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National Forestry Accounting Plan

Chapter 1: General Introduction

1.1 General description of the forest reference level for Germany

This National Forestry Accounting Plan has been prepared pursuant to Article 8 of 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 (hereafter referred to as: the Regulation), and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU and especially in accordance with the requirements set out in Annex IV B of the Regulation.
About 30% of Germany's area is forested and all forest lands are considered managed. The actual management and the management applied in the Reference Period are sustainable and in line with EU- and national forest and natural resource use related policies.
The German Forest Reference Level (FRL) has been estimated in accordance with the requirements and framing conditions set out in the Regulation. It contains all gases and pools given in Annex I of the Regulation.
The FRL was estimated to be net emissions of -39.217 million tons CO_2-equivalent per year in the first Compliance Period 2021 – 2025.

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

The German FRL is based on forest management practices conducted between 2000 and 2009. These were sustainable by the standards and criteria of the MCPFE (Forest Europe 2015). They resulted in net removals in this period, as shown in the 3rd NFI (2012). Thus, the forest management applied and the resulting FRL are oriented towards "achieving a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century" as requested in Annex IV A (a) of the Regulation. They also contribute "to the conservation of biodiversity and the sustainable use of natural resources, as set out in the EU forest strategy, Member States' national forest policies, and the EU biodiversity strategy" as requested in Annex IV A (f). Forest management in the reference period (RP) covered all age classes and, as shown in Annex I, table 2, yielded considerable removals by ageing forest stocks as called for in Annex IV (A) a of the Regulation.The calculation of the FRL is based on changes or rates of change

for all pools considered, so the mere presence of carbon stocks is excluded from accounting as requested by Annex IV A (b) of the Regulation.

The FRL is also embedded in the existing and proven reporting framework used under the Convention, including the provisions on HWP, and is derived from and replicates historical data already included in the GHG Inventory and Reporting, so the requirements of Annex IV A (c), (d), (g) and (h) of the Regulation are also fulfilled.

Chapter 2: Preamble for the forest reference level

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

The German Forest Reference Level includes the following pools:
- above-ground (living) biomass
- below-ground (living) biomass
- litter
- dead wood
- soil organic carbon
- harvested wood products

and gases:
- CO_2
- CH_4
- N_2O

as requested by Annex I of the Regulation and as already reported under the Convention and currently accounted under the Protocol of Kyoto.

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

See Chapter 3.

2.3: Description of the long-term forest strategy

2.3.1: Overall description of the forests and forest management in Germany and the adopted national policies

The state of Germany's forests is documented in the National Forest Inventory, openly accessible at https://www.bundeswaldinventur.de. The latest full inventory is of 2012 (BMEL 2015). As reported for the greenhouse gas emissions assessment in

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2016, Germany's stocked forest land covers appr. 10.8 million hectares and is completely reported under the Convention in the respective land use category "Forest Land remaining Forest Land". All forests in Germany are considered to be under management and are thus covered by the approach chosen to estimate the FRL.

The legal frame for forest management in Germany is set by the Federal Forest Act and the Forest Acts of the Federal States. National forest-related policies include the National Forest Strategy 2020 (Waldstrategie 2020, BMELV 2011), the Charter for Wood (Charta für Holz 2.0, BMEL 2018), the Climate Action Plan 2050 (Klimaschutzplan 2050, BMUB 2016), and the National Strategy on Biological Diversity (Nationale Strategie zur biologischen Vielfalt, BMUB 2007).

2.3.2: Description of future harvesting rates under different policy scenarios

Projections of future forest management are available from the WEHAM 2012 base scenario (Schmitz *et al.* 2016) and a research project ("WEHAM-Szenarien", Oehmichen *et al.* (2018)).

The base scenario describes forest and timber resource development for 2012 – 2052 based on the state of the forest as shown in the NFI 2012. The scenario is deducted from measurements (e.g., increments) and expert judgement on future harvest intentions of forest owners and managers. An earlier version of the Base Scenario's management data are currently used for the FMRL under the Protocol of Kyoto. While the Base Scenario reflects the intentions and possibilities currently known and foreseeable, the scenarios applied in the „WEHAM-Szenarien" project are also based on the state of the forest in 2012, but describe alternative policies ("wood preference" and "nature conservation") and also a "business as usual"-scenario that keeps up trends etc. as in force in 2012. The scenarios have been developed with regard to stakeholder perspectives, but are research-oriented and do not reflect any officially adopted policies.

The wood-preference scenario aimed to reduce the volume of standing stock to the level of the NFI in 1987 (i.e., by appr. 14%) by reducing production times and target diameters in relation to the base scenario. To satisfy an (assumed) higher demand for timber in the future, the share of area of Douglas fir is significantly increased in rejuvenated stands, at the expense of spruce and pine.

The nature conservation-oriented scenario is aimed at increasing the share in area of actual potential natural vegetation by converting stands of mainly spruce and pine, where they are not on their natural sites. Thus, the share of coniferous stands is decreased and that of broadleaved species increased. For trees growing on their natural sites, production times are also increased and, by this, standing timber volumes are raised.

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The harvesting potentials of the three scenarios for the CPs are given in Table 1. Please note that these scenarios and the FRL originate from different methodological frameworks and have different underlying assumptions about harvest intensities and strategies. Therefore, the FRL does not equal any of the three scenarios and comparisons should take the methodological differences into account.

Table 1: Harvest (raw wood potential as useable timber, [Mio. m^3 a^{-1} (over bark)]) of three scenarios (Base: Base Scenario, WPS: wood preference scenario, NCS: nature conservation oriented scenario).

CP	Base	WPS	NCS
2021-2025	76,95	115,94	83,62
2026-2030	74,61	116,76	79,88

Chapter 3: Description of the modelling approach

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

Germany applies a stock-difference method in GHG reporting and applies comparable approaches in constructing the FRL. Changes in the different pools during the RP have been determined individually per pool and are also modelled (for the CP) per pool. The development of the living biomass and the amount of wood harvested is modelled using the approach described in Annex I and the calculation framework of the NFI already used in the German GHG Inventory and Reporting. The use of the stock difference method assures that all forest characteristics mentioned in Annex IV B (e) III of the Regulation are implicitly regarded without having to be addressed individually. The amount of harvested wood is used to estimate the changes in the HWP pool with the model Wood Carbon Monitor (Rüter 2016). Emissions from changes in the dead wood pool and from forest fires were assumed to be equal to the mean from the RP, respectively. The development of the litter pool is modelled with soil carbon in Yasso15 (for details, see Ziche *et al.* 2019). Details on the different models and simulators are given in the most recent NIR and Annexes I and II.

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Assumptions concerning climate change

In preparing the FRL it was assumed that climate change between the RP and the CP does not influence net emissions or removals from any pool significantly. Climate trends present in the data from the RP are indirectly included in the parametrization and modelling of the FRL, e.g. influences of changes in climate on tree increment. This is considered to be in line with the "business as usual" requirement. Soil carbon in mineral soils and litter and dead wood were modelled in a project where climate scenario data were employed (Ziche *et al.* 2019). For the other pools, no models are available that incorporate climate data, and, because these pools are far less sensitive to climatic drivers than e.g. litter decomposition, there is no need to include climate data when projections span only comparatively short time frames.

Assumptions concerning area of MFL

For the FRL, the following changes in the area of managed forest land are considered: for deforestation (which is subject to legal permission in Germany), the projected value is set to zero. This way, all deforestation is assured to be accounted for. With regard to afforestation, the transition of afforested land after 20 year transition period is included in the forest area of the respective years of the CP.

Starting year of projection

In order to properly consider the dynamic age-related characteristics of the managed forest lands as requested by Art. 8 (5) of the Regulation in the stock-difference approach chosen for the German GHGI framework, the most recent data on area and age-class distributions available are used in the projection of living biomass and HWP. To date, the most recent information result from the NFI 2012 and the values given in this paper are based on this data. The results of the Carbon Inventory 2017 will be available in 2019 and Germany plans a technical correction for the FRL projections accordingly.

Assumptions concerning HWP

The projection of emissions and removals arising from the HWP pool is implemented with the computer model WoodCarbonMonitor already used for the German GHG inventory reporting. It is documented in the NIR 2018 and in Rüter (2016). In order to derive the contribution of the HWP pool to emissions and removals in the FRL, the time series of wood-removals projected by the forest management model are used as input parameter for the calculation. In a first step, annual rates of change of the projected wood-removals as compared to the historic average within the RP (2000 to 2009) are derived. In a second step, these annual rates of change are applied to the average historic carbon inflow during the RP to the HWP pool within the three relevant HWP commodity classes, which represent the material use of wood (i.e. sawnwood, wood-based panels and paper and paperboard). The subsequent calculations of future emissions and removals arising from the HWP pool are

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conducted in exactly the same way as for the GHG inventory reporting, thus full methodological consistency between FRL and GHGI is ensured.

The projected harvest amounts are given with the description of the forest management modelling in Annex I.

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

The FRL is based on data gathered by the National Forest Inventories (1987, 2002, 2012), the Inventory Study 2008, the Carbon Inventory 2017, the National Forest Soil Inventories I (1987 – 1994) and II (2004 - 2008) and the Forest fire statistics (2001-2017).

3.2.1: Documentation of stratification of the managed forest land

For the purpose of estimating the FRL the managed forest land was stratified by volume class (of growing stock) and age class (20 yrs.) as described in detail in Annex I.

3.2.2: Documentation of sustainable forest management practices as applied in the determination of the forest reference level

The objective of sustainable Forest Management in Germany is defined as "permanently and optimally secure the diverse economic, ecological and social benefits of the forest for the use of the present and future generations." (BMEL 2015). The basic principles are laid down in the Federal Forest Act and the respective Forest Acts and Laws of the Länder and other laws concerning the use of natural resources. The enforcement of the respective rules and regulations is in the hands of the responsible authorities in the Federal States (Länder). In addition, between 70 % and 80 % of Germany's managed forest lands were subject to certification by either FSC, PEFC (or both), or NATURLAND (BMEL 2017). The forest management practices applied in Germany in the RP were sustainable with regard to the criteria set out by the MCPFE (Forest Europe 2015) and as assessed by the UNECE / FAO Forestry and Timber Section (UNECE 2017). As far as Forest Management Practices have been differentiated for modelling purposes, these are documented and explained in the respective Annex to this document.

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

The modelling is conducted in several steps:
First, the annual change of above- and belowground biomass is modelled in volume class – age class strata, using the stock-difference approach and the same

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algorithms and functions as in the existing GHGI (see Annex I for details). In the same step, the amount of harvested wood is projected (see Annex I) and used as input in the modelling of the HWP pool with the model Wood Carbon Monitor. The litter pool was simulated, together with the soil carbon pool of mineral soils, with YASSO15, and projections for net emissions from organic soils and dead wood were added (see Annex II for details).

Natural disturbances

To date, Germany does not intend to apply the Natural Disturbance provision laid down in Article 10 of the Regulation.

Chapter 4: Forest reference level

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

The aggregated FRL for Germany is estimated to be net emissions of -39.217 million tons CO_2-equivalent per year in the first Compliance Period 2021 – 2025. The contribution of the individual pools considered here are given in Table 2. Net emissions from the respective pools from the RP are given for comparison.

Table 2: annual net emissions from different pools (Mio. t CO_2-eq. a^{-1})

pool	2021 - 2025
Living biomass	-36.183
Soil (including litter)	5.063
dead wood	-2.202
Forest fires	36
HWP	-5.931
sum	**-39.217**

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

Consistency between the FRL and the latest national inventory report is assured by using the same methodological framework and the same data sources (see above and Annex I – III for details).

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

See 4.1 and Annex I and II

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