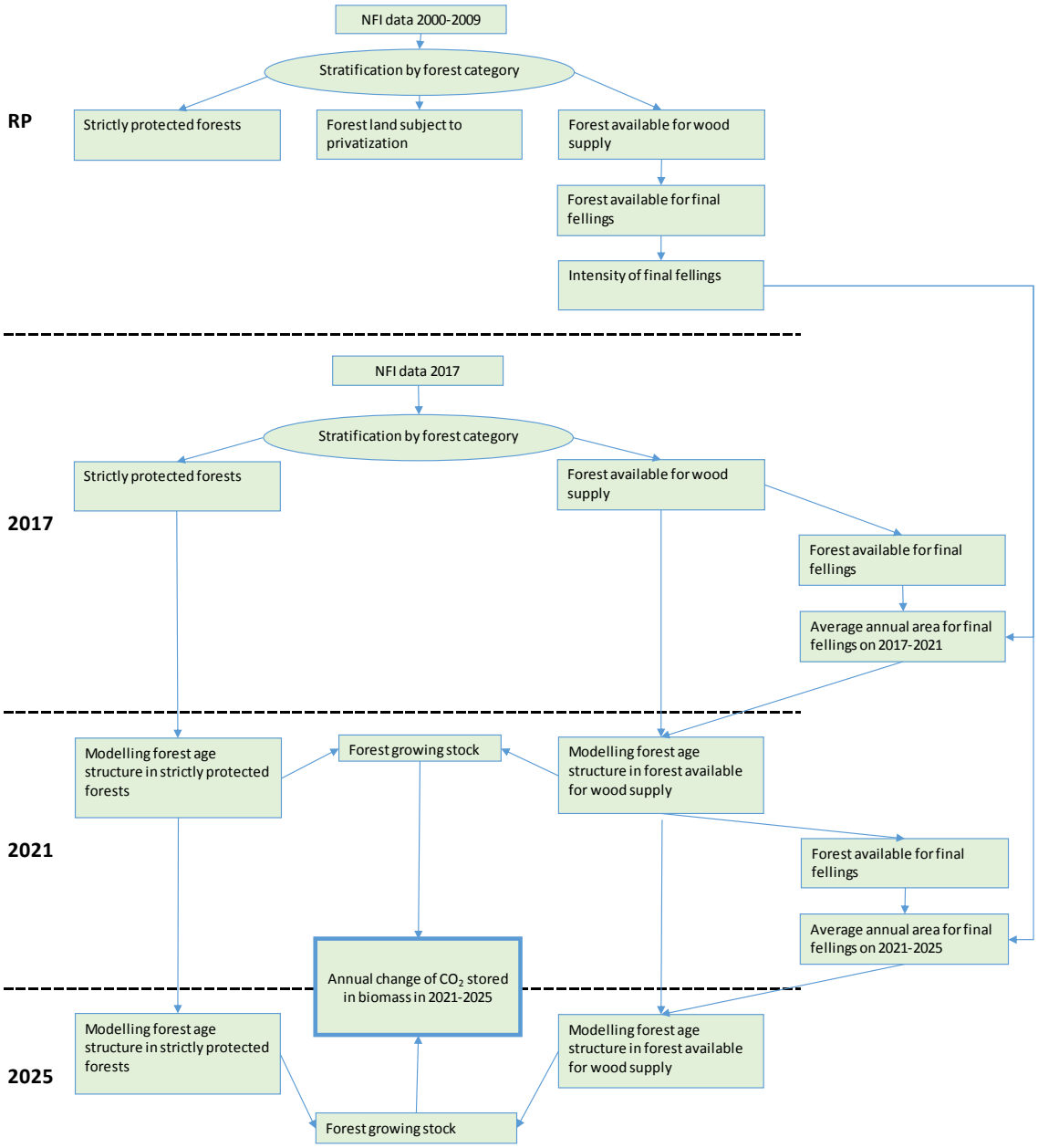
| **Step 1: Stratify the area of MFL, according to country-defined criteria, and apply the stratification in a consistent manner over time, including the RP 2000-2009.** | |
|---|---|
| **Information to be represented in NFAP** | **Explanation** |
| Document how the area of Managed Forest Land is considered in the determination of the FRL (Annex IV B.) of the LULUCF Regulation) | Chapter 1.1 |
| Document how large a share of the national forests was covered by a given FMP in the period from 2000 to 2009 | Table 3.3 and Table 3.6 |
| Document each criterion used for the stratification of the MFL. | Chapter 3.2.1 |
| Document data sources used to perform the stratification. | Chapter 3.2 and Chapter 3.2.1 |
| Document and justify any deviation between the stratification for the FRL and any stratification already used in the GHGI or NFI. | Chapter 3.2.1 |
| Document the sources of information used to determine the forest characteristics for each stratum (see Table 2 for an example of this can be documented). | Chapter 3.2 |
| Document the forest definition used for the construction of FRL and explain whether it differs from that used in the national GHGI. | Chapter 2.3.1 and Table 2.1 |
| **Step 2: Identify and document the FMPs in each strata for 2000-2009 based on country-defined operational criteria and quantifiable data.** | |
| **Information to be represented in NFAP** | **Explanation** |
| Document the sources of information used to identify and specify the FMPs. | Chapter 3.1.1 |
| Describe in qualitative terms each FMP as applied during the RP (see Table 3 for an example of how this can be documented). | Chapter 3.1.1and Table 3.6 |
| Describe in quantitative terms each FMP as applied during the RP (see Table 4 and Table 5 for examples of how this can be documented). | Chapter 3.1.1and Table 3.6 |
| Document the use of FMPs according to the stratification of the forest land (see Table 6 for an example of how this can be documented). | Table 3.6 |
| Verify that the documentation of the FMPs include specifications about: (i) how each management activity is performed, and (ii) when is each management activity being carried out. | Chapter 3.2.1 |
| Check that the above descriptions of FMPs and forest characteristics include a description of the following forest characteristics (Annex IV B.):<br>- dynamic age-related forest characteristics<br>- increments<br>- rotation length | Chapter 2.3.1 and Table 3.2 |

| | |
|---|---|
| - other information on forest management activities | |
| Confirm that any trends in when an management activity is carried as observed during the period from 2000 to 2009 are not projected to continue during the CP | Chapter 3.1.1 |
| Document and confirm that only data sources from the period 2000 to 2009 are being used to define the FMPs. If data sources outside the period from 2000 to 2009 are used, document and justify this deviation.<br>Also, document an assessment of the impact of this deviation on the FRL. | Chapter 3.3 |
| Document how the principles of sustainable FMPs are being applied within the country. | Chapter 1.2 |
| Document the use of the FMPs in each strata of the MFL (see Table 6 for an example of this can be documented). | Table 3.6 |
| **Step 3: Select the appropriate methodology to project the development of carbon pools based on available data and national circumstances.** | |
| **Information to be represented in NFAP** | **Explanation** |
| Document the methodology as selected to project to the development of carbon pools. | Chapter 3.3 |
| Document the 'Age structure module' | Chapter 3.3 |
| Document the 'Harvest module' | Chapter 3.3 |
| Document the 'C pool variation module' | Chapter 3.3 |
| Document how natural disturbances have been estimated in the projection of the FRL, including data sources as applied. | Chapter 3.1 |
| Document how the HWP pool has been estimated in the projection of the FRL, including data sources as applied. | Chapter 3.3 |
| **Step 4: Calibrate the selected methodology based on real observed data and show that the methodology is able to reproduce the GHGI estimates.** | |
| **Information to be represented in NFAP** | **Explanation** |
| Document the model estimates of Biomass gains, Biomass losses, and Net GHG emissions/removals from the year 2000 until the starting year of the projection of the FRL. | Figure 4.1 |
| Document the emissions and removals from forests and HWP as shown in GHGIs and relevant historical data (Annex IV (B)), from the year 2000 until the starting year of the projection of the FRL. | Figure 4.2 |
| **Step 5: Select the appropriate methodology to project the development of carbon pools based on available data and national circumstances.** | |
| **Information to be represented in NFAP** | **Explanation** |
| Specify the assumptions taken concerning climate change and documentation of data sources applied. | Chapter 3 |
| If a projection of future climate conditions are used (Alternative 2 in Box 17), document:<br>- Assumptions and projections for future climatic conditions as applied | Chapter 3 |

| | |
|---|---|
| - Document the potential impact on the FRL by not considering the future climate effect (i.e. applying Alternative 1 instead of Alternative 2 (see Box 17)) | |
| Specify and justify the assumptions taken concerning the area development of MFL and documentation of data sources as applied. | Chapter 3.3.1 |
| Specify the assumptions taken concerning the area development of MFL and documentation of data sources as applied. | Chapter 3.3.1 |
| Document and justify the selected starting year for the projection of the FRL. | Chapter 3.3 |
| Document and justify the assumptions taken concerning the period from 2010 to 2020. | Chapter 3.3 |
| Specify the data sources used to describe the State of the forest as of the starting year of the projection of the FRL. | Chapter 3 and Table 3.2 |
| Confirm that area of land allocated to each stratum remains constant from the starting year of the projection | Chapter 3.3.1 |
| Confirm that the FMPs as defined and documented in Step 2 for the RP are consistently applied from the starting year of the projection onwards. | Chapter 3.3 |
| Describe the historical and future harvesting rates disaggregated between energy and non-energy uses. (Annex IV B.) | Chapter 3.3 |
| **Step 6: Calculate the FRLs as average of emissions and removals during 2021-2025 and 2026-2030.** | |
| **Information to be represented in NFAP** | **Explanation** |
| Document the 5-year average of projected values for the periods 2021-2025 and 2026-2030. | Table 1.1 |

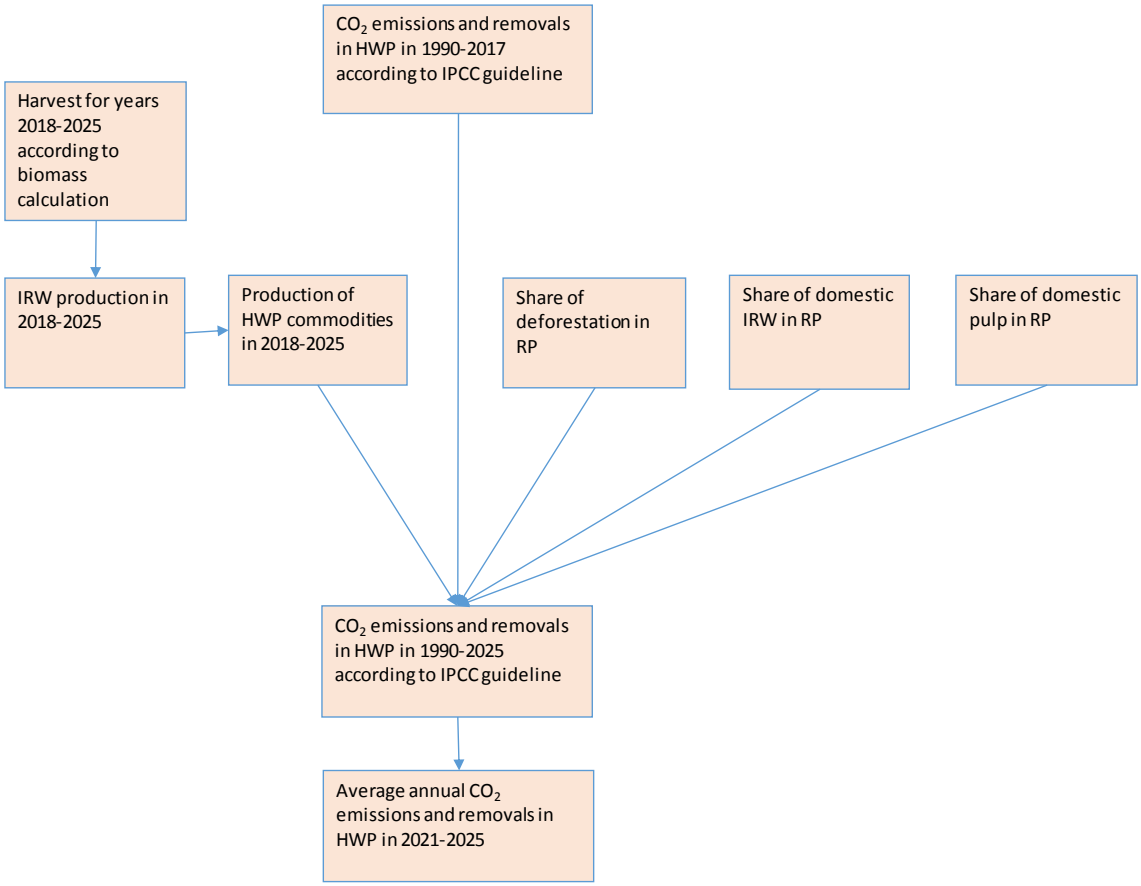
# Annex II

## Forest biomass scheme



# Annex III

HWP Scheme



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