



D6.3 National and EU baseline pathway for forest sector

**Report documenting the
dataset for forest mitigation
baseline**



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Abstract

In recent years, the EU27 forest carbon sink—including forest land and harvested wood products—has shown a marked decline due to natural disturbances, climate change impacts, forest aging and changes in harvest intensity. This weakening sink poses a challenge for EU climate policy. To assess future trajectories of the forest sector, we developed a cross-scale, harmonized Baseline scenario within the ForestNavigator project, representing the development of forest emissions and removals under a continuation of current management practices and recent wood demand trends, without the introduction of new policy measures after 2023. This Baseline integrates projections from national forest carbon models (CBM-CZ, CBM-IE, CBM-IT, Heureka) and the EU-level GLOBIOM-G4M-X modelling framework.

The Baseline scenario reveals that, in the absence of additional policy measures, the EU27 forest sink will continue to decline gradually, approaching a long-term equilibrium consistent with previous studies (e.g., Pilli et al., 2022). While national trajectories exhibit heterogeneity reflecting the effects of recent disturbances and differences in forest structures. The study examined and reduced cross-model differences and identified remaining cross-model discrepancies, notably in deadwood, litter, and soil carbon pools, arising from structural differences in model boundaries and parameterizations. Nonetheless, the harmonized Baseline provides a robust reference for evaluating future policy and climate scenarios.

Keywords

Forest carbon sink, LULUCF, baseline scenario, EU climate policy, greenhouse gas emissions

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Abbreviations

BAU	Business As Usual
CBM	Carbon Budget Model
CZ	Czech Republic
GAI	Gross Annual Increment
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GHGI	Greenhouse Gas Inventory
HWP	Harvested Wood Products
IE	Ireland
IPCC	Intergovernmental Panel on Climate Change
IT	Italy
LULUCF	Land Use, Land Use Change and Forestry
MS	Member State
NAI	Net Annual Increment
NECP	National Energy and Climate Plan
NFI	National Forest Inventory
NPV	Net Present Value
NUTS	Nomenclature of Territorial Units for Statistics
RED	Renewable Energy Directive
SE	Sweden
SSP	Shared Socioeconomic Pathway
UNFCCC	United Nations Framework Convention on Climate Change

Executive summary

In recent years, the EU27 forest carbon sink, including both forest land and harvested wood products, has shown a decline due to the combined impacts of ageing forests, natural disturbances, climate change, and harvest levels. This reduction of sink raises concerns regarding the future role of the sector in the context of EU climate policies, given that forests have historically compensated for around 10% of total EU greenhouse gas emissions and are essential for achieving the EU's long-term climate neutrality objectives.

This report presents the results of Task 6.3 of the ForestNavigator project, which develops a cross-scale consistent Baseline scenario for EU27 forest-sector emissions and removals under a continuation of wood demand trends, current management practices, and existing policy measures. The Baseline represents a no-additional-policy scenario, where only the legacy effects of policies implemented before 2023 are considered (e.g. excludes LULUCF Regulation targets 2023-2030 and the Nature Restoration Regulation). The Baseline serves as a reference for evaluating future forest and climate policy pathways within WP8.

To ensure comparability across scales, the Baseline integrates projections from national models (CBM-CZ, CBM-IE, CBM-IT, HEUREKA-SE) and the EU-level GLOBIOM-G4M-X framework, harmonized through the alignment protocol established in Task 6.1 and the new calibrations and developments presented in Task 6.2. The results reveal a gradual decline of the EU27 forest land and Harvested Wood Product (HWP) sink, from approximately 270 MtCO₂ year⁻¹ in 2023 to 161 MtCO₂ year⁻¹ by 2070.

The Baseline provides a transparent and reproducible reference to (i) identify sources of divergence between national and EU projections, (ii) assess remaining uncertainties, and (iii) support the design of coherent, science-based policy measures for strengthening the EU forest sink in upcoming Policy Reference (Task 8.1) and Ambitious Policy scenarios (Task 8.2).

I. Introduction

In recent years, the EU27 forest sector carbon sink (including forest land and harvested wood products) has declined due to multiple factors, including forest ageing, natural disturbances, climate change impacts, and changes in harvest levels (Korosuo et al., 2023). This weakening sink raises concerns for EU climate policy, as forests have historically offset around 10% of the EU's total greenhouse gas emissions (Migliavacca et al., 2025) and thus represent a crucial component of the EU's long-term climate neutrality strategy. Previous projections of the EU's forest carbon sink show that, without additional policy measures, the ability of EU forests to absorb carbon will gradually decline and reach a saturation point (Pilli et al., 2022). At the same time, expectations placed on the forest sector are increasing, as it is expected to simultaneously provide renewable materials, bioenergy, and carbon storage, thereby contributing to the European Green Deal, the LULUCF Regulation, and the EU Climate Law (EC, 2021).

To quantify the potential impact of policy measures on the forest sink, it is first necessary to assess how the sector would evolve in the absence of additional policy interventions. However, past experience has shown substantial variation among forest sink projections, which largely depend on the modeling framework and spatial or temporal scales considered (Böttcher et al., 2012; Groen et al., 2013). This demonstrates that a robust assessment of forest pathways requires combining projections from different forest models operating at different resolutions. To account for this uncertainty and strengthen the robustness of policy pathways, the ForestNavigator project develops modeling toolboxes at both the National and EU27 scales. These toolboxes can run in parallel and be jointly deployed to assess future pathways while reflecting uncertainties introduced by modelling endogenous characteristics (i.e. level of detail in modelling carbon pools, different modelling equations and parametrizations) but maintaining a cross-scale consistency.

Under Task 6.3, we aim to establish a cross-scale consistent “Baseline” scenario that projects the future development of forest emissions/removals without additional policy interventions. This “Baseline” represents a projection of forest emissions and removals under a continuation of current management practices and historical wood demand trends, without the introduction of new policy measures after 2023. This means that only legacy effects (from policies that have already influenced forest management before 2023) are implicitly included in the modeling.

After creating the Baseline scenario, national policy measures (i.e. the ones from NECPs) and EU adopted policies will be tested under the WP8 Policy Reference Scenario (T8.1) and more ambitious policies under “Ambitious” scenarios aligned to the EU Climate Neutrality goal (T8.2).

The Baseline scenario presented here integrates outputs from national Carbon Budget Model (CBM) forest models (CBM-CZ in the Czech Republic, CBM-IE in Ireland, CBM-IT in Italy, and HEUREKA in Sweden) and the EU-level model (GLOBIOM-G4M-X).

To ensure alignment between projections of forest emissions/removals from national and EU models under the Baseline scenario, we rely on the cross-scale alignment framework developed in Task 6.1 and the calibrations and advancements of EU and national models carried out in Task 6.2. These efforts have already reduced some of the inconsistencies between scales and identified a common set of drivers (i.e. forest harvest levels, afforestation/deforestation area) and data inputs to be applied in cross-scale aligned projections, facilitating the comparability of results.

The main objective of this report is therefore to test the cross-scale modeling framework by means of the Baseline scenario, serving as a reference point for more ambitious future pathways at the national and EU level.

The results are expected to:

- Identify the main sources of divergence between national and EU models and highlight entry points for reducing the cross-scale differences.
- Reveal the remaining uncertainties in projections of emissions/removals and, in particular, identify those stemming from structural differences between models.
- Provide a transparent and reproducible reference scenario that can inform the design of future EU forest and climate policies.

The report is structured as follows: Section 2 presents the modelling framework, scenario assumptions, and model setups. Section 3 outlines Baseline emissions/removals projected by each model. Section 4 compares EU and national model results, followed by a discussion of the main findings in Section 5.

The baseline projection results from GLOBIOM-G4M-X for the EU and MS can be accessed through: <https://zenodo.org/communities/forestnavigator/records>.

The MS projections from CBM-CZ, CBM-CBM-IE, CBM-IT, and Heureka-SE, as well as the WoodCarbonMonitor projections, they are available upon request through forestnavigator.info@iiasa.ac.at.

2. Methods

2.1. Modelling chain

We present an integrated modelling framework that enables consistent projections of emissions and removals for both forest land and the HWP pool. This framework also facilitates the comparison of forest land emissions and removals between EU-level and national models under harmonized scenario specifications.

The modelling chain used in this report follows the setup described in [D6.1](#) (shown in Figure 1). The simulations begin with the GLOBIOM model, which is calibrated for the period 2000-2020 and run in 10-year time-steps until 2100. Based on scenario-specific demands for semi-finished wood products (see Section 2.2) and associated supply constraints, GLOBIOM operates at the national scale using an economic optimization that maximizes consumer and producer economic surplus (i.e., societal welfare). As part of its output, GLOBIOM provides harvest levels (volumes) for roundwood (comprising sawlogs, pulplogs, other industrial logs, and fuelwood) and logging residues required at each timestep to satisfy the exogenous wood demand.

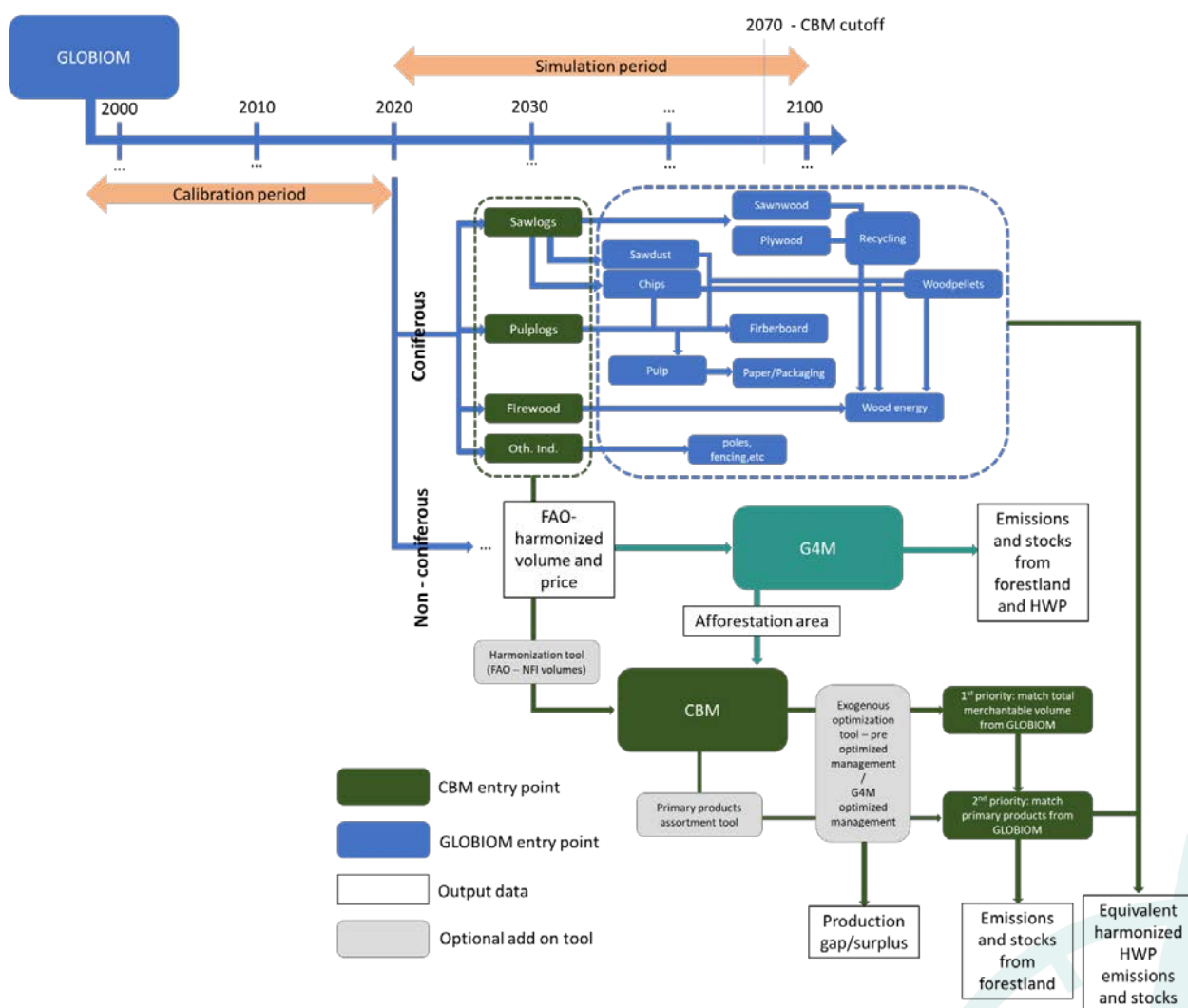


Figure 1: Scheme for the alignment between the EU Policy Modelling and the Member State Policy Modelling Toolbox (Source D6.1 ForestNavigator).

The GLOBIOM and the G4M (Global Forest Model) models are harmonized through the exchange of spatially explicit annual increments, representing forest growth potential derived from G4M and used within GLOBIOM, as well as forest land area data. This setup allows GLOBIOM to constrain G4M to match its decadal harvest levels, while G4M downscales GLOBIOM's decadal wood harvests to annual time steps following calibration over the 1990-2023 period. In addition, G4M projects afforestation and deforestation areas that are consistent with GLOBIOM's harvest levels. These yearly afforestation and deforestation projections are determined through G4M's internal intertemporal land-use optimization, which compares the net present value (NPV) of agricultural land and forest land for each Member State (MS). Consequently, G4M produces annual afforestation and deforestation projections for each MS.

The annual G4M projections are then transferred to the national models (CBMs and Heureka), which reproduce the same annual harvest volumes (CBMs and Heureka) and afforestation/deforestation areas (CBMs) specified by GLOBIOM-G4M. GLOBIOM-G4M and the national models are run in parallel to assess emissions and removals from forest land under the aligned harvest and afforestation/deforestation assumptions.

Finally, GLOBIOM estimates yearly emissions and removals from the HWP pool using its post-hoc HWP module, which applies the Production approach and is calibrated to the WoodCarbonMonitor (D5.2). The annual HWP emissions and removals are derived through linear interpolation of GLOBIOM's 10-year output periods.

2.2. Comparison protocol

To enable a consistent comparison of forest emissions and removals across different models, we established a reporting protocol based on standardized modelling input/output variable definitions tested among modelling partners participating in the ForestNavigator [Forest Policy Modelling Forum](#).

Accordingly, the outputs from each model simulation were reported as annual projections of carbon stocks and emissions/removals from 2024 (the first projection year) to 2070, following each model's calibration to historical data for preceding periods.

The G4M model reported carbon pool data for living biomass, deadwood, and litter. Although G4M also produced estimates for the soil carbon pool associated with afforestation, this pool was excluded from the intercomparison exercise.

The CBM models reported carbon pool data for living biomass, deadwood, litter, and soil. For comparability with G4M, only the living biomass, deadwood, and litter carbon pools were considered.

The Heureka model reported aboveground living biomass carbon separately, while aggregating other carbon pools (deadwood, litter, and soil carbon). For comparison with G4M, we considered both the aboveground living biomass carbon and the total carbon pool.

In the comparison between G4M and CBM, results were aggregated across the land categories “forest land remaining forest land”, “afforestation”, and “deforestation”, yielding total emissions and removals from “forest land”. For the comparison between G4M and Heureka, only “forest land

remaining forest land” was used, as Heureka does not explicitly represent afforestation or deforestation.

Additional indicators were reported to assess consistency across models, including total forest area, harvested volume, gross annual increment (GAI), and net annual increment (NAI).

For visual comparison of model results, we used the IIASA Accelerator workspace (See Figures in Section 4).

Table 1. Carbon pool modelling system boundaries for CBM and G4M.

Carbon Pool	CBM	G4M
Aboveground biomass	Live stemwood plus bark, live branches and foliage, stumps and small trees plus bark	Stemwood converted to aboveground biomass using allometric equations. Total aboveground biomass, including leaves, is considered.
Belowground biomass	Live coarse roots (>5 mm diameter), live fine roots (<5 mm)	Root-shoot ratio estimated using allometric equations as root mass divided by aboveground biomass (including stem, branches and bark and foliage).
Deadwood	Standing dead trees (incl. bark), lying dead trees, dead branches, dead stumps and coarse roots > 510 mm	Standing dead trees (incl. bark), lying dead trees and dead branches of diameter greater than 10 cm
Litter	Dead coarse roots (5cm), dead fine roots, small woody debris (< 5 mm), L horizon (foliage litter), F, H, O horizons	Standing dead trees (incl. bark), lying dead trees and dead branches of diameter less than or equal to 10 cm
Mineral soils	Humified C in mineral soil	Not included
Organic soils	Not included	Not included
Harvested Wood Products	Not included	Not included

2.3. GLOBIOM-G4M Baseline scenario assumptions

For the modelling of the Baseline scenario, we have selected one of the scenarios presented in ForestNavigator [D5.1](#). Specifically, the scenario in which the future increase in forest biomass demand follows a trend resembling the recent past (2000-2020). This corresponds to the “BaseBIOEN_BaseCIRCU_BaseCONST” scenario in D5.1, which assumes baseline developments in bioenergy demand, wood for construction, growth of circularity in wood use, and Business-as-Usual (BAU) demand growth for other semi-finished wood products. In this subchapter, we describe the assumptions covered for projections in wood demands, forest land use, wood harvest and afforestation.

2.3.1. Wood demands

Under the baseline scenario, the demand for forest feedstocks for bioenergy is expected to increase by 11% by 2030, and 15% by 2050, relative to 2020 levels, based on energy system projections using the PRIMES model. Over the same period, demand for construction wood is expected to rise by 20%. Wood-use circularity follows the standard development in GLOBIOM, where the maximum recovery rate for recycled wood can increase up to 50% over time. The EU27 demand for textiles is projected to reach 2 Mt/year by 2050.

The demand for other semi-finished wood products (e.g., pulp products) is modelled endogenously in GLOBIOM, based on projected developments in GDP and population, using historical-based income elasticities. Population and GDP projections for the EU are derived from the CIRCABC database and aligned with the forthcoming EU Reference Scenario. For the rest of the world, the demand for semi-finished wood products is aligned with the SSP2 scenario (IIASA, 2020), while bioenergy demand is based on the MESSAGE model (Riahi et al., 2017), where selecting a compatible energy system pathway is compatible with the internal one for the EU. For years after 2050, the level of bioenergy demand for forest biomass was assumed to remain the same as in 2050 (until 2070). For regions outside the EU, the demand for semi-finished wood products is aligned with the SSP2 pathway (IIASA, 2020), while bioenergy demand is based on the MESSAGE model (Riahi et al., 2017), ensuring consistency with the EU energy system pathway. For years beyond 2050, the level of bioenergy demand for forest biomass is assumed to remain constant at the 2050 level, extending to 2070.

2.3.2. Forest land use

The protection of forest land (close to nature and strict protection management classes) was maintained in GLOBIOM-G4M-X in the year 2020, and no further protection target for the future was enforced. According to the REDIII constraints, we have excluded the harvest of primary forest areas, and afforestation was excluded from high-value natural lands.

We allowed GLOBIOM-G4M-X to adjust the forest management intensity according to wood demand (changes in rotations in G4M or changes from one management class to another in GLOBIOM). However, some constraints on the rate of management conversion from one class to another were introduced in GLOBIOM to contain the deviations from historical management intensification. Specifically, in Italy and Sweden, we have limited the periodic intensification of management (transition from one class to another) according to expert judgment, because, unless constrained, the model would produce excessive management intensification.

Compared to the results in [D5.1](#), we have also revised the calibration of GLOBIOM forest increments. Specifically, for the case of the Czech Republic, considering the effect of the recent disturbance events and assuming a more conservative post-recovery increment development (return to pre-disturbance increments and not exceeding them). According to experts' recommendations, the future harvest of logging residues in Ireland was also excluded in both GLOBIOM and G4M (previously, it was allowed in both models).

The afforestation/deforestation in G4M was aligned with the bioenergy demand development set in GLOBIOM. Accordingly, the model has produced land use change projections taking into account historical land use development and future demands of bioenergy for mitigation.

2.3.3. Wood harvest and afforestation

According to the wood demands development and land use constraints, GLOBIOM projected the future development of roundwood and total biomass harvest over time (2030-2070) for each EU27 MS. These developments were transferred as 10-year time steps results to the G4M model which downscaled the harvest to yearly time steps in the period 2024-2070 and included a yearly projection of afforestation for the same period. The projection of harvest and afforestation output obtained from G4M was transferred to national models.

Under the Baseline scenario, total EU27 wood harvest (including roundwood and logging residues) is projected to increase from 610 Mm³ in 2023 to 703 Mm³ in 2070, the relative increases are 7% by 2030, 13% by 2050 and 15% by 2070 (*Figure 2*). When considering roundwood harvest (over bark), the 2023 harvest level is 539 Mm³, the relative increase is 9% by 2030, 11% by 2050 and 16% by 2070.

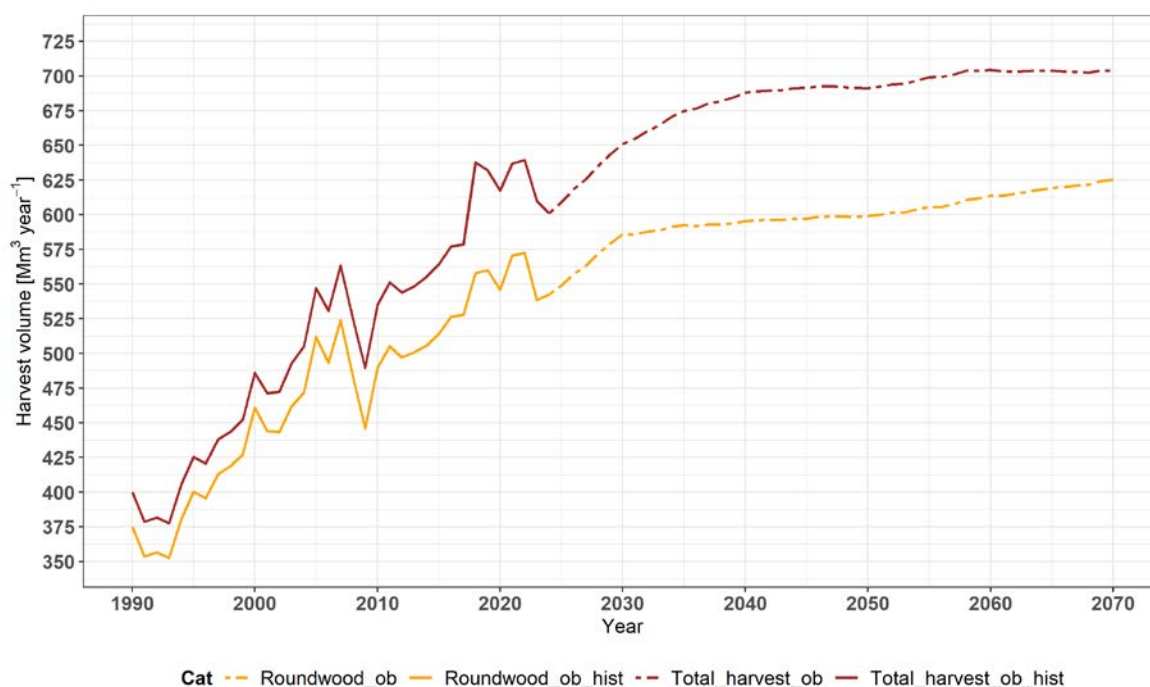


Figure 2. Historical (1990-2023) and projected (2024-2070) (GLOBIOM-G4M) harvest for the EU27 under the Baseline scenario: Roundwood_ob = roundwood over bark, Total_harvest_ob = Total harvest of roundwood and extracted logging residues.

The harvest projections at the national level are generally aligned with the overall EU27 trend. The largest differences in harvest volumes (total harvest) in absolute amounts between 2023 and 2070 are observed in France (+17 Mm³), Poland (+16 Mm³) and Sweden (+10 Mm³).

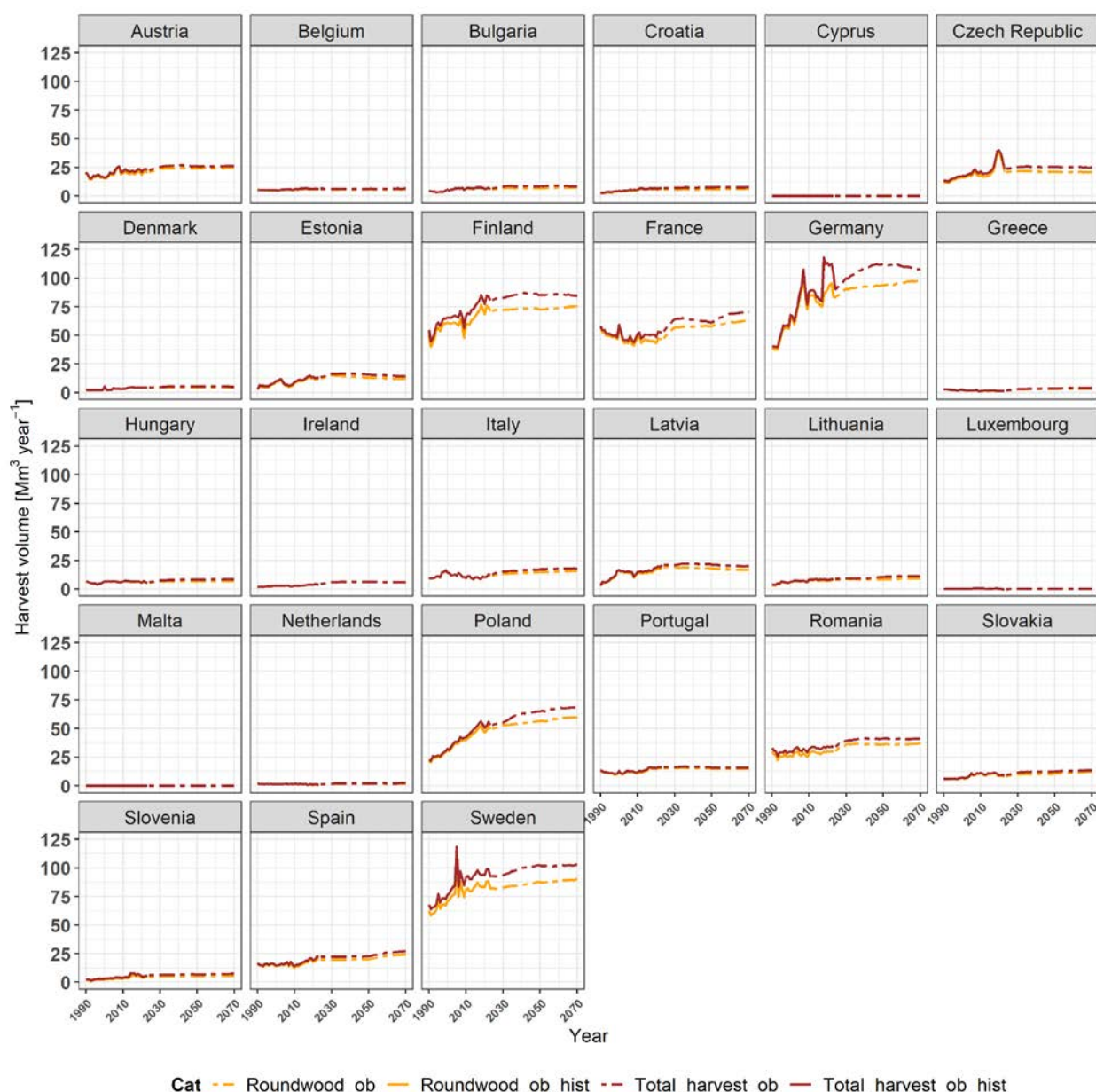


Figure 3. Historical (1990-2023) and projected (2024-2070) (GLOBIOM-G4M) harvest for the EU Member States under the Baseline scenario: Roundwood_ob = roundwood over bark, Total_harvest_ob = Total harvest of roundwood and extracted logging residues.

The yearly afforestation rate at the EU27 level is projected to decrease from 437 Kha in the period 2010-2023 to an average of 107 kha in the period 2060-2070. Over the same time period, the yearly deforestation rate is projected to decrease from 120 kha in 2010-2023 to an average of 15 kha in 2060-2070 (Figure 4). The EU27 forest area in the model is 160 Mha in 2023. Due to changes in afforestation/deforestation, the area reaches 161 Mha by 2030, 163 Mha by 2050 and 165 Mha by 2070.

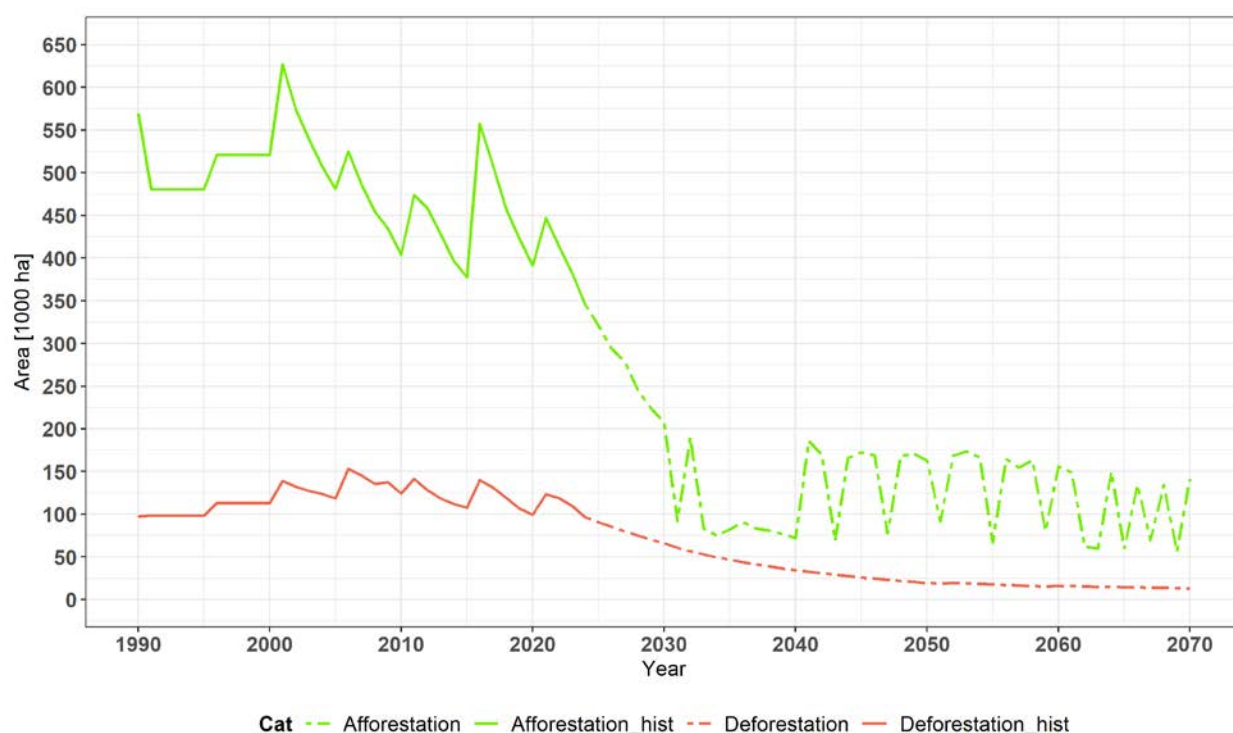


Figure 4. Historical (1990-2023) and projected (2024-2070) yearly afforestation and deforestation according to the G4M model for the EU27.

Afforestation and deforestation follow specific national patterns that are driven mostly by recent historical trends. During the projection period, amounts of afforestation exceeding 10 Kha year⁻¹ can be observed in France, Germany, Italy, Poland, Spain, and Sweden (Figure 5).

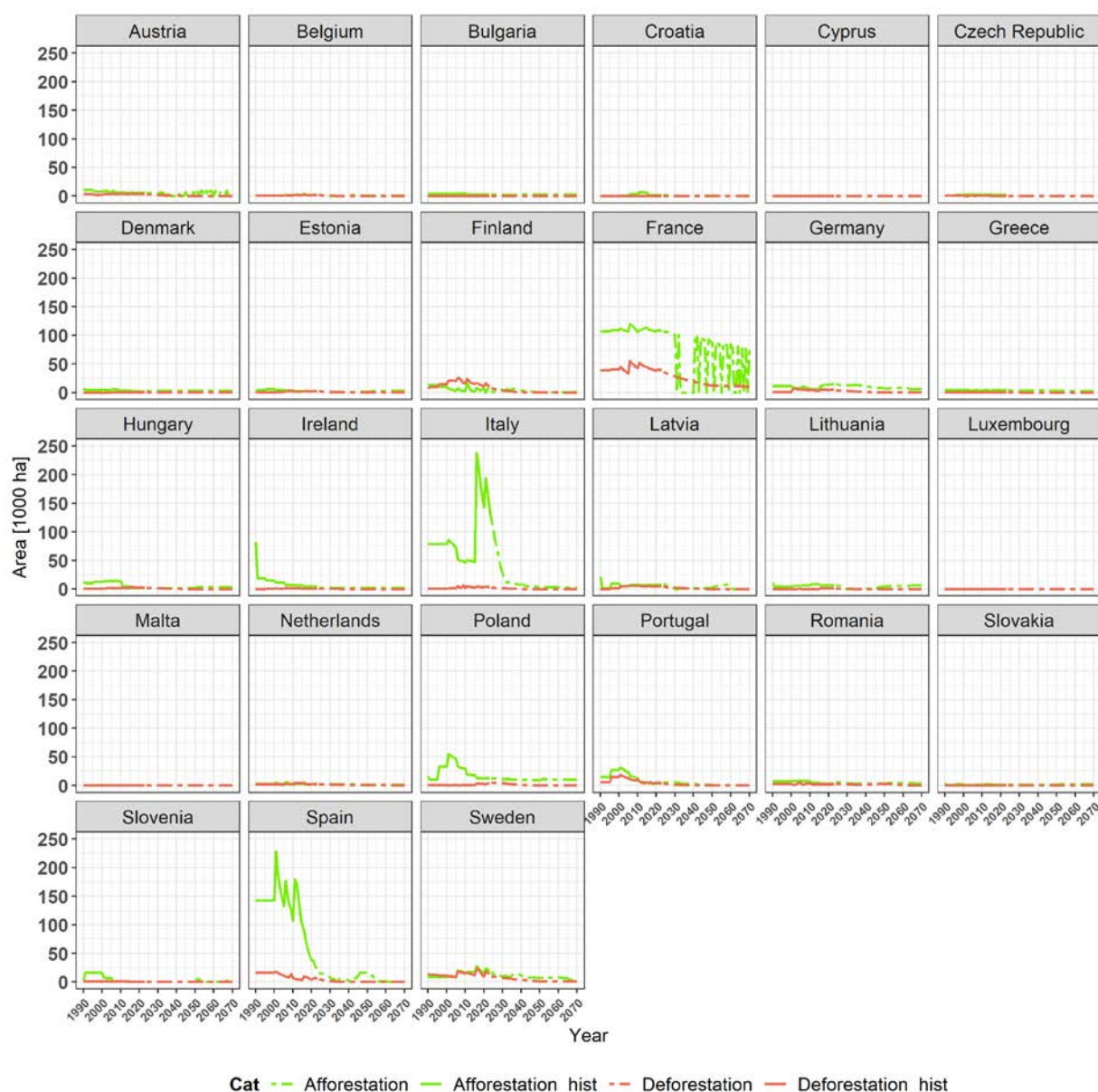


Figure 5. Historical (1990-2023) and projected (2024-2070) yearly Afforestation and Deforestation for EU Member States using G4M

2.4. National models set-up

2.4.1. CBM Chech Republic

We used the CBM-CFS3 model (Kull et al., 2019; Kurz et al., 2009) with its pilot parametrization primarily based on National Forest Inventory (NFI) data (Kučera & Adolt, 2019; Máslo, Adolt, & Kučera, 2024) as elaborated in the ForestNavigator deliverable D6.2 (Augustynczyk et al., 2025). The calibration, including growth, biomass and dead organic matter variables, included the period 2011-2023, of which 2011-2020 covers the data and estimates of NFI2 and NFI3 as released by the Czech Forestry Institute (CFI), Brandýs n. Labem (e.g., (Máslo, Adolt, & Kohn, 2024; Máslo, Adolt, & Kučera, 2024; Máslo et al., 2023a, 2023b). Complementary data on land areas, land categories from the Czech Office for Surveying, Mapping and Cadastre (COSMC) and reports of the Czech Statistical Office (CzSO), including harvest data and other related information on forestry that are essential for model runs, are available on an annual basis.

The applicable projection period of the IIASA baseline scenario included years 2024 to 2070. Hence, the Czech CBM model simulation represents a single run covering 60 years from 2011 until 2070. Spatially, the model application covers 14 regional (NUTS3) units, and seven forest types determined by species groups. They include four broadleaves (BE - beech, OA - oaks, LB- other long-lived broadleaves, SB – short-lived broadleaves) and three coniferous types (SP - spruce, PI - pine and larch, and FI – firs). In terms of forest management, the application discerns forestry interventions such as clearings & thinnings, sanitary logging, and planned final cuts. Additionally, it includes specific handling of dead forest trees with postponed harvest as methodologically introduced in our earlier CBM application (Cienciala & Melichar, 2024). This was essential for mirroring the recent extreme dieback of spruce trees (Brázdil et al., 2022; Cienciala et al., 2024), which was attributed to an unprecedented, cumulated drought during the last 2100 years (Büntgen et al., 2021). The model run included tree species change following the observed trend in the Czech Forestry and implementation of adaptation strategies (Cienciala et al., 2015; Hlásny et al., 2014). In general, forest management interventions implemented in the model fully retain the requirements and obligations arising from the applicable Czech forestry legislation (Czech Republic, 1995).

For the projection period, annual data on forest land changes (Afforestation, Deforestation), roundwood harvest, and extraction of harvest residues were specified. The model matches these prescribed variables; the relevant interpretation is documented in Section 3.1 below.

2.4.2. CBM IE

The Irish CBM model, growth, biomass and dead organic matter parameters have been calibrated using the Irish National Forest Inventory (Black et al., 2025). The model is not spatially explicit, but harvest and growth parameters are defined using 18 species/management strata applied to the whole national forest area. Following calibration and validation, the CBM model was set up to simulate the period 2006 to 2070. The historical period model runs from 2006 to 2023, using the refined greenhouse gas inventory's (2026 submission) afforestation, deforestation, and harvest rates. For the historic period, CBM is initiated using the 2006, 2012, 2017 and 2021 National Forest Inventory data to define age class structure, species composition and available wood supply (Black et al. 2025). The baseline projection (2024-2070) afforestation, deforestation and harvest rates were used as input variables for CBM, as defined by GLOBIOM.

Changes in the forest age class structure and available wood supply have been largely influenced by harvest and high afforestation rates since the 1990s. More than half of the forest estate in 2024 comprises afforested land planted since 1990. Therefore, to run a greenhouse gas (GHG) profile for the entire forest estate, two separate CBM simulations are done: a) an afforestation run representing the planting and management of new forests from 1990 and b) the management of existing forest land afforested before 1990. Only the existing forest land model run (b) requires an initialization spin-up to equilibrate the dead organic matter pool before initiation of the simulation (Kurz et al., 2009). CBM-CFS3 does not simulate emissions from organic soils, so emissions are estimated based on drained organic soil areas and emission factors used for the Irish greenhouse gas inventory (Duffy et al., 2025; Black et al., 2025). More than 60% of Irish forests occur on organic soils.

Although the projected harvest target is defined by GLOBIOM, the harvest of available wood supply is constrained in the CBM framework by application of silvicultural rules for species strata based on marginal thinning intensity and frequency and defined rotation ages (Black et al., 2025). In order to allocate the harvest target set by GLOBIOM, 20% of the harvest was assumed to originate from thinnings. The allocation of harvest between afforested lands and existing forest, broadleaves and conifers are automatically assigned based on silvicultural rules.

Wildfires are the only natural disturbances considered in the baseline projection, and these are set at based on the average historical rates of 169 ha yr⁻¹. Windthrow disturbances from extreme events such as the 2025 Storm Eowyn are not considered in the baseline projection.

2.4.3. CBM IT

The CBM model was run for the entire simulation period, 2005 to 2070. Until 2023, the harvested amount and annual afforestation/deforestation rates were applied as defined during the modelling calibration stage. After 2024, the harvested amount and annual afforestation/deforestation rates are obtained by the GLOBIOM model scenario. Based on GLOBIOM data, total removals in Italy are expected to increase from 11.4 Mm³ in 2023 to 16.0 Mm³ in 2070 (+38%, corresponding to about +0.8% yr⁻¹). After 2023, both the annual afforestation (AR) and deforestation (D) rates are expected to abruptly decrease. In 2046 D rate < 100 ha yr⁻¹ and since 2061, a constant AR rate, equal to 2,800 ha yr⁻¹, is applied by the model.

The model applies key parameters defining the silvicultural practices for each forest type and management system (i.e., type of harvest, harvest intensity, minimum rotation length, etc.). These parameters were held constant throughout the entire simulation period, using the values defined during the calibration period (2005 – 2023). The area affected by wildfires was assumed to be constant from 2024 onward, and equal to the average inferred from the calibration period (i.e. about 14,000 ha yr⁻¹, further distinguished between crown fires and underwood fires, applying the same criteria defined within the calibration period). No other natural disturbance event was applied after 2023, as far as no change on the forest species composition (e.g. substitutions of coniferous species with broadleaves species).

Until 2023, the annual harvest amount was distributed between coniferous and broadleaf species based on information derived from an integrated assessment of remote sensing and NFI data. During the calibration period (2005-2023), broadleaf species accounted for an average of about 57% of total removals, while coniferous species contributed around 43%. The share of coniferous harvest removals increased notably after the 2018 windstorm.

From 2024 onwards, the total harvest amount projected by GLOBIOM was allocated between coniferous and broadleaf species, taking into account the share of broadleaf and coniferous species reported by FAOSTAT. Based on these data, we assumed that during the calibration period, about 74% of total removals came from broadleaf species, with the remainder from coniferous species.

2.4.4. Heureka

For Sweden, forest development and management were simulated using the Heureka (Lämås et al. 2023) and the optimization was conducted using MultiOptForest (Eyvindson et al. 2024). The Swedish forest was represented by a representative sample of approximately 31,000 National Forest Inventory (NFI) plots. Only productive forest land, defined as forest growing more than $1 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$, was included in the dynamic simulations, corresponding to roughly 23.2 million hectares of the national forest area. The remaining 3.1 million hectares of unproductive forest land, where harvesting is not permitted, were treated as set-aside and later added to national totals to account for their contribution to carbon storage but not to harvest volumes. The NFI plot network has a spatially variable density, with higher plot density in southern Sweden than in the north, ensuring representative coverage of all major forest types and ownership categories.

The simulations were performed at five-year intervals from 2011 to 2070. The first two periods (2011–2015 and 2016–2020) were used as burn-in to stabilize the model, since no harvest occurs in the initial year, and the early carbon sink would otherwise be biased. For this period, we harvested in accordance with ten-year averaged forest statistics, stratified by assortment and region. From 2021 onward, the results provide reliable projections of forest carbon and harvest dynamics. Heureka outputs included aboveground biomass carbon, below-ground biomass carbon, deadwood, and soil carbon, expressed per hectare and aggregated to the national level.

Each NFI plot was simulated under nine active management regimes plus set-aside, representing three silvicultural treatment intensities for each of the following regimes: (i) Business-as-usual (BAU) clear-cutting (planting with bred material), (ii) Continuous Cover Forestry (CCF), and (iii) BAU with natural regeneration (applied only in southern NFI regions 4 and 5, see below). Default Heureka silvicultural parameters were used for thinning, regeneration, and rotation rules.

The resulting dataset served as input for a national-scale multi-objective optimization framework designed to determine optimal management portfolios under policy and harvest constraints. The optimization maximized Net Present Value (NPV) while meeting harvest volumes prescribed by GLOBIOM. Additional constraints specified that approximately 7% of forest land was managed under BAU with natural regeneration (here only allowed in the southern regions 4–5), 3% under CCF, and circa 15% set-aside as protected, with the remainder under standard BAU. The optimization selected one management regime per NFI plot, together forming a national-level forest management portfolio and projections for carbon stocks, harvest levels, and profitability up to 2070.

3. Case studies simulations

3.1. Czechia

The harvest targets prescribed by GLOBIOM-G4M were almost perfectly replicated throughout the projection period (Figure 6). This close match occurs because the prescribed harvest rates can be fully satisfied by the available biomass, as demand remains well below the production capacity of Czech forests during the study period. In contrast, no attempt was made to match harvest rates for the calibration period (2011-2023), which relies entirely on official country-specific input data from CzSO and NFI (see also Augustynczyk et al., 2025).

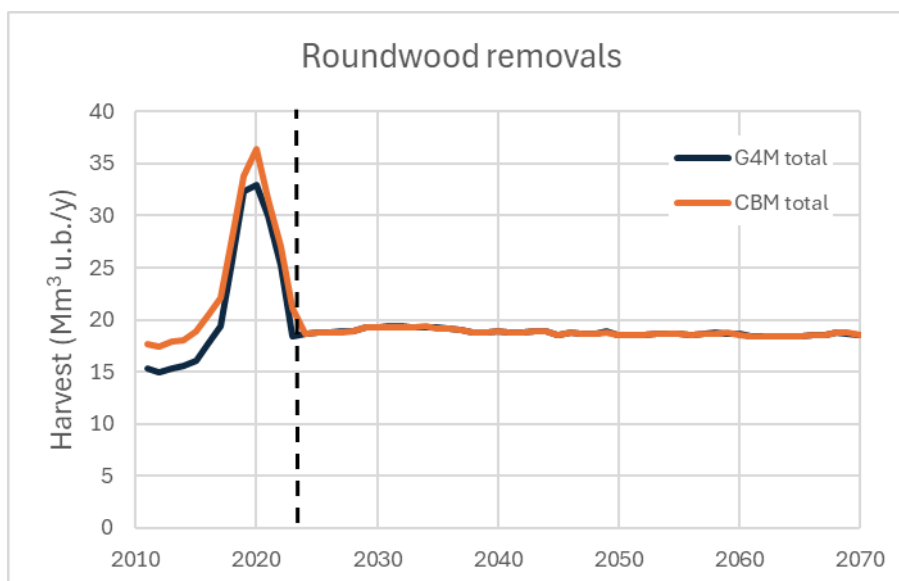


Figure 6. Total roundwood removals (in Mm³ under bark) for the Czech Republic over the period 2011 to 2070 using GLOBIOM-G4M and CBM. The dashed line splits the calibration (actual harvest) and projection period (harvest by a base scenario assumption).

Figure 7 shows harvest quantity by disturbance type as implemented by CBM. While the amounts for the calibration period reflect the actual reported information of CzSO and NFI, the harvest types in the projection period have been allocated based on expert-informed assumptions. Note that the baseline scenario represents an optimistic and adaptive scenario for the projection period, as salvage logging is set to represent only ca. 20% of the total harvest, whereas a considerable amount is prescribed for thinning that approaches almost 30% of the total harvest. These numbers contrast heavily with the period of the observed extreme calamity in recent years, when the share of sanitary logging (including snag harvest) topped 95%, while the planned management, such as thinning, was severely limited due to mandatory reallocation of harvest capacities to prioritize salvaging.

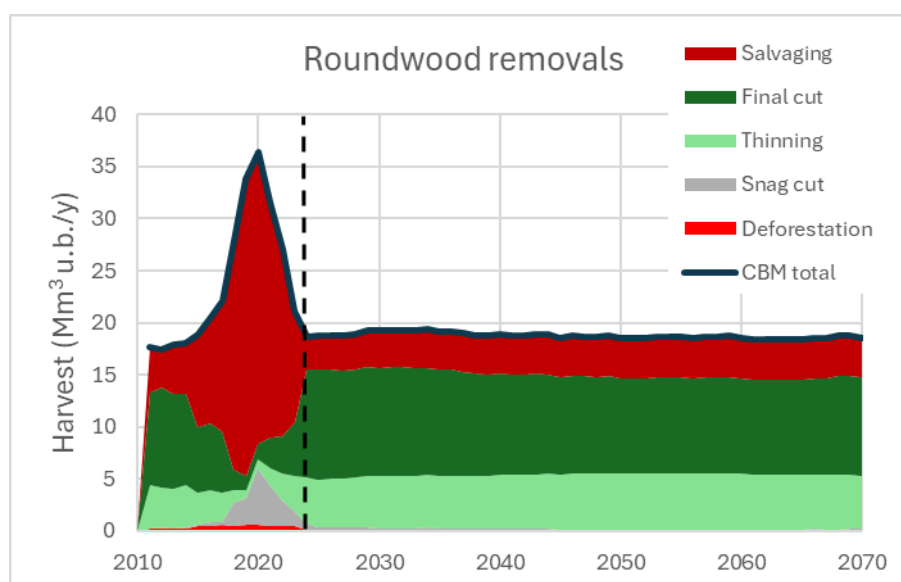


Figure 7. Total roundwood removals (in Mm³ under bark) for the Czech Republic over the period 2011 to 2070 by harvest types in CBM. The dashed line splits the calibration and projection period.

An important component of the baseline scenario is the extraction of harvest residues (Figure 8). It can be observed that for the projection period, the extraction of harvest residues by CBM matches the prescribed amount applied in G4M practically perfectly. The requested quantity of 2.5 Mm³/y represents about 60% of the available biomass from salvage logging and final cut. No extraction of harvest residues is assumed for thinning. Extraction intensity of 60% is somewhat heavy for the conditions of the Czech forestry with its current and expected environmental, legal and economic constraints. In comparison, the Czech National Inventory Document (NID) assumes an extraction intensity for harvest residues of 20% (Figure 8). However, that assumption is also likely to be revised upwards for the coming NID.

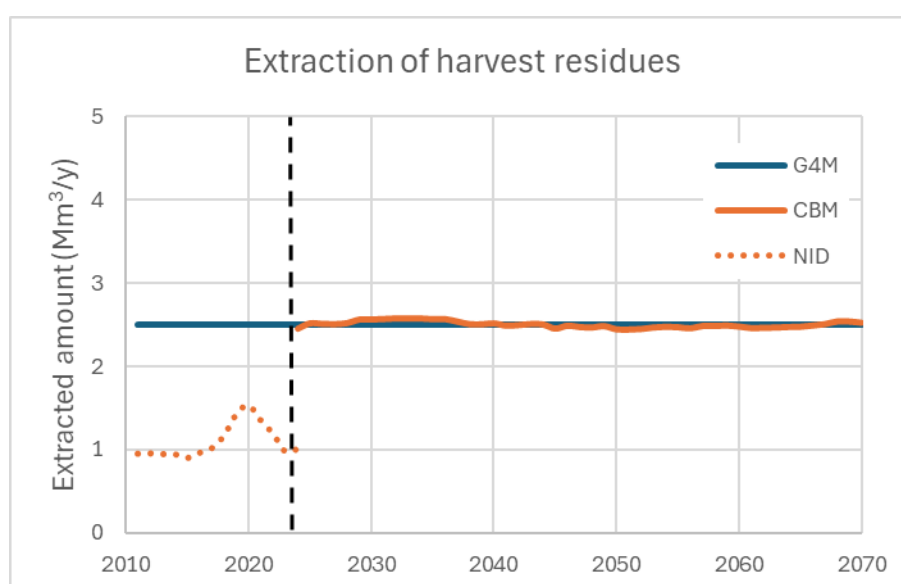


Figure 8. Extraction of harvest residues (in Mm³/y) for the Czech Republic over the period 2011 to 2070 assumed by G4M, and its match for the projection period by CBM. The dashed line splits the calibration and projection period. The estimated amount by the more moderate extraction intensity assumption, as reported in the Czech NID, is included for comparison within the calibration period.

The other key variable affecting forest carbon balance is increment, expressed either as Gross annual increment (GAI), including natural mortality, or Net annual increment (NAI), excluding natural mortality. Its estimate for the calibration period 2011-2023 and the projection following the baseline scenario for 2024 to 2070 is shown in Figure 9. The significant NAI decline that peaks in 2019 mirrors the observed extreme dieback of mostly coniferous (spruce) stands in the country. Evidently, it also affected GAI somewhat with decreased production capacity following the calamity years. Thereafter, both NAI and GAI show a gradual recovery under the optimistic assumptions of the baseline scenario used for the projection period.

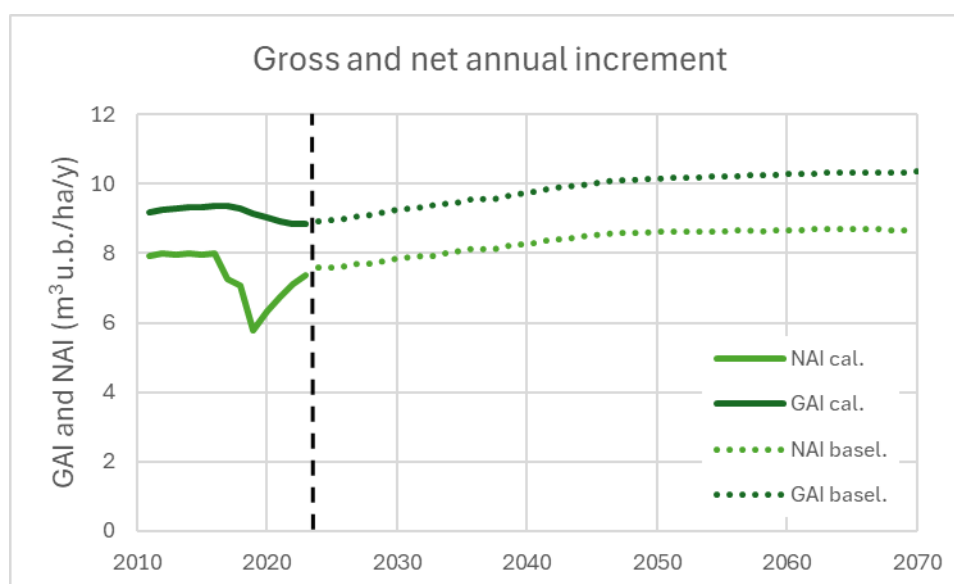


Figure 9. Gross and net annual increment (GAI, NAI, respectively) in m^3 under bark per hectare and year resulting from a pilot model calibration for the period 2011-2023 (cal.) and the estimate for the baseline scenario covering the period 2024 to 2070.

The resulting GHG emission profile is shown in Figure 10. It can be observed that a dominant component of the carbon balance is living biomass and its changes. However, during the extreme calamity years, the contribution of other pools becomes significant. Note, for example, the input to the deadwood carbon pool from declining spruce trees, which is reflected by the specific dynamics of the deadwood carbon pool and its components. Relative to that, the contribution of litter and mineral soil is smaller. In total, the overall sink capacity, which approaches 13 Mt CO₂ eq., must be considered positive, leaving some potential for more intensive wood removal. Harvest of roundwood is currently at about 78% of net annual increment for the projected period 2024-2070.

At the same time, adequate thinning and progressive change in species composition as a part of adaptive management should improve forest resilience for the coming decades. Specifically, the share of sensitive and overrepresented spruce should decrease from the current (2023) share of 36% to 30% in 2070. This would retain considerable softwood production capacity for the Czech forestry, as the share of pine would remain stable at around 13 %, accompanied by increased representation of firs including both the domestic Silver fir and the introduced Douglas fir. Correspondingly, the share of broadleaved tree species would gradually become dominant, reaching 54% in 2070, as compared to current (2023) representation of 49%. Finally, note that the total forest area would increase from the current area of 2,835 kha to 2,895 kha in 2070. This is a net increase of 60 kha, although most of it is expected to be realized due to the general greening and fragmentation of agricultural land.

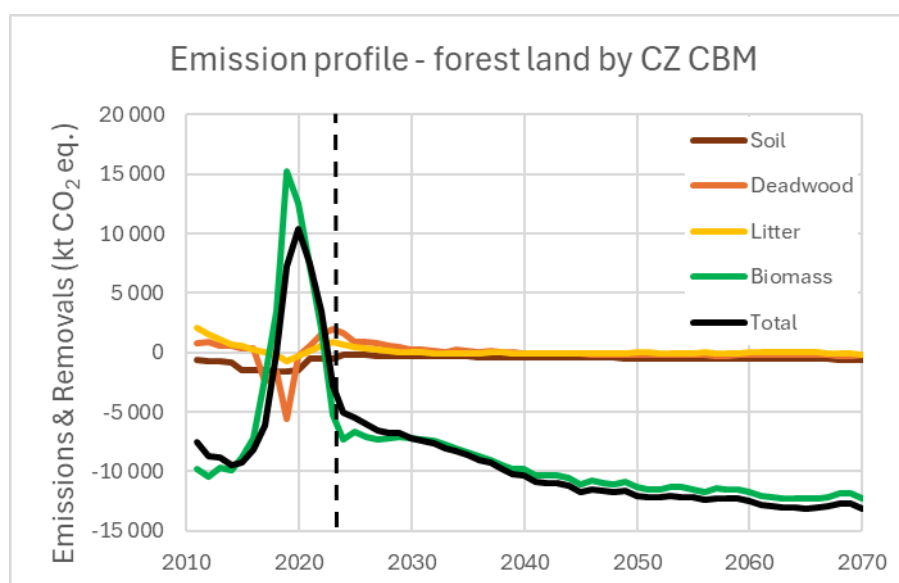


Figure 10. Emissions and removals for forest land (incl. contribution by afforestation and deforestation) by carbon pools as estimated by CBM for the Czech Republic over the period 2011 to 2070. The dashed line splits the calibration and projection period.

3.2. Ireland

Comparison of the harvest target set by GLOBIOM-G4M with CBM over the period 2017 to 2070 shows good agreement. The relative difference was slightly higher for the historic period 2017-2023 (-0.26 to 1.56%), compared to the projected period 2024-2070 (-0.48 to 0.85%).

The projected harvest increases from 4.2 Mm³ in 2024 to 5.1 Mm³ by 2070 (Figure 11) due to an increase in wood supply from afforested lands. The projected harvest estimated by GLOBIOM is lower than the 2024 Irish Climate Change Action Plan (CAP24) scenario for existing policy measures (WEM), which is expected to increase to over 7Mm³ by 2045, followed by a sustained harvest of 6Mm³ (Black et al, 2025). However, the CAP24 projections are based on wood supply and under current silvicultural practice and not market-driven supply and demand estimates as derived from GLOBIOM.

During the simulation period (2024-2070), ca. 10% of the harvest originated from broadleaf crops, the remainder of which comes from conifer crops, dominated by Sitka spruce under rotation forest management. The harvest from recently afforested land increases from 30% in 2017 to over 50% from the mid-2030s onwards due to the increase in available wood supply from afforested stands reaching rotation age.

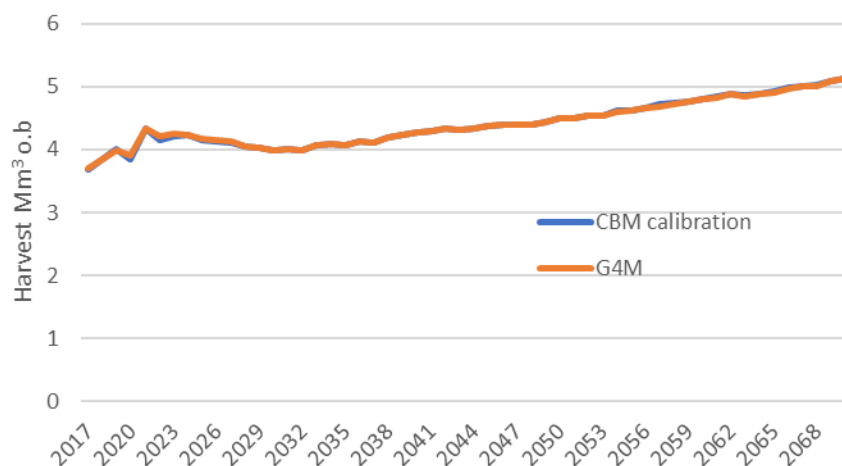


Figure 11. Total roundwood removals (in Mm³) for Ireland over the period 2017 to 2070 using GLOBIOM-G4M and CBM

One of the limitations of G4M, at present, is that afforestation can only be simulated from 2000 onwards. In contrast, CBM afforestation simulations were initiated in 1990. This means that the age profiles of afforested land are different when G4M and CBM are compared, despite the relatively good agreement in afforestation rates from 2000 onwards (Figure 12). Afforestation rates in Ireland have declined from a peak at 25,000 ha yr⁻¹ in 1995 to a rate of less than 2,000 ha yr⁻¹ by 2024. Projected afforestation rates are expected to stay at the current rate of 2,000 ha yr⁻¹ from 2024 to 2070 (Figure 12). This is lower than the ambitious Irish national target of 8,000 ha yr⁻¹.

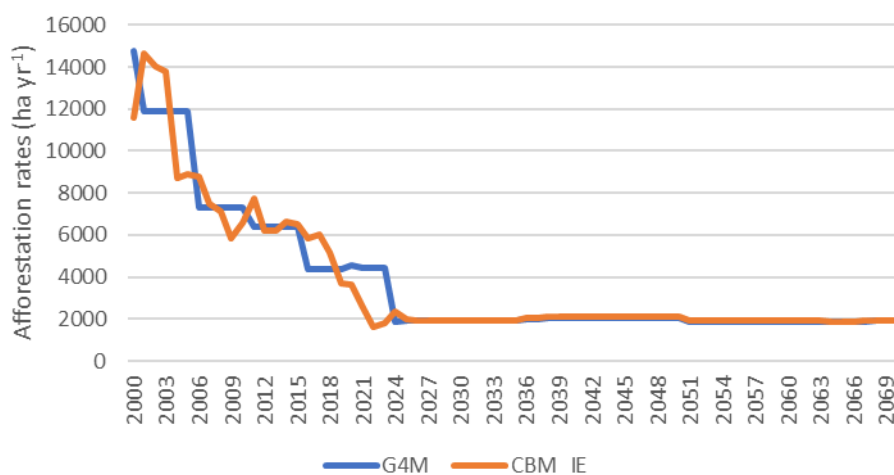


Figure 12. Afforestation rates applied to GLOBIOM-G4M and CBM for Ireland over the period 2000 to 2070.

Deforestation rates are considerably higher for CBM over the historic period up to 2023, when compared to G4M. CBM used historic deforestation rates derived from the NFI and GHG inventory. Most historic deforestation involves transitions to grassland, settlement, and peatland restoration. Nevertheless, projected deforestation rates for CBM and G4M are identical, and these are estimated to decline to less than 100 ha yr⁻¹ by 2070 under the baseline scenario. This contrasts with the Irish

CAP24, which projects deforestation rates to be 992 ha yr⁻¹ due to the expansion of the dairy sector and peatland restoration initiatives (Figure 13).

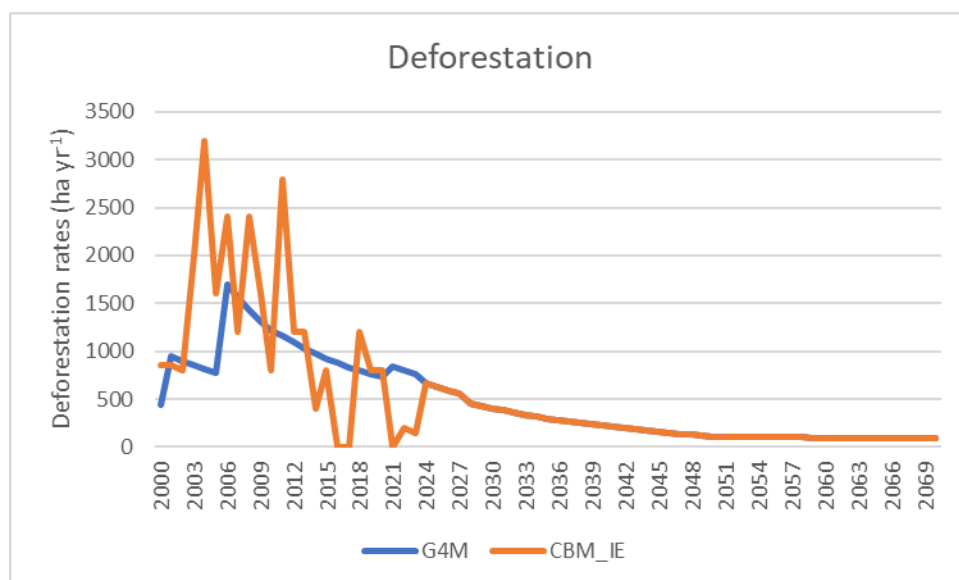


Figure 13. Deforestation rates applied to GLOBIOM-G4M and CBM for Ireland over the period 2000 to 2070.

The Irish forest (excluding HWP) sink has declined from a peak of 3.4 MtCO₂ yr⁻¹ in 2015 to 2.3 MtCO₂ yr⁻¹ by 2023, and these trends are expected to continue under the baseline scenario (Figure 14). By 2027, the forest is projected to be a net emitter, but there is a slow decrease in net emissions up to 2070. The greenhouse gas profile is dominated by sustained emissions from organic soils and a decrease in the biomass sink (Figure 14). Forest stands on organic soils transition from a net sink to a net emission following clearfell, followed by a slow recovery to a net sink over 5-15 years, depending on species and productivity.

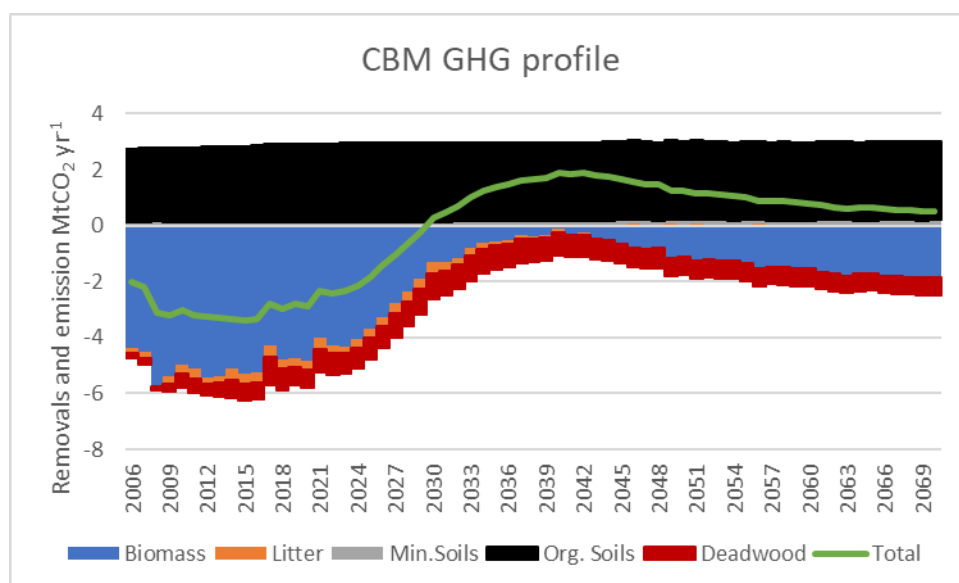


Figure 14. The CBM greenhouse gas profile (excluding HWP) for the baseline projection showing emissions and removals for biomass, deadwood, litter, mineral and organic soils over the period 2006-2070.

The decline in the biomass removals can be attributed to numerous factors, including an increase in harvest and the rate of harvest, expressed as a percentage of increment (Figure 15) and a decline in net annual increment (Figure 16). Net annual increment is related to shifts in the age class structure and afforested lands mature and are harvested (Black et al., 2025).

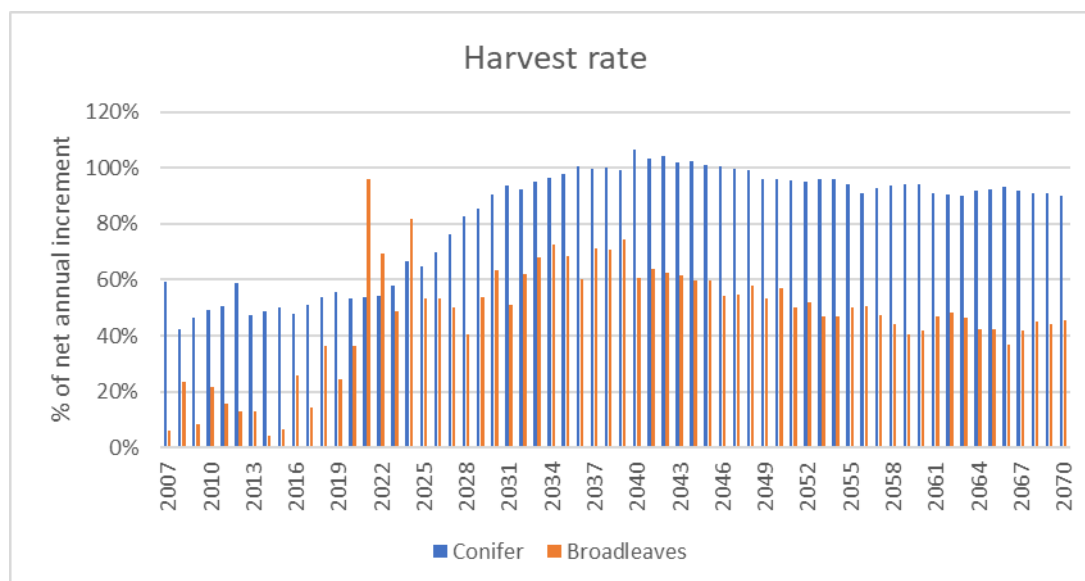


Figure 15. The harvest rate, expressed as a percentage of net annual increment, for conifers and broadleaves.

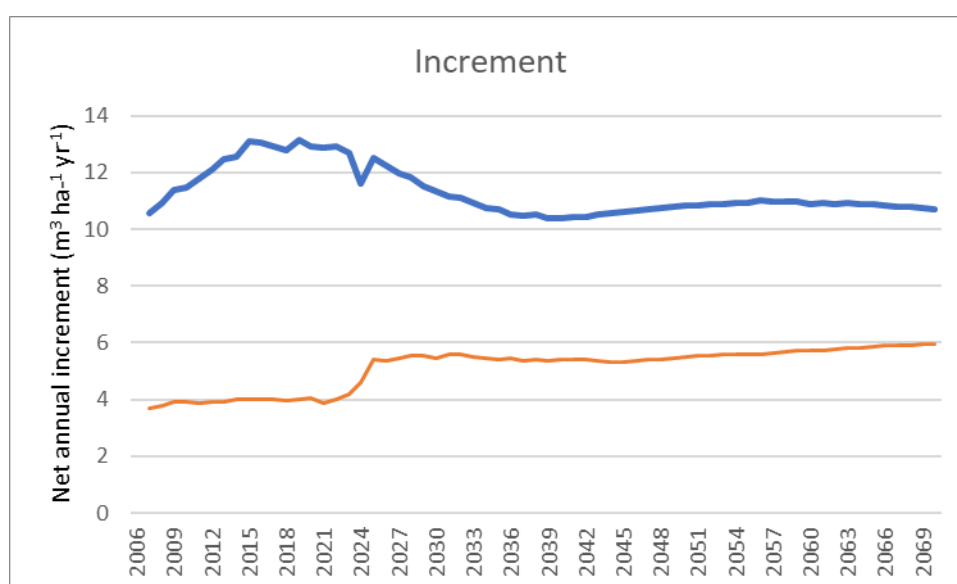


Figure 16. Net annual increment of conifer and broadleaf crops over the baseline projection period

3.3. Italy

The following figure reports the total amount of roundwood removals as expected by GLOBIOM-G4M and applied by CBM within the entire simulation period 2005 – 2070. The overall trend, as far as the absolute amount of harvest considered by CBM, is well aligned with the data applied by G4M, with a relative difference on total harvest ranging between +10% and -7% within the period 2005 – 2023, and between +3% and -1% within the period 2024 – 2070.

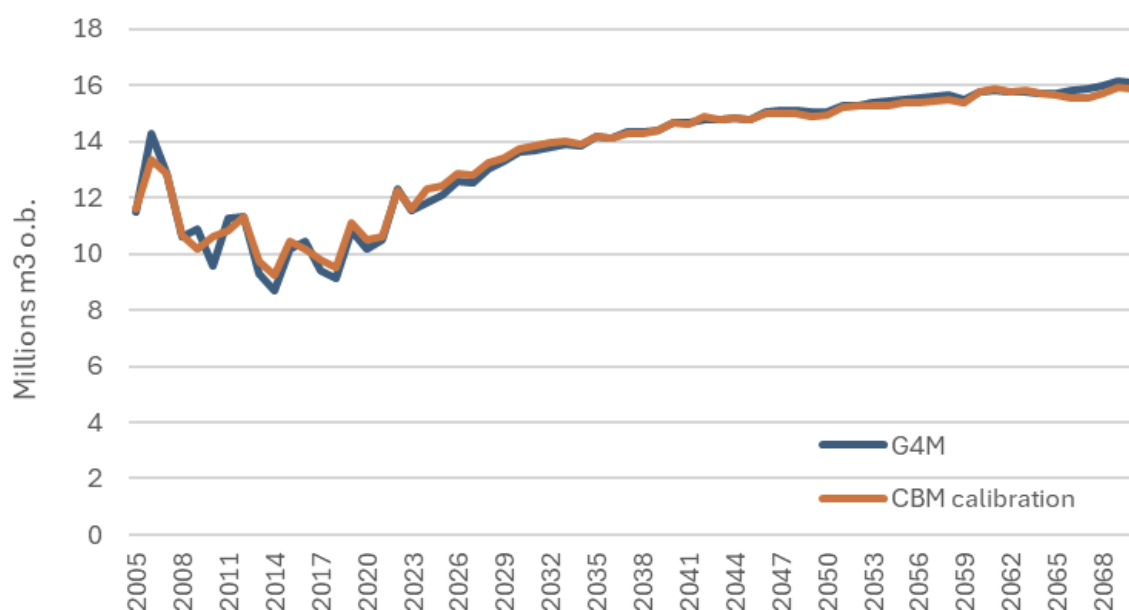


Figure 17. Total roundwood removals (in Mm^3) for 2005 to 2070 using GLOBIOM-G4M (blue) and CBM (orange)

As highlighted by Figures 18 and 19, the annual afforestation and deforestation rates applied by CBM from 2024 onward are also well aligned with the input data applied by G4M. Before 2024, input data used by CBM were inferred from the data reported by NFI 2015 and NFI 2005, before 2015, and from the latest information reported by the Italian National Inventory Document (Italy, 2025), between 2016 and 2023. For this reason, the AR rate reported by CBM differs from the data applied by G4M. Nevertheless, the total forest land considered by CBM in 2023, equal to 8.78 million ha, is consistent with the value reported by G4M (8.76 million ha).

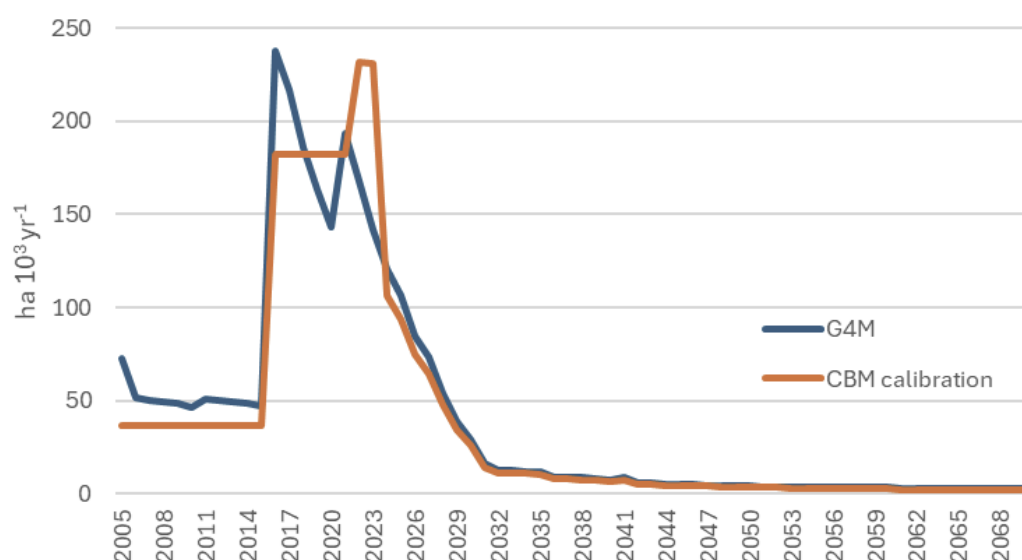


Figure 18. Afforestation (in $ha \cdot 10^3 \cdot yr^{-1}$) for 2005 to 2070 using GLOBIOM-G4M (blue) and CBM (orange)

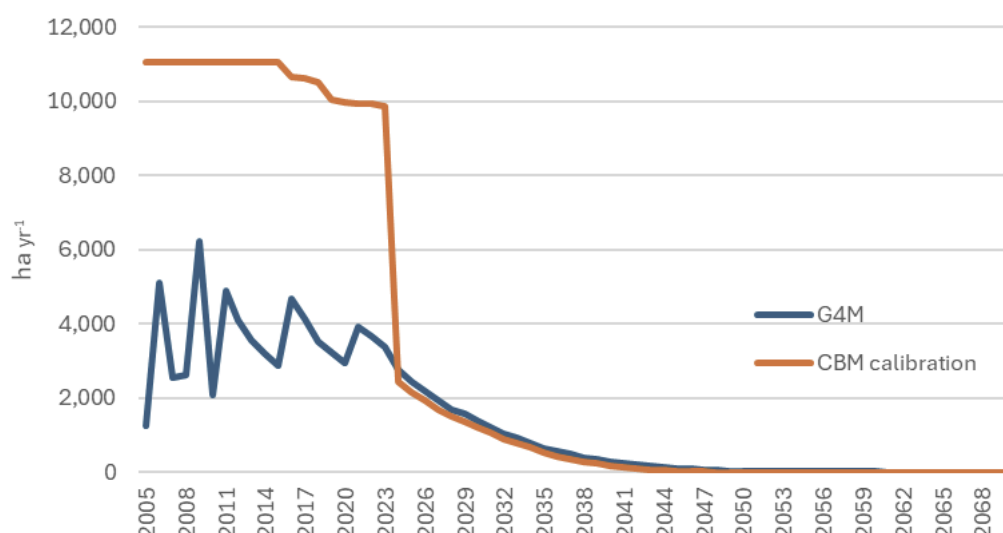


Figure 19. Deforestation (in ha 103 yr⁻¹) for 2005 to 2070 using GLOBIOM-G4M (blue) and CBM (orange)

Between 2024 and 2070, the total carbon sink under the baseline scenario is projected to decline from about -53 Mt CO₂ yr⁻¹ in 2024 to -47 Mt CO₂ yr⁻¹ by 2070 (Figure 20). This decrease is mostly driven by the increasing amount of harvest, which reduces the living biomass sink from -37 Mt CO₂ yr⁻¹ in 2024 to -27 Mt CO₂ yr⁻¹ by 2070. Similarly, the carbon sink associated with Dead Organic Matter drops from -15 Mt CO₂ yr⁻¹ in 2024 to -13 Mt CO₂ yr⁻¹ in 2070. Conversely, the soil carbon pool is expected to increase, rising from around -0.5 Mt CO₂ yr⁻¹ in 2024 to -8 Mt CO₂ yr⁻¹ by 2070.

In comparison to the latest Italian GHGI (Italy, 2025), we highlight an overall good fit with the living biomass sink estimated by our analysis, even if we report a slightly different pattern when considering the impact of major disturbance events, which occurred in 2007 and 2018. However, the DOM and soil pools reported by the Italian GHGI are not fully comparable with the estimates reported by CBM.

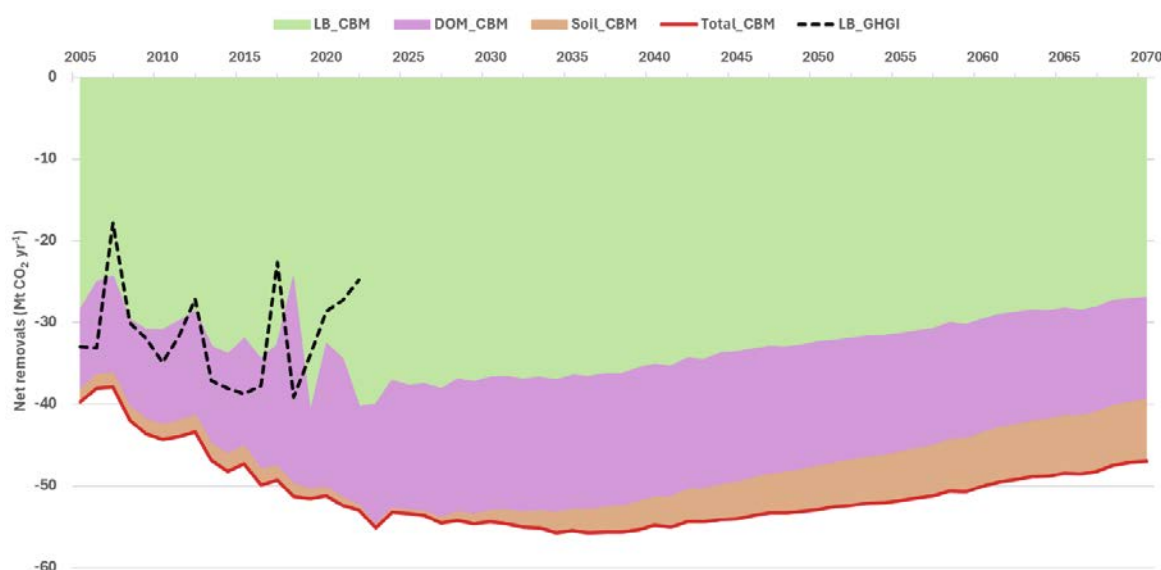


Figure 20. Net GHG emissions/removals estimated by CBM for Italy, for total forest land (i.e., including afforestation and deforestation) over the period 2005-2070. Data until 2023 are based on model's calibration assumptions, with the black dot line highlighting net emissions/removals reported by the Italian GHGI (2025) for living biomass pool.

GAI averaged $3.85 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$ within the 2005-2023 calibration period and is expected to increase to $4.43 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$ by 2070 (Figure 21). During the calibration period, a period with major disturbances between 2018 and 2022, NAI averaged $2.97 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$. Under the baseline scenario, it is projected to peak at $3.56 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$ around 2040 and reach $3.24 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$ by 2070.

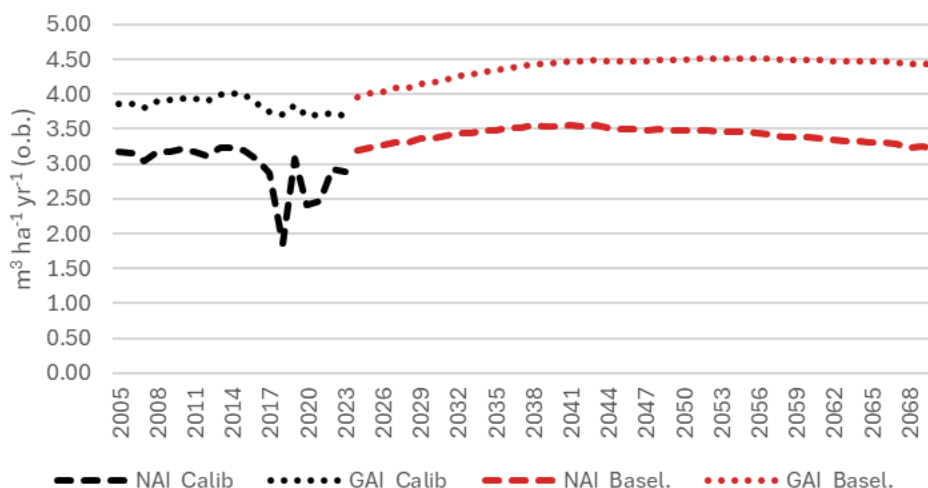


Figure 21. Gross (GAI) and net (NAI) annual increment estimated by CBM for Italy, within the calibration period 2005 – 2023 and under the baseline scenario, from 2024 onward. All values are referred to the merchantable biomass volume over bark.

Based on the ancillary harvest information reported by NFI 2015 (Gasparini et al., 2022) and the regional distribution of fellings inferred by Pilli et al. (2025), the share of removals from broadleaf species ranged between 61% and 50%, within the calibration period. This share was generally lower after 2018 due to salvage logging, which primarily affected coniferous species (Figure 22). For the projection period (2024 – 2070), the share of harvest from broadleaf species was aligned with FAOSTAT data, corresponding to approximately 73% of the total harvest.

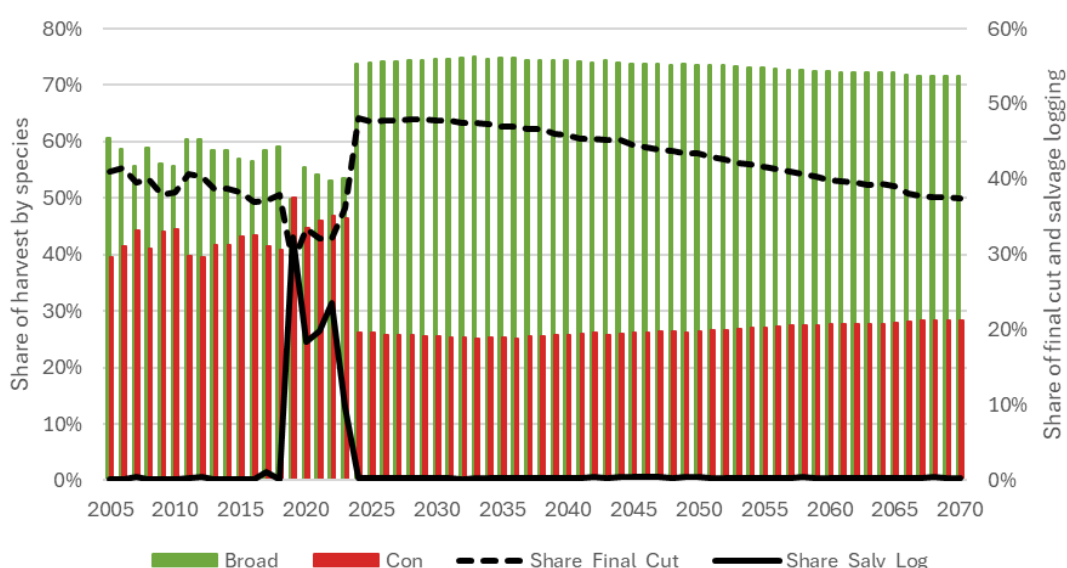


Figure 22. Share of harvest provided by broadleaves and coniferous species (left axis) and by final cut and salvage logging (right axis), within the 2005 – 2023 calibration period and the 2024 – 2070 simulation period, using the CBM modelling framework applied to the Italian case study.

Within the period 2024 - 2070, when no deforestation and major disturbance events were included within our model run, about 44% of total removals were provided by final cuts or other stand-replacing silvicultural treatments (against 38% within the historical period, see Figure 22). The remaining fraction was provided by thinnings and partial cuts applied on uneven-aged forests, which cover, in Italy, about 30% of the total forest area.

Final cuts together with afforestation influence the long-term age structure of even-aged forests. Figure 23 displays the evolution of the age structure of Italian forests. Notably, significant afforestation reported by Italy since 2016 (Italy, 2023) increased the area of the youngest age class from 2005 to 2023. This forest area will shift into older classes during the 2024–2070 simulation period.

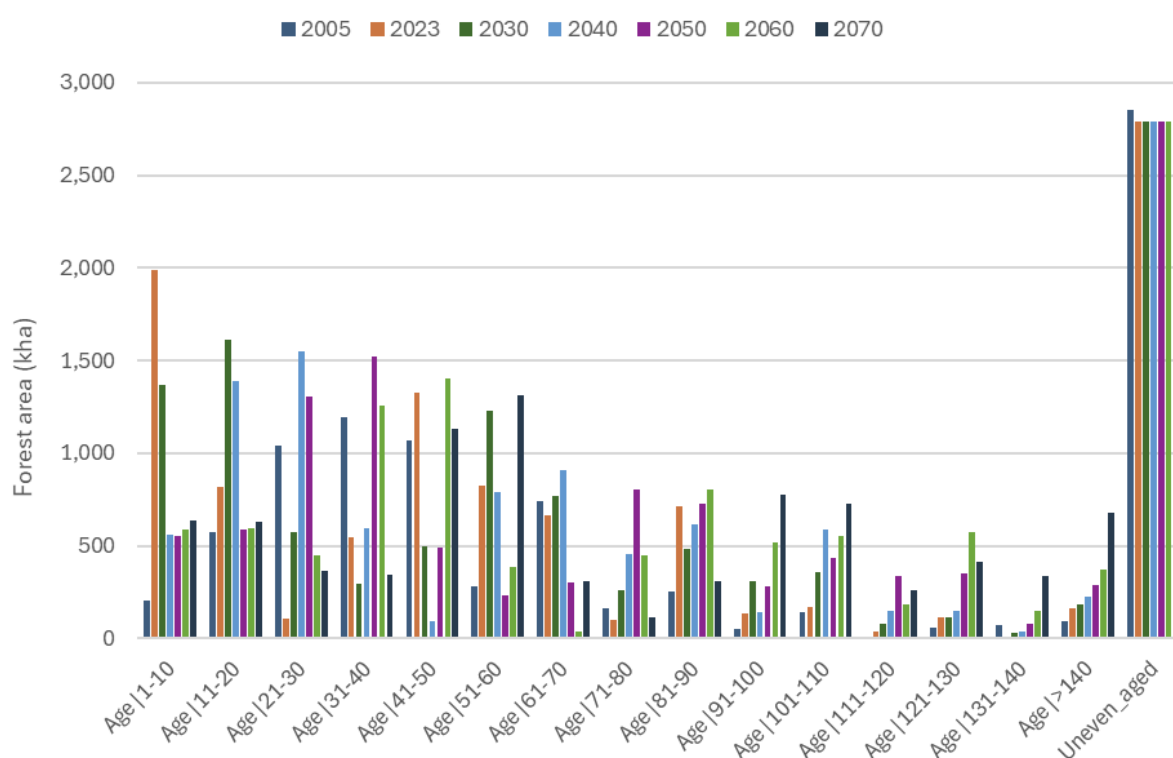


Figure 23. Expected long-term evolution of age structure of the Italian forests (including afforested lands) within the simulation period 2005 – 2070.

3.4. Sweden

The Heureka-based simulation for Sweden reproduced the overall stable harvest trajectory projected by the GLOBIOM–G4M baseline scenario for 2025–2070, albeit with a higher national harvest level (Figure 24). The simulated harvest increases marginally from approximately 97 Mm³ yr⁻¹ in 2025 to 103 Mm³ yr⁻¹ by 2070, in line with the gradual rise projected by G4M.

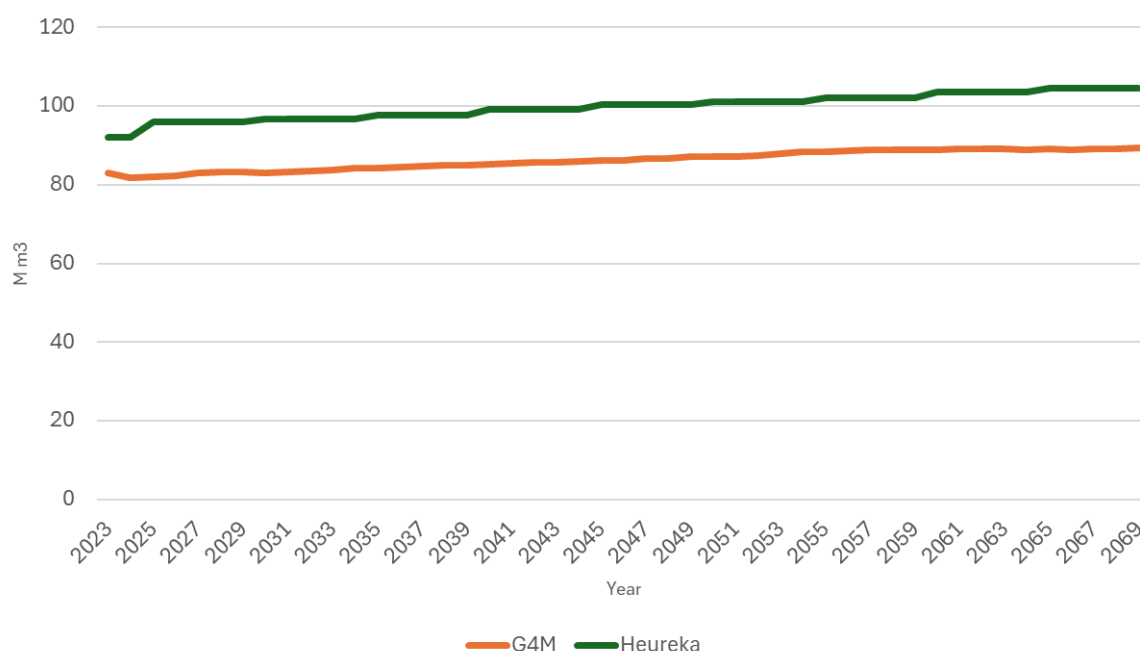


Figure 24. Total national harvest level ($\text{Mm}^3 \text{yr}^{-1}$) for Sweden during 2025–2070 as projected by GLOBIOM–G4M (orange) and Heureka (green).

The standing volume remains stable or slightly increases throughout the projection period (Figure 25). Spruce and pine dominate Swedish forests. Together, they account for more than 80% of the total growing stock, while mainly birch and additionally other broadleaves contribute the remaining fraction. The projected species composition remains largely unchanged.

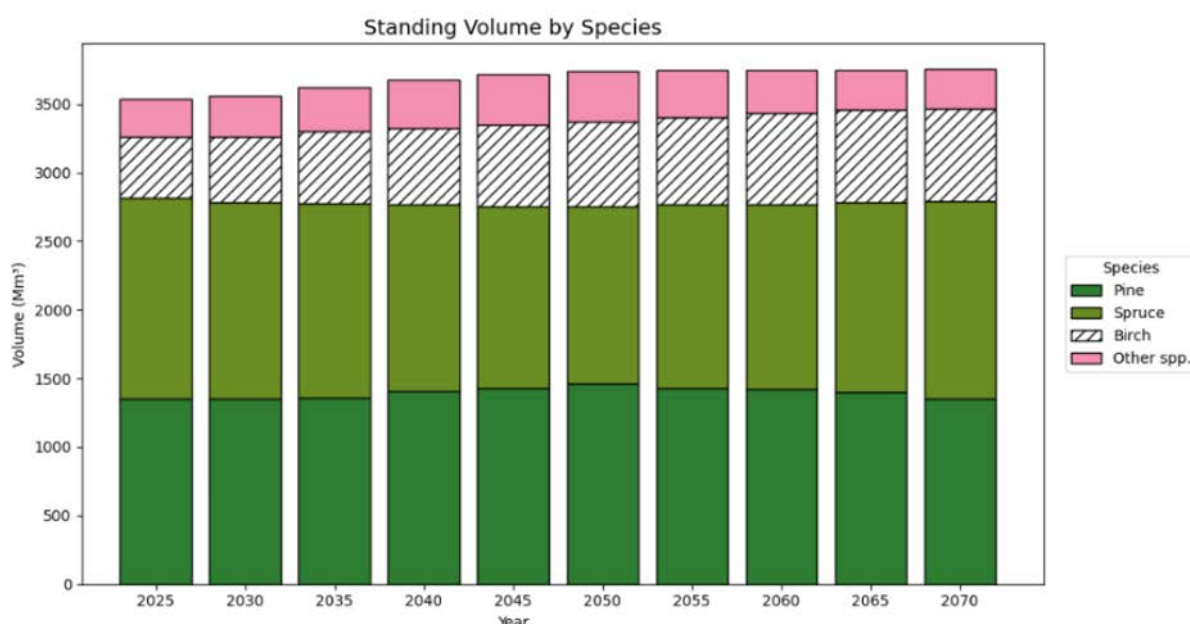


Figure 25. Projected standing volume (Mm^3) of the main tree species in Sweden.

The optimized management portfolio (Figure 26) reflects the predominance of conventional even-aged management in Swedish forestry. BAU clear-cutting remains the dominant practice, covering about 70% of the productive forest area. Natural regeneration variants of BAU, here only implemented in southern Sweden, account for roughly 7% of the area. This aims to reflect that,

according to the Swedish Forest Agency, only private landowners dominant in the south, practice natural regeneration. However, in reality, this practice also occurs further north. We simulated Continuous Cover Forestry (CCF) on approximately 3% of the productive forest land, primarily in spruce-dominated stands, reflecting that even-aged BAU is practised on 97% of productive land according to the Swedish Forest Agency. Finally, about 20% of the total forest area is protected as set-aside.

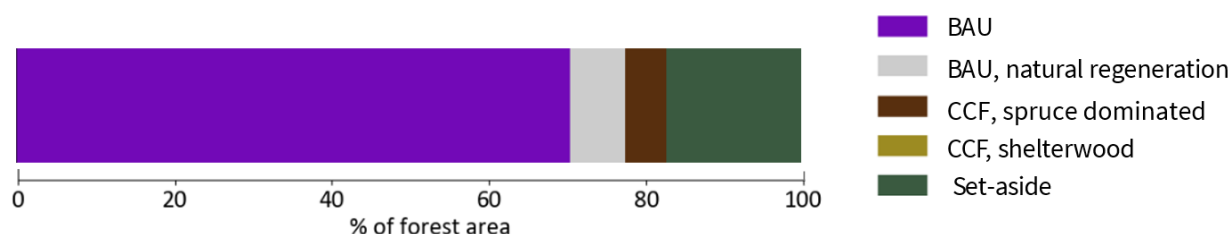


Figure 26. Share of productive forest area (%) allocated to each management regime in Sweden.

The age-class distribution (Figure 27) shows a gradual rejuvenation of the forest structure between 2025 and 2070. The share of young forests (<40 years) increases, while the area in older classes (>100 years) decreases slightly. The proportion of mature and over-mature stands (>140 years) decreases.

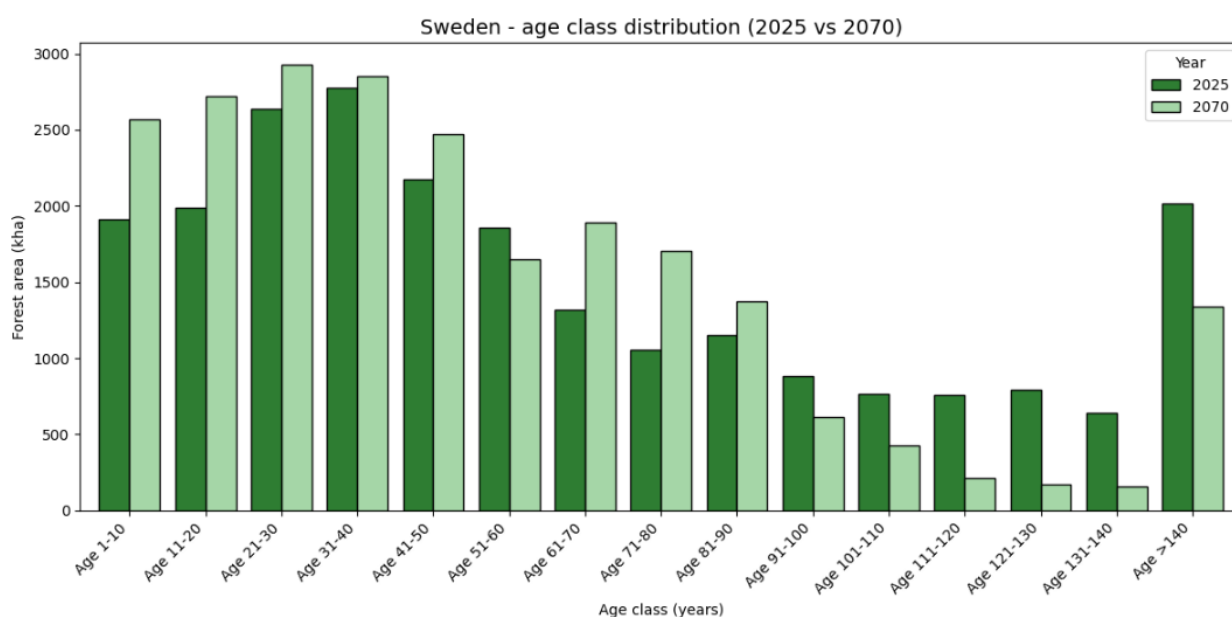


Figure 27. Distribution of productive forest area in Sweden (kha) by age class for 2025 and 2070.

In terms of productivity, the Gross Annual Increment (GAI) remains close to $5 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$ throughout the projection period (Figure 28). The Net Annual Increment (NAI) follows a similar pattern, stabilizing around $4 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$ by 2070 (Figure 29). These values confirm that harvest rates remain below the increment.

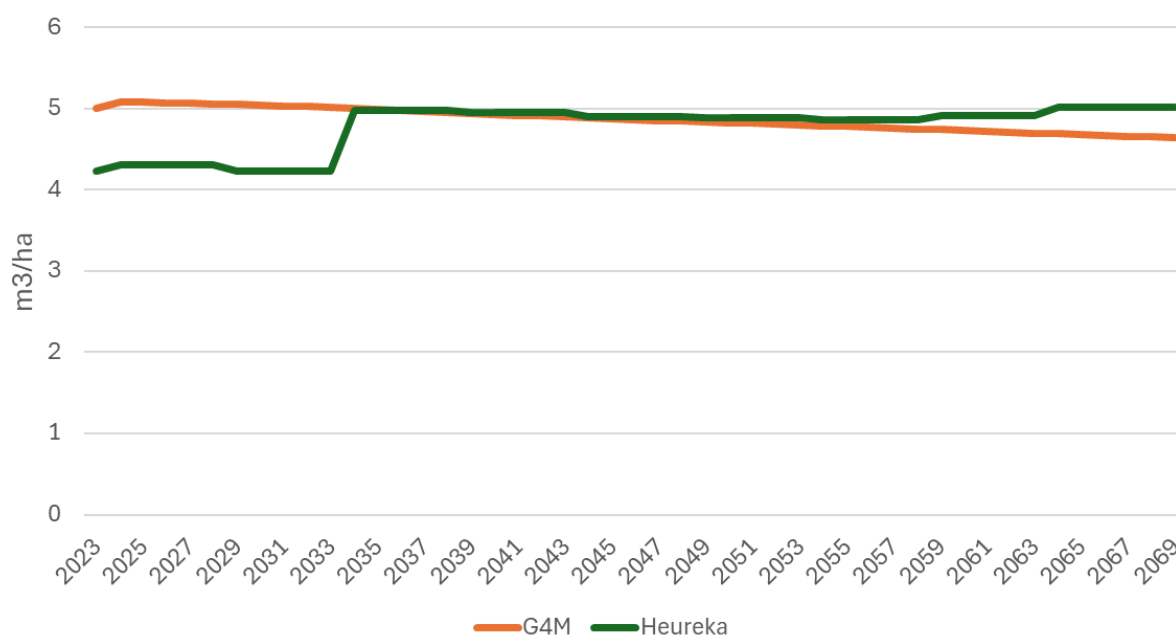


Figure 28. Comparison of gross annual increment ($\text{m}^3 \text{ha}^{-1} \text{yr}^{-1}$) for 2023–2070 from GLOBIOM-G4M (orange) and Heureka (green).

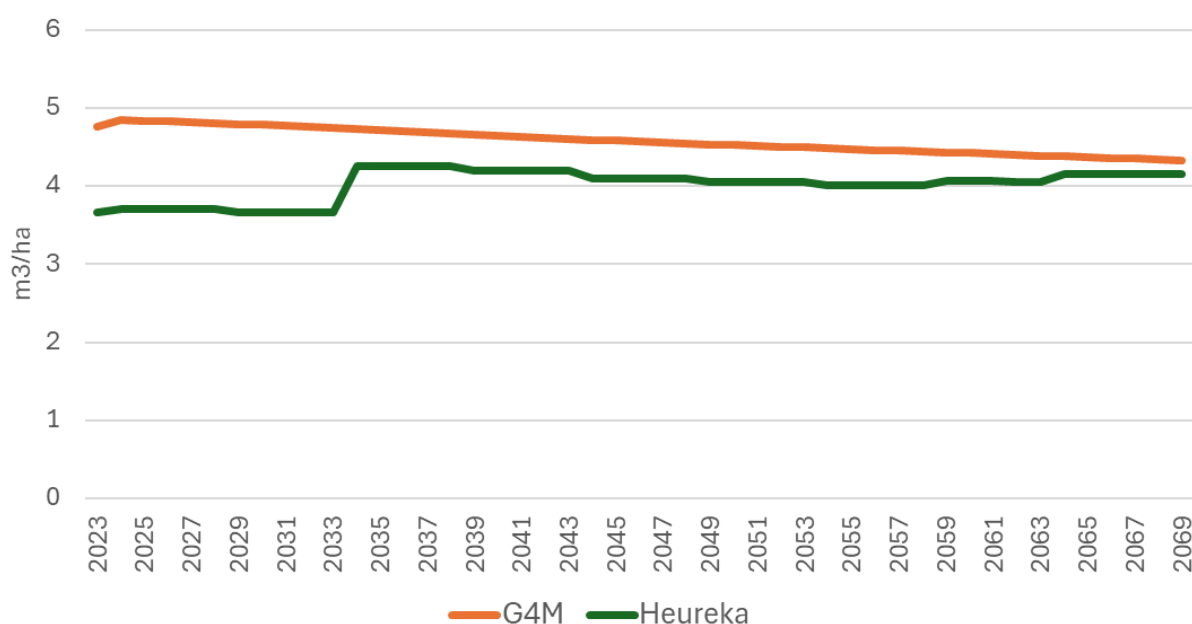


Figure 29. Comparison of net annual increment ($\text{m}^3 \text{ha}^{-1} \text{yr}^{-1}$) simulated by GLOBIOM-G4M (orange) and Heureka (green) for 2023–2070.

For aboveground living biomass emissions/removals, Heureka’s simulations show an initial period of strong removals that gradually decline after 2040, stabilizing near $-5 \text{ Mt CO}_2 \text{ e yr}^{-1}$ by 2070 (Figure 30). The Heureka simulations also show a decline in total forest removals/emissions over time, which stabilizes around $-10 \text{ Mt CO}_2 \text{ e yr}^{-1}$ by 2070 (Figure 31).

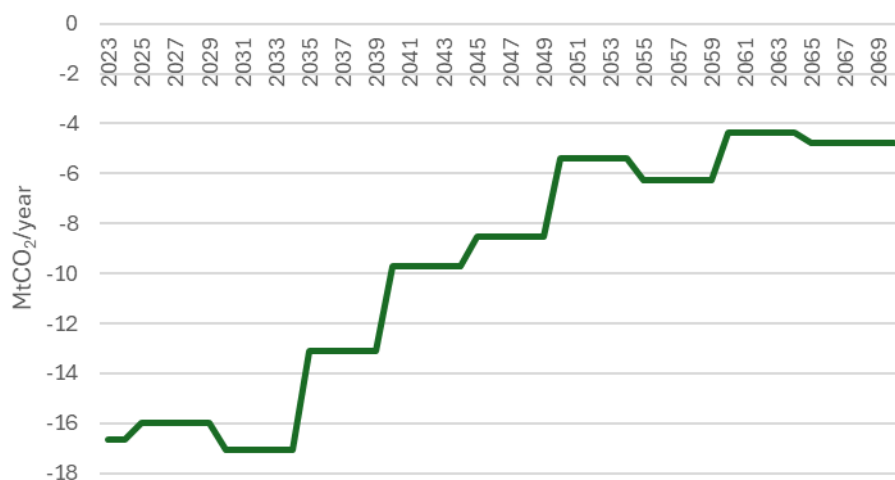


Figure 30. Aboveground living biomass emissions (Mt CO₂ e) in Sweden over 2023–2070, simulated by the Heureka model.

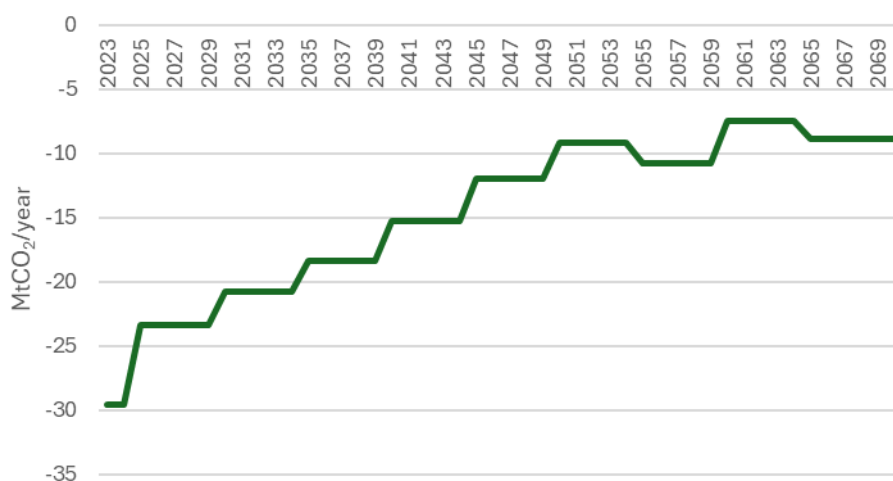


Figure 31. Total net greenhouse-gas emissions and removals from Swedish forests (Mt CO₂ e yr⁻¹) for 2023–2070, simulated by the Heureka model.

4. Comparison of national and EU modelling results

In this section of the report, we present the cross-scale comparisons of the national models' and the EU model's projections. We include examples where we were able to improve alignment across the modelling scales by means of common input/calibration variables. In the cases where alignments of input variables were performed, we present the procedure that we have followed by means of visualizations from the IIASA Accelerator.

4.1. Comparison of emission/removals according to carbon pools

Living Biomass

In general, the comparison of the living biomass pool shows that the trends and levels of emissions/removals between the national models and G4M could be aligned by revising some key input variables and by using them consistently across these scales.

Czech Republic

The preliminary runs for the Czech Republic have shown a marked difference in levels of emissions/removals between CBM-CZ and G4M (Figure 32 A, in the order of 5-10 MtCO₂). This difference was minimized in the final runs (Figure 32 B), by implementing the following steps:

- Adding ca. 200 kha of “forests not in production” in G4M for matching the forest area in CMB-CZ, according to the most up-to-date national statistics. These new forests were assigned by G4M to young forests (assumed to be planted during the period 2000-2010), consequently also modifying the age structure included in the model.
- We have tried to match G4M age structure as much as possible with the one in CBM-CZ for the period 2000-2020 and for new forests planted after the year 2000.

In the final runs, we still observe a remaining difference in trends, with divergence increasing after year 2030 (Figure 32 B). This is due to the different ways G4M and CBM represent long-term effects of forest management on carbon sink, where G4M is approaching in the long term a steady state (i.e. equilibrium between emissions and removals), which is not observed in the CBM-CZ simulation. The difference in projections also originates from the way forests are impacted by disturbances, as the share of stock being affected and regenerated, which is larger in CBM-CZ.

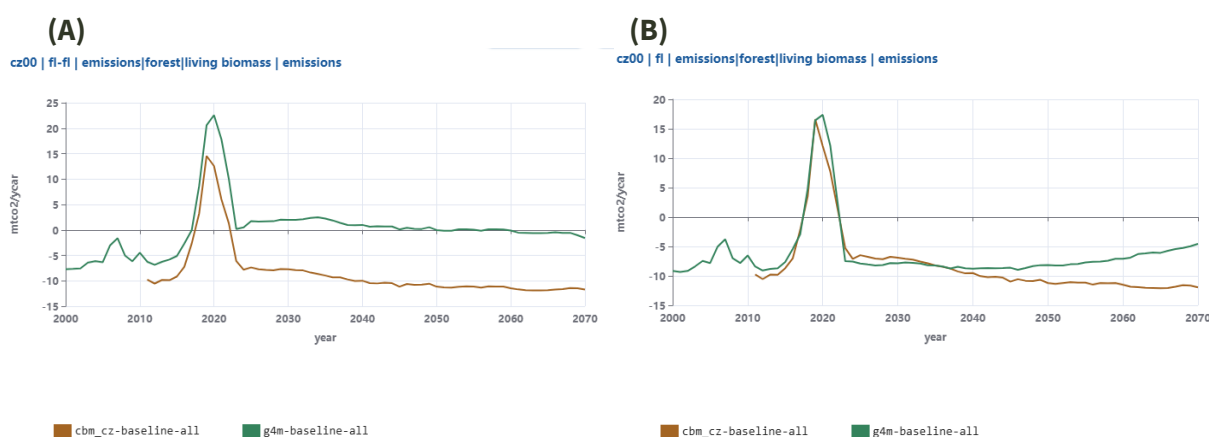


Figure 32. Comparison of living biomass pool emissions/removals between CBM-CZ and G4M-X before (A) and after (B) alignment efforts.

Ireland

In the projection of the living biomass sink, we observe a consistent trend across the models after the year 2030, when the difference in level is less than 1 MtCO₂ eq (Figure 33). In contrast, before 2030, we observe more differences between the models both in trends and levels. In Ireland, these differences can be explained by the representation of historically afforested areas and how these areas have been included in the two models. New forest areas between the two models do not fully match, because in G4M, afforestation starts in the year 2000, while in CBM, afforested areas between 1990-2000 are included. This difference affects the age structure and, consequently, the projections of short-term emissions/removals. Additionally, the two models differ in the way growth for very productive species (i.e. Sitka spruce) is calibrated. For better alignment, we have used harvest volumes in the period 2020-2023 from national sources, due to differences in national sources when compared to FAOSTAT historical reported volumes.

ie00 | fl | emissions|forest|living biomass | emissions

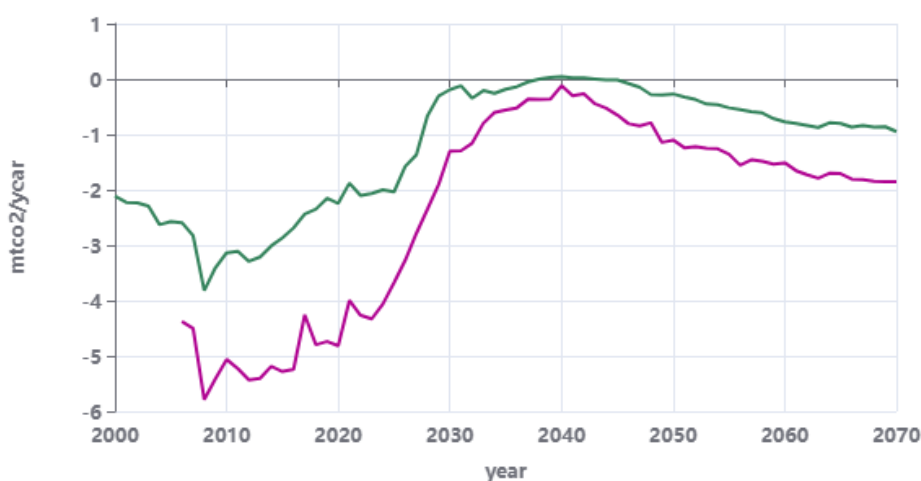


Figure 33. Comparison of living biomass pool emissions/removals between CBM-IE (purple) and G4M-X (green).

Italy

The Italian living biomass preliminary projections presented a good alignment in trend between the models, but a difference in level in the order of 10-15 MtCO₂eq (Figure 34, A). We minimized this difference by adopting in G4M (Figure 34, B):

- the age structure used in CBM-IT,
- the reconstruction of historical harvest volumes for Italy according to Pilli et al. (2025) to reproduce the harvest of CBM-IT during the historical period (2000-2023).

After these improvements, the projected emissions/removals appear to be well aligned both in trend and level.

Two discrepancies between CBM-IT and G4M remain. First, the G4M model during the historical period does not explicitly represent damaged wood volume resulting from large natural disturbances (i.e., the 2018 Vaia storm and following bark beetle outbreaks), due to missing consistent records on salvage logging. Second, the deforestation representation differs between the two models. Historically, deforestation is larger in CBM-IT due to the use of NFI data in the model calibration.

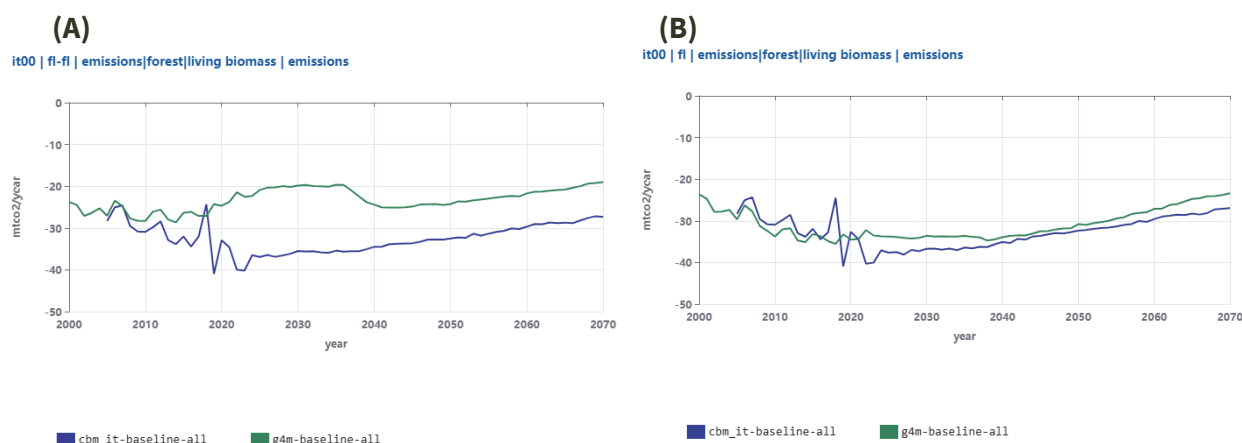


Figure 34. Comparison of living biomass pool emissions/removals between CBM-IT and G4M-X before (A) and after (B) alignment efforts.

Sweden

For Sweden, we have compared the ‘aboveground’ living biomass pool output of Heureka and G4M. Overall, the alignment between the two models is good in terms of level and trend in the projections (Figure 35). On average, the difference in emissions/removals levels equalled 15% during the period 2024-2070. Both models indicate a gradual weakening of the aboveground biomass sink during the projection period. G4M produces a stronger decline than Heureka in future removals, however, both models reach similar values by the end of the century. We could not compare the historical period, due to missing historical emissions computation in Heureka (the historical period is used for model spin-up).

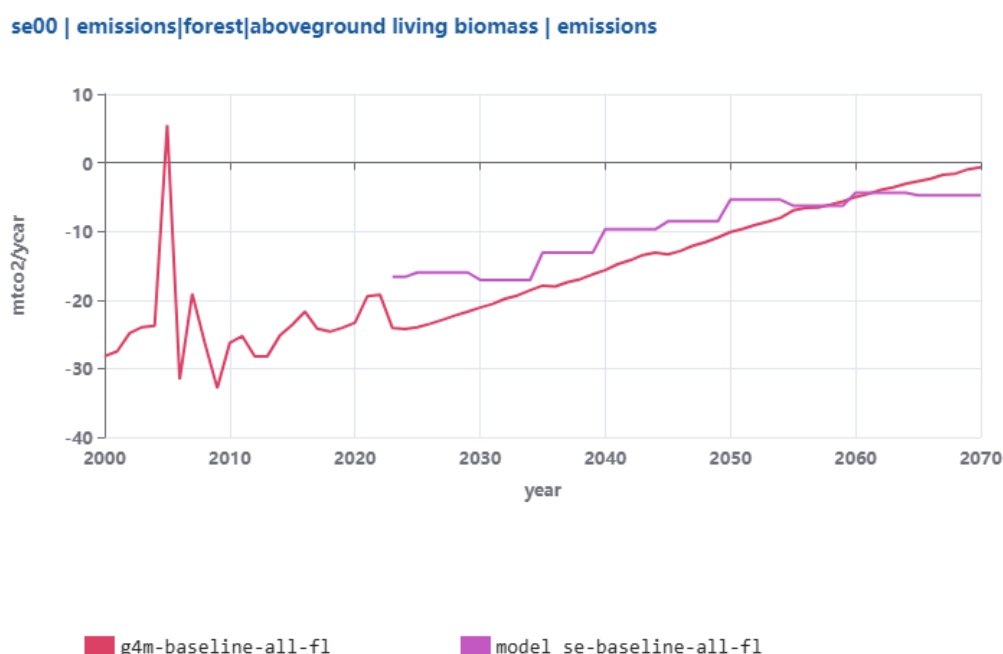


Figure 35. Comparison of aboveground living biomass pool emissions/removals between Heureka (purple) and G4M-X (red).

Deadwood

Deadwood dynamics have shown more marked differences across models than living biomass, which is due to different sub-pools included in the models and different system boundaries (Table

1). G4M is missing the belowground deadwood sub-pool and considers a minimum deadwood fraction diameter of 10 cm. The national models include belowground deadwood sub-pools, and the minimum size for deadwood fractions reaches a diameter of 5mm (see Table 1). Additionally, for deadwood, as for living biomass, G4M has the long-run tendency to equilibrium, which is not observed in national models.

Czechia

We observe a good alignment in the projection of the deadwood pool (Figure 36). However, differences are observed in years with large disturbances (e.g., 2017-2020 bark beetle infestation). Here, G4M observes fewer dead trees than CBM-CZ. Additionally, in G4M, trees are salvaged mostly the same year as the event occurrence, while in CBM-CZ, this is more fractioned, which causes differences in the amount of deadwood entering the pool at a disturbance event.

cz00 | fl | emissions|forest|deadwood | emissions

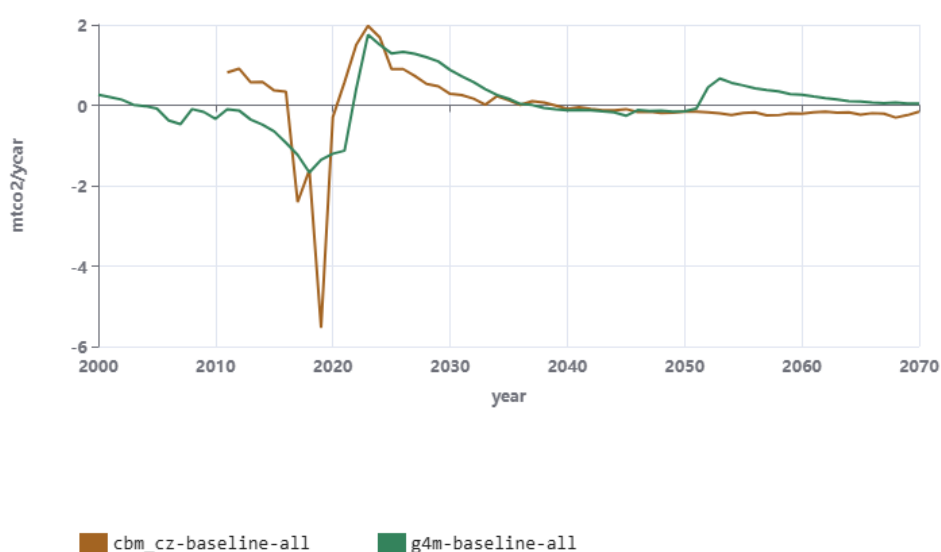


Figure 36. Comparison of deadwood pool emissions/removals between CBM-CZ and G4M-X.

Ireland

In the case of Ireland, we observe a difference in deadwood sink increasing over time and stabilizing in the long run at 0.6 MtCO₂ eq (Figure 36). The difference in trend during 2010-2020 is an effect of a) the different age structure in afforested areas, as discussed for the living biomass; b) the exclusion of belowground deadwood pools in G4M (Table 1), hence a lower inflow of C into the deadwood pools due to turnover and disturbances.

ie00 | fl | emissions|forest|deadwood | emissions



Figure 37. Comparison of deadwood pool emissions/removals between CBM-IE (purple) and G4M-X (green).

Italy

In Italy, the trend projections mostly align, but differ up to 9 MtCOeq in level, due to the different representation of the deadwood pool across the two models. As for living biomass, G4M does not include the historical effect of the recent natural disturbance event on the deadwood pool (year 2018 and following years).

it00 | fl | emissions|forest|deadwood | emissions

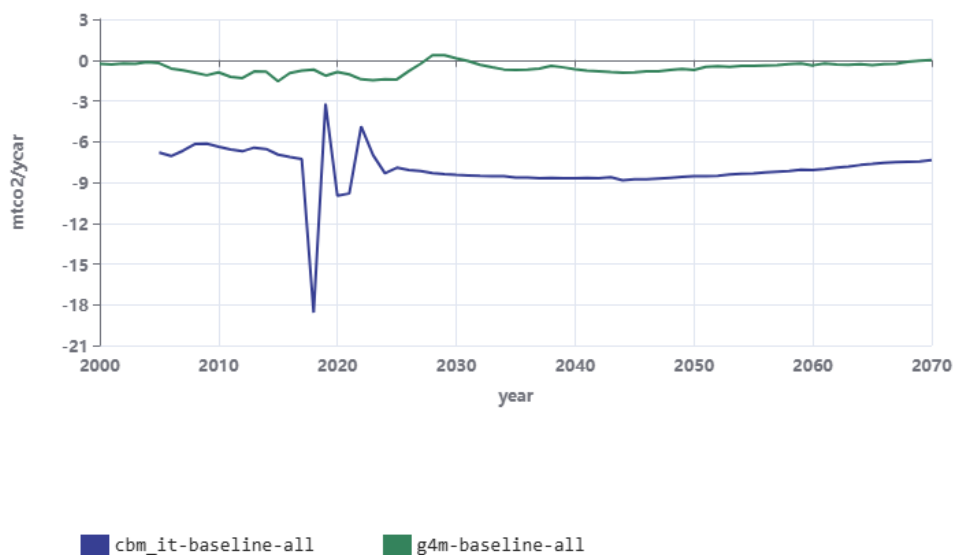


Figure 38. Comparison of deadwood pool emissions/removals between CBM-IT (blue) and G4M-X (green).

Litter

For the litter pool, there are some differences in system boundaries between G4M and CBM. G4M includes fractions below 10 cm in diameter, whereas CBM includes fractions below 5 mm. Additionally, CBM also includes fine roots and the F, H and O soil horizons, which are not included in G4M (Table 1). These differences in the sub-pool representation lead to different levels of emissions/removals between the models.

Czechia

The litter pool shows a good alignment across models, similarly to deadwood, with both models aligning in the long-term to 0 emissions/removals.

cz00 | fl | emissions|forest|litter | emissions

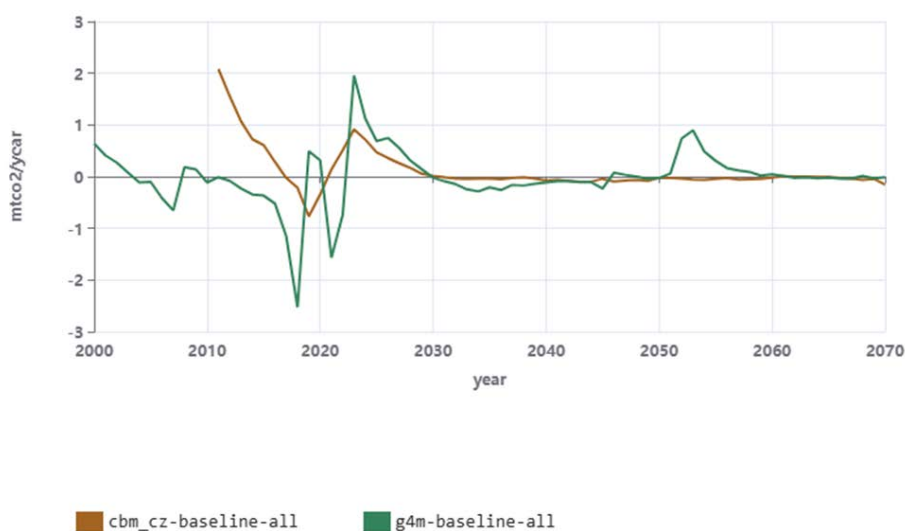


Figure 38. Comparison of litter pool emissions/removals between CBM-CZ (brown) and G4M-X (green).

Ireland

The litter pool shows a difference in the order of 0.1-0.3 Mt CO₂ eq. in the short term (2020-2030), with a progressive reduction over time towards a 0 emissions/removals for both models (after year 2040).

ie00 | fl | emissions|forest|litter | emissions



Figure 39. Comparison of litter pool emissions/removals between CBM-IE (purple) and G4M-X (green).

Italy

For litter, the difference between the two models varies between 3 and 8 MtCO₂ eq. In the long run, G4M aligns with 0 emissions/removals, while CBM continues to project a significant sink (Figure 41).

it00 | fl | emissions|forest|litter | emissions

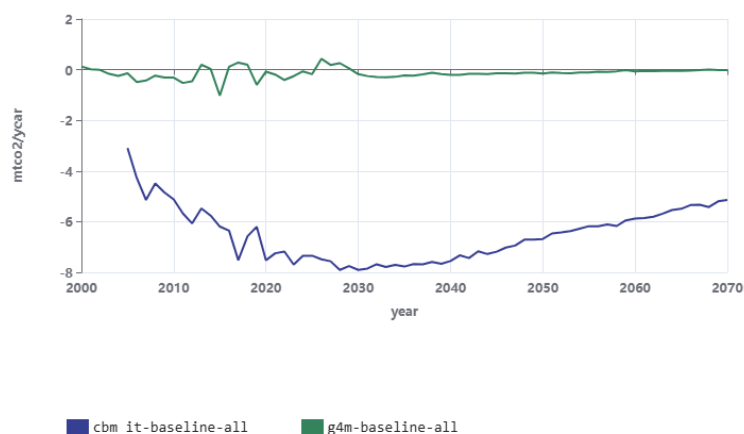


Figure 39. Comparison of litter pool emissions/removals between CBM-IT (blue) and G4M-X (green).

Due to differences in how the deadwood and litter pool boundaries are defined between CBM and G4M, these pools show the largest discrepancies in carbon stock levels. However, the differences in emissions/removals trends between the two models are less pronounced (Table 2).

Table 2. Carbon stocks and emissions/removals per hectare of forest land.

Country & Model	Carbon Pool	Carbon stock historical (2000-2023)* t C ha ⁻¹	Carbon stock projection (2024-2070) t C ha ⁻¹	CO ₂ sink/source historical (2000-2023)* t CO ₂ ha ⁻¹ year ⁻¹	CO ₂ sink/source projection (2024-2070) t CO ₂ ha ⁻¹ year ⁻¹
Czechia CBM*	Living biomass	117	135	-0.63	-3.52
	Deadwood	8.44	8.07	-0.06	0.01
	Litter	10.1	9.73	0.18	0.00
	Soil	74.2	74.6	-0.36	-0.15
Czechia G4M	Living biomass	128.0	144.6	-1.31	-2.65
	Deadwood	3.1	2.6	-0.12	0.10
	Litter	0.8	0.9	-0.06	0.03
Ireland CBM	Living biomass	73.7	99.5	-7.3	-5.30
	Deadwood	12.0	13.1	-0.81	-0.99
	Litter	11.8	12.3	-0.43	-0.27
	Soil	58.5	56.2	0.18	0.17
Ireland G4M	Living biomass	57.7	63.2	-3.62	-0.63
	Deadwood	6.1	6.6	-0.33	0.00
	Litter	1.1	1.5	-0.09	-0.01
Italy CBM	Living biomass	73.6	89.9	-3.40	-3.02
	Deadwood	20.4	23.8	-0.80	-0.75
	Litter	18.0	20.9	-0.63	-0.62
	Soil	89.1	89.6	-0.18	-0.39
Italy G4M	Living biomass	64.4	79.4	-3.38	-2.74
	Deadwood	1.6	2.0	-0.09	-0.04
	Litter	0.3	0.4	-0.02	-0.01
Sweden Heureka	Living biomass	48.7	57.1	-1.21	-0.53
Sweden G4M	Living biomass	53.4	60.4	-1.04	-0.60
	Deadwood	3.9	4.0	-0.04	0.00
	Litter	1.5	1.4	-0.03	0.01

* The historical period for the Czech Republic and its CBM estimates is limited to the period 2011-2023

4.2. Comparison of total forest land emissions/removals

For further comparison of the models' projections of total CO₂ emissions/removals, we have summed living biomass, deadwood and litter pools for G4M and CBM. This comparison shows that after improving the alignment of variables affecting the single pools, the outputs demonstrate good alignment in the trends over time, even if there are some residual differences in the respective annual emission/removal levels. The results suggest that, despite structural differences between models, alignment protocols and harmonized assumptions can achieve broadly comparable projections across national scales.

Czech Republic

The total emissions/removals reflect mostly the alignment shown for living biomass, where the two models reach full alignment in 2030 and start to diverge afterwards.

[cz00](#) | [fi](#) | [emissions](#)|[forest_comp](#) | [emissions](#)

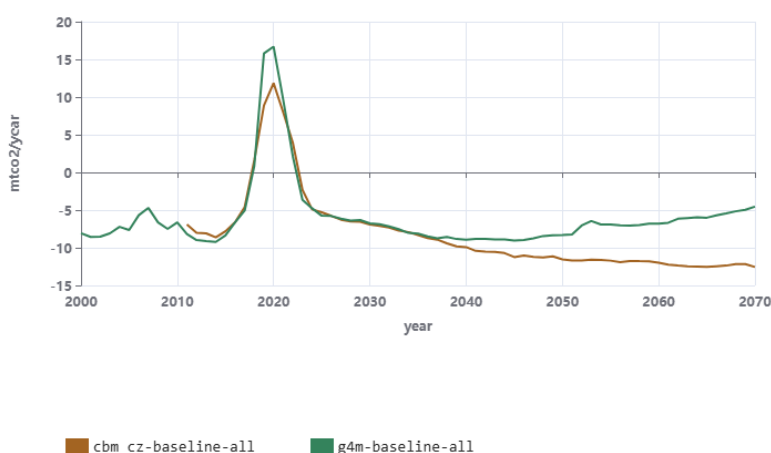


Figure 40. Comparison of total (living biomass, deadwood, litter) emissions/removals between CBM-CZ (brown) and G4M-X (green).

Ireland

The total emissions/removals reflect the living biomass trends differentiation until 2030, afterwards the difference in levels reaches 1.5 MtCO₂ eq., due to the sum of differences from the single pools.

[ie00](#) | [fi](#) | [emissions](#)|[forest_comp](#) | [emissions](#)

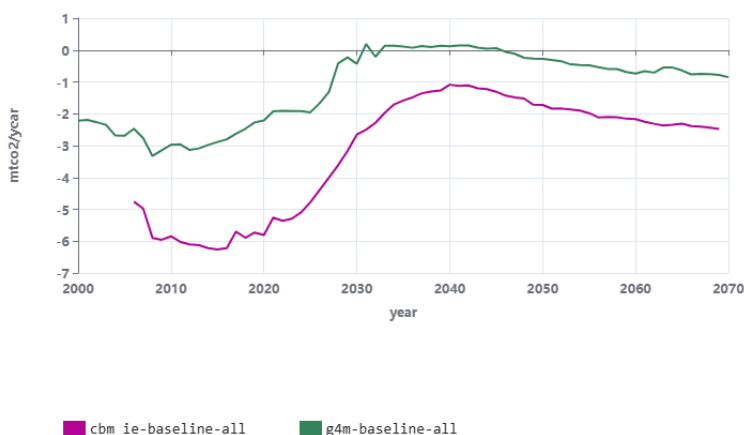


Figure 41. Comparison of total (living biomass, deadwood, litter) emissions/removals between CBM-IE (purple) and G4M-X (green).

Italy

Despite a good alignment for living biomass trends and levels, when including deadwood and litter, the resulting sum of emissions/removals shows a long-term difference of around 16 MtCO₂ eq.

it00 | fl | emissions|forest_comp | emissions

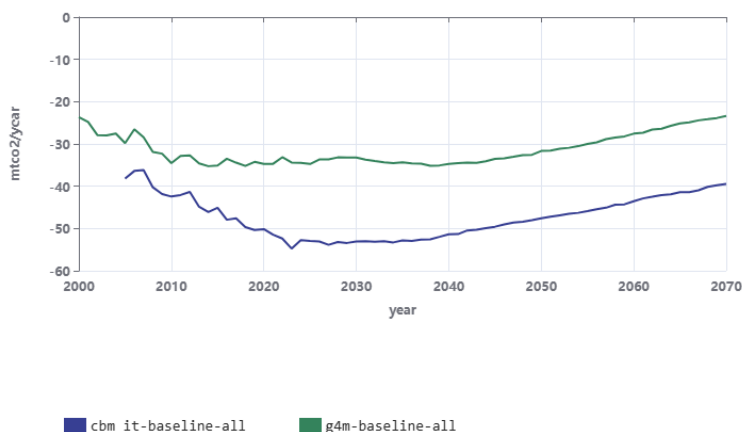


Figure 42. Comparison of total (living biomass, deadwood, litter) emissions/removals between CBM-IT (blue) and G4M-X (green).

Sweden

For Sweden, we have compared the total forest emissions from Heureka (including also soils) to the emissions included in G4M (living biomass, deadwood, litter). The total forest sink declines progressively throughout the projection period in both models, consistent with the decreasing biomass sink. By 2070, the Heureka simulation stabilizes around -10 Mt CO₂-eq year⁻¹, while G4M projects a slightly weaker sink approaching -5 Mt CO₂-eq year⁻¹. Overall, the alignment between the models' projections is good, despite differences in the pools included in each specific case.

The total emissions from the National and EU models align with the official UNFCCC GHG inventories as total forest land emissions. However, there have been recent changes in the share of total emissions/removals from living biomass and other pools (deadwood, litter, soil) in the GHG inventories, which were not captured by the models either at the national or EU scale.

se00 | emissions|forest | emissions

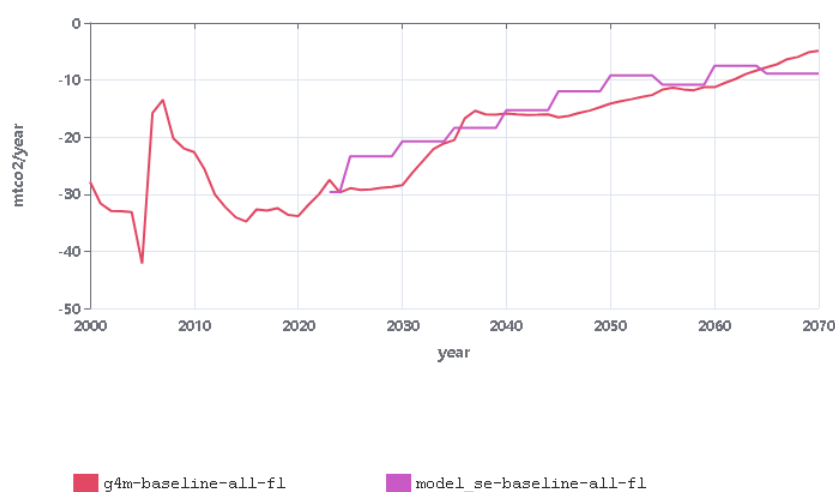


Figure 43. Comparison of total emissions/removals between Heureka (red, including: living biomass, deadwood, litter, soil) and G4M-X (purple, including: living biomass, deadwood, litter).

4.3. Comparison of Harvested Wood Products pool emissions and removals

The Baseline projection of emissions/removals for the HWP carbon pool was conducted using the GLOBIOM post-hoc module together with the WoodCarbonMonitor detailed model. Both models applied the IPCC “Production” Approach. Their historical calibration of production and trade volumes is based on FAOSTAT statistics. However, they differ in their representation of wood product categories and in the parametrization of wood decay equations (e.g., treatment of inherited emissions). These differences result in variations in both historical and projected emissions/removals levels.

On average, WoodCarbonMonitor projections were +10.5 MtCO₂eq higher than those of GLOBIOM at the EU27 scale (calculated as the sum of MS-level differences) over the period 1990-2050. This average difference was applied to scale GLOBIOM projections to match the WoodCarbonMonitor levels (see Annex for WoodCarbonMonitor updated Baseline projections used as MS reference).

After this correction, a +2.8 MtCO₂eq difference remained in 2023 between GLOBIOM’s calibrated emissions/removals and the official UNFCCC GHG inventories, reflecting underlying differences between WoodCarbonMonitor and the national GHG inventories. For the HWP pool, we chose to align GLOBIOM to WoodCarbonMonitor rather than with the UNFCCC GHG inventories. This decision was based on the consideration that both GLOBIOM’s HWP pool post-hoc module and WoodCarbonMonitor implement the IPCC Production Approach consistently, using the latest IPCC requirements and the same data sources. This alignment ensures a more transparent and conservative comparison than using the national GHG inventory submissions, which often lack the necessary methodological details needed for sound cross-model comparison.

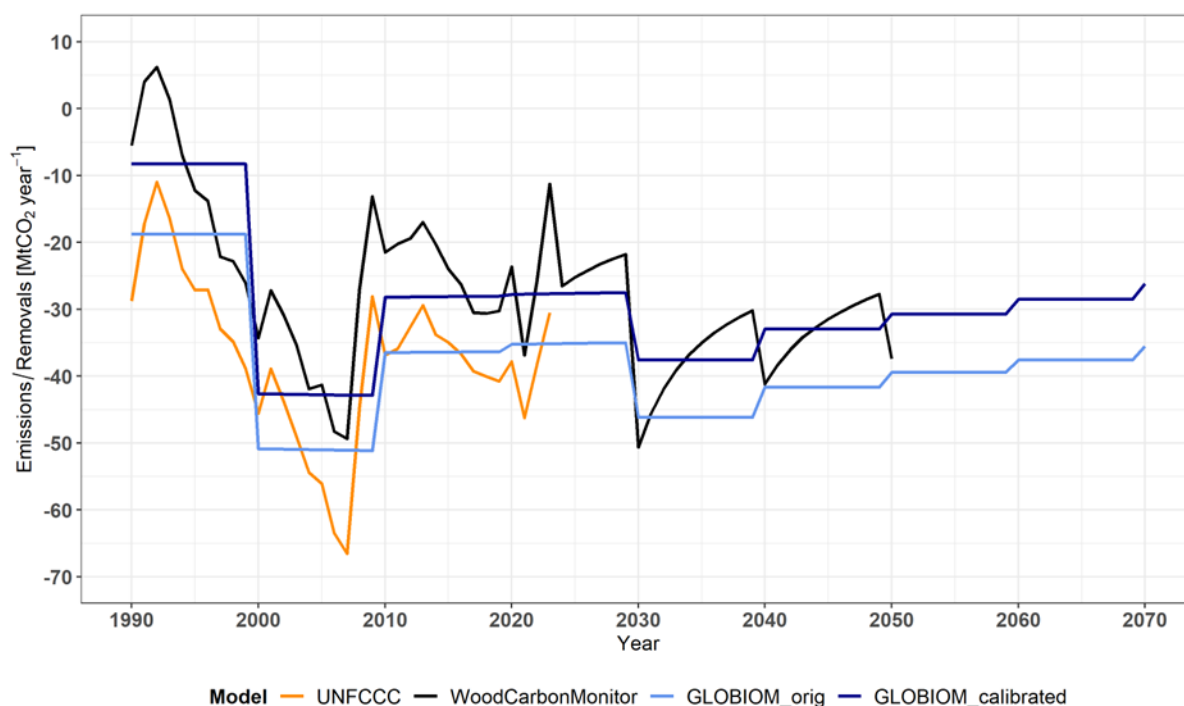


Figure 44. EU27 HWP emissions/removals in historical period (1990-2023) and in model-based projections (2023-2050), presented for UNFCCC GHG inventories, WoodCarbonMonitor, and GLOBIOM (GLOBIOM_orig= original, GLOBIOM_calibrated = GLOBIOM corrected to match WoodCarbonMonitor).

5. EU27 and National Baselines

5.1. EU Model projections

National Baselines

At the level of EU Member States, G4M-X projections of emissions/removals (i.e. including living biomass, deadwood and litter) show that in most countries, the sink will slowly evolve towards an equilibrium, meaning that a “0” emissions/removals state is reached. By 2070, MSs still showing a forest land sink over 1 MtCO₂ are Finland, Slovenia, Bulgaria, Denmark and Poland (Figure 47). MSs showing a sink over -5 MtCO₂ are the Czech Republic, Sweden, and Spain, while MSs showing a sink over -10 MtCO₂ are France, Italy, and Germany.

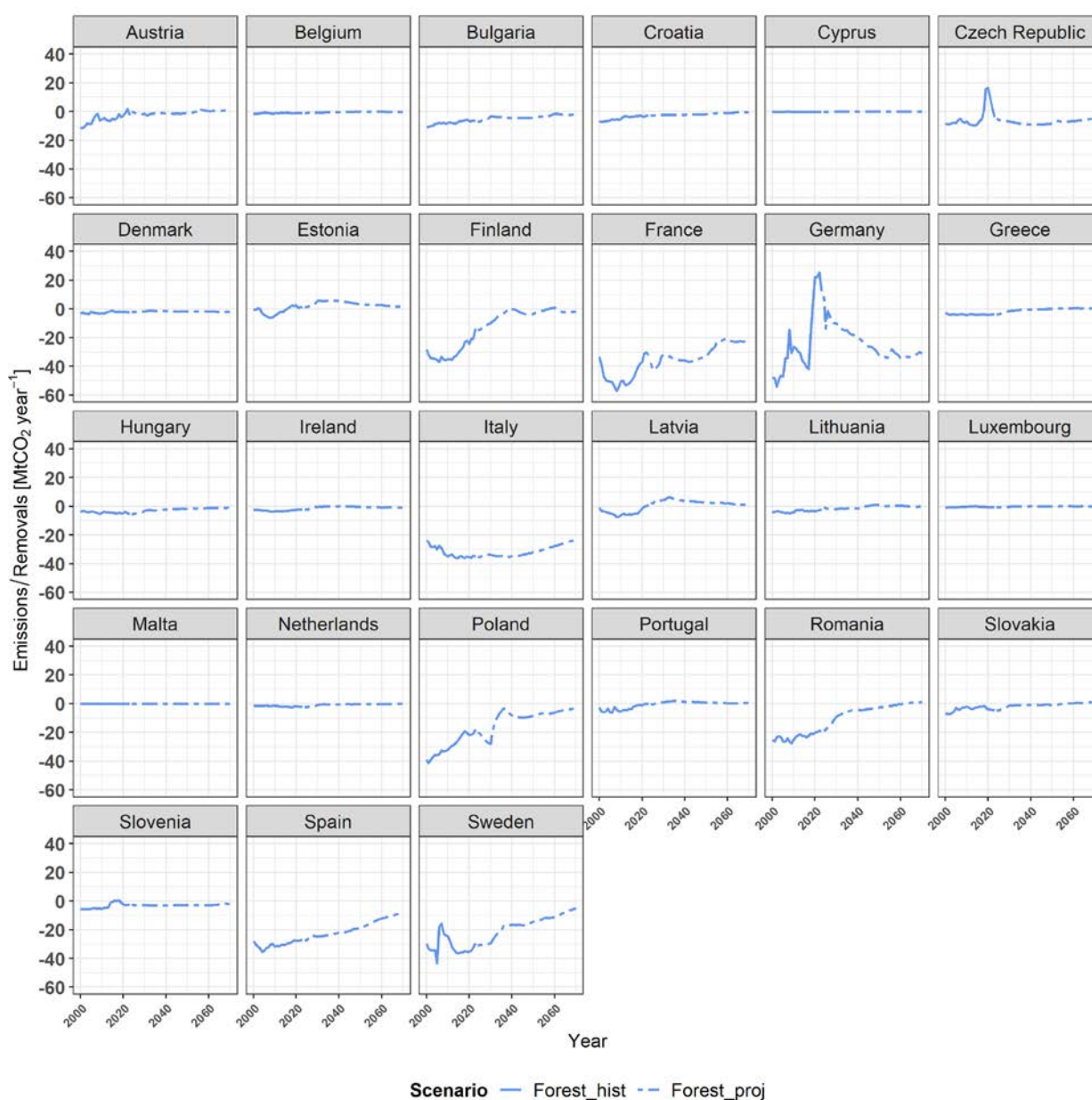


Figure 45. Historical and projected emissions/removals for forest land (including living biomass, deadwood, litter) using the G4M-X model.

Figure 48 shows the average HWP pool contribution to emissions/removals during the projection period (2024-2070). This indicates reaches the highest level in Germany (-6.5 Mt CO₂/year) and Poland (-6.3 Mt CO₂/year), while relatively large contributions are also observed in Romania (-3.7 Mt CO₂/year) and Sweden (-3.1 Mt CO₂/year).

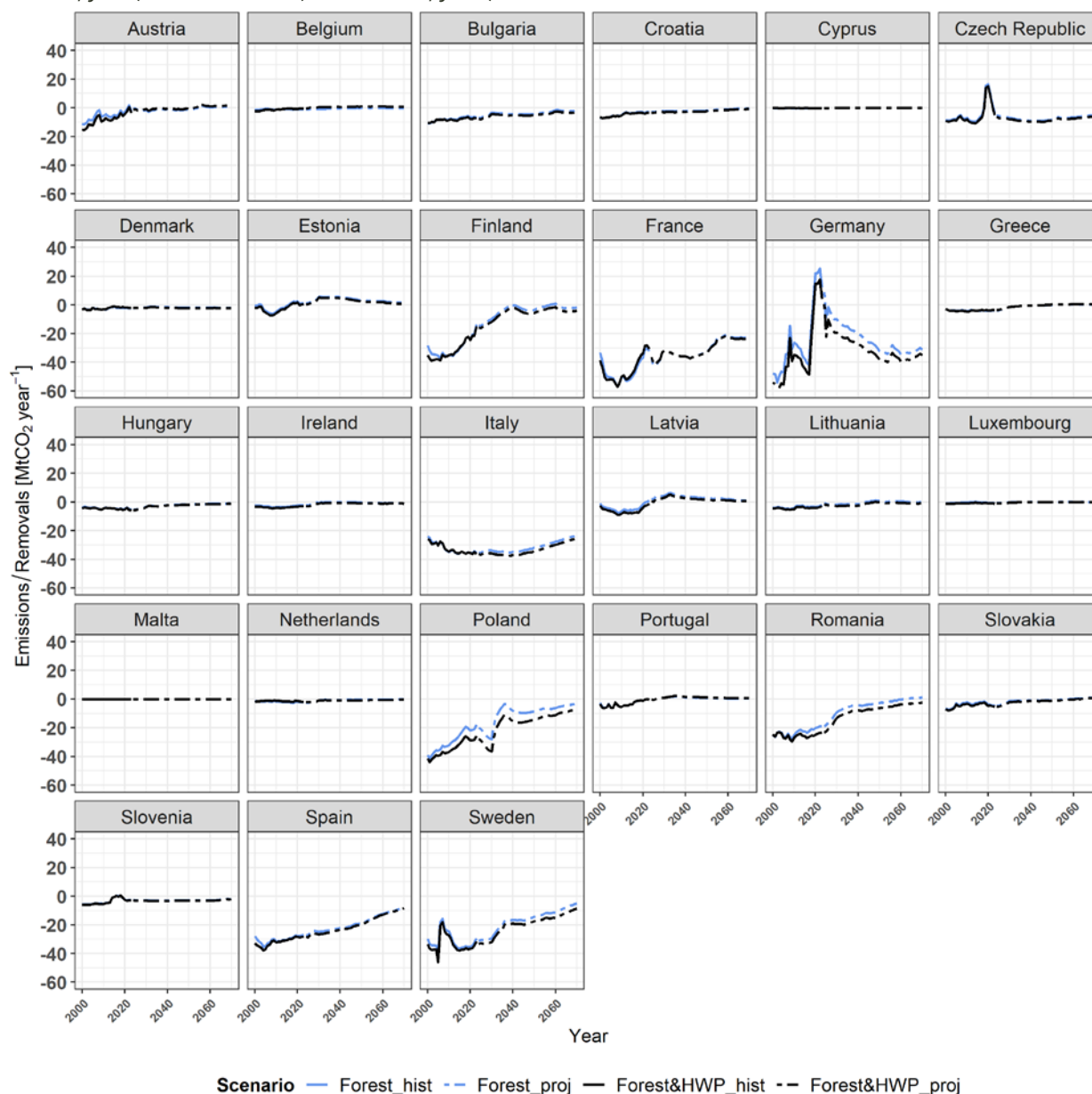


Figure 46. Historical and projected emissions/removals for forest land (Forest) and including the HWP pool (Forest&HWP) according to the G4M-X model.

EU Baseline

The GLOBIOM-G4M-X emissions/removals (living biomass, deadwood and litter) projection for the EU27 under the baseline scenario (without additional policies) shows a general reduction in forest land sink (i.e. including forest land remaining forest land, afforestation and deforestation emissions/removals) from -202 MtCO₂year⁻¹ in 2023 to -101 MtCO₂year⁻¹ by 2070. The reduction of forest land sink over time is quantified to be 8 MtCO₂ by 2030, 42 MtCO₂ by 2050 and 101 MtCO₂ by 2070 compared to 2023 (Forest_proj in Figure 49).

The additional EU27 sink from the HWP pool, as results of the GLOBIOM HWP calculator calibrated to WoodCarbonMonitor, amounts to $-33 \text{ MtCO}_2 \text{ year}^{-1}$ in 2023, it is $-37 \text{ MtCO}_2 \text{ year}^{-1}$ by 2030, $-30 \text{ MtCO}_2 \text{ year}^{-1}$ by 2050 and $-25 \text{ MtCO}_2 \text{ year}^{-1}$ by 2070. Hence, the HWP sink remains rather constant over time, and its contribution to the total forest sector sink oscillates between 14% (2023) and 20% (2070).

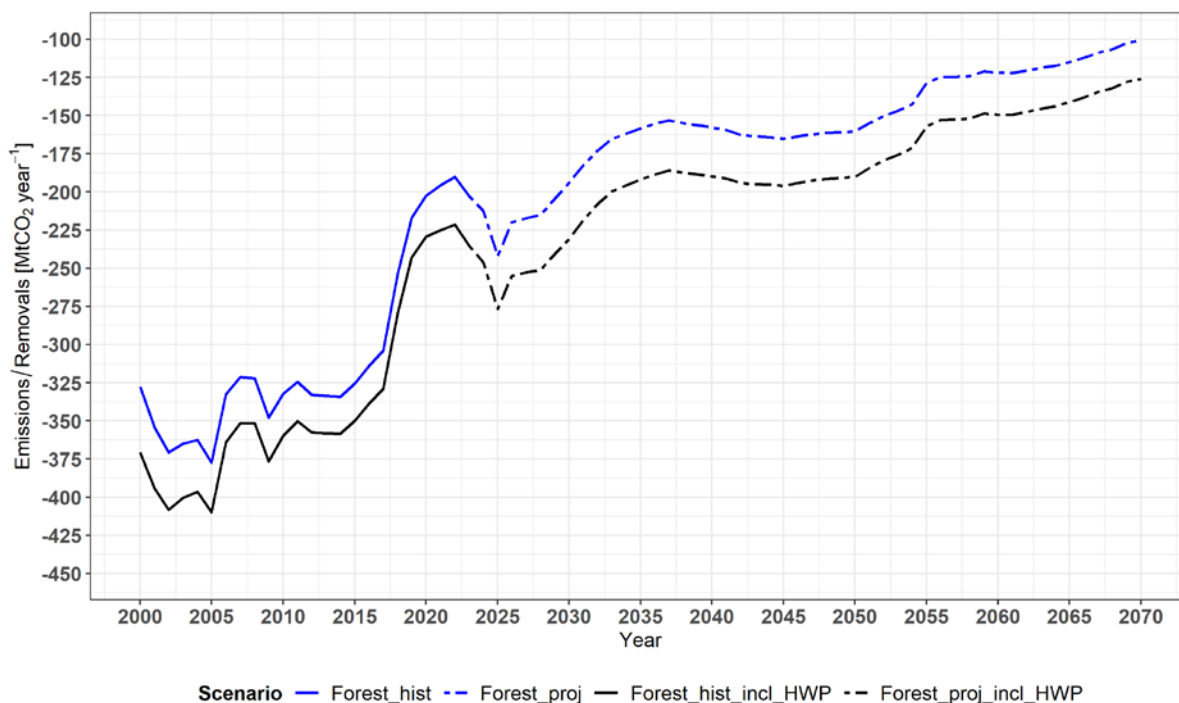


Figure 47. EU27 forest land (Forest) and Forest land including the HWP pool (Forest_incl_HWP) emissions/removals: GLOBIOM-G4M-X model outputs (historical and projected).

The EU27 aboveground biomass carbon stock in forest land, according to the modelling results, is expected to increase from 8,121 MtC (in 2023) to 9,419 MtC (in 2070). The corresponding change in total biomass carbon stock varied between 10,268 MtC (in 2023) and 11,884 MtC (in 2070).

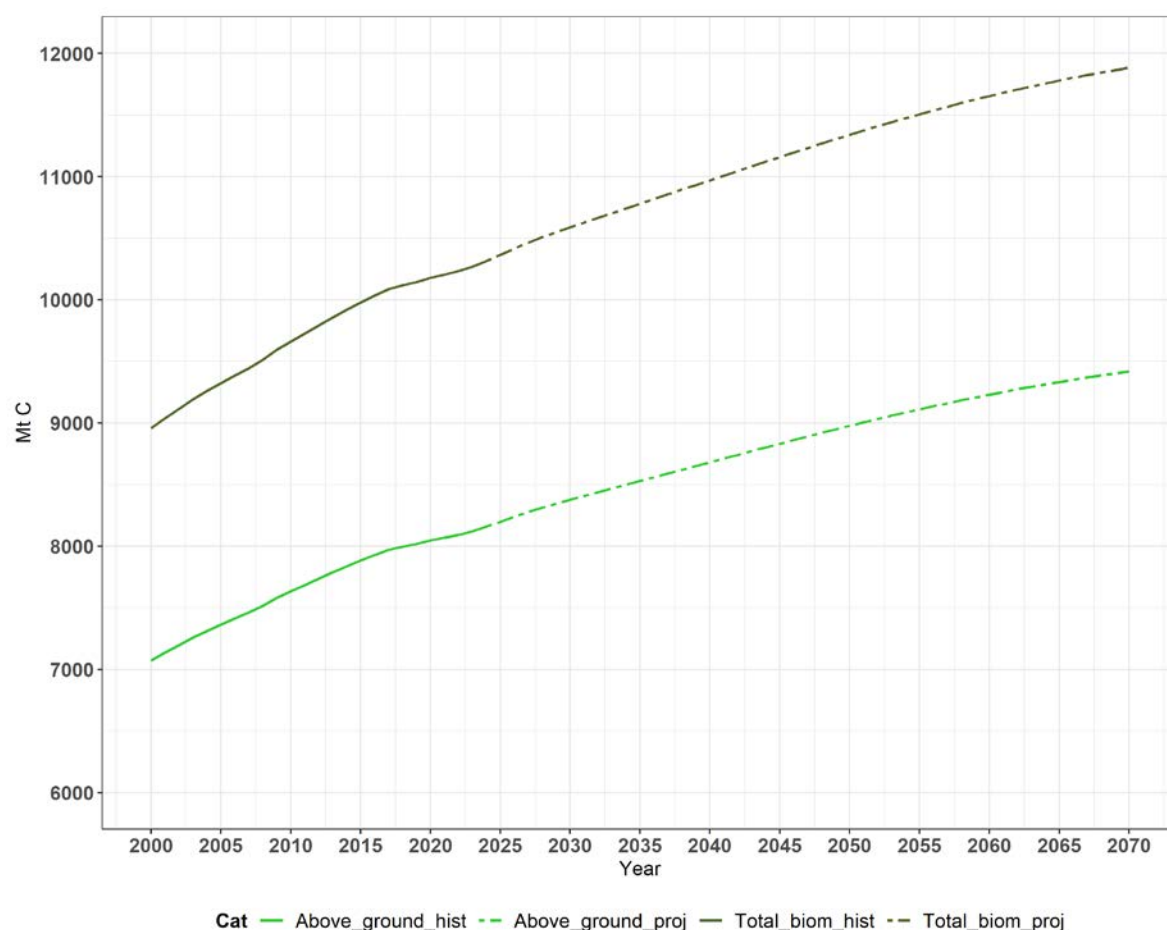


Figure 48. Historical and projected EU27 aboveground and total forest biomass carbon stock according to G4M.

5.2. EU Model projections aligned to UNFCCC GHG inventories

National Baselines

The forest land emissions/removals projections obtained from G4M-X did not account for all carbon pools, given that forest soils are excluded from the modelling. In order to account for the difference between G4M projections and the total emissions/removals in GHG inventories, we relied on historical shifters obtained by comparing G4M-X historical emission/removal levels to UNFCCC GHG inventories in the last ten years. The national-level shifters were computed by comparing the output of the G4M-X model (as the sum of living biomass, deadwood and litter) to UNFCCC inventories of forest land emissions/removals, including “forest land remaining forest land”, “afforestation”, and “deforestation”.

Table 3: Computed shifters applied to align G4M-X output to UNFCCC GHGI reported emissions.

Country	Shifter to UNFCCC GHG inventory (MtCO ₂)
Austria	1.120
Belgium	-0.253
Bulgaria	-1.353
Croatia	-2.598
Cyprus	-0.011
Czech Republic	-1.023
Denmark	-1.157
Estonia	-0.365
Finland ⁱ	12.457
France	0.224
Germany	2.317
Greece	1.801
Hungary	-0.504
Ireland	0.073
Italy ⁱⁱ	-8.398
Latvia	0.905
Lithuania	-4.560
Luxembourg	-0.122
Malta	0.000
Netherlands	0.785
Poland	-9.982
Portugal	0.634
Romania	-6.678
Slovakia	-1.798
Slovenia	-0.296
Spain	-17.427
Sweden ⁱⁱⁱ	0.659

ⁱ In the case of Finland, we have excluded the litter pool from this comparison to achieve a better alignment with UNFCCC latest reporting years.

ⁱⁱ The shifters were computed for a 10-year period, except in Italy and Sweden, where a 5-year period was used to better reflect recent abrupt changes.

ⁱⁱⁱ Idem

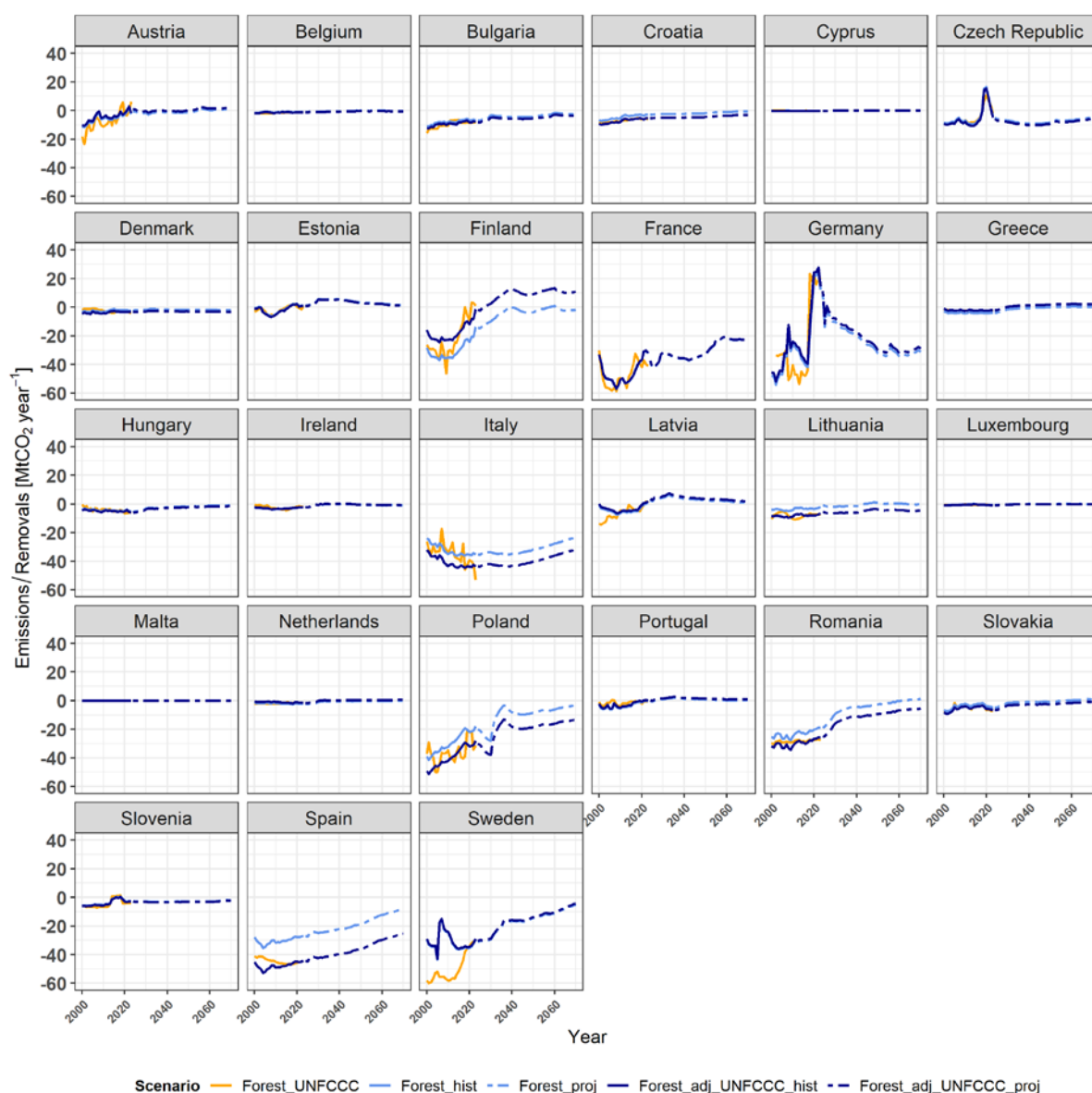


Figure 49. Historical and projected emissions/removals for forest land (including living biomass, deadwood, litter) using the G4M-X model before (Forest) and after (Forest_adj_UNFCCC) alignment to UNFCCC GHG inventories.

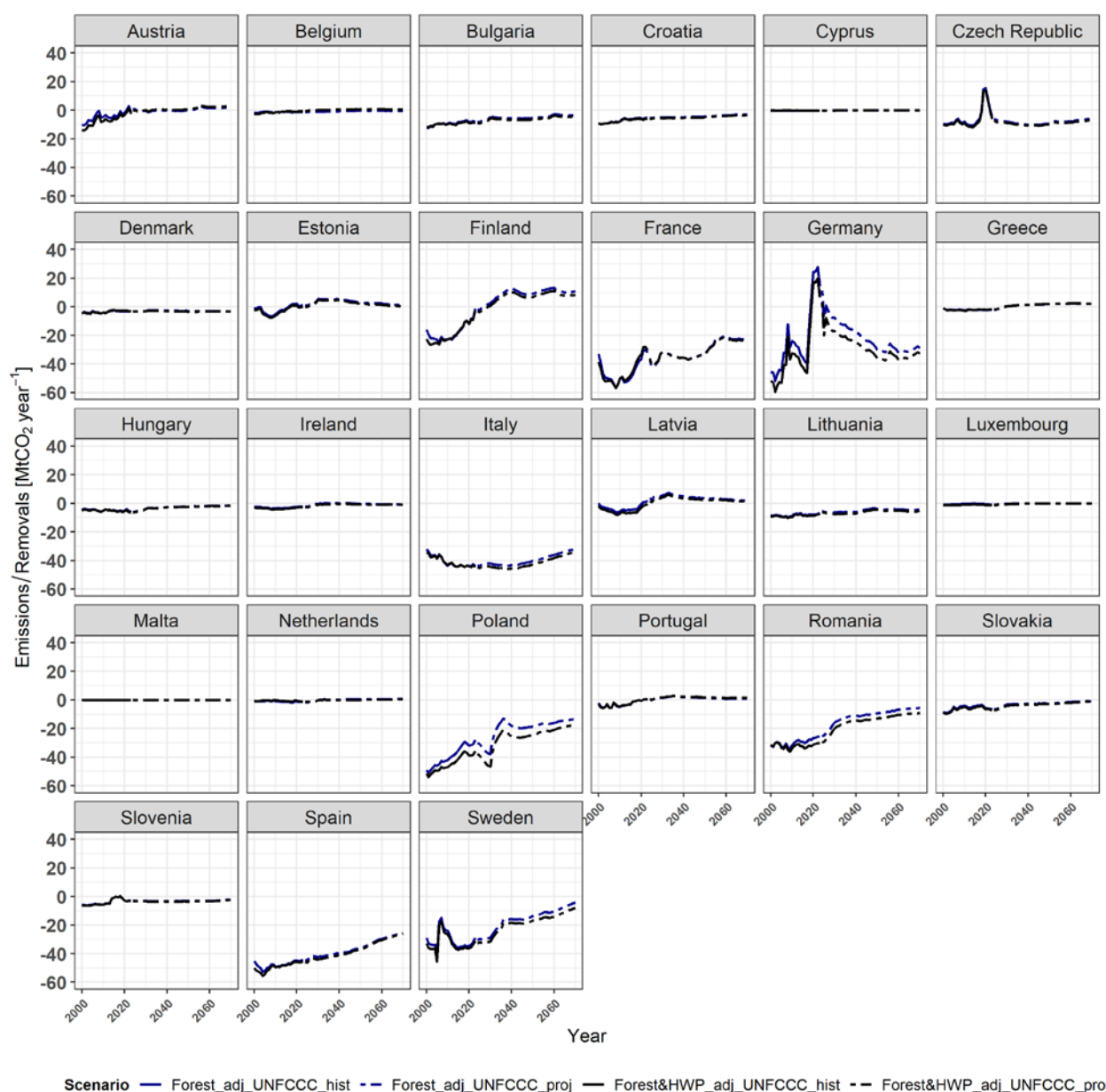


Figure 50. Historical and projected emissions/removals for forest land (Forest) and forest land including the HWP pool (Forest&HWP) according to the G4M-X model after alignment to UNFCCC GHGI (Forest_adj_UNFCCC).

EU Baseline

After shifting the historical period emissions/removals to UNFCCC GHG inventories (average of period 2014-2023, including forest land remaining forest land, afforestation and deforestation), we have added -35 MtCO₂ year⁻¹ to the Baseline and consequently realigned G4M-X model projections to the historical emission/removal “level”. The resulting forest land emissions (Forest_adj_UNFCCC in Figure 53) were -237 MtCO₂ year⁻¹ in 2023, -229 MtCO₂ year⁻¹ by 2030, -195 MtCO₂ year⁻¹ by 2050 and -135 MtCO₂ year⁻¹ by 2070.

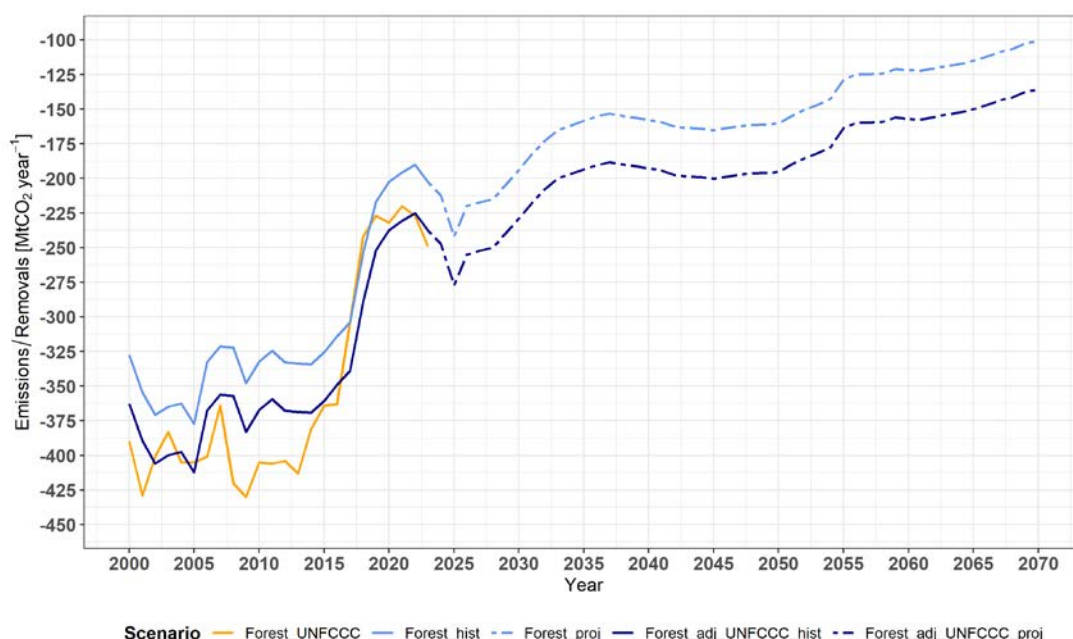


Figure 51. EU27 forest land emissions/removals (including afforestation and deforestation): G4M-X model outputs (historical and projected) and scaled after estimates aligned with UNFCCC GHG inventory emissions/removals (2014-2023)

The inclusion of HWP pool emissions/removals to the forest land increases the projected sink by -31 MtCO₂ year⁻¹, on average during the period 2024-2070, compared to the forest land alone. Figure 54 shows a small variation of the HWP contribution over time, with a maximum of -36 MtCO₂ year⁻¹ by 2030, which decreases to -30 MtCO₂ year⁻¹ by 2050 and -25 MtCO₂ year⁻¹ by 2070. The total sink resulting from forest land & HWP is -270 MtCO₂ year⁻¹ in 2023, -266 MtCO₂ year⁻¹ by 2030, -225 MtCO₂ year⁻¹ by 2050 and -161 MtCO₂ year⁻¹ by 2070.

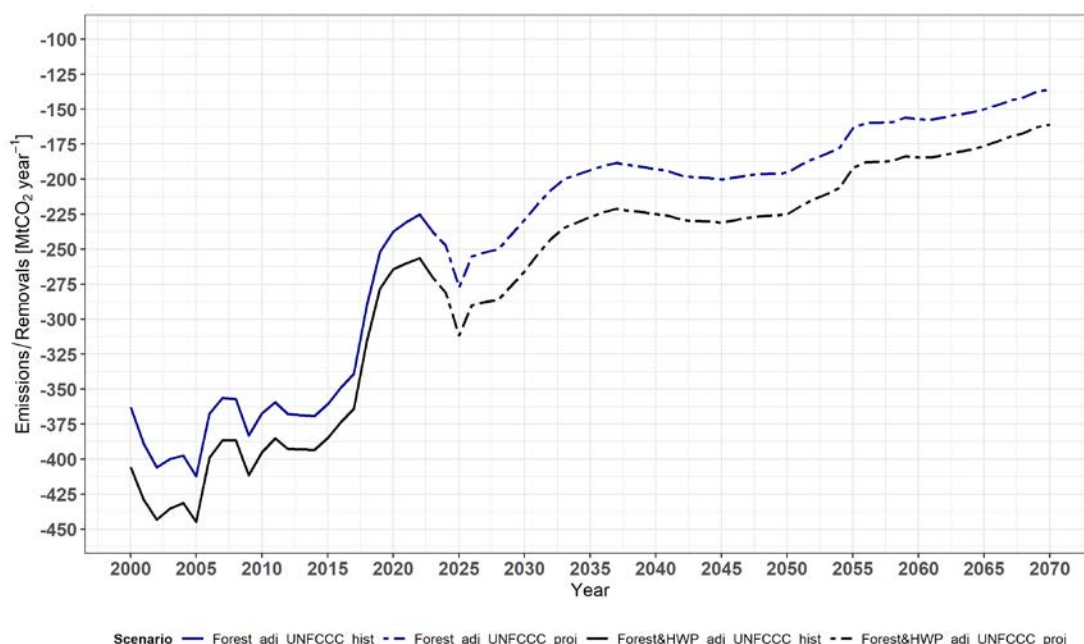


Figure 5253. EU27 forest land emissions/removals (including afforestation and deforestation) and the sum of Forest Land and Harvested Wood Products. GLOBIOM-G4M-X model output scaled after estimates aligned with UNFCCC GHG inventory emissions/removals (2014-2023)

6. Discussion

The Baseline scenario developed in this study represents the reference projection of EU and national forest-sector emissions and removals under a continuation of current management practices and recent wood demand trends, without the implementation of any additional policy measures beyond 2023. The Baseline does not include additional policy initiatives such as enhanced climate targets, afforestation incentives, or bioeconomy support measures. Rather, it provides a counterfactual reference trajectory against which the potential effects of new policy measures can later be assessed.

By maintaining historical demand trends, the Baseline assumes a continuation of recent wood demand growth. However, this assumption also embeds certain country-specific limitations. For instance, in Ireland, the projected harvest levels may be relatively low in the Baseline scenario, largely because GLOBIOM demand trends are not adjusted to the historical afforestation rate that occurred in the 1990s and early 2000s. This leads to a temporary underestimation of potential harvest supply in national projections, even though the standing biomass stock in Ireland remains relatively young and capable of supporting a higher harvest rate over time.

Overall, the comparison between national models (CBM-CZ, CBM-IE, CBM-IT, HEUREKA) and the EU-scale G4M-X model shows a good alignment in trends for the living biomass pool once critical input variables (such as forest area, age-class structure, and increment rates) were harmonized. These improvements were particularly effective in minimizing initial differences for the Czech Republic and Italy, where alignment was achieved through adjustments in forest area and age classes distributions, as well as the use of consistent national harvest statistics, instead of FAOSTAT.

Nevertheless, residual discrepancies remain between the models. For example, in Ireland, forests established between 1990–2000 are included differently in G4M and CBM age structures and species strata. Further differences arise from the endogenous structure and system boundaries of the models. For the deadwood and litter pools, G4M-X excludes belowground components (e.g., roots or small fractions below 10 cm), while national models include finer fractions and soil organic horizons. Such structural differences explain the observed gap in total carbon pool estimates and highlight the importance of clearly defining system boundaries when comparing or aggregating model outputs.

A further systematic difference between the EU and national projections is the treatment of soil carbon. G4M-X does not explicitly simulate soil carbon dynamics, leading to an underestimation of the total sink compared to UNFCCC greenhouse gas inventory (GHGI) data. This gap was partially addressed through post-calibration using historical shifters based on inventory data (2014–2023), allowing for an implicit correction to account for pools not represented in G4M-X. In countries with large organic soil emissions (most notably Ireland), this omission remains particularly relevant, as soil carbon fluxes can significantly influence national-level net sink estimates. In the post-calibration to the GHG inventories, we have observed a time-mismatch in emissions/removals dynamics at the disturbance events between the UNFCCC GHG inventories and G4M-X, because G4M-X uses salvage logging data, which are reported a year or two after the disturbance, compared to the reporting in GHG inventory data.

At the EU27 level, the Baseline projections obtained with GLOBIOM–G4M-X are consistent with previous studies (e.g., Pilli et al., 2022), confirming that in the absence of new measures, the forest

sector sink is expected to decline gradually and move toward a long-term equilibrium. This pattern suggests that while forests will continue to sequester carbon, their net contribution to EU climate targets will weaken unless active measures are taken.

At the national scale, Baseline trajectories are more heterogeneous. In several Member States, the forest sink remains influenced by legacy effects of recent disturbance events (such as the bark beetle outbreaks in Central Europe), which create temporary rebounds in carbon fluxes as forests regenerate. Over the long term, however, most countries display a gradual reduction of the sink, aligning with the EU-wide trend toward equilibrium.

Importantly, the Baseline projections do not yet incorporate future climate change impacts or potential increases in natural disturbances, which may further reduce the sink in the coming decades. These aspects will be addressed in WP8, where both policy and climate-related uncertainties will be explored under the Policy Reference and Ambitious scenarios using the same cross-scale modelling framework. Firstly, in T8.1, we will consider the impacts of climate change on forest emissions/removals and national policy measures that are included in national policy planning. Secondly, in T8.2, we will consider the impacts of additional policies going beyond the national plans.

Finally, it is worth noting that while certain pools (e.g., soil carbon) or sub-national processes are not yet explicitly modelled at the EU scale, the cross-scale Baseline developed here provides a robust and harmonized reference scenario. It offers a solid foundation for testing mitigation measures and evaluating the coherence of policy pathways between national and EU-level modelling tools.

7. Conclusion

The Baseline scenario developed in Task 6.3 provides a harmonized and cross-scale reference projection of the EU27 forest-sector emissions and removals under a continuation of current management practices and existing policy frameworks. By aligning input variables and methodological assumptions between the EU-level (GLOBIOM-G4M-X) and national forest models (CBM-CZ, CBM-IE, CBM-IT, HEUREKA), this work establishes a consistent analytical foundation for assessing future policy pathways.

The results confirm that, in the absence of new policy measures, the EU forest sink (including forest land and HWP) will continue to weaken, declining from approximately $-270 \text{ MtCO}_2 \text{ year}^{-1}$ in 2023 to $-161 \text{ MtCO}_2 \text{ year}^{-1}$ by 2070. This reduction is mainly driven by the ageing of forest stands, harvest trend, and the legacy effects of past disturbances, while the harvested wood products (HWP) sink remains relatively constant. Although national models exhibit country-specific variations, often linked to differences in age structure, disturbance dynamics, and soil carbon representation, the overall trend across models points toward a progressive saturation of the forest land sink at both national and EU levels.

The Baseline provides a critical benchmark for evaluating additional climate and bioeconomy policies in WP8. The upcoming Policy Reference and Ambitious scenarios will build on this baseline to test the potential of enhanced forest management, afforestation, wood uses, and resilience measures to strengthen the forest sink and support the EU's climate neutrality objective. In doing so, the cross-scale modelling framework will serve as a key tool for improving policy coherence, transparency, and scientific robustness in future scenario assessments.

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9. Annex

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Annex to D6.3

HWP contribution potentials for baseline scenario RCP_Ip9_I2

Grant Agreement	101056875
Call identifier	HORIZON-CL5-2021-D1-01
Project full title	ForestNavigator: Navigating European forests and forest bioeconomy sustainably to EU climate neutrality
Deliverable lead	Sebastian Rüter
Authors	Sebastian Rüter and Fulvio Di Fulvio

Abstract

This Annex provides updated information on CO₂ emissions and removals arising from Harvested Wood Products (HWP) under the baseline scenario RCP_1p9_12 that have been calculated with the WoodCarbonMonitor model using the GLOBIOM data provided on 15/07/2025. The results are based on the ForestNavigator [D5.2 report on HWP contribution potentials to EU forest sector mitigation](#). Results are an update on the WoodCarbonMonitor output reported in D5.2, which includes a chapter on the aggregated EU results that have been derived from the country-specific estimates, which are also presented.

Keywords

Harvested Wood Products, biogenic CO₂ emissions and removals, approaches, wood use

This report reflects only the author's view, and that the Agency is not responsible for any use that may be made of the information it contains.

Dissemination level

- PU** Public, will be published on CORDIS
- SEN** Sensitive, limited under the conditions of the Grant Agreement



Nature of the deliverable *

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I. Aggregated EU results for the HWP contribution

The results presentation of the HWP contribution that has been conducted with the WoodCarbonMonitor (Rüter, 2017) in WP5.2, discriminates between the two applied carbon pool-based approaches, which is the stock-change and the production approach. Further details are included in the ForestNavigator report D5.2 (Rüter and Fulvio, 2025). The results on biogenic CO₂ emissions and removals arising from the HWP pool at the EU level are made up exclusively of the results of the calculations for the EU member states. Due to the availability of FAO data starting in different years, which for some countries only begins in 1992, 1993 or 2000, the initial value of the carbon pool magnitude and the stock-change based on it must always be calculated individually for each country. Simply adding up the available data on the production and foreign trade of semi-finished wood products of all member states and calculating the HWP contribution at the EU level would result in a significant overestimation of the carbon storage effect in wood products within the EU.

In particular, for the production approach, this Annex contains further detailed information in chapter 2, that contributes to an understanding of the partially diverging dynamics of the development of biogenic CO₂ emissions and removals in the EU member states. It also includes figures on the time series for the respective carbon inflow into the HWP pool and the underlying raw material factors calculated on the basis of the available country data.

I.1. HWP on the basis of the production approach

Figure A shows the estimate of the HWP contribution to biogenic CO₂ emissions and removals for the updated “baseline” scenario (RCP 1p9_12) within EU27 based on the country-by-country calculations presented in section 2 of this Annex using the production approach.

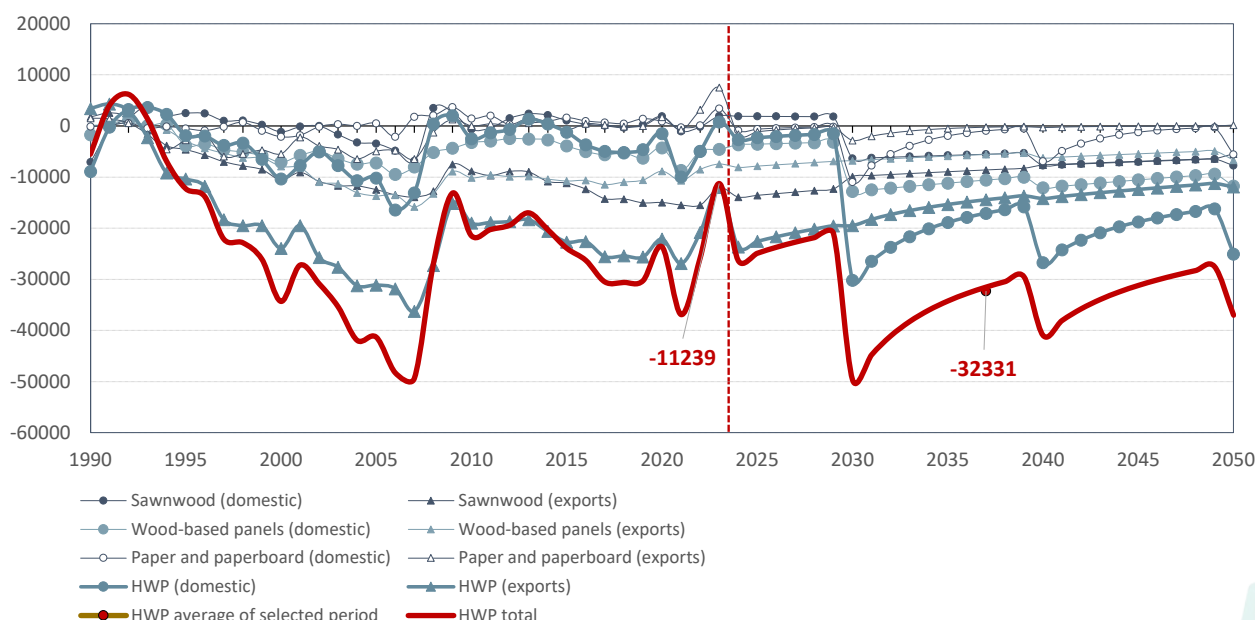


Figure A: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach within EU [in kt CO₂]

Under the “baseline” scenario, at the EU level, by 2050, there is a 13 % increase in sawnwood production and a 23 % increase in fiberboard (i.e. particle board, oriented strand board, low-medium- and high-density fiber boards), and pulp production increases by 19 %. Under the

Baseline EU remains a net importer of industrial roundwood, but its level of net import decreases by 2 % over time, hence, the share of internally sourced industrial roundwood is relatively stable. However, this development is very country-specific and differs from the EU average in individual cases (see also Country-specific results for the HWP contribution in Section 2. In most cases, the assumption on the baseline development leads to an increase in the domestic production of semi-finished wood products (i. e., HWP) derived from domestically produced sawlogs and pulpwood (relevant under the production approach) and an increased semi-finished products export. However, the increase in this export is transient due to the long-term reduction of EU trade competitiveness towards the year 2050.

The increase in semi-finished wood products being manufactured from domestic harvest in most of the EU member states has a direct impact on the changes of the respective HWP pools within the relevant countries and its associated sink effect, which increases for the EU as a whole by around 40 % on average during the same period (i. e. as compared to the average CO₂ emissions and removals from 2019 to 2023, see Table 1-A). The increase in the sink effect of the HWP pool at the EU level is due to the increase in the sink in 18 countries, with the increase being mainly due to the three countries Germany, Italy, France and Finland.

Table 1-A: Country overview on the total emissions and removals arising from HWP for the baseline scenario under the production approach [in kt CO₂]

	2000	2010	2020	2021	2022	2023	Ø 19-23	Ø 24-29	Ø 30-39	Ø 40-49	2050	(Ø40-49) - (Ø19-23)
DE	-7684	-4572	-7865	-8028	-4779	-1506	-5617	-7369	-9302	-8209	-8918	-2593
IT	-2269	319	-244	-1354	-139	486	-369	-651	-2719	-2627	-3244	-2258
FR	-3212	1244	2665	-238	771	2235	1422	2003	-448	-672	-1683	-2094
FI	-5263	-505	716	-1594	-1303	1047	-456	-1019	-1741	-2133	-2653	-1677
AT	-384	-1071	608	-799	-917	278	-227	598	-1027	-895	237	-668
SE	-2261	-2343	-2463	-3097	-2657	-681	-2242	-2968	-2175	-2811	-4163	-569
DK	230	285	120	145	132	142	133	127	-307	-394	-611	-527
PT	-280	326	427	136	256	904	411	369	-103	33	-90	-377
GR	282	-134	156	163	159	155	149	6	-198	-224	-296	-373
EE	-965	-983	-911	-851	-804	-502	-814	-818	-1068	-1100	-790	-286
LT	-521	-739	-539	-1053	-1280	-981	-932	-421	-1315	-1172	-1010	-241
SL	-28	-120	-53	-40	-141	-92	-115	-77	-301	-332	-489	-217
SK	-835	-1343	-167	-322	-104	-222	-290	-233	-510	-404	-449	-115
ES	-2945	594	-953	-1681	-1822	-1772	-1645	-769	-2166	-1694	-1996	-48
IE	-839	-517	-556	-532	-572	-559	-558	-477	-596	-583	-628	-26
NL	186	173	-181	-436	-143	490	-28	86	-4	-30	-184	-1
HR	-17	-207	-589	-595	-503	-259	-519	-548	-597	-520	-483	-1
BE	238	316	1413	1215	771	363	851	909	1141	870	604	19
HU	198	119	-418	-591	-402	-453	-493	-349	-672	-114	-266	378
BG	72	-526	-815	-1074	-1025	-1022	-937	-599	-614	-482	-468	455
PL	-4115	-5491	-6598	-8166	-5577	-4547	-6622	-5372	-7134	-5917	-5513	705
LV	-2345	-1769	-1963	-2361	-1754	-2077	-1966	-1691	-1258	-1194	-1346	771
RO	-660	-3292	-3966	-3531	-2232	-1742	-3133	-3447	-3398	-2003	-2244	1131
CZ	-882	-1250	-1450	-2195	-1753	-925	-1568	-706	-302	-122	-316	1446
EU27	-34301	-21485	-23626	-36880	-25816	-11239	-25565	-23413	-36816	-32729	-36997	-7164

For Germany, for example, the average sink from the total HWP pool over the last five years (2019-2023) would increase by a further -2593 kt/yr in the 2040s decade on average (Table 1-A). For Italy, the GLOBIOM estimate on increased harvest and industrial roundwood consumption under the “baseline” scenario (RCP 1p9_12) leads even to a sevenfold increase of the total HWP sink by the

same period (i.e. -2,627 kt CO₂/yr on average) as compared to the five-year average from 2019 to 2023. This would, in turn be almost entirely due to an estimated increase in the domestic consumption of domestically produced wood products (see Table 1-B and country results in Section 2). For France, the “baseline” scenario (RCP 1p9_12) assumes that the HWP contribution will turn from a historic net source of 1422 kt CO₂/yr on average (2019-2023) to a net sink of -672 kt CO₂/yr on average by the 2040s and also in Finland, the relative small HWP sink -456 kt CO₂/yr on average of would mor than quadruple up to -2133 kt CO₂/yr on average in the 2040s decade. As in Italy, this development within the two countries is driven by the calculated domestic consumption of solid wood products, which in Germany is mainly due to wood-based panels and in France due to sawnwood.

By contrast, the opposite development is forecast for some countries, particularly for Czechia, Romania, Latvia and Poland under the “baseline” scenario (RCP 1p9_12). The reasons for these contrasting developments may lie both in the country-specific assumptions on future harvest patterns or the predicted production amounts of semi-finished wood products and their foreign trade, as well as in the very country-specific dynamics of the carbon stocks in the particular HWP pool. For example, a slowdown in the growth of carbon stock that has grown very dynamically in the past can cause a sink effect to decrease or even cause the HWP pool to become a source of biogenic CO₂ emissions. This also applies to any sub-segments of the HWP pool; in the case of the production approach, in particular to the HWP produced and consumed domestically as shown in Table 1-B for the “baseline” scenario (RCP 1p9_12).

Table 1-B: Country-overview on emissions and removals arising from domestically consumed HWP from domestic HWP production for the baseline scenario under the production approach [in kt CO₂]

	2000	2010	2020	2021	2022	2023	Ø 19-23	Ø 24-29	Ø 30-39	Ø 40-49	2050	(Ø40-49) - (Ø19-23)
DE	-1736	2108	-551	-386	1296	2968	862	-931	-4849	-4964	-6359	-5826
IT	-1505	524	254	-91	289	353	149	-143	-2103	-2206	-2846	-2355
FR	-1115	1450	2924	285	957	2159	1745	2432	137	-193	-1091	-1938
SE	-736	-1160	451	-1038	-272	769	-170	44	-950	-1462	-2641	-1292
FI	-1582	-152	497	72	-464	807	314	378	-578	-821	-1376	-1136
ES	-1983	1894	-3	-383	-930	-1165	-656	132	-1517	-1366	-1845	-711
DK	161	352	200	192	185	179	193	163	-306	-325	-434	-519
AT	207	161	292	-274	-433	88	-48	337	-304	-528	-333	-480
IE	-473	188	3	62	10	12	56	0	-320	-401	-495	-456
EE	-282	-644	-324	-323	-422	-302	-358	-283	-680	-804	-659	-446
PT	-525	-482	-23	146	53	326	168	54	-351	-219	-259	-386
GR	284	-85	160	162	158	154	150	61	-197	-218	-293	-368
SK	-359	-1116	58	263	239	173	127	34	-218	-181	-221	-307
HR	206	66	62	272	244	177	154	24	-128	-114	-89	-268
SL	-6	214	191	147	93	138	156	163	-23	-63	-181	-219
HU	470	541	319	-7	265	245	155	256	-97	32	-84	-124
BE	41	-213	369	359	182	-65	225	233	217	141	-4	-84
LT	-104	-563	-226	-429	-687	-478	-441	-165	-612	-520	-410	-79
NL	117	28	-20	-109	19	65	-6	13	-46	-70	-161	-64
RO	942	-450	-1888	-1466	-910	-662	-1424	-1669	-2323	-1487	-1399	-63
LV	-388	-460	65	-201	175	-407	-20	70	-52	27	69	47
BG	378	-24	-368	-631	-738	-738	-573	-246	-411	-305	-285	268
PL	-2626	-4500	-4915	-6131	-4054	-3650	-5004	-3992	-5859	-4643	-4021	361
CZ	241	-157	977	-481	-230	-368	185	1035	747	599	350	414
EU27	-10372	-2481	-1496	-9990	-4974	777	-4061	-2001	-20821	-20092	-25065	-16031

Further details on the country-specific dynamics under the “baseline” scenario for the production approach can be obtained in the relevant sections of the country-specific results in chapter 2 of this Annex.

1.2. HWP on the basis of the stock-change approach

As for the results of the production approach, the calculations for the stock-change approach for the EU-27 are based on country-by-country calculations, the results of which are presented in detail in Section 2 of this Annex. It is important to note that the data used to calculate the ForestNavigator scenarios under the stock-change approach, namely the respective country-specific production quantities of semi-finished wood products and their traded amounts are exactly the same as for the production approach.

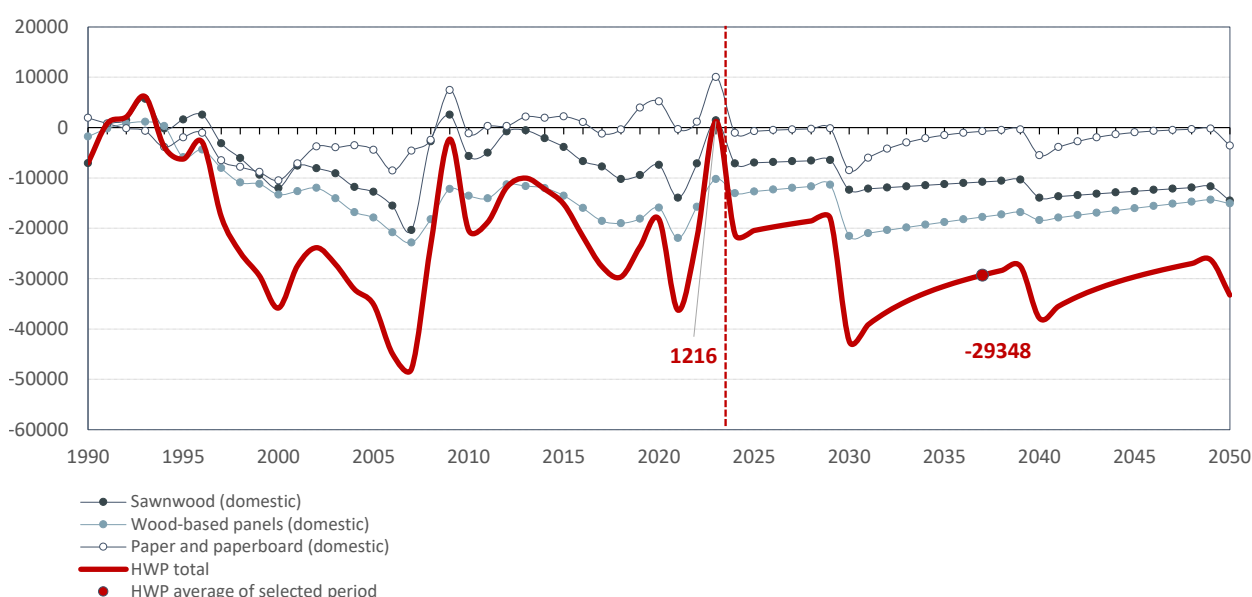


Figure B: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for EU [in kt CO₂]

Figure B presents the entire time series of the HWP contribution to biogenic CO₂ emissions and removals for the updated “baseline” scenario (RCP1p9_12) within EU27 using the stock-change approach, whereby the subtotals of the three aggregated semi-finished wood product groups of sawnwood, wood-based materials and paper and paperboard are also shown.

Just as with the production approach, the development of CO₂ emissions and removals arising from HWP in the EU member states vary considerably (see).

Table 1-C Country-overview on emissions and removals arising from domestically consumed HWP for the baseline scenario under the stock-change approach [in kt CO₂]

	2000	2010	2020	2021	2022	2023	Ø 19-23	Ø 24-29	Ø 30-39	Ø 40-49	2050	(Ø40-49) - (Ø19-23)
DE	-6629	-167	-1099	-2890	2349	7752	1162	-3000	-6347	-5522	-6083	-6685
FR	-3862	-422	3509	-117	488	2920	1794	2185	-168	-514	-1170	-2307
BE	-60	-84	-99	-1319	-285	685	-281	-495	-917	-1493	-1588	-1212
SE	-2133	-2109	-149	-1608	-1050	877	-709	-619	-1827	-1823	-2146	-1115
IT	-5775	-65	3660	1807	-432	1525	1388	2058	389	446	54	-941
FI	-2463	-621	199	-263	-424	1387	272	35	-610	-596	-976	-868
NL	-229	812	465	-411	1183	855	582	147	-188	-101	-252	-683
IE	-792	432	-99	-13	-181	-139	-61	-87	-593	-493	-603	-431
DK	-1032	366	-729	-747	-753	-761	-731	-744	-1341	-1153	-1155	-422
SL	-185	-304	-507	-236	-202	-58	-288	-434	-459	-670	-583	-382
AT	-2109	-1394	-1744	-2516	-1941	-328	-1628	-1512	-1407	-1872	-2991	-244
ES	-2109	-1394	-1744	-2516	-1941	-328	-1628	-1512	-1407	-1872	-2991	-244
GR	-800	-291	255	248	240	250	240	221	87	129	169	-110
EE	-568	-1237	-1580	-1959	-1642	-973	-1538	-1366	-1198	-1611	-1498	-73
HR	-54	-96	-344	-123	41	-407	-261	-304	-449	-301	-216	-41
SK	-891	-1868	-803	-433	-548	-56	-512	-655	-652	-460	-402	52
HU	-171	525	-181	-614	-340	-364	-449	-195	-527	-392	-416	57
PT	-1089	-887	-640	-579	-690	-407	-555	-419	-741	-465	-377	90
RO	736	-1101	-3364	-3050	-2363	-1933	-2830	-2715	-3446	-2655	-2262	175
LT	-432	-1134	-1697	-2276	-2125	-1164	-1845	-1389	-1056	-1641	-1129	205
LV	-583	-762	-1020	-1645	-565	-684	-929	-878	-785	-518	-369	411
BG	292	-257	-546	-899	-1143	-1079	-867	-379	-560	-404	-332	462
CZ	-649	-765	-56	-2025	-1433	-1003	-913	12	-377	-307	-484	607
PL	-4261	-7606	-9911	-12095	-8043	-5351	-9167	-7484	-8692	-6637	-5477	2530
EU27	-35849	-20427	-18225	-36278	-21800	1216	-19756	-19526	-33271	-30925	-33277	-11170

While many countries experience an tremendous increase in the sink effect in the 2040s compared to their historical values, the slower increase of the HWP pool under the stock-change approach, particularly in Poland, Czechia, Bulgaria, and Latvia, slows down the sink effect in the EU as a whole. Nevertheless, it should be noted that the HWP pool development, especially for these later countries, is still assumed to represent a sink.

Under the “baseline” scenario (RCP1p9_12), total EU remains a net exporter of sawnwood and fiberboard products with a slight variation of their volumes over time (-2 %, + 4%) by 2050. At the same time, there is a growth in net export of paper and paperboard products over time (+ 23%). Overall, this leads to an increase in the sink within the EU as a whole of 25 % on average during the 2040s as compared to average of the last five historic years (2019-2023).

When comparing this HWP contribution to the CO₂ emissions and removals estimated under the production approach for total EU, the estimated total sink for the 2040’s decade is only slightly lower of the value estimated using the production approach, but also the increase in the sink is slower. As a result, the HWP contribution estimated under the baseline scenario for the EU as a whole in the 2040s based on the stock-change approach is -22.5 Mt CO₂, which corresponds to a 12% lower projected increase than under the production approach (see Table 3.2.1-B).

2. Country-specific results for the HWP contribution

This section represents a corrigendum of the Annex of D5.2 and provides updated relevant information on CO₂ emissions and removals arising from Harvested Wood Products (HWP) that have been calculated with the model WoodCarbonMonitor for the baseline scenario RCP_1p9_12 using the GLOBIOM data provided on 15/07/2025.

For each country, the results are presented in the following order: starting with the relevant information necessary for applying the **production approach**. This includes **figure A**, which illustrates the country-specific harvest amounts represented by the particular domestic production of

- *industrial roundwood*, made up of *stem- and pulpwood* and *other industrial roundwood* (poles etc) as well as
- *fuel wood*.

All those wood harvest classes are further subdivided into coniferous and non-coniferous assortments.

Figure B shows the country-specific time series of the relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RECP} which are to be applied in line with IPCC requirements under the production approach for calculating the share of domestically manufactured semi-finished wood products originating from the relevant domestic forests. The figure is also important because the country-specific data quality can be estimated based on the historical data of this time series. For example, if individual years are missing from the FAOSTAT database or if total exports exceed the quantities of production and import of a product group in a given year, the missing value for the respective year corresponds to a missing carbon inflow into the product pool, which has a significant impact on the CO₂ balance to be determined. At the same time, the comparison of the historical development of these factors with the assumed future time series allows the assumptions made under the baseline scenario to be classified and their plausibility to be checked.

Furthermore, **Figure C** presents the calculated carbon inflow to the particular segments of the quantities of carbon in the three aggregated commodity groups: sawnwood, wood-based panels, and paper and paperboard. These commodity groups originate from domestic forests and are consumed domestically (HWP_{DOM}) or exported (HWP_{EXP}).

Figure D contains the detailed results on historic and projected biogenic CO₂ emissions and removals arising from HWP following the production approach for baseline scenario.

Figures E and F, finally, illustrates the country-specific results for the biogenic CO₂ emissions and removals arising from HWP as shown in the later figures D but on the basis of the stock-change approach.

Further details on the applied calculation models, methods and the scenario can be found in the ForestNavigator report D5.2.

Austria (AT)

For Austria, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach** (, are illustrated in Figure AT-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

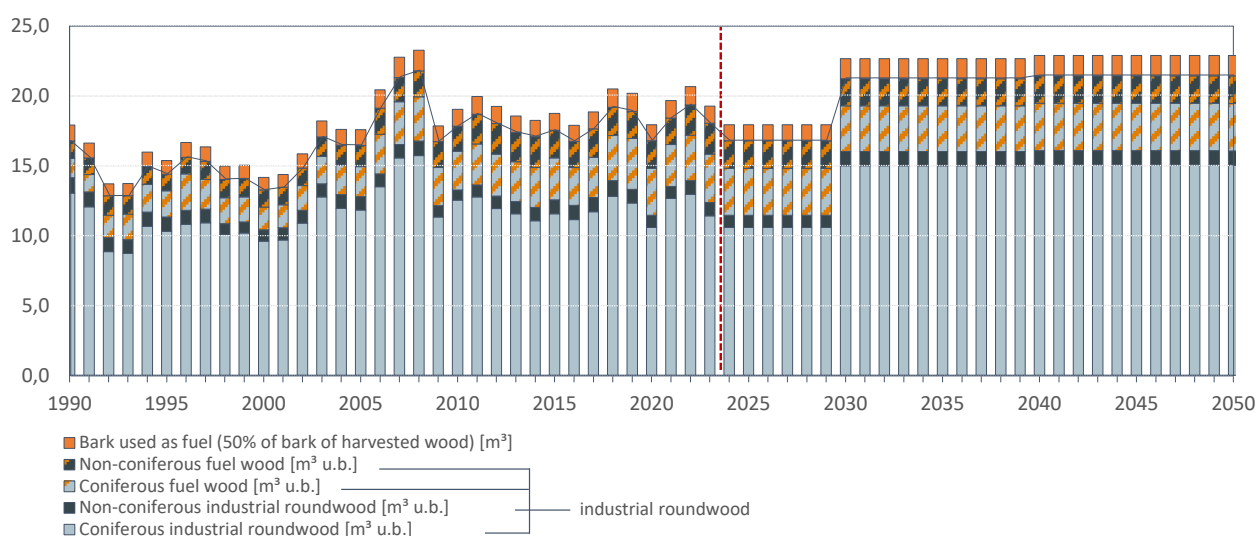


Figure AT-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Austria [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure AT-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the baseline scenario RCP1p9_12.

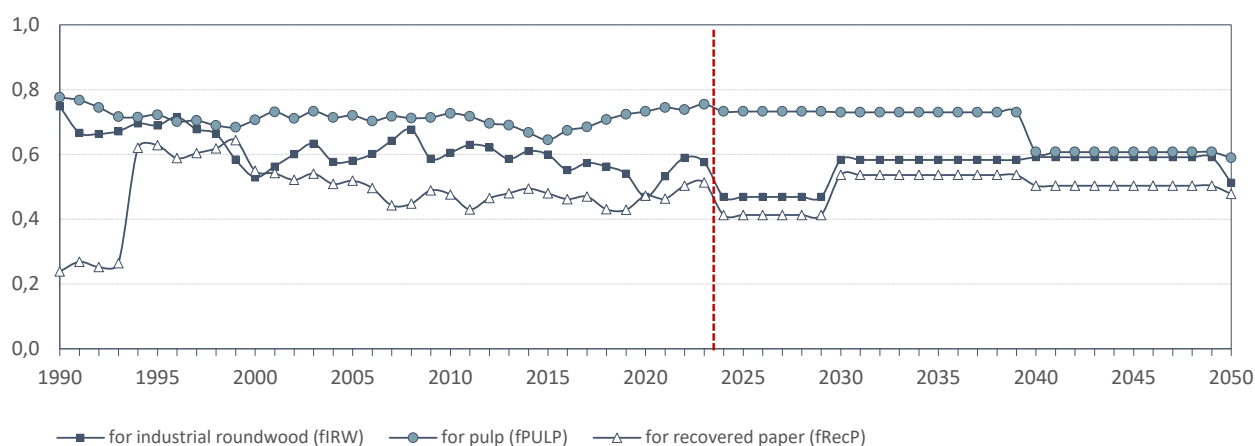


Figure AT-B: Historic and future development of the applied domestic feedstock factors for Austria

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure AT-C shows the results for the “baseline” scenario (RCP1p9_12).

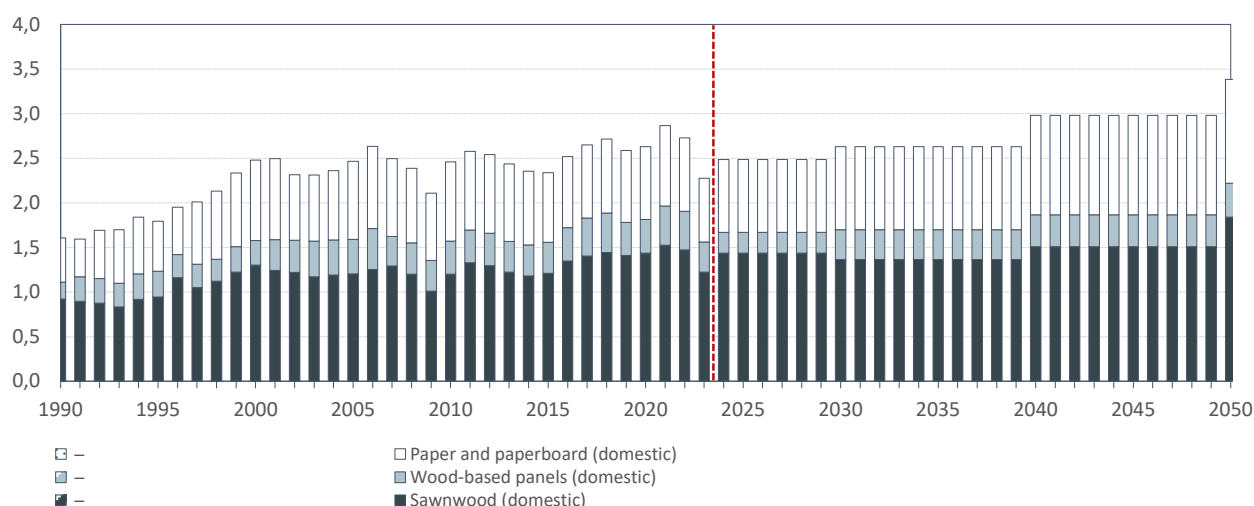


Figure AT-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Austria [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool is calculated using the methods following the production approach.

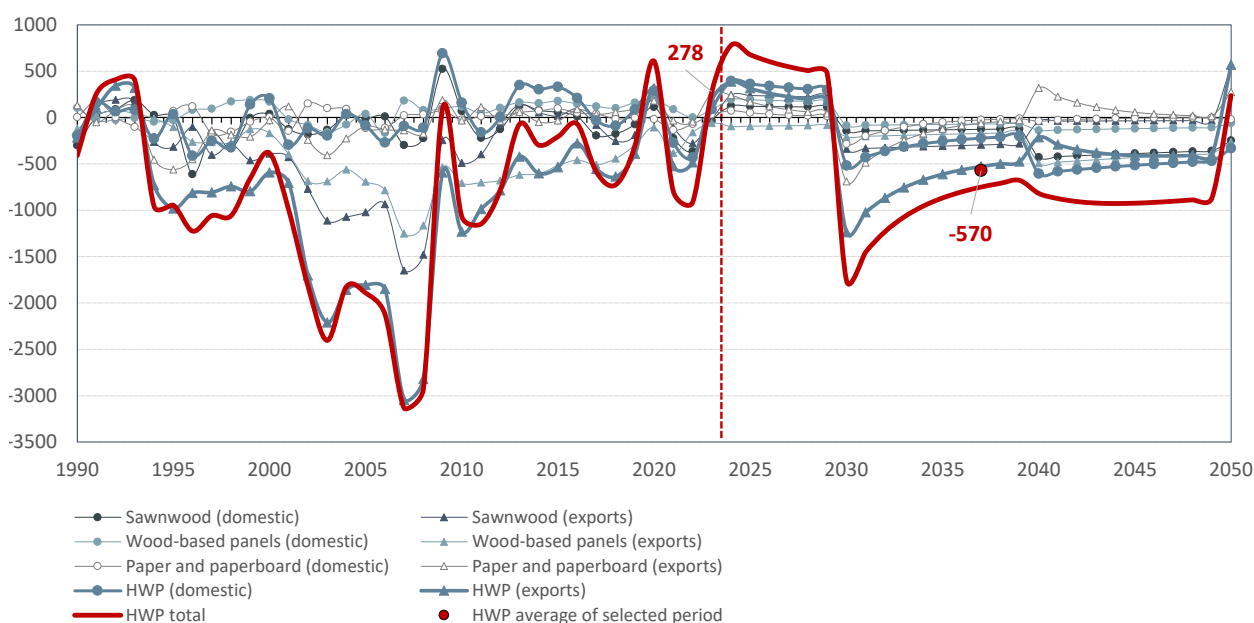


Figure AT-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for baseline scenario following the production approach for Austria [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i. e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Austria applying baseline scenario RCP1p9_12 in Figure AT-E.

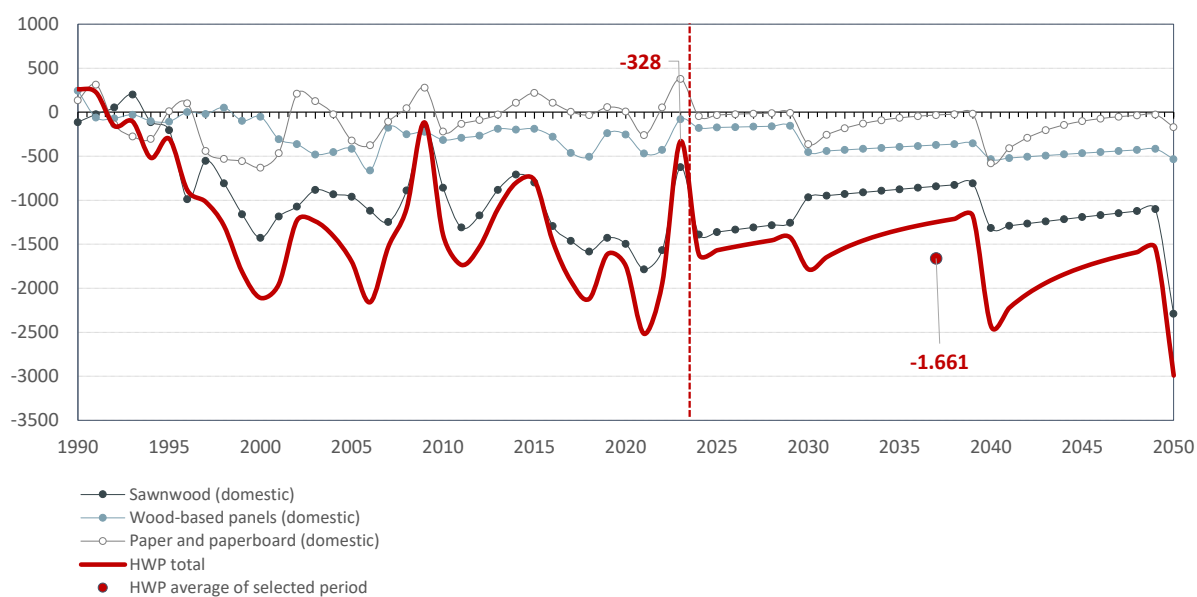


Figure AT-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Austria [in kt CO₂]

Belgium (BE)

For Belgium, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 2000 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure BE-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

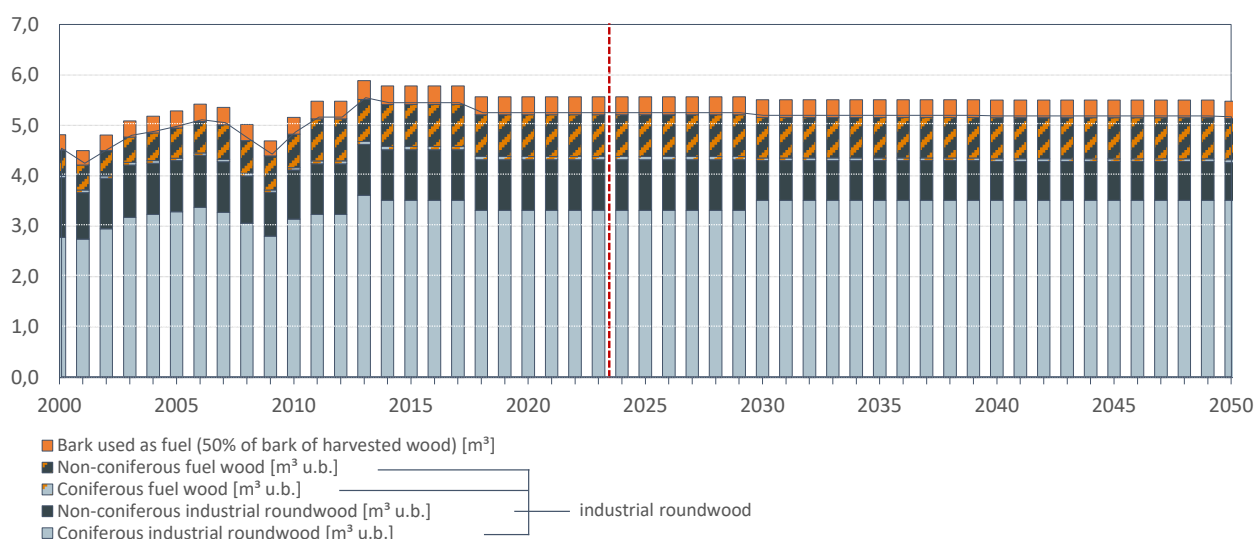


Figure BE-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Belgium [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure BE-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

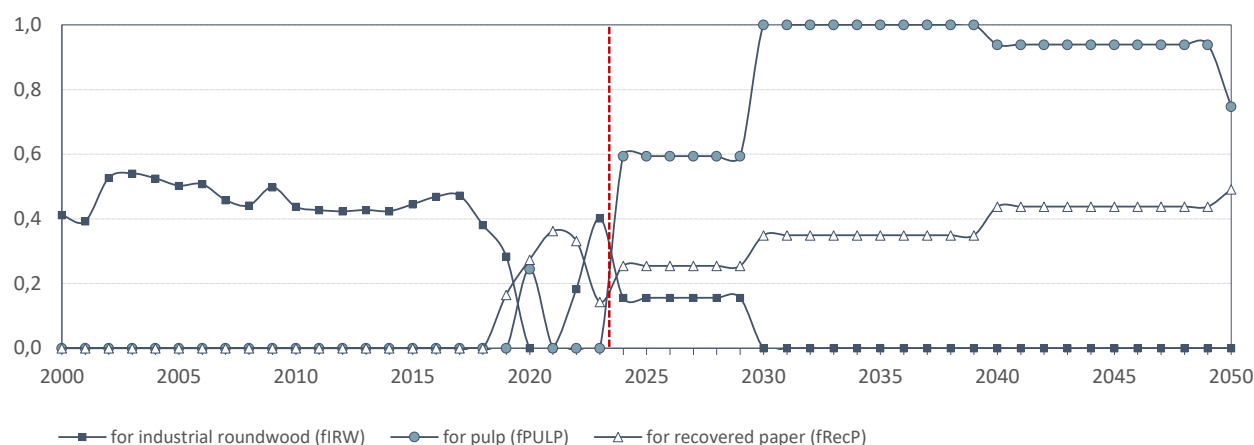


Figure BE-B: Historic and future development of the applied domestic feedstock factors for Belgium

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure BE-C shows the results for Scenario (RCP1p9_12).

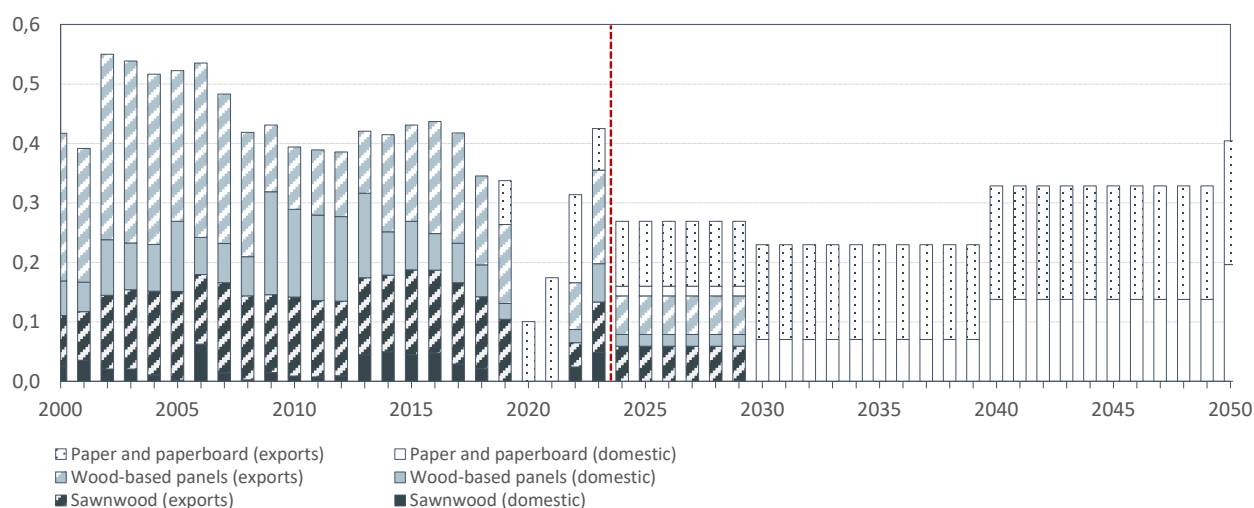


Figure BE-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Belgium [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

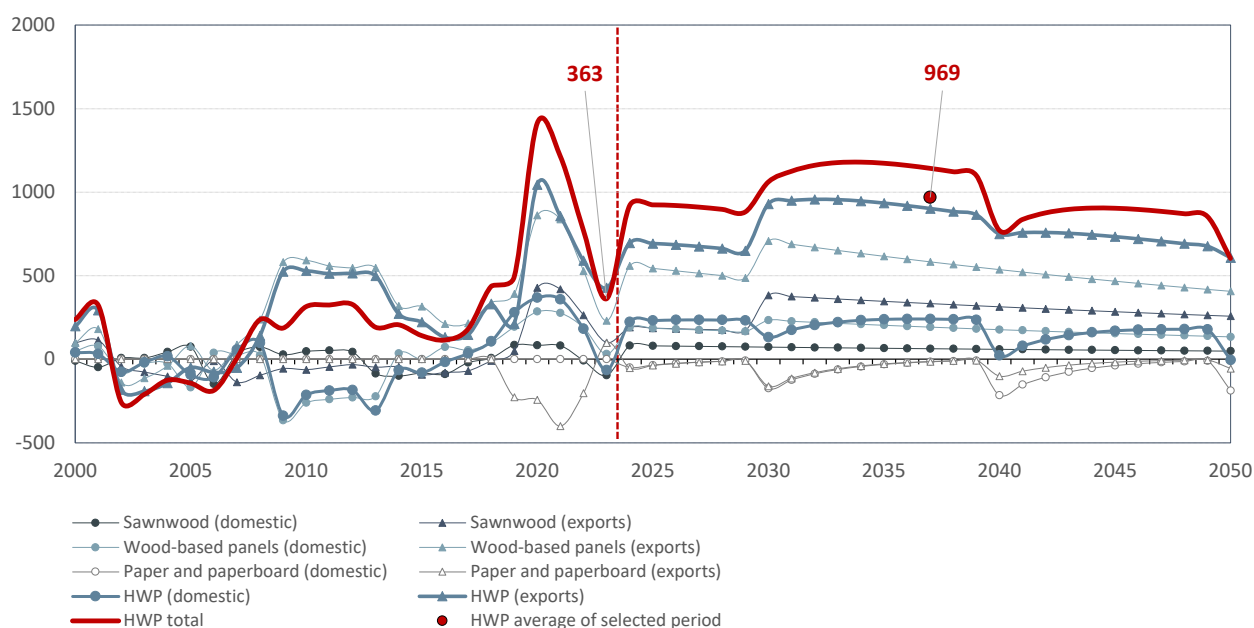


Figure BE-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Belgium [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Belgium applying baseline scenario (RCP1p9_12) in Figure BE-F.

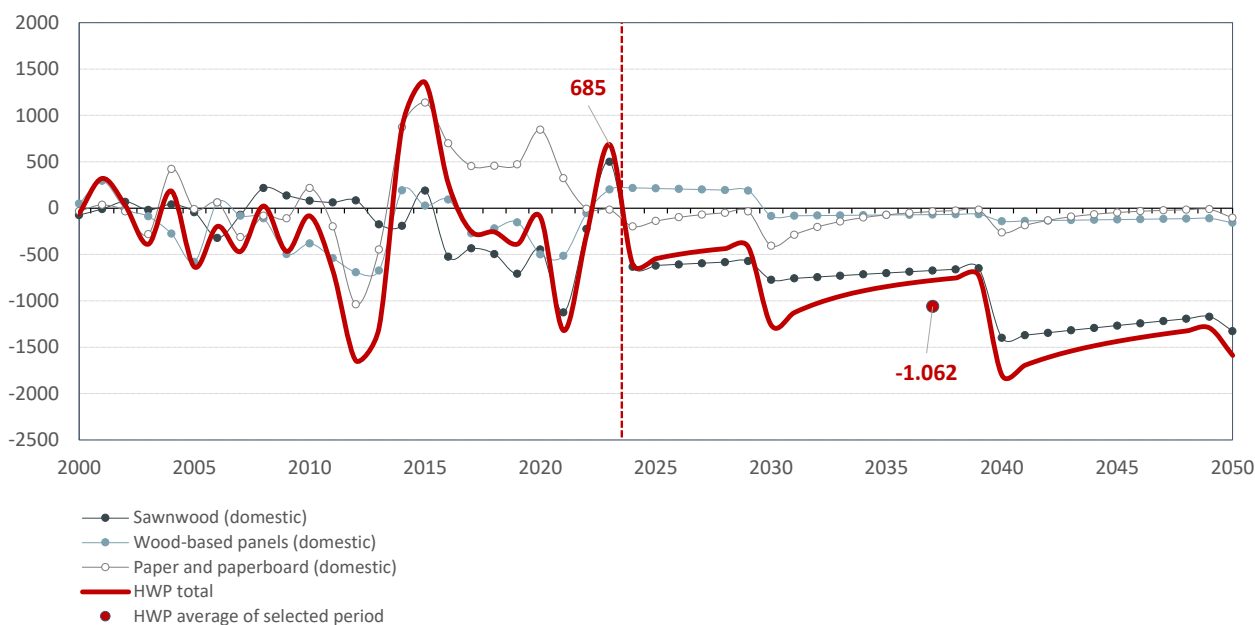


Figure BE-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Belgium [in kt CO₂]

Bulgaria (BG)

For Bulgaria, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure BG-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

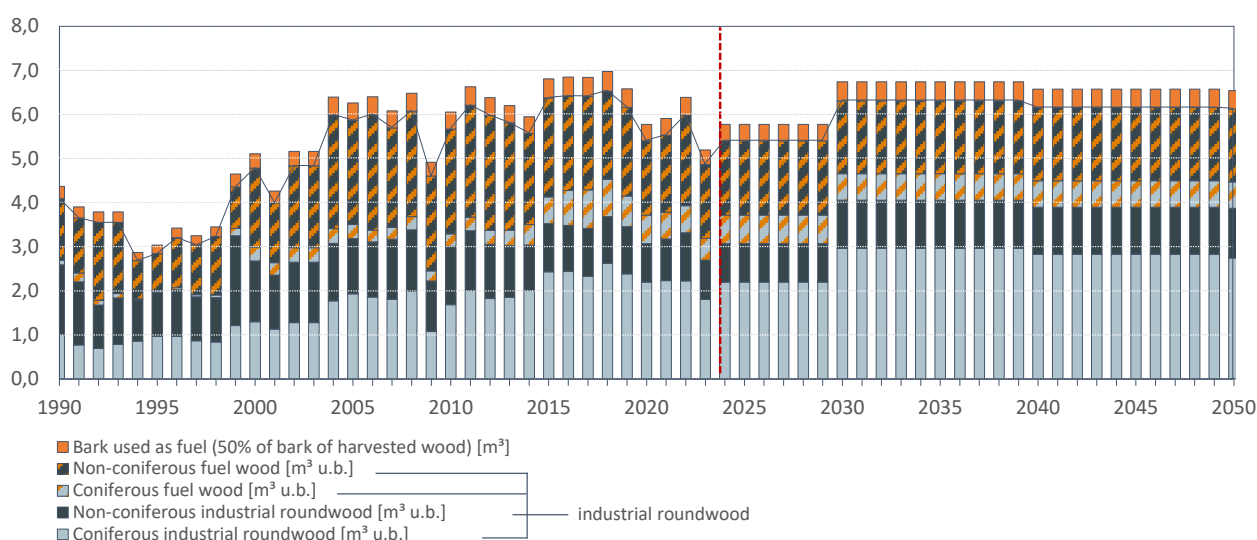


Figure BG-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Bulgaria [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure BG-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} its assumed future development for the “baseline” scenario RCP1p9_12.

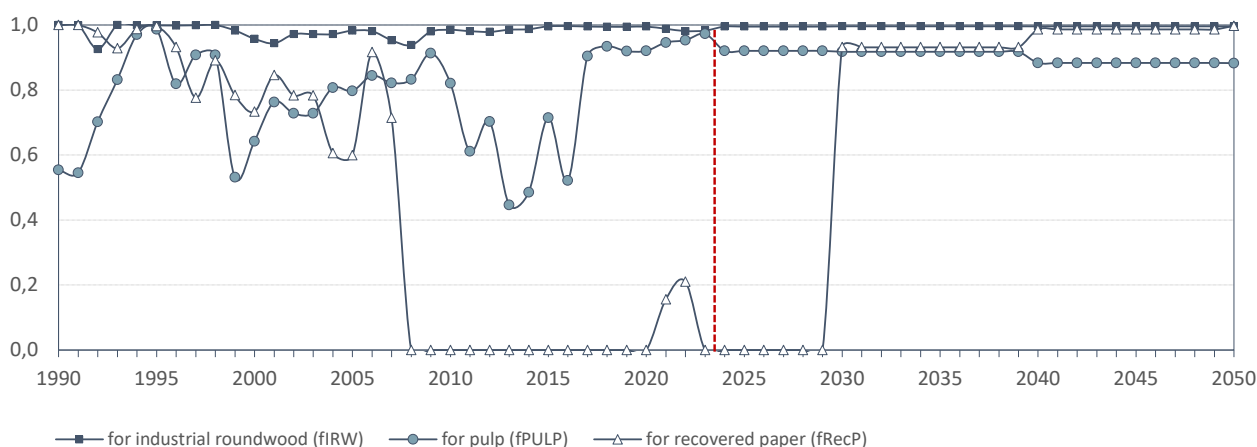


Figure BG-B: Historic and future development of the applied domestic feedstock factors for Bulgaria

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure BG-C shows the results for the “baseline” scenario (RCP1p9_12).

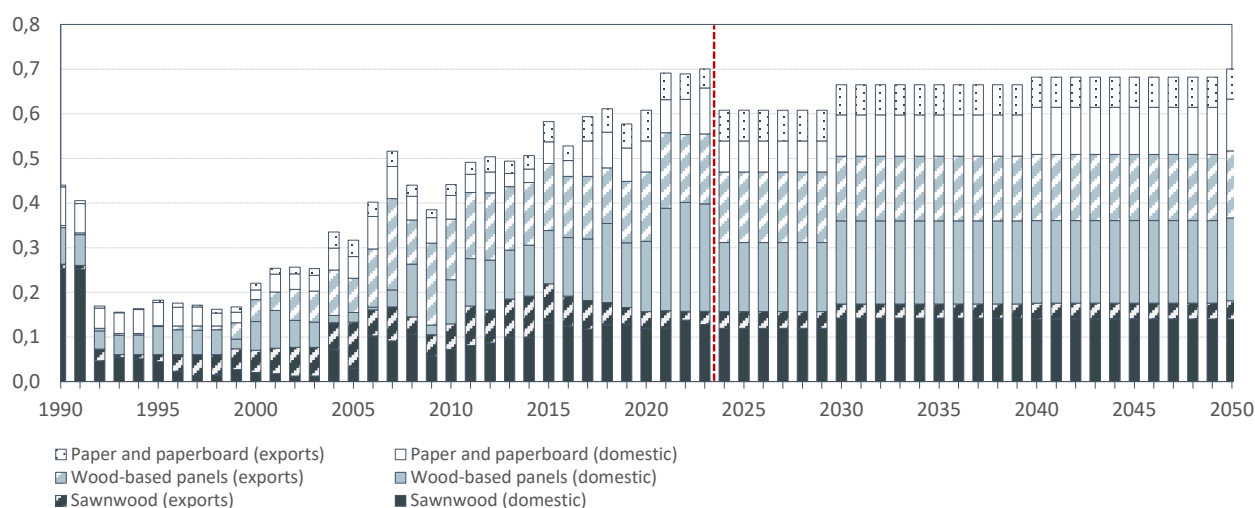


Figure BG-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Bulgaria [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

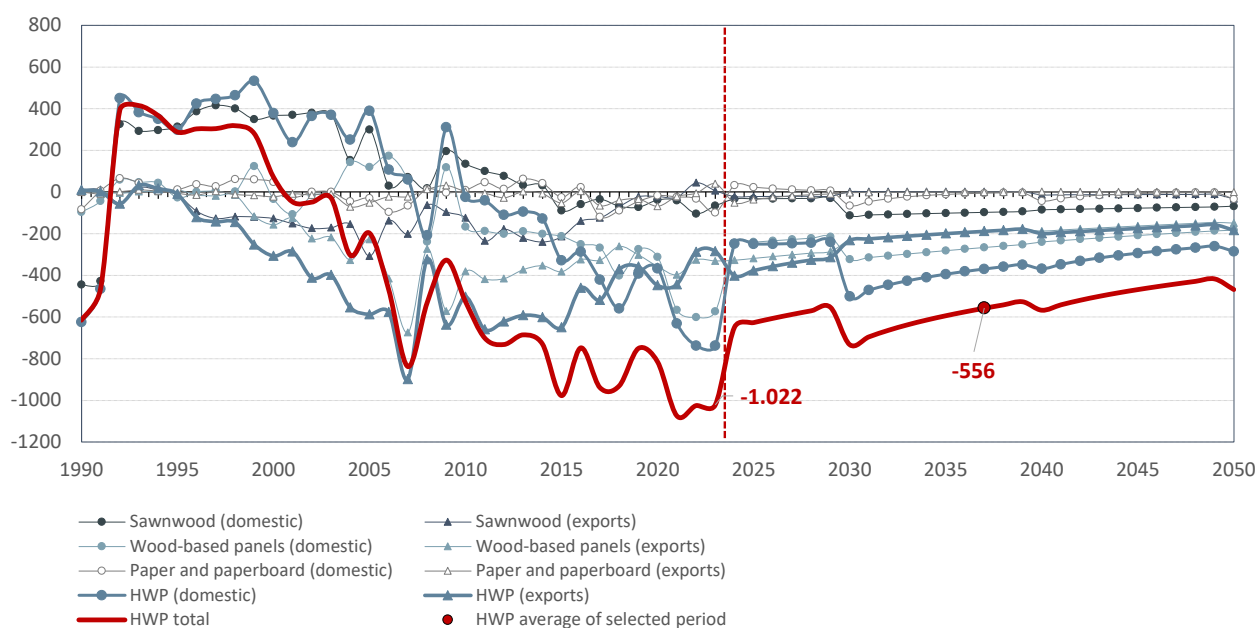


Figure BG-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Bulgaria [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Bulgaria applying the “baseline” scenario (RCP1p9_12) in Figure BG-E.

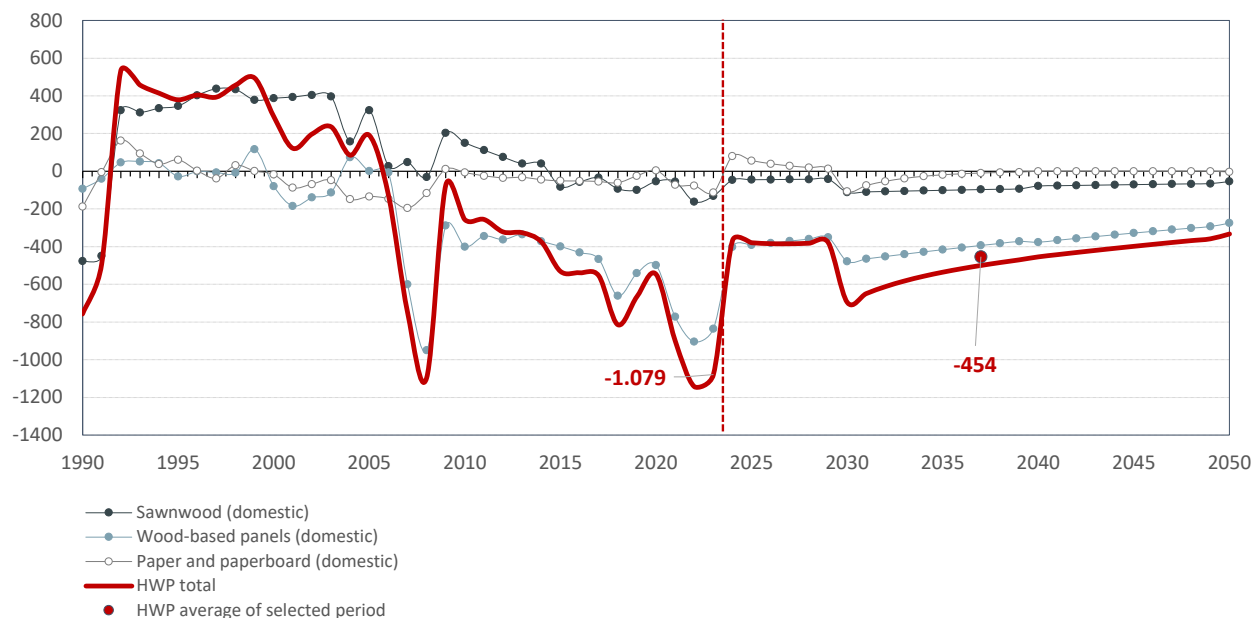


Figure BG-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Bulgaria [in kt CO₂]

Czechia (CZ)

For Czechia, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1992 to 2023. In order to complement the missing years since 1990, for the sake of completeness the data determined proportionally from the data of Czechoslovakia were used, which were also used for the estimation of the HWP contribution to the FMRL of the Czech Republic (UNFCCC 2011).

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure CZ-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

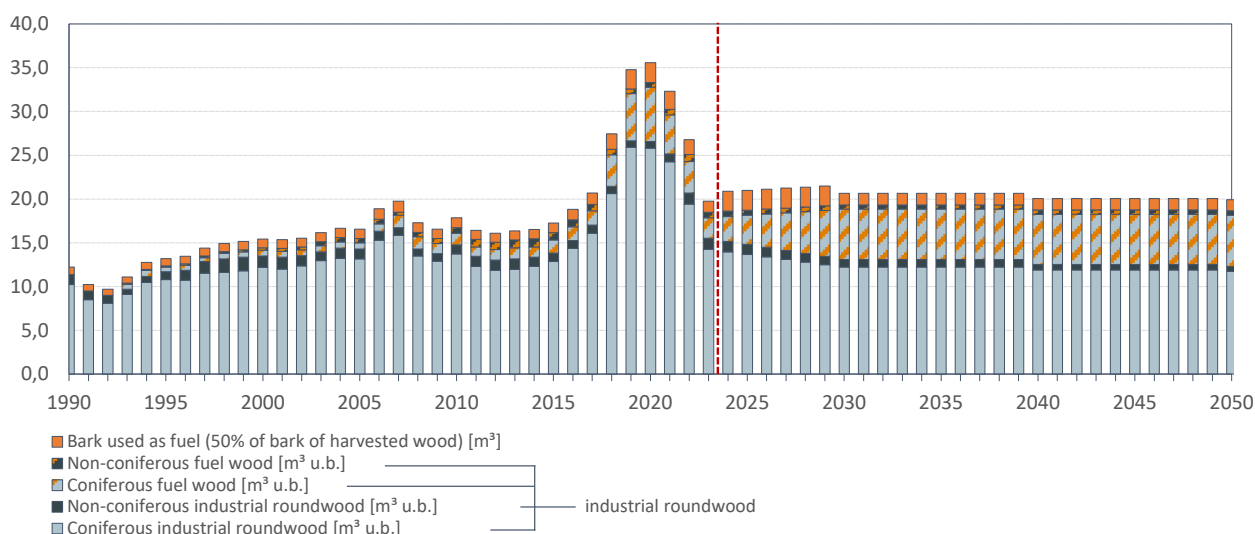


Figure CZ-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Czechia [in Mm³]

Due to the extremely high dynamics of change in timber harvesting between the modelling base year 2020 and its impact on the calculated domestic feedstock factors f_{INDRW} (see Figure CZ-B), the last available year of the statistical time series (i.e. 2023) and the GLOBIOM data for sawlog and pulplog production under the “baseline scenario”, the time series for fuel wood and especially coniferous and non-coniferous industrial roundwood were interpolated between the statistical data for 2023 and the GLOBIOM data for 2030.

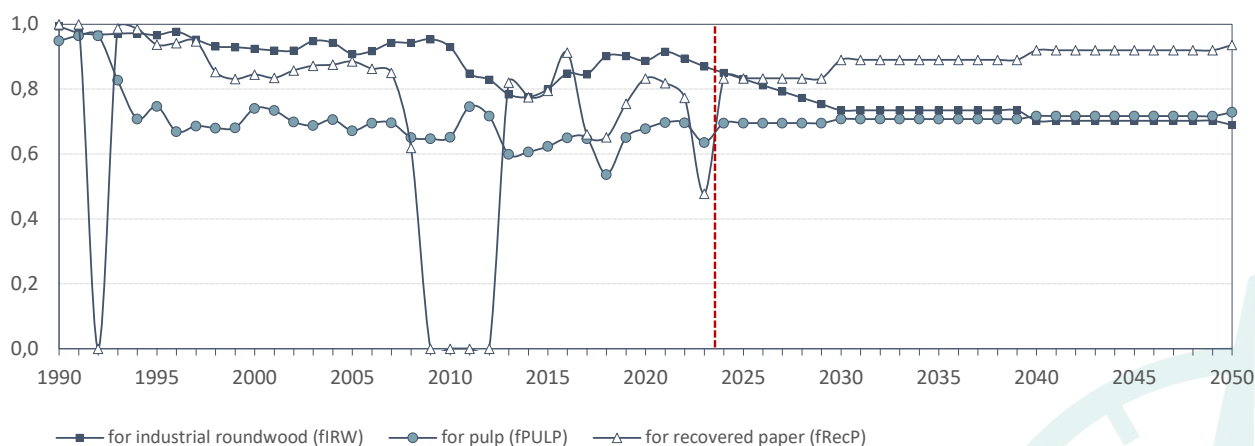


Figure CZ-B: Historic and future development of the applied domestic feedstock factors for Czechia

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure CZ-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure CZ-C shows the results for the “baseline” scenario (RCP1p9_12).

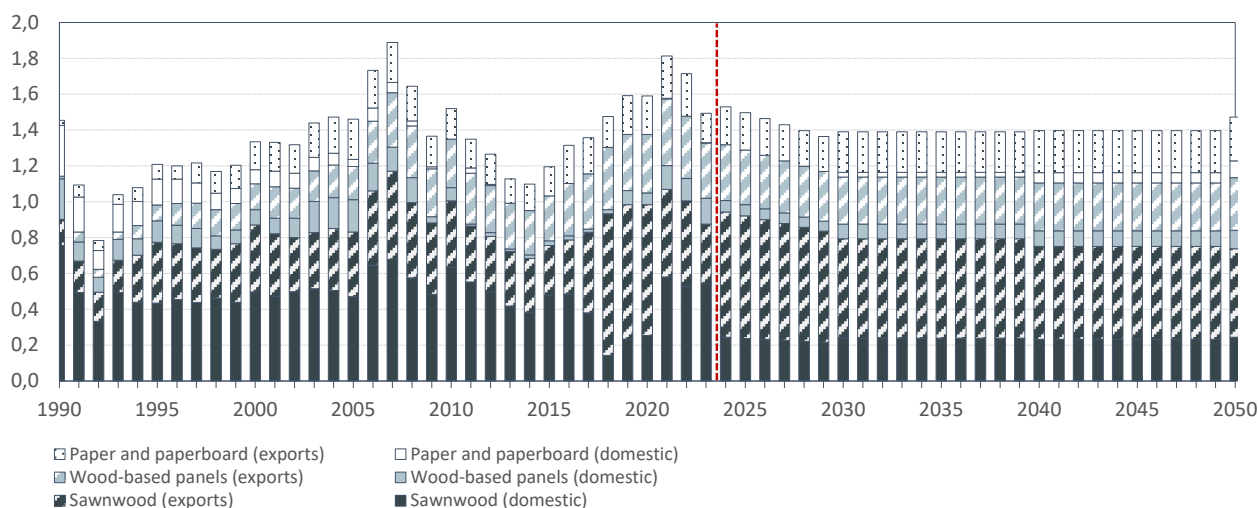


Figure CZ-C: Calculated historic and future carbon inflow on the basis of to the HWP pool applying the production approach for Czechia [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

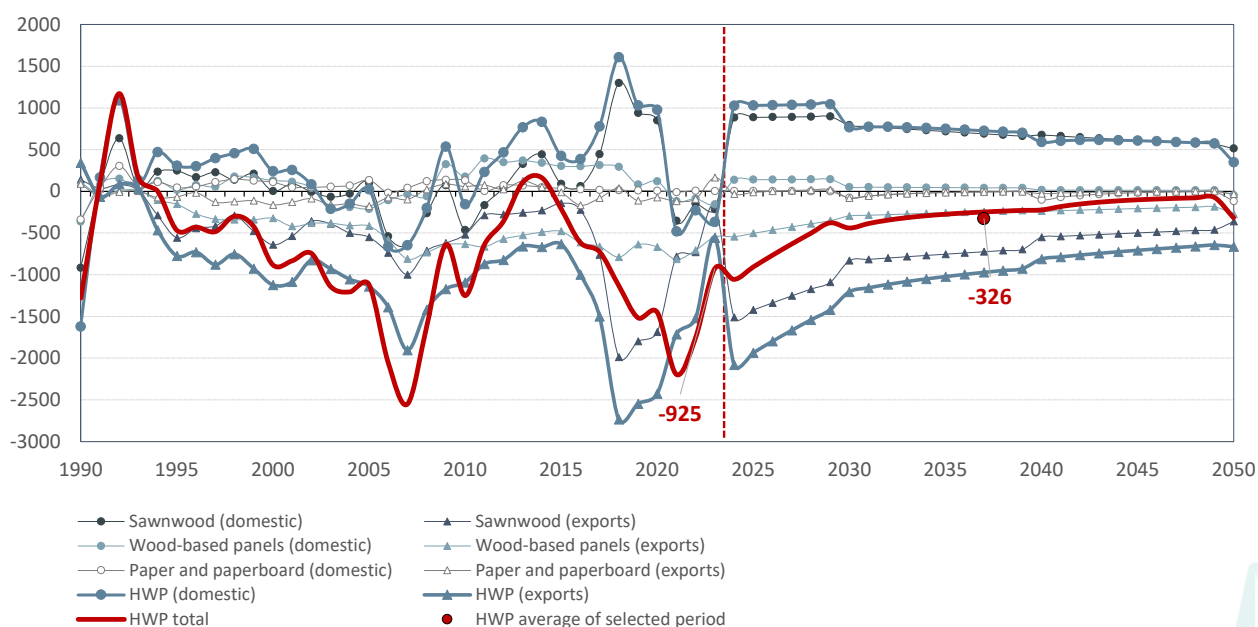


Figure CZ-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Czechia [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i. e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Czechia applying “baseline” scenario (RCP1p9_12) in Figure CZ-E.

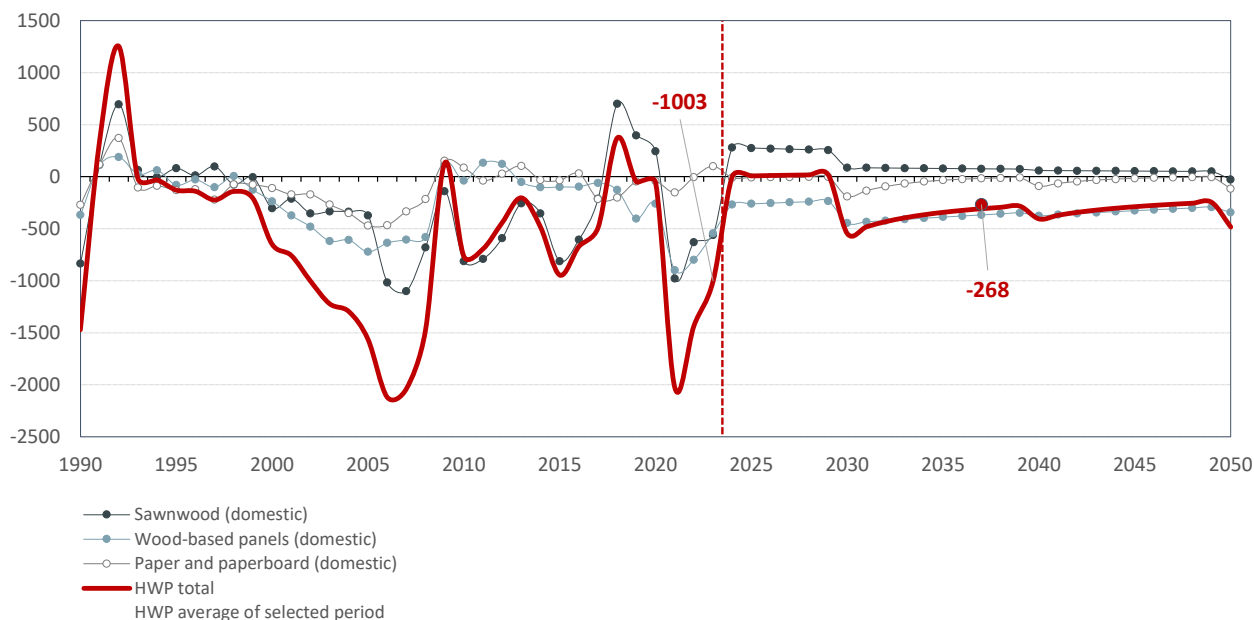


Figure CZ-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Czechia [in kt CO₂]

Germany (DE)

For Germany, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure DE-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

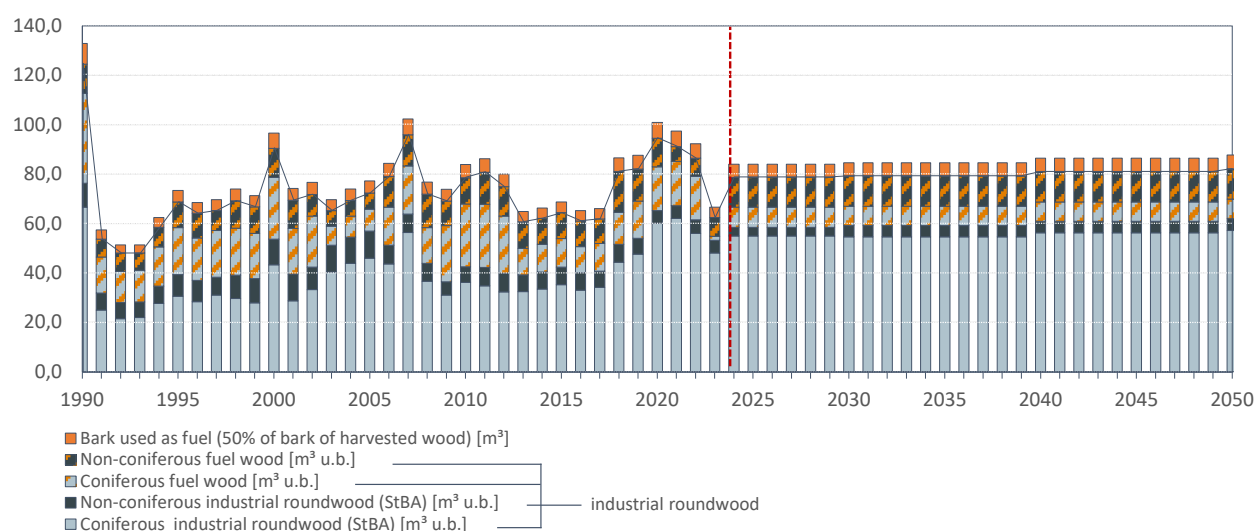


Figure DE-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Germany [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure DE-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

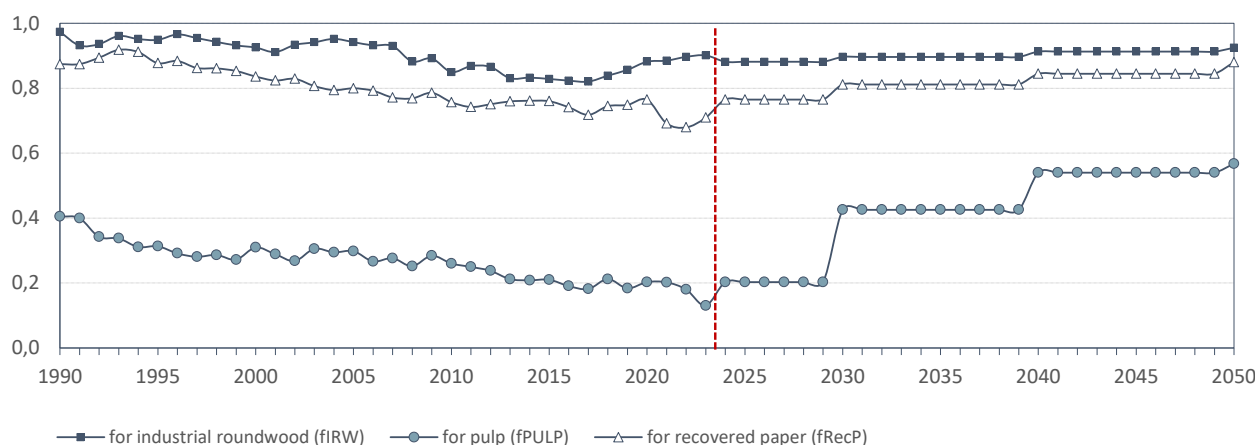


Figure DE-B: Historic and future development of the applied domestic feedstock factors for Germany

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure DE-C shows the results for the “baseline” scenario (RCP1p9_12).

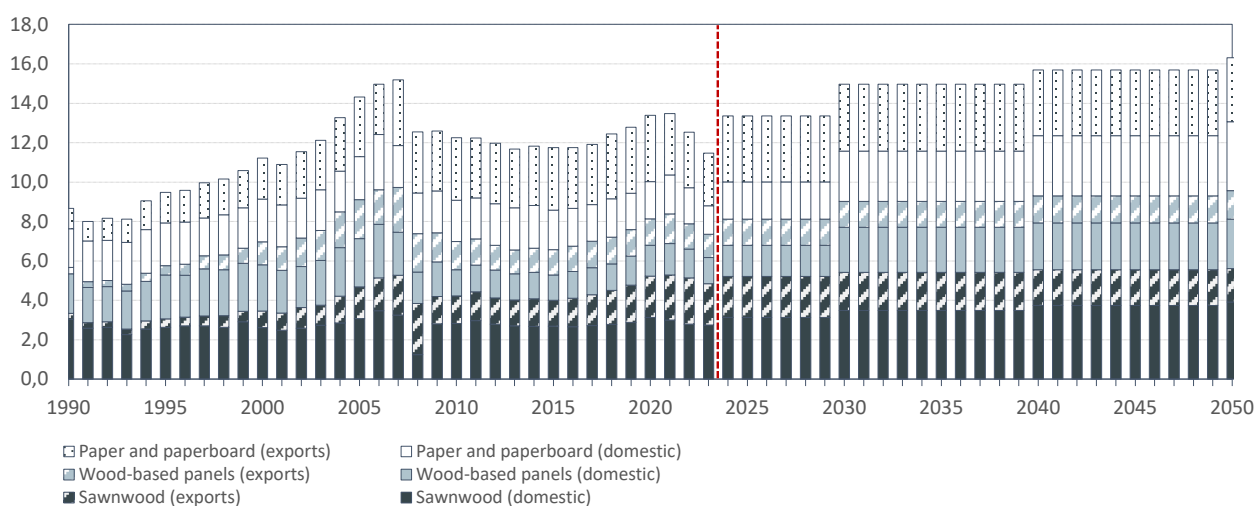


Figure DE-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Germany [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

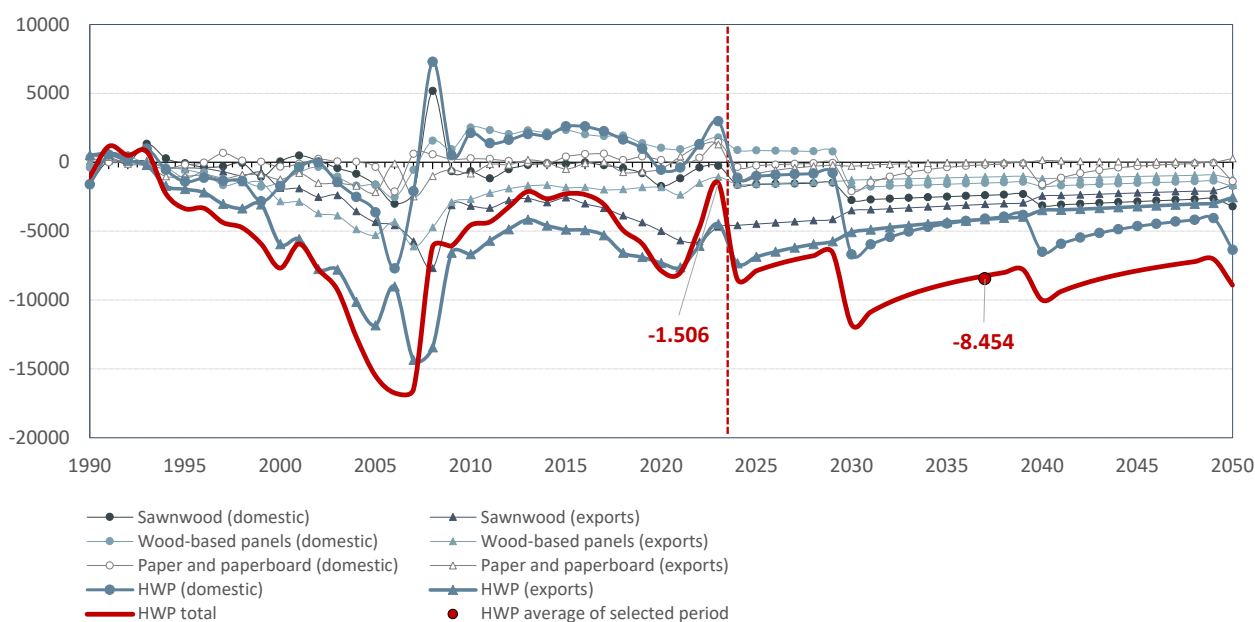


Figure DE-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Germany [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Germany applying the “baseline” scenario (RCP1p9_12) in Figure DE-E.

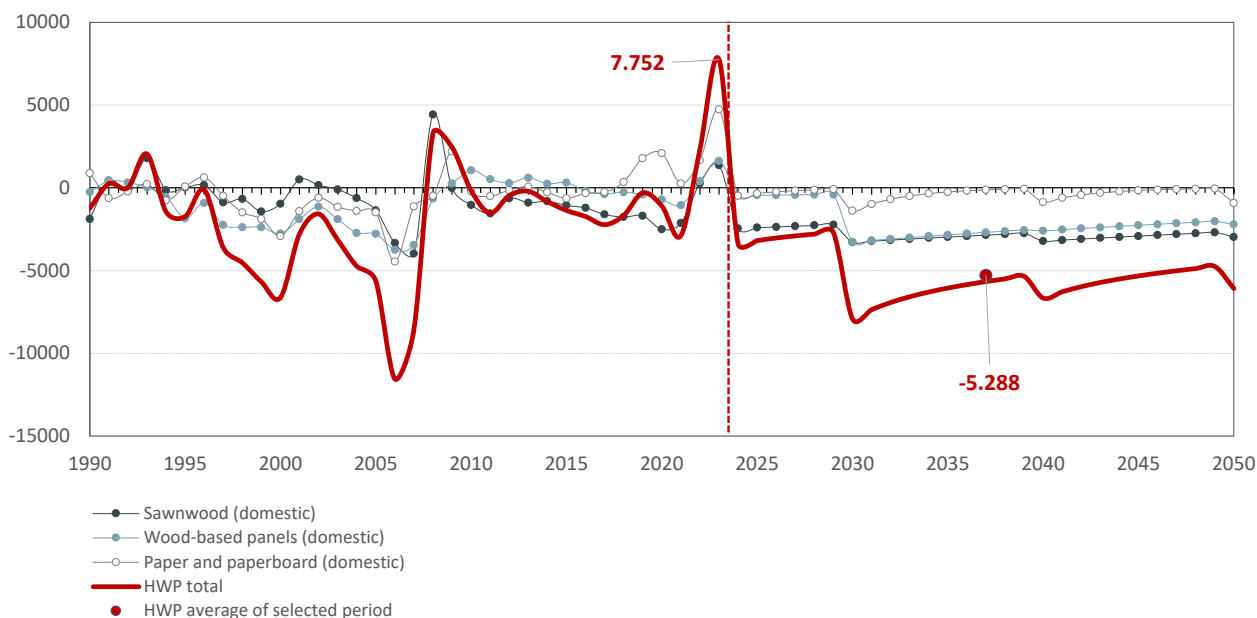


Figure DE-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Germany [in kt CO₂]

Denmark (DK)

For Denmark, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure DK-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

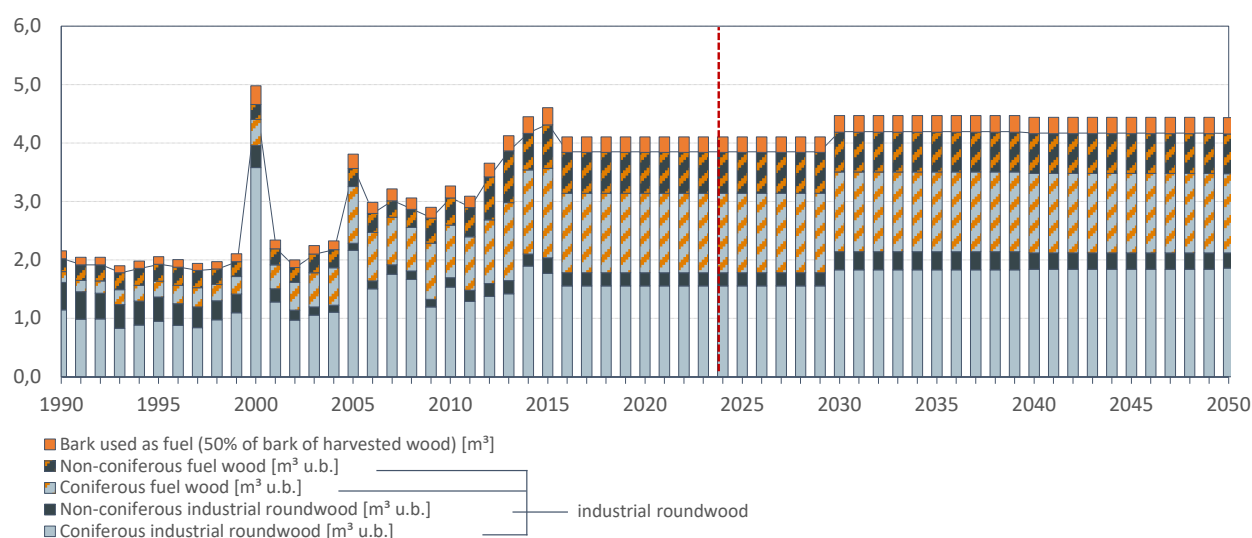


Figure DK-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Denmark [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure DK-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} its assumed future development for the “baseline” scenario (RCP1p9_12).

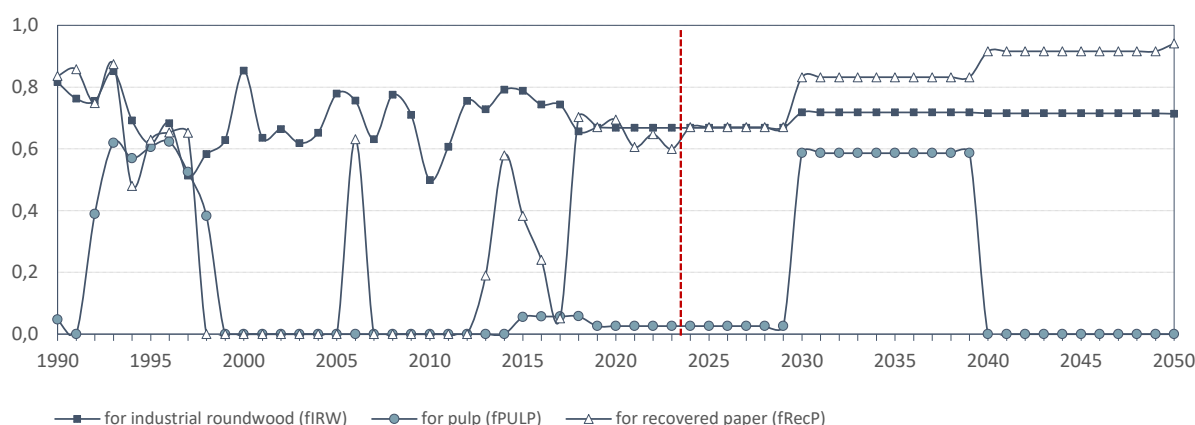


Figure DK-B: Historic and future development of the applied domestic feedstock factors for Denmark

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure DK-C shows the results for the “baseline” scenario (RCP1p9_12).

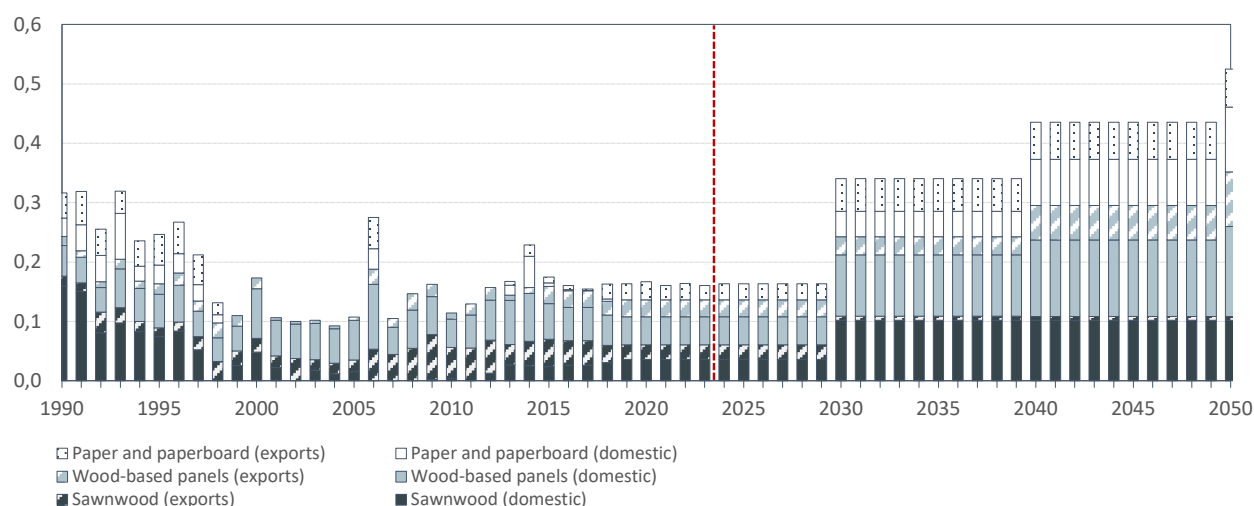


Figure DK-C: Calculated historic and future carbon inflow on the basis of to the HWP pool applying the production approach for Denmark [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

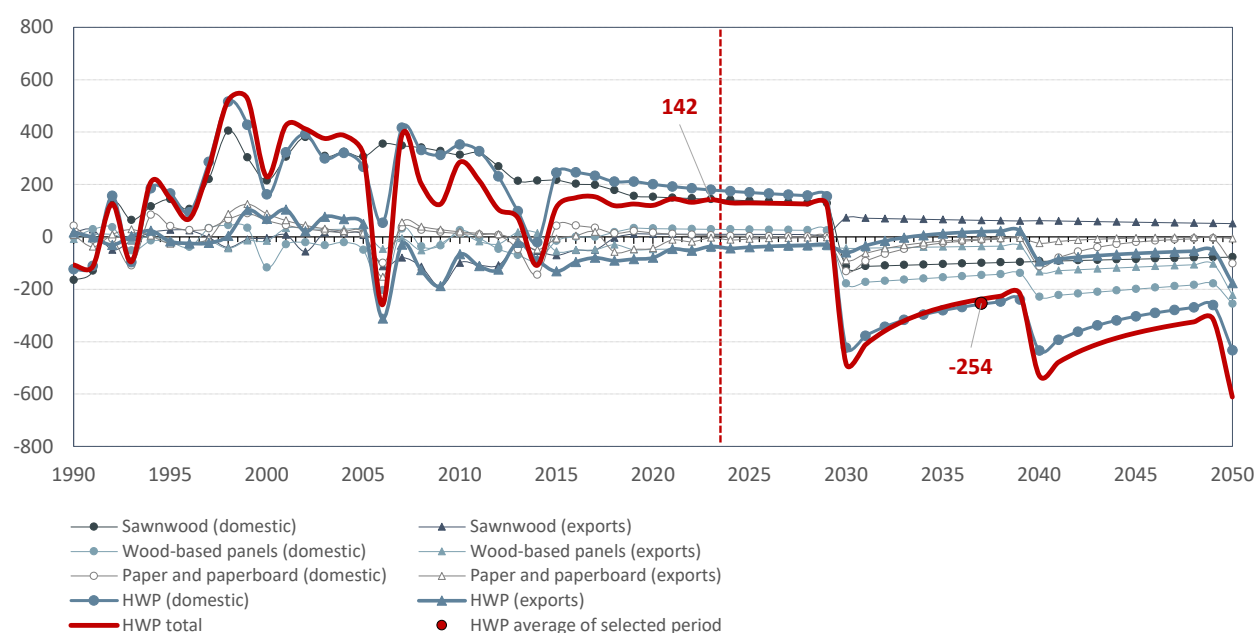


Figure DK-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Denmark [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Denmark applying the “baseline” scenario (RCP1p9_12) in Figure DK-E.

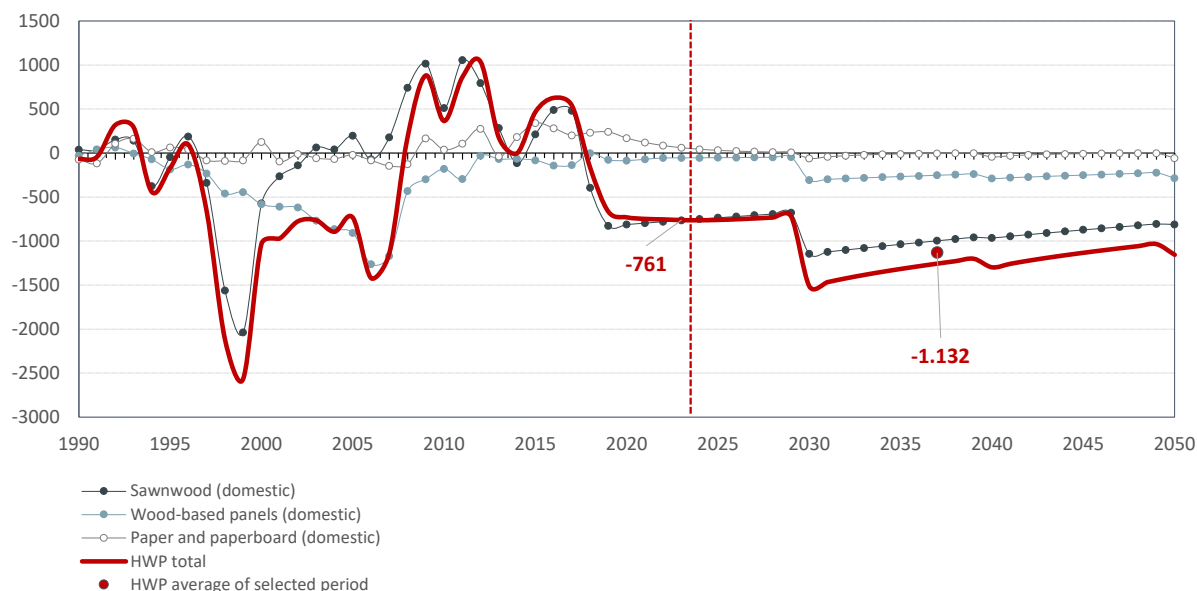


Figure DK-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Denmark [in kt CO₂]

Estonia (EE)

For Estonia, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1992 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure EE-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

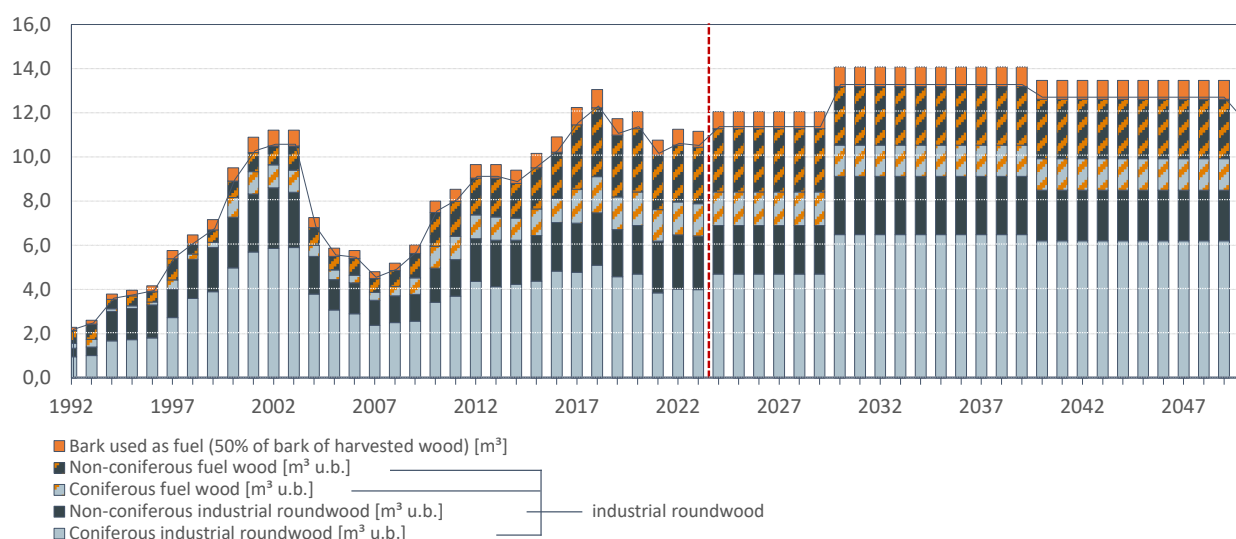


Figure EE-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Estonia [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure EE-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

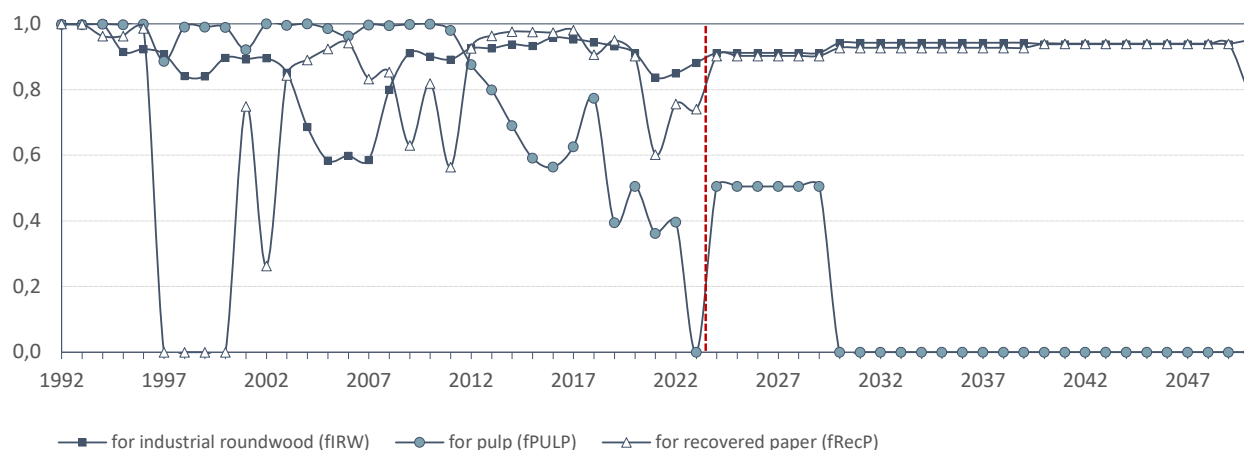


Figure EE-B: Historic and future development of the applied domestic feedstock factors for Estonia

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure EE-C shows the results for the “baseline” scenario (RCP1p9_12).

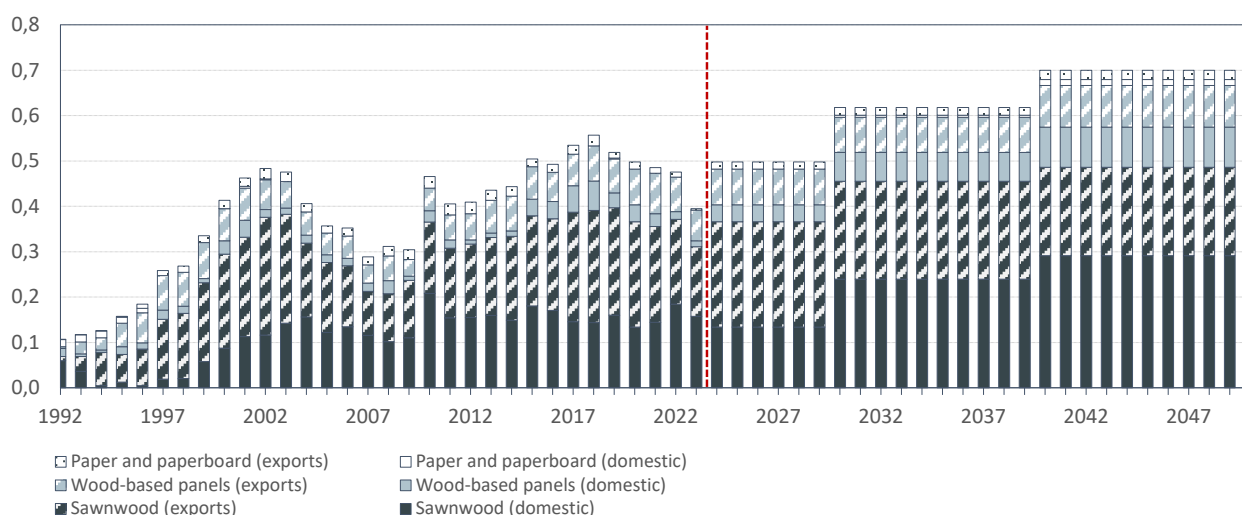


Figure EE-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Estonia [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

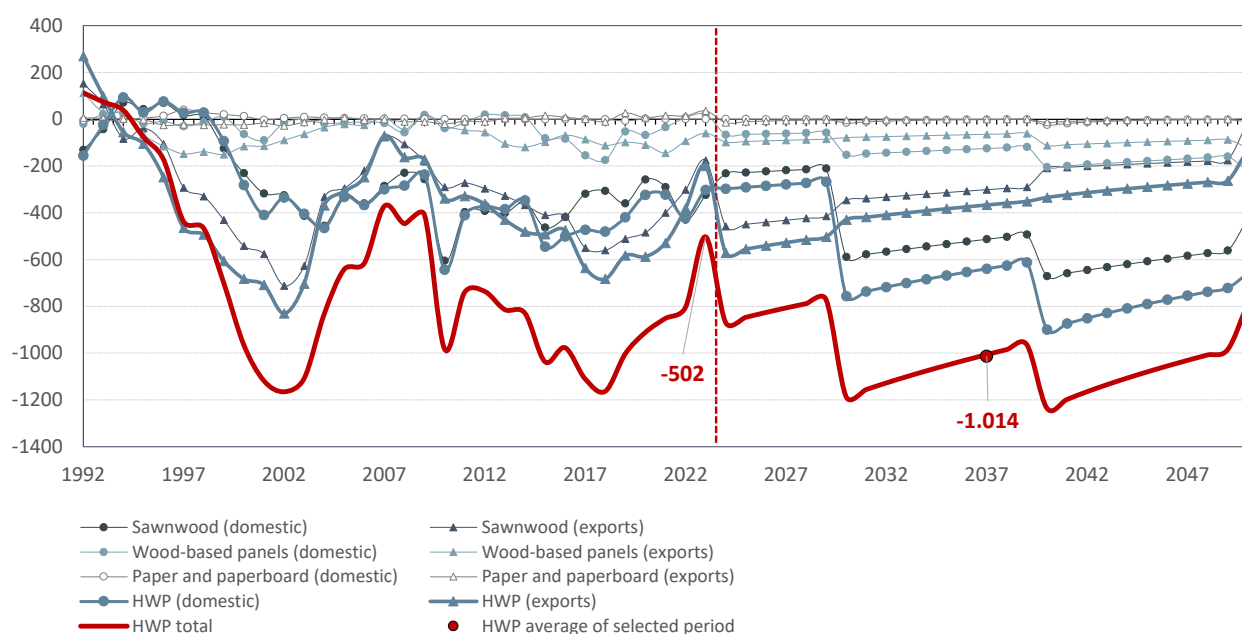


Figure EE-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Estonia [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Estonia applying “baseline” scenario (RCP1p9_12) in Figure EE-E.

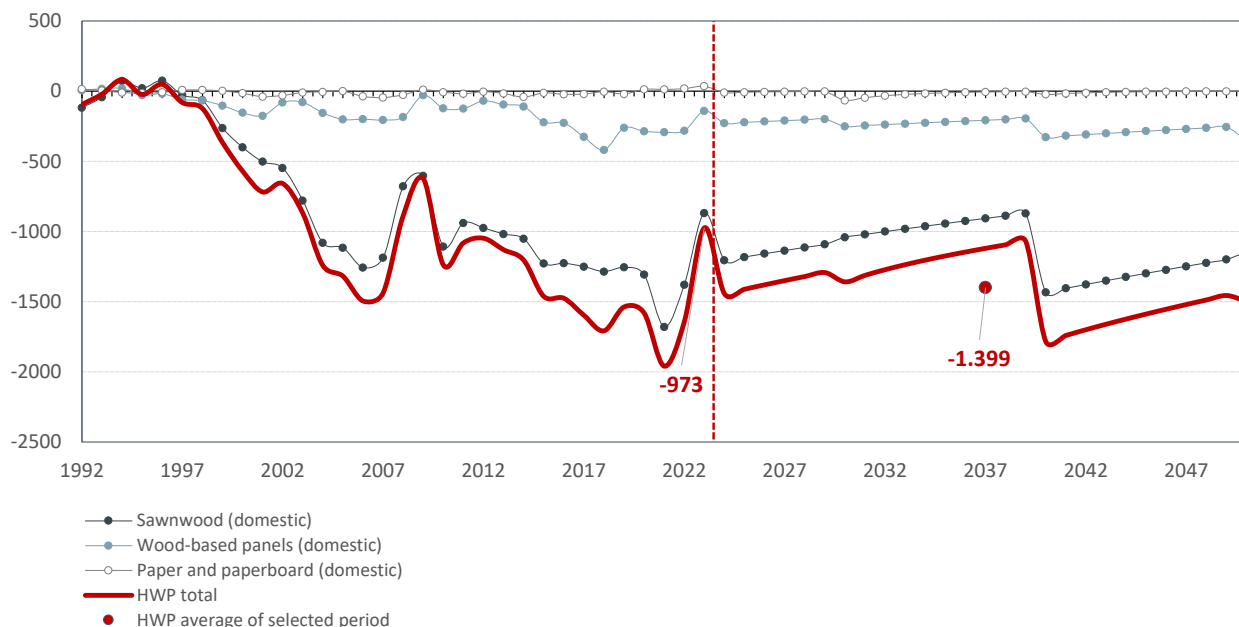


Figure EE-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Estonia [in kt CO₂]

Spain (ES)

For Spain, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure ES-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

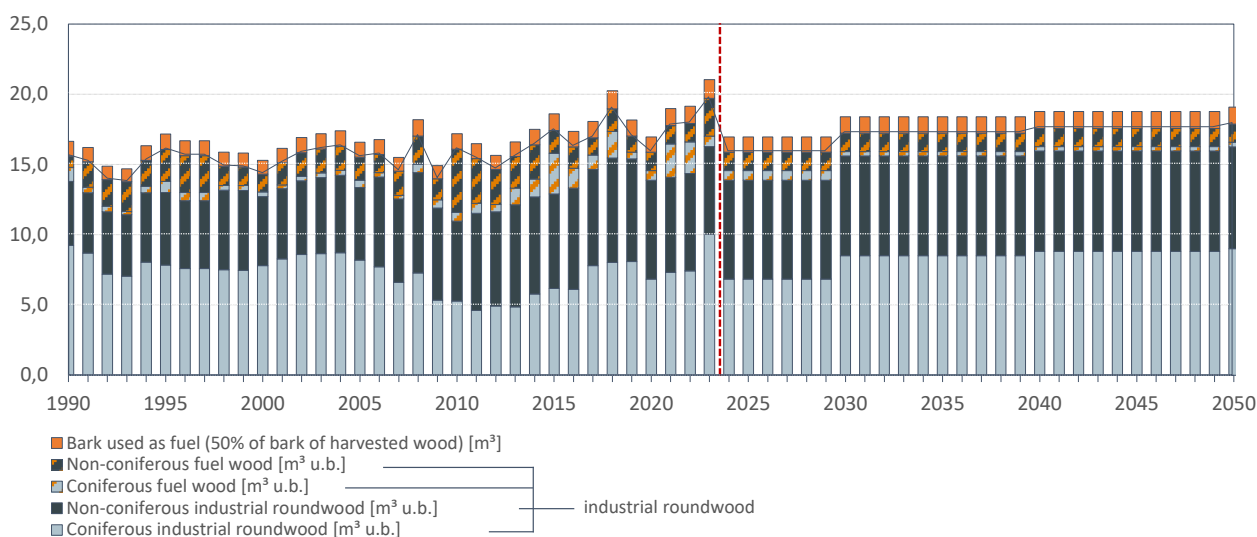


Figure ES-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Spain [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure ES-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

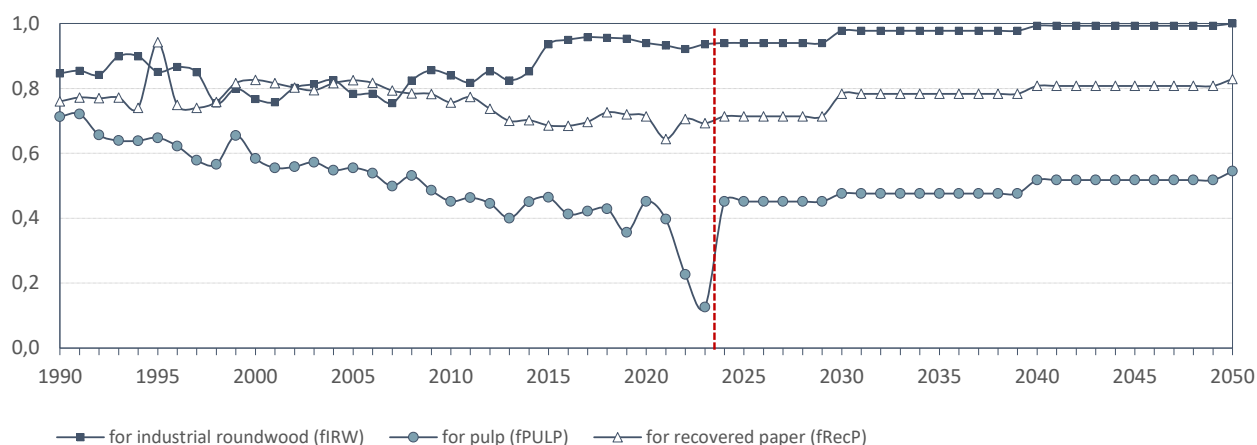


Figure ES-B: Historic and future development of the applied domestic feedstock factors for Spain

, 2030-2039 and 2040-2049 up to 2050 can be found in Table ANX-ES-0-A in the Annex II.

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure ES-C shows the results for the “baseline” scenario RCP1p9_12.

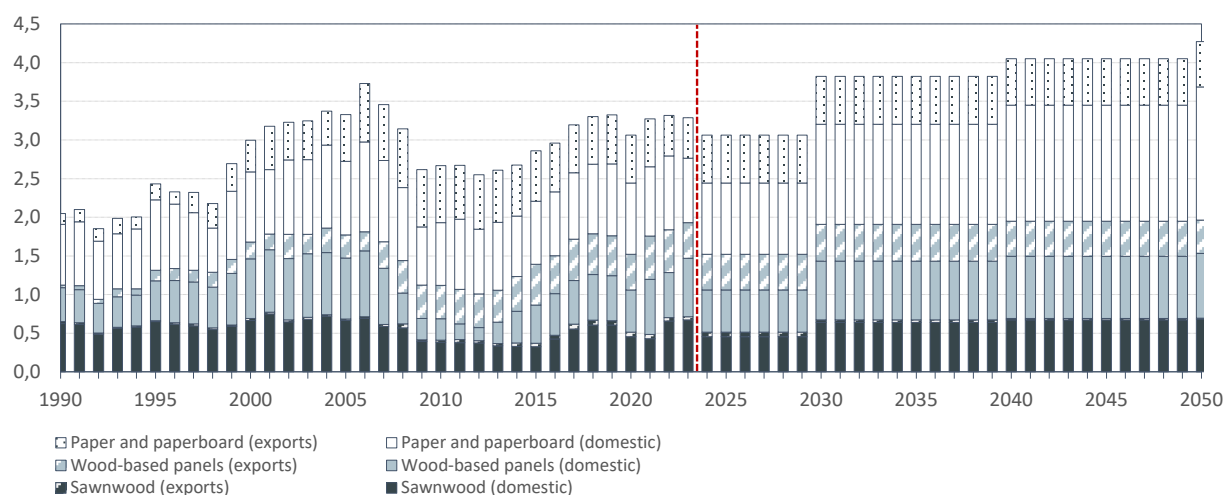


Figure ES-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Spain [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

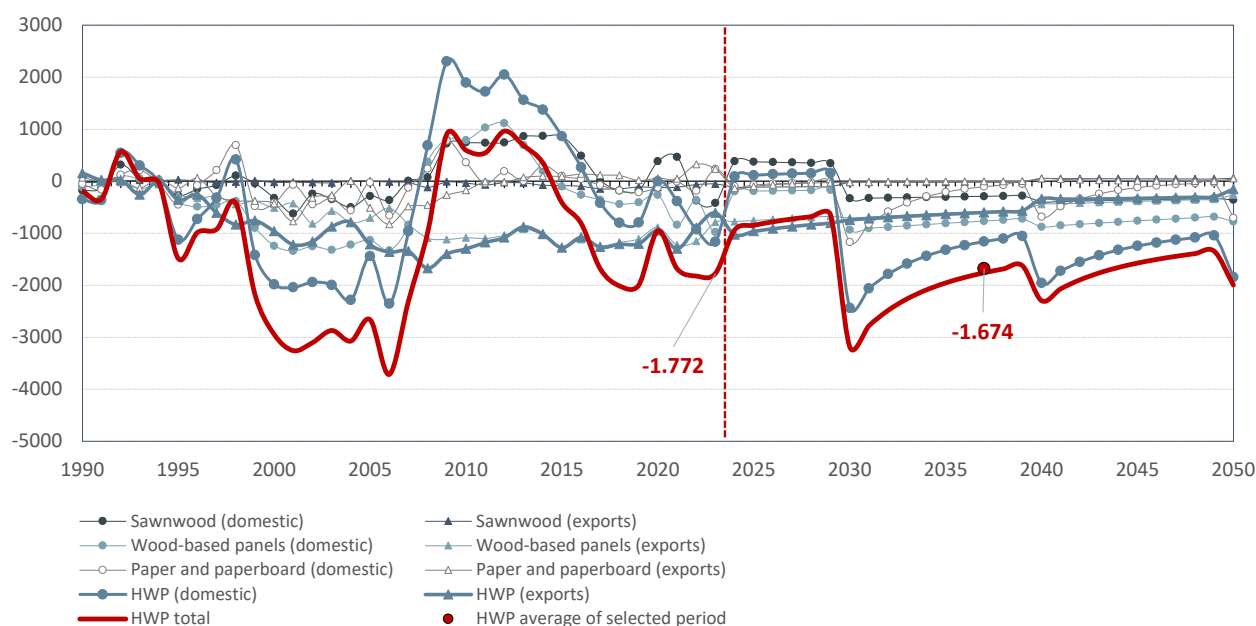


Figure ES-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Spain [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Spain applying the “baseline” scenario (RCP1p9_12) in Figure ES-E.

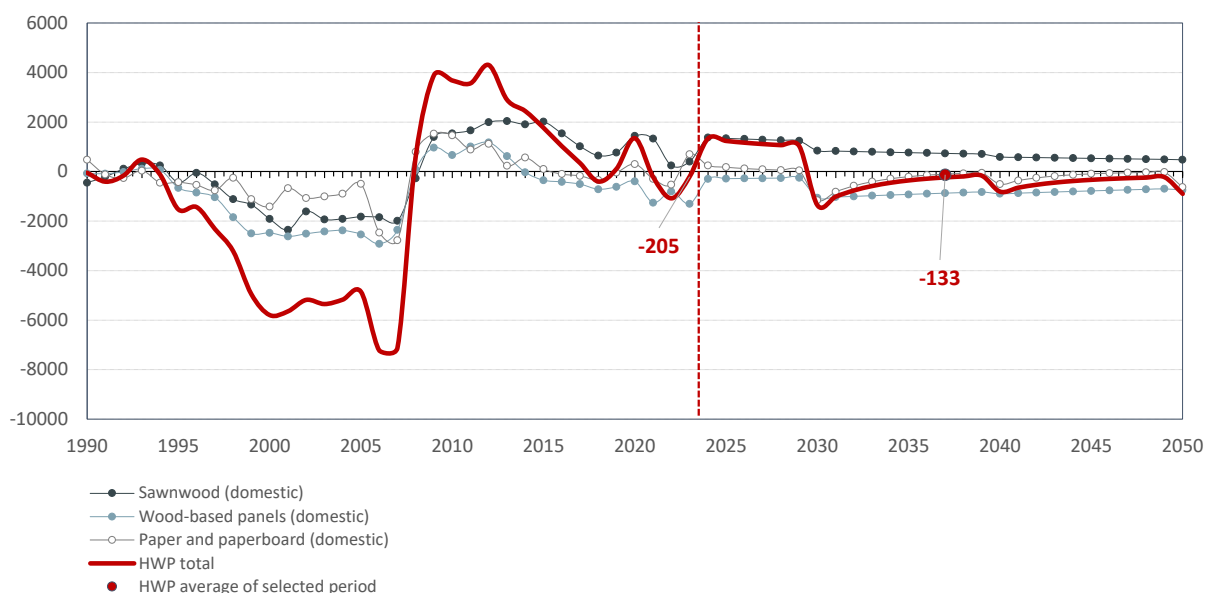


Figure ES-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for scenario RCP1p9_12 following the stock-change approach for Spain [in kt CO₂]

Finland (FI)

For Finland, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure FI-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

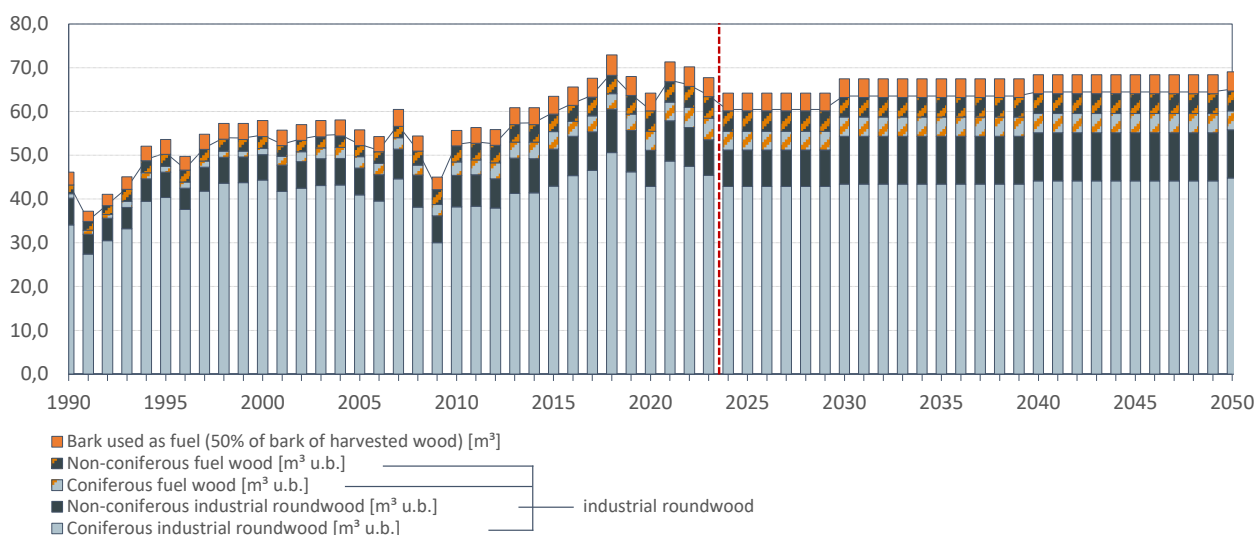


Figure FI-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Finland [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure FI-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} its assumed future development for the “baseline” scenario (RCP1p9_12).

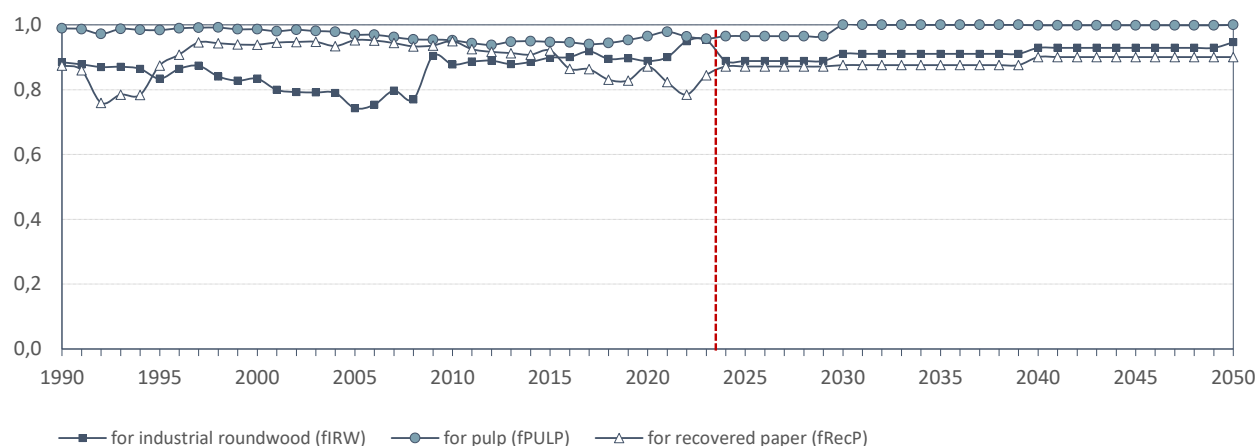


Figure FI-B: Historic and future development of the applied domestic feedstock factors for Finland

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure FI-C shows the results for the “baseline” scenario (RCP1p9_12).

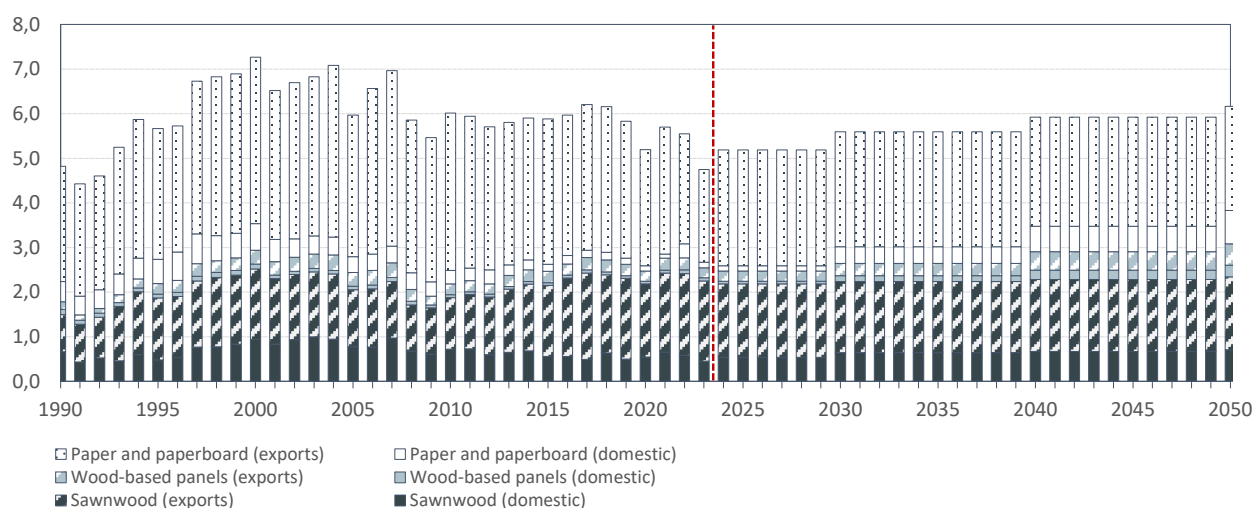


Figure FI-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Finland [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

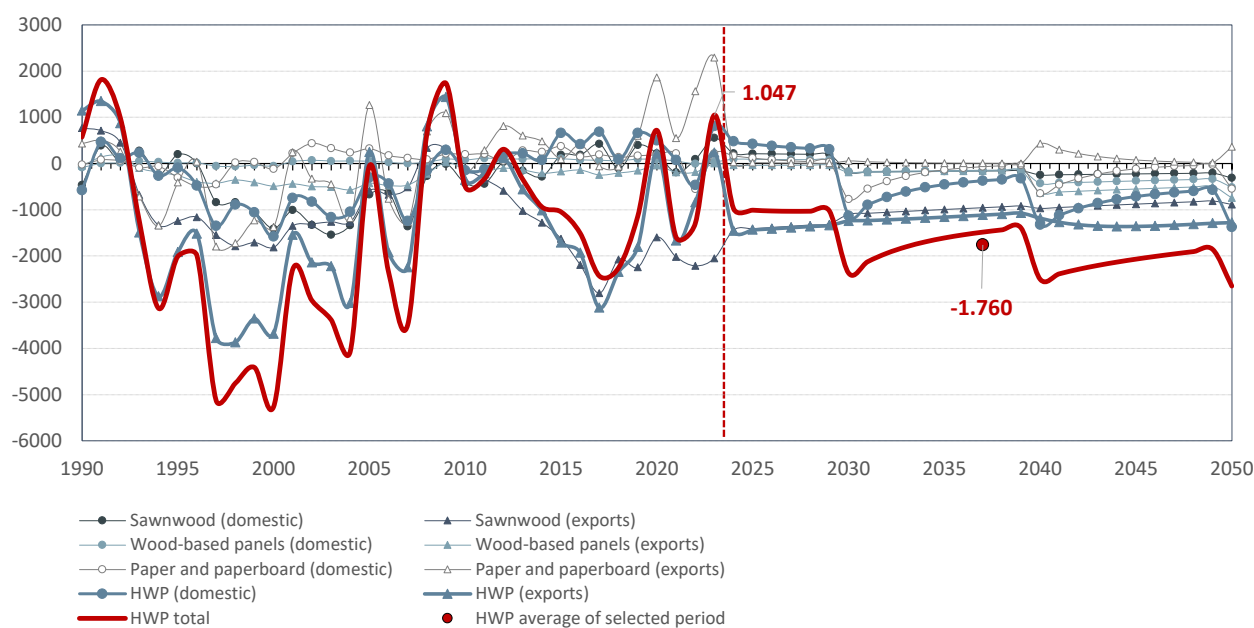


Figure FI-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for scenario RCP1p9_12 following the production approach for Finland [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Finland applying the “baseline” scenario (RCP1p9_12) in Figure FI-E.

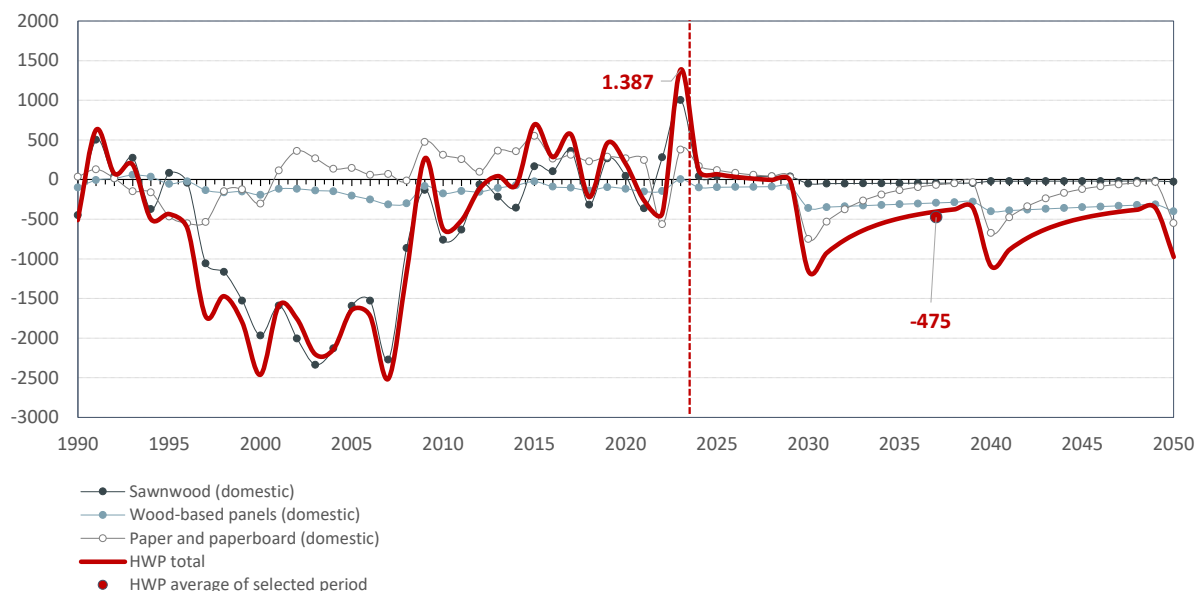


Figure FI-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Finland [in kt CO₂]

France (FR)

For France, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure FR-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

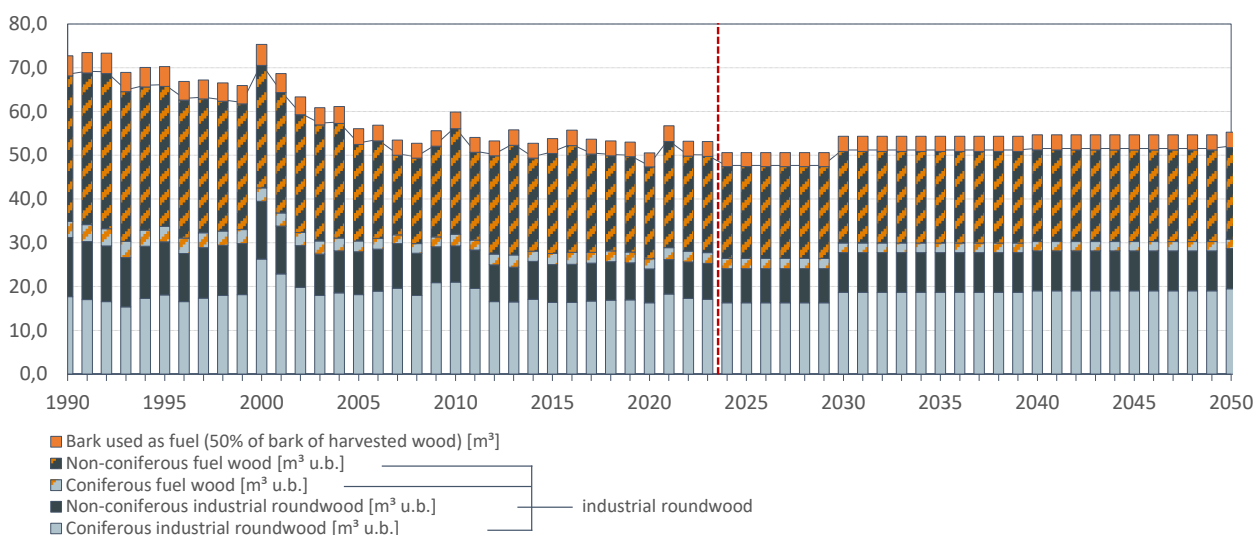


Figure FR-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in France [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure FR-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

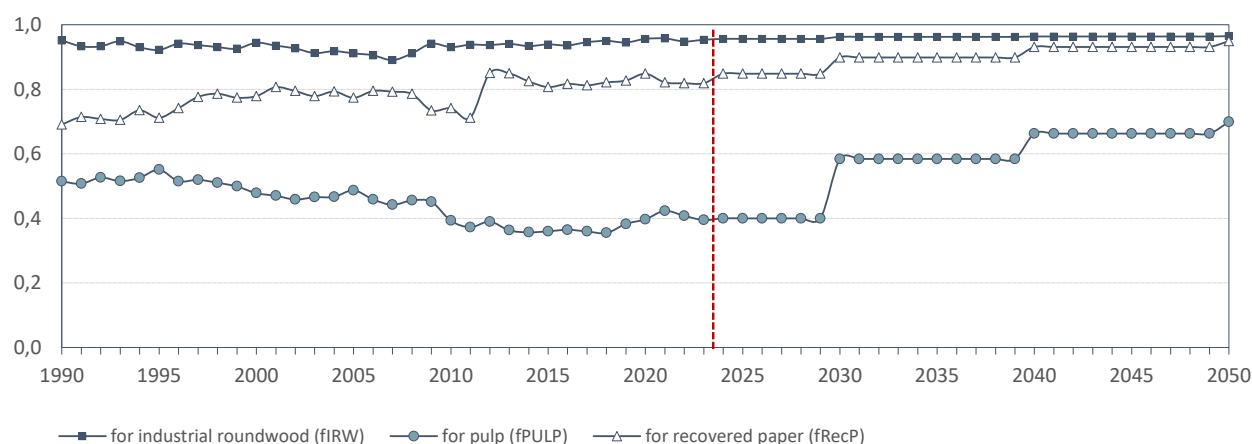


Figure FR-B: Historic and future development of the applied domestic feedstock factors for France

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure FR-C shows the results for the “baseline” scenario (RCP1p9_12).

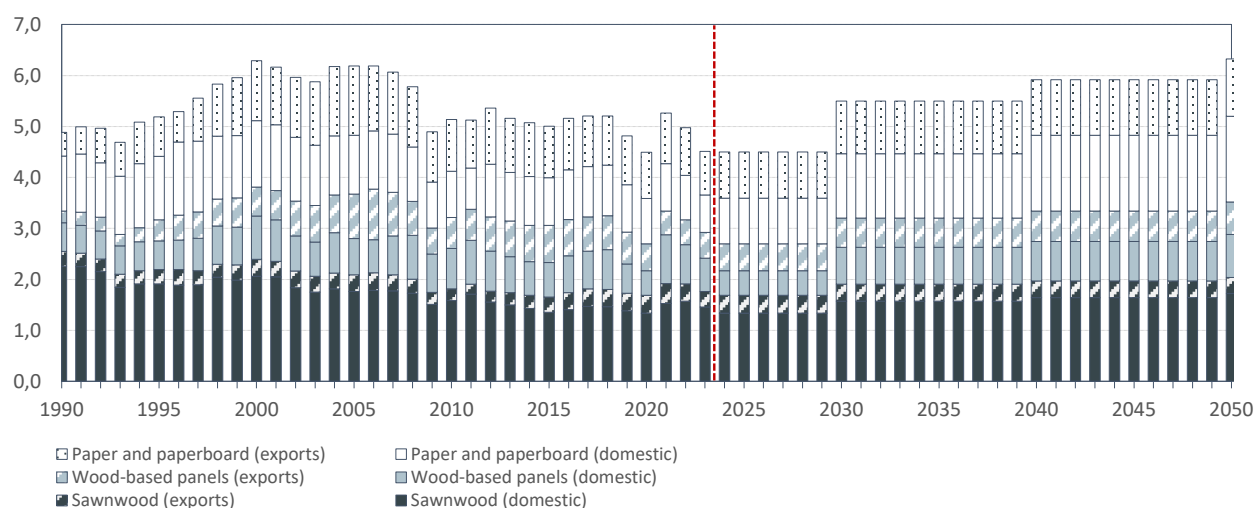


Figure FR-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for France [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

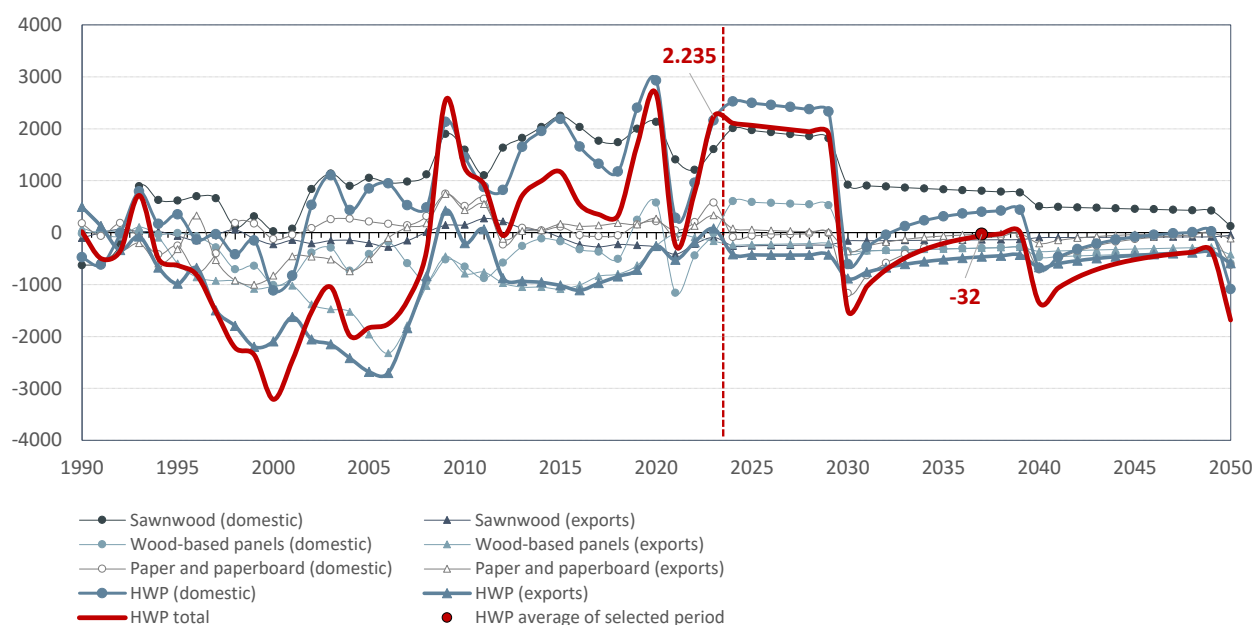


Figure FR-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for France [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for France applying the “baseline” scenario (RCP1p9_12) in Figure FR-E.

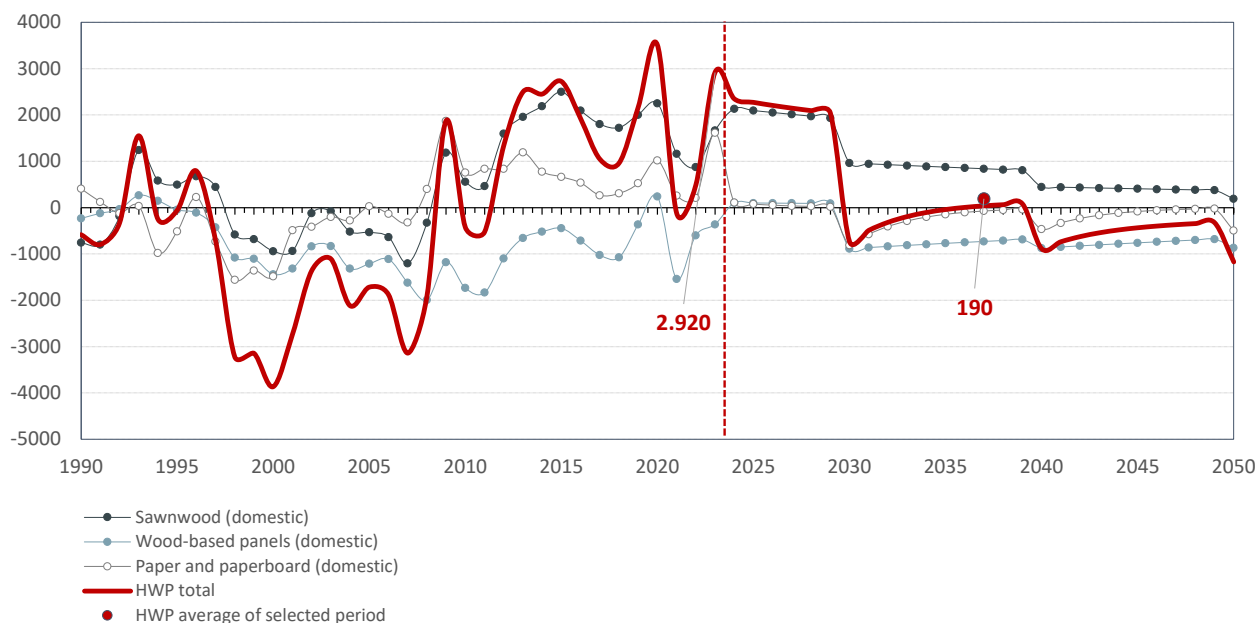


Figure FR-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for France [in kt CO₂]

Greece (GR)

For Greece, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach** are illustrated in Figure GR-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

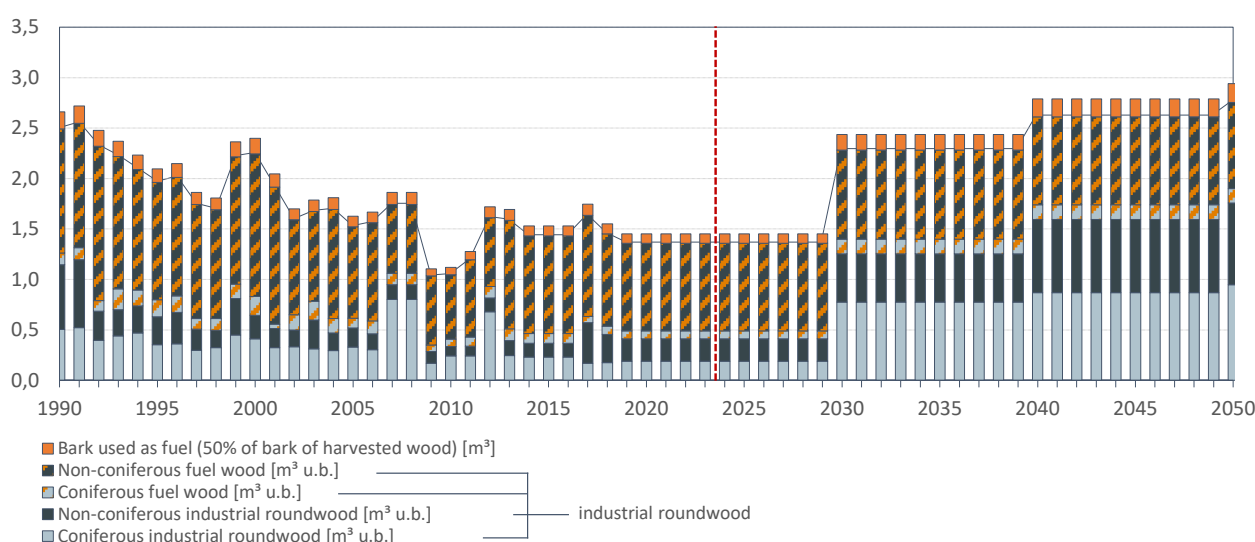


Figure GR-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Greece [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure GR-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

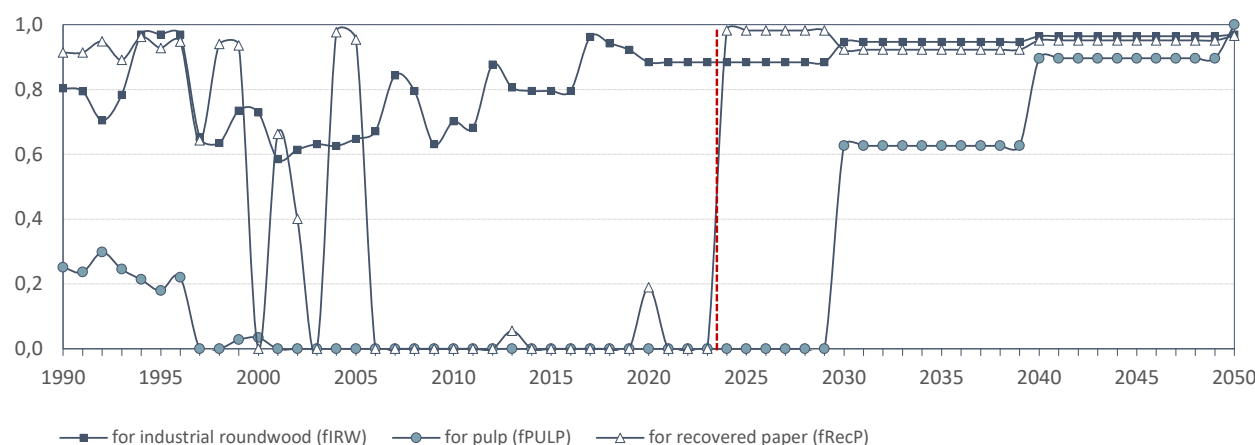


Figure GR-B: Historic and future development of the applied domestic feedstock factors for Greece

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure GR-C shows the results for the “baseline” scenario (RCP1p9_12).

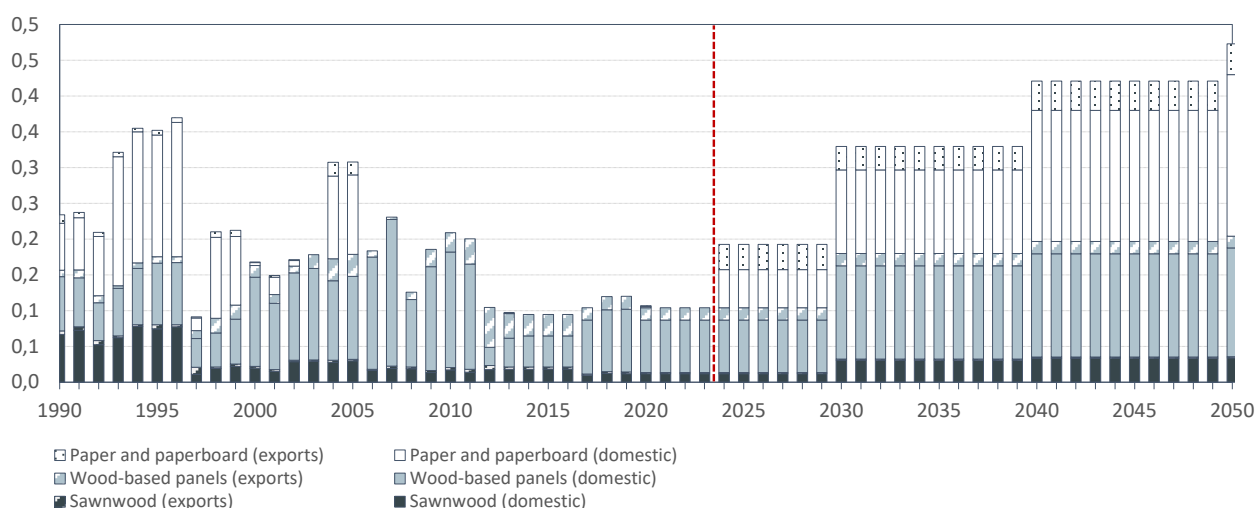


Figure GR-C: Calculated historic and future carbon inflow on the basis of to the HWP pool applying the production approach for Greece [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach

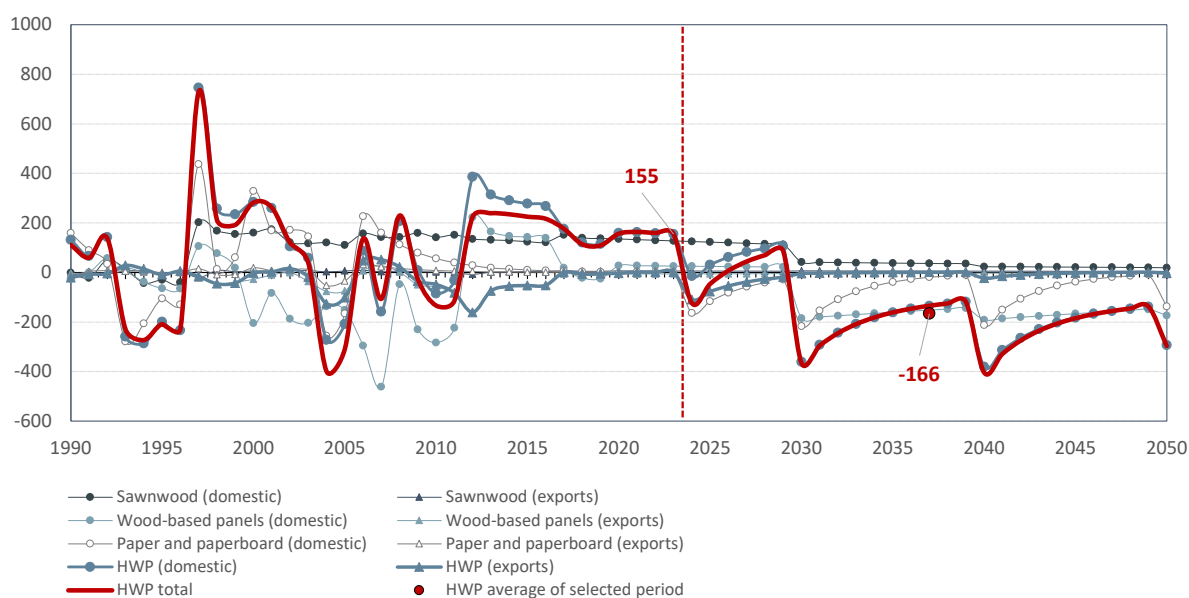


Figure GR-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Greece [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Greece applying the “baseline” scenario (RCP1p9_12) in Figure GR-E.

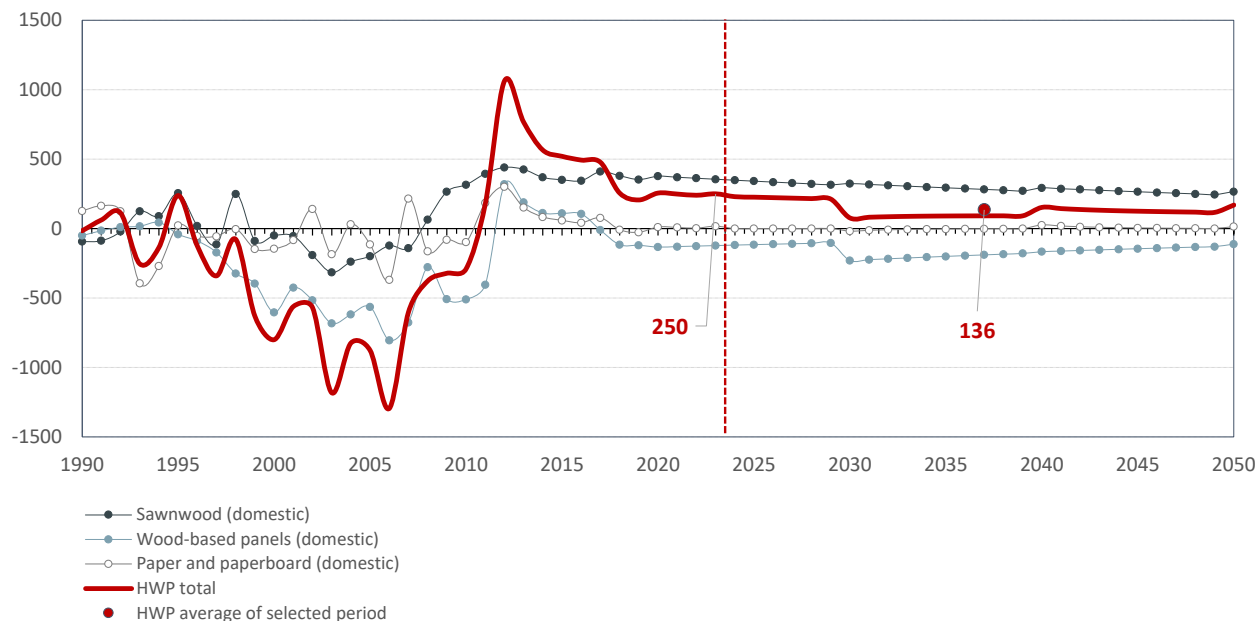


Figure GR-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Greece [in kt CO₂]

Croatia (HR)

For Croatia, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1992 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure HR-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

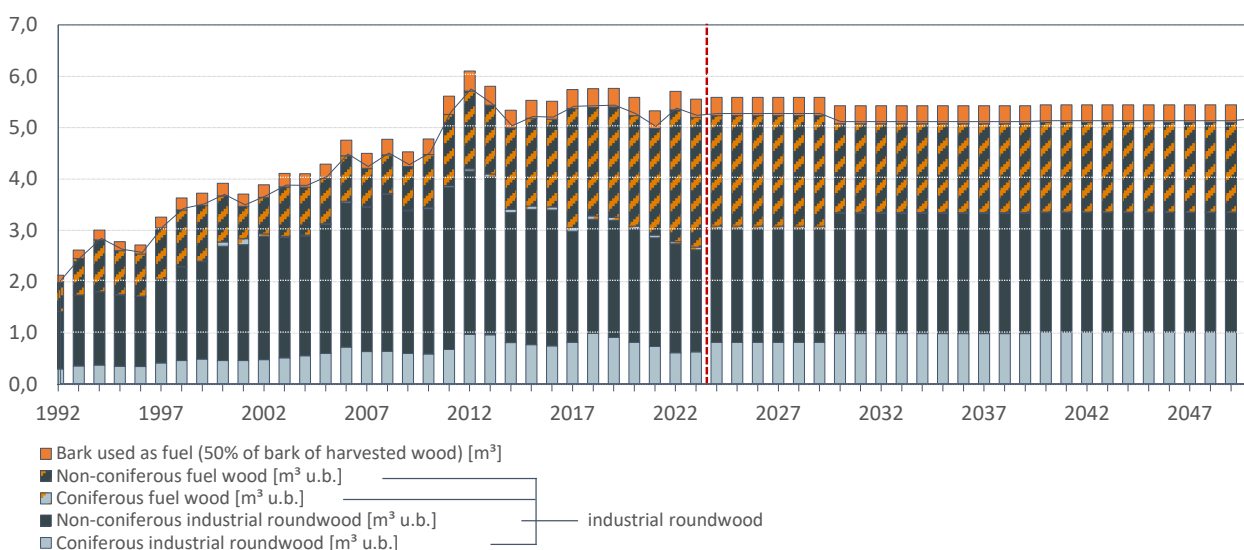


Figure HR-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Croatia [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure HR-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

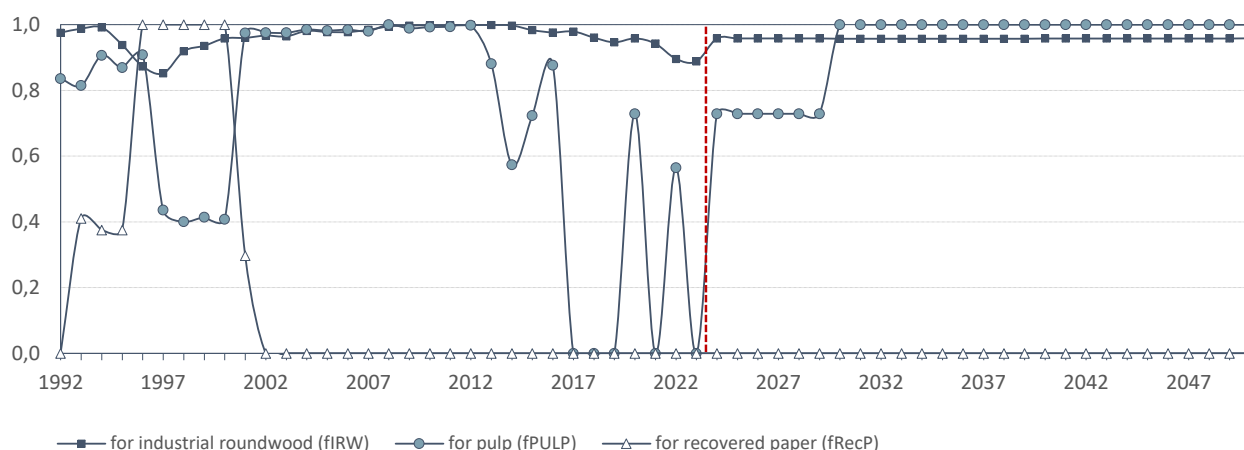


Figure HR-B: Historic and future development of the applied domestic feedstock factors for Croatia

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure HR-C shows the results for the “baseline” scenario (RCP1p9_12).

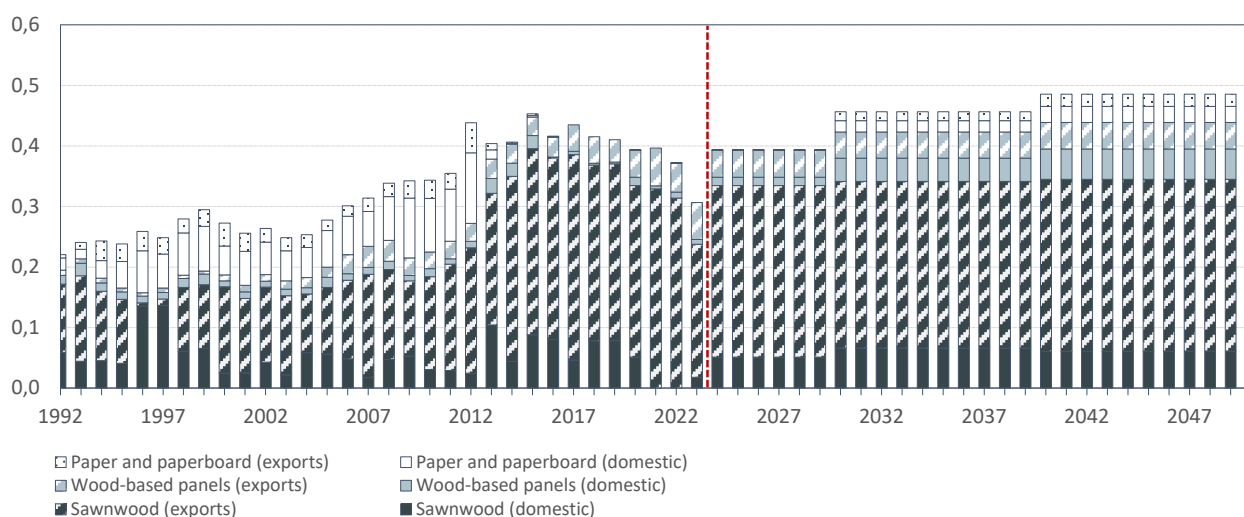


Figure HR-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Croatia [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

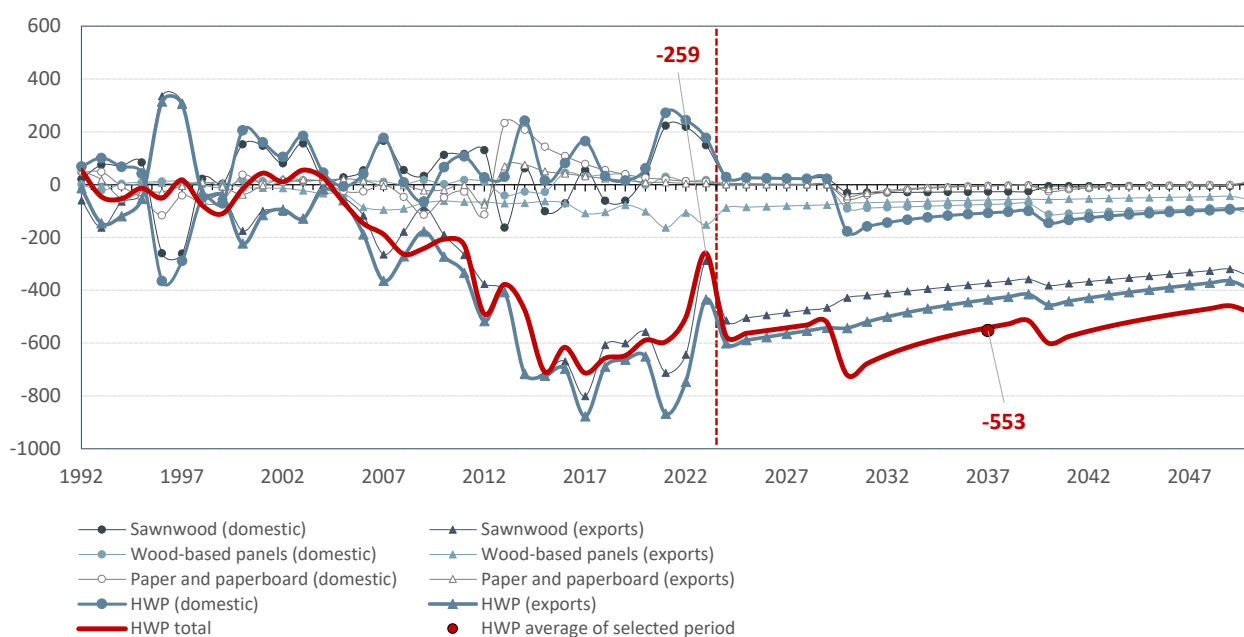


Figure HR-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Croatia [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Croatia applying the “baseline” scenario (RCP1p9_12) in Figure HR-E.

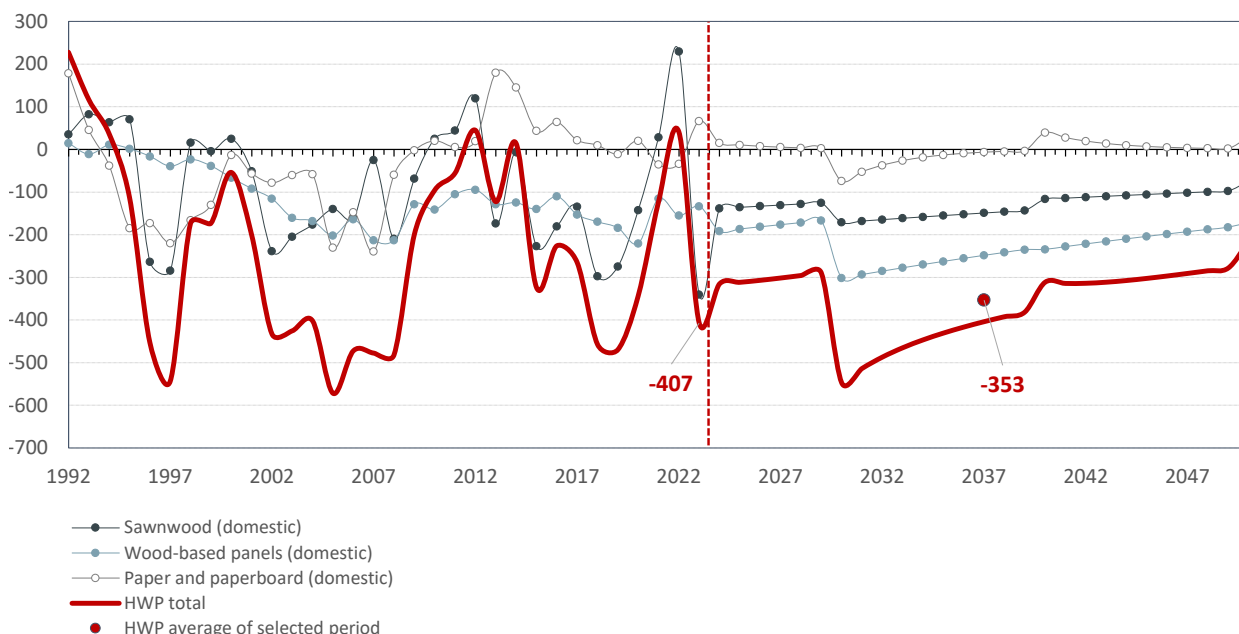


Figure HR-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Croatia [in kt CO₂]

Hungary (HU)

For Hungary, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure HU-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

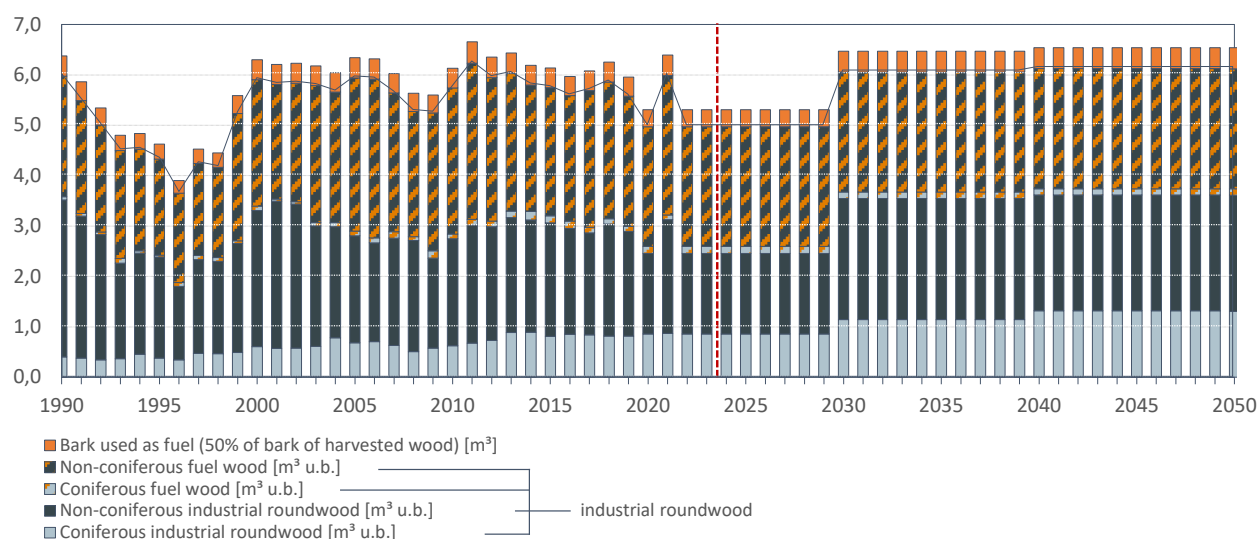


Figure HU-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Hungary [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure HU-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

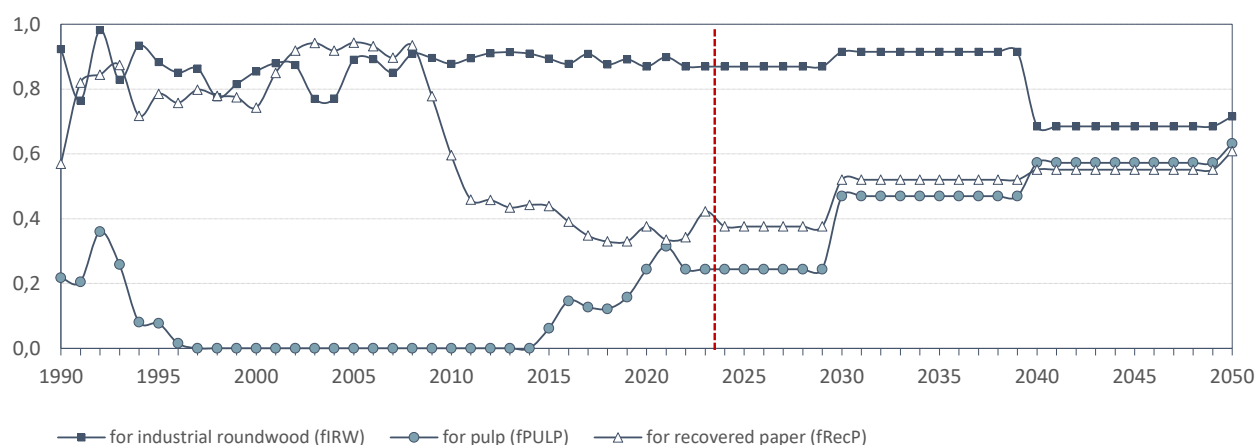


Figure HU-B: Historic and future development of the applied domestic feedstock factors for Hungary

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure HU-C shows the results for the “baseline” scenario (RCP1p9_12).

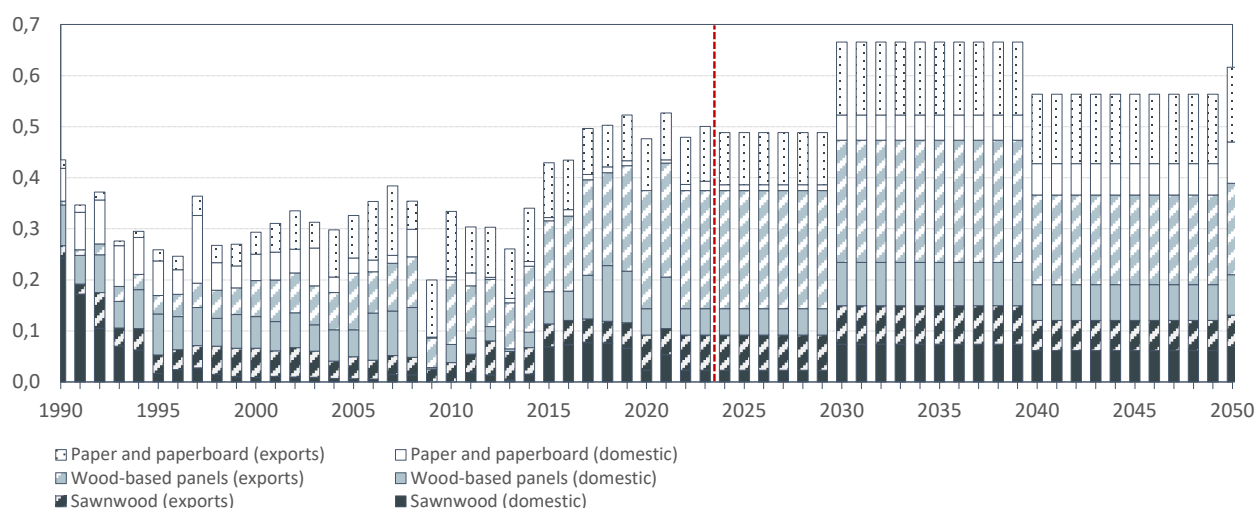


Figure HU-C: Calculated historic and future carbon inflow on the basis of to the HWP pool applying the production approach for Hungary [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

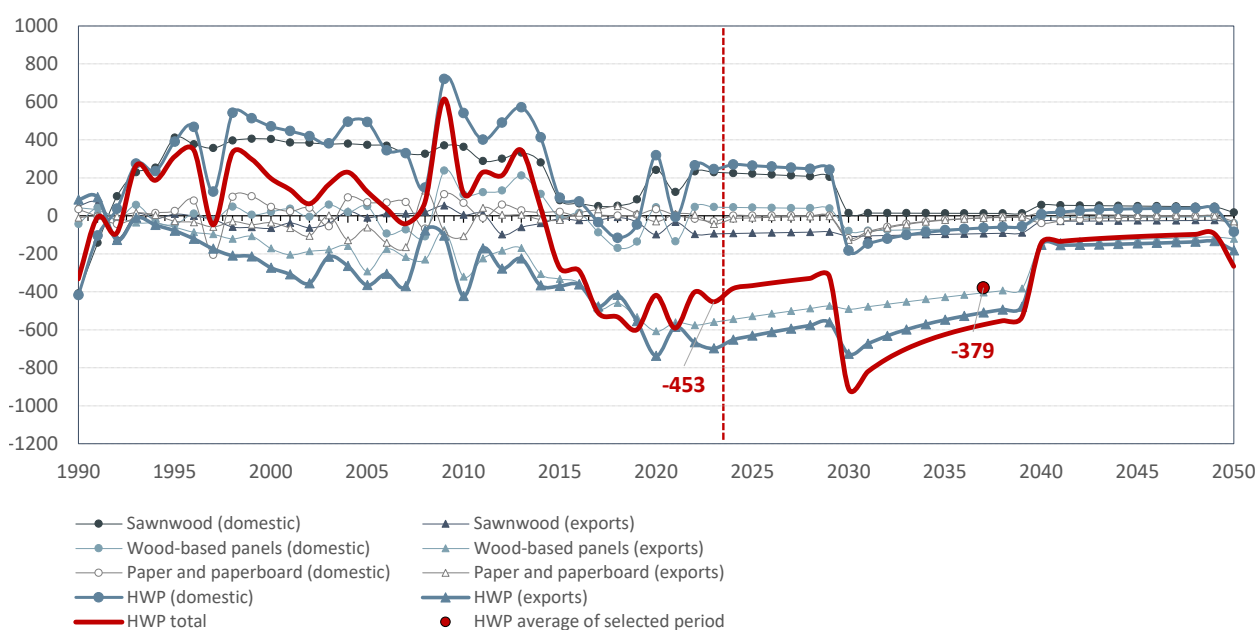


Figure HU-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Hungary [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Hungary applying the “baseline” scenario (RCP1p9_12) in Figure HU-E.

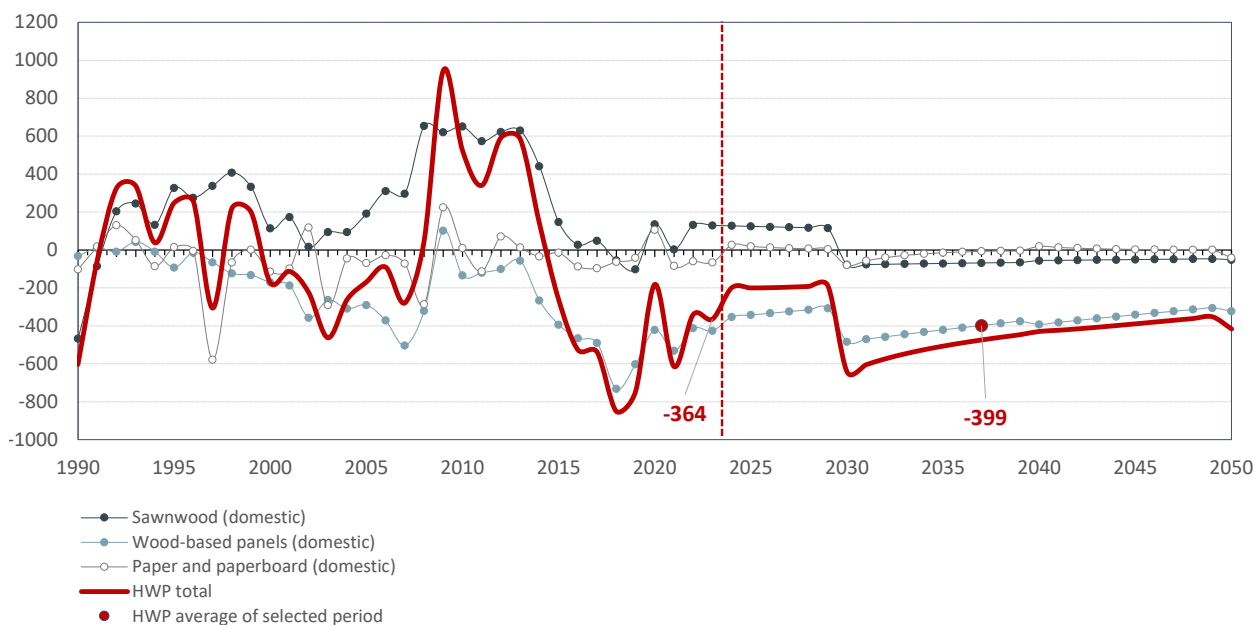


Figure HU-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Hungary [in kt CO₂]

Ireland (IE)

For Ireland, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure IE-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

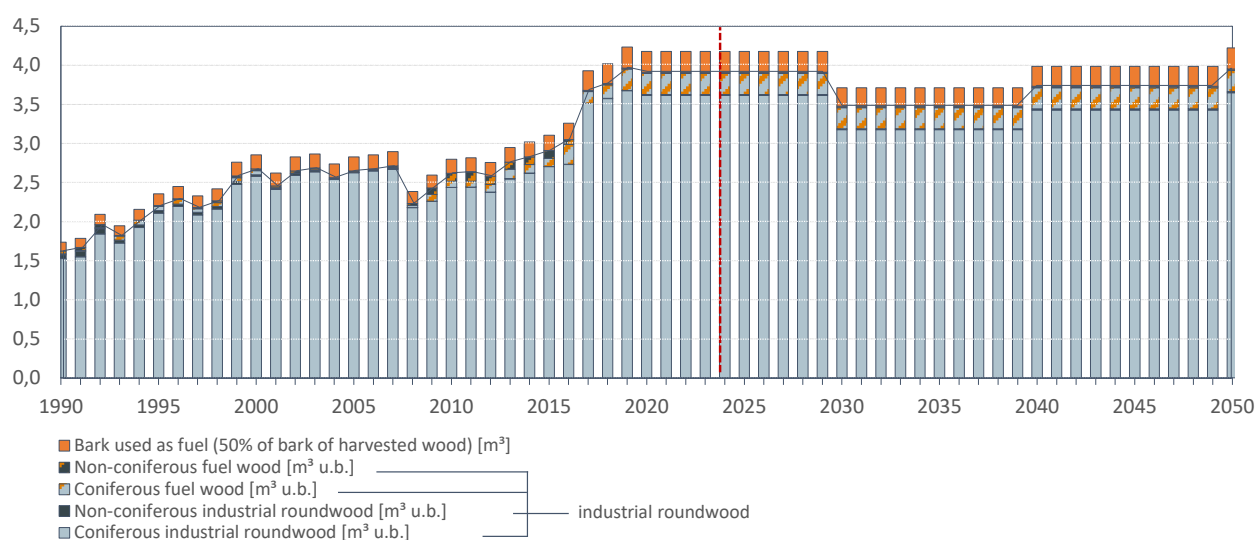


Figure IE-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Ireland [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure IE-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

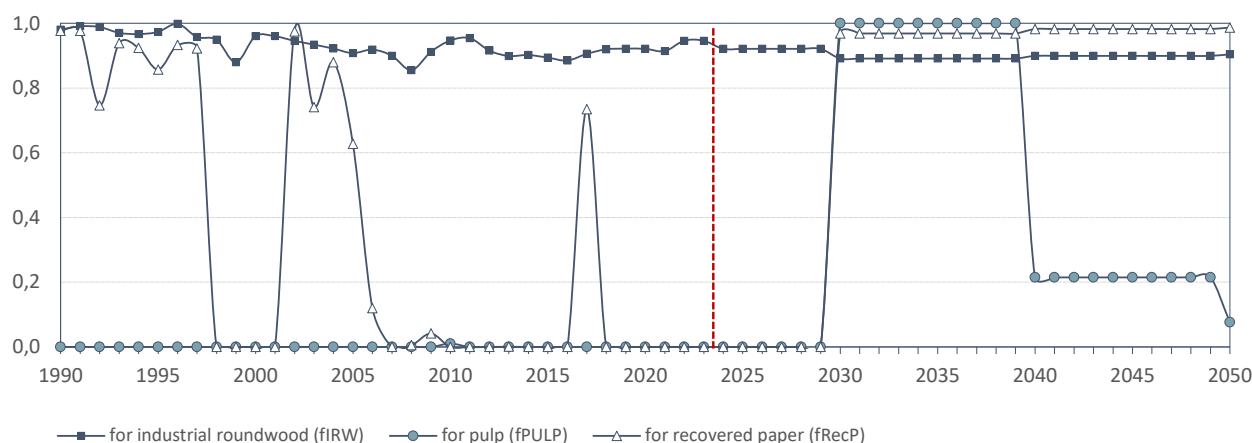


Figure IE-B: Historic and future development of the applied domestic feedstock factors for Ireland

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure IE-C shows the results for the corrected “baseline” scenario (RCP1p9_12).

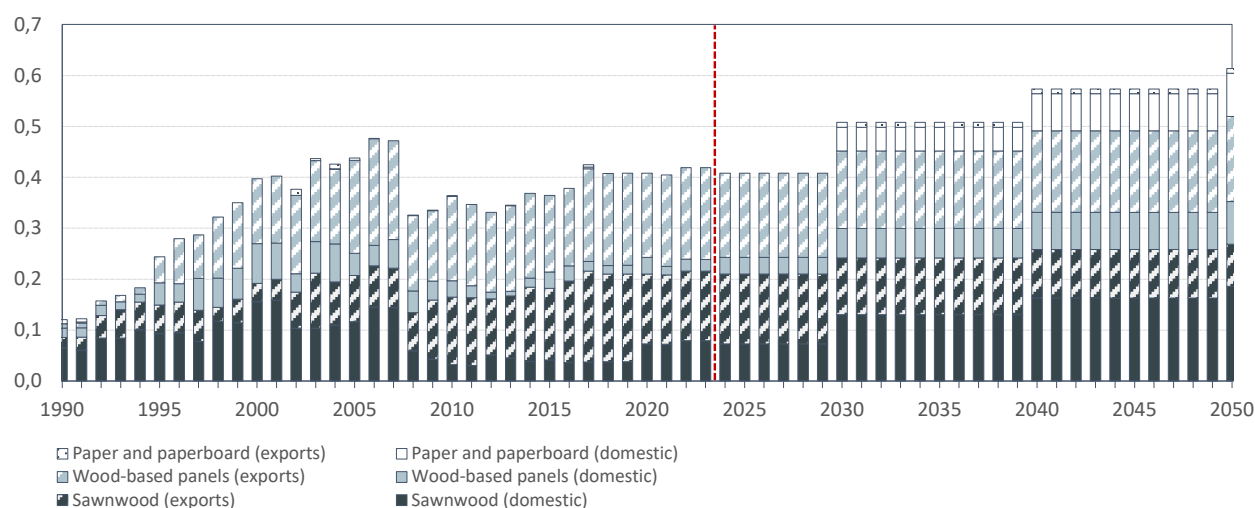


Figure IE-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Ireland [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

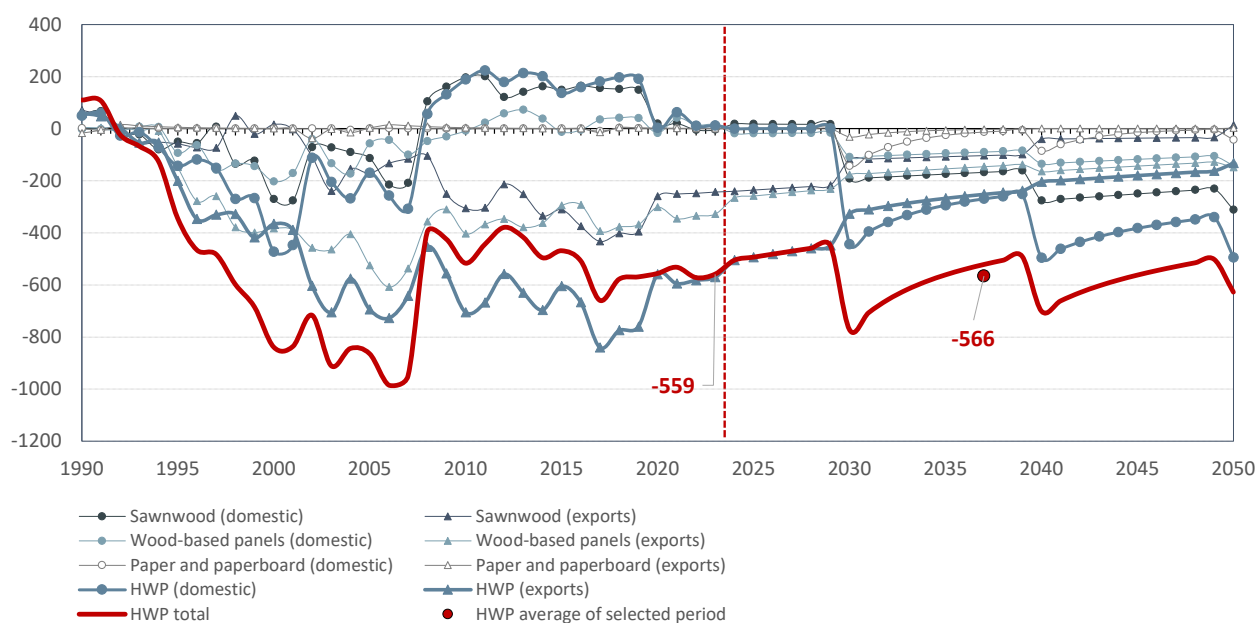


Figure IE-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Ireland [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Ireland applying the “baseline” scenario (RCP1p9_12) in Figure IE-E.

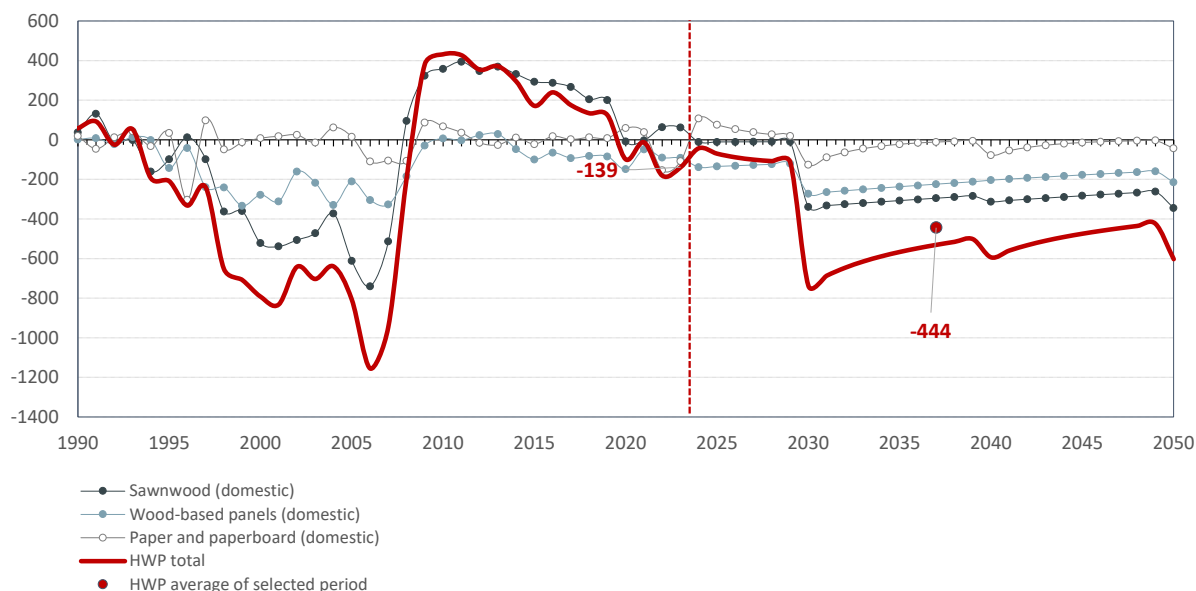


Figure IE-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Ireland [in kt CO₂]

Italy (IT)

For Italy, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure IT-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

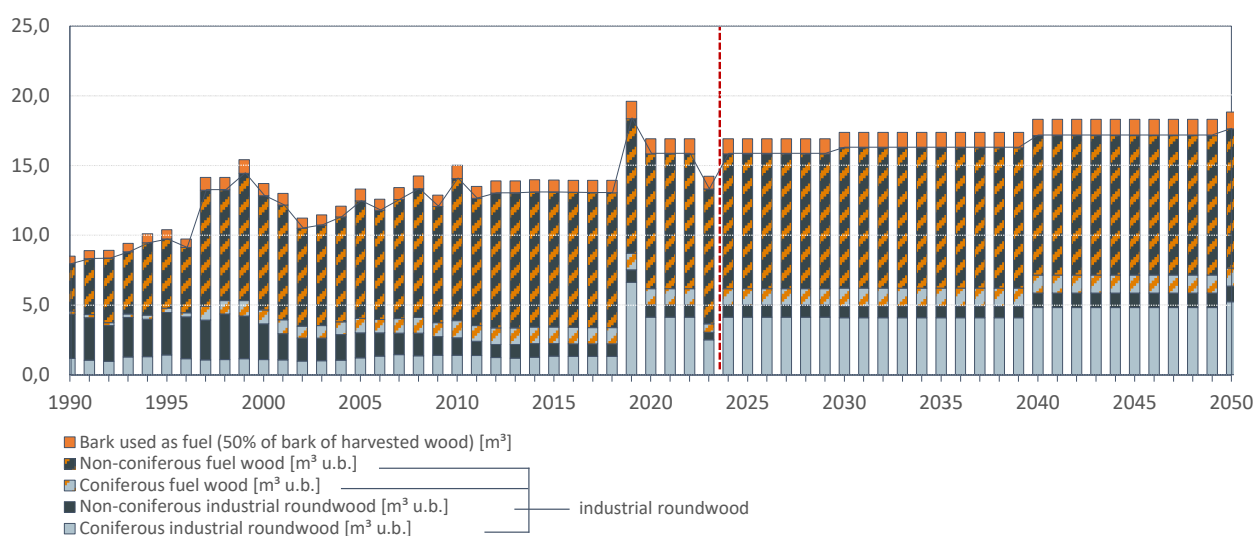


Figure IT-A: Historic and future harvest acc. to scenario RCP1p9_12 for industrial roundwood and fuel wood in Italy [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure IT-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

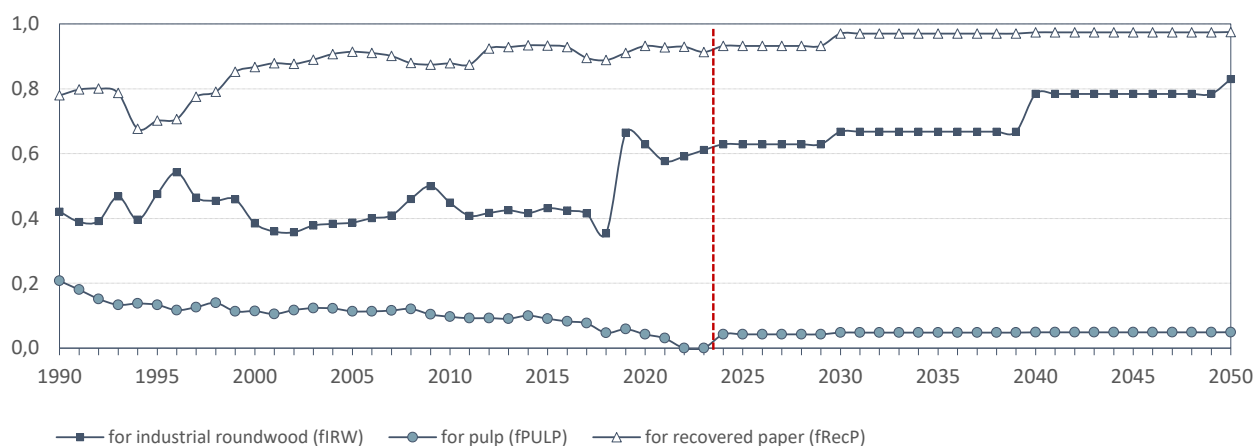


Figure IT-B: Historic and future development of the applied domestic feedstock factors for Italy

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure IT-C shows the results for the “baseline” scenario (RCP1p9_12).

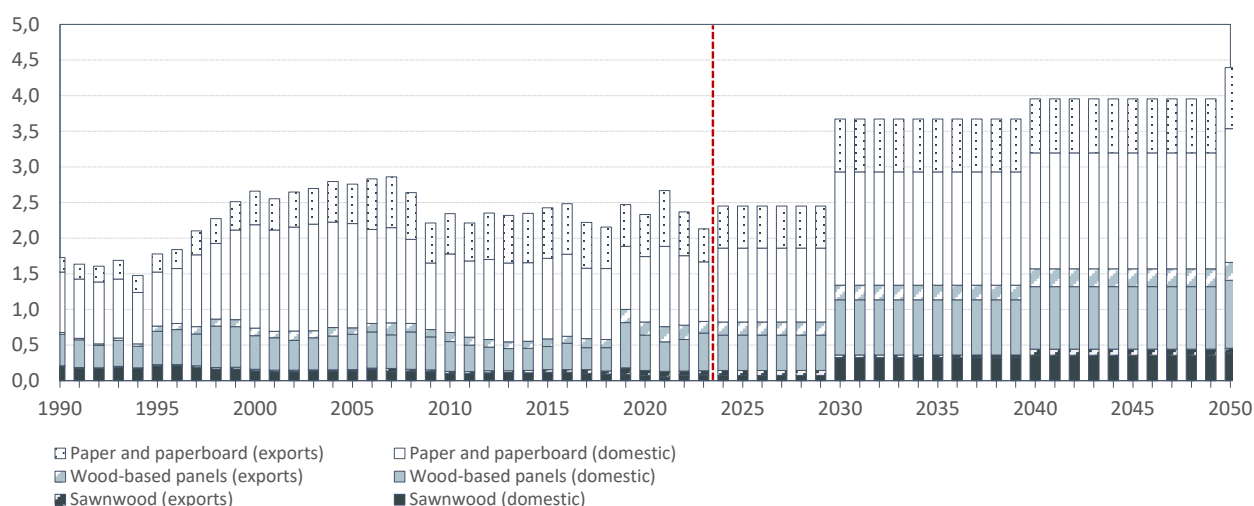


Figure IT-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Italy [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

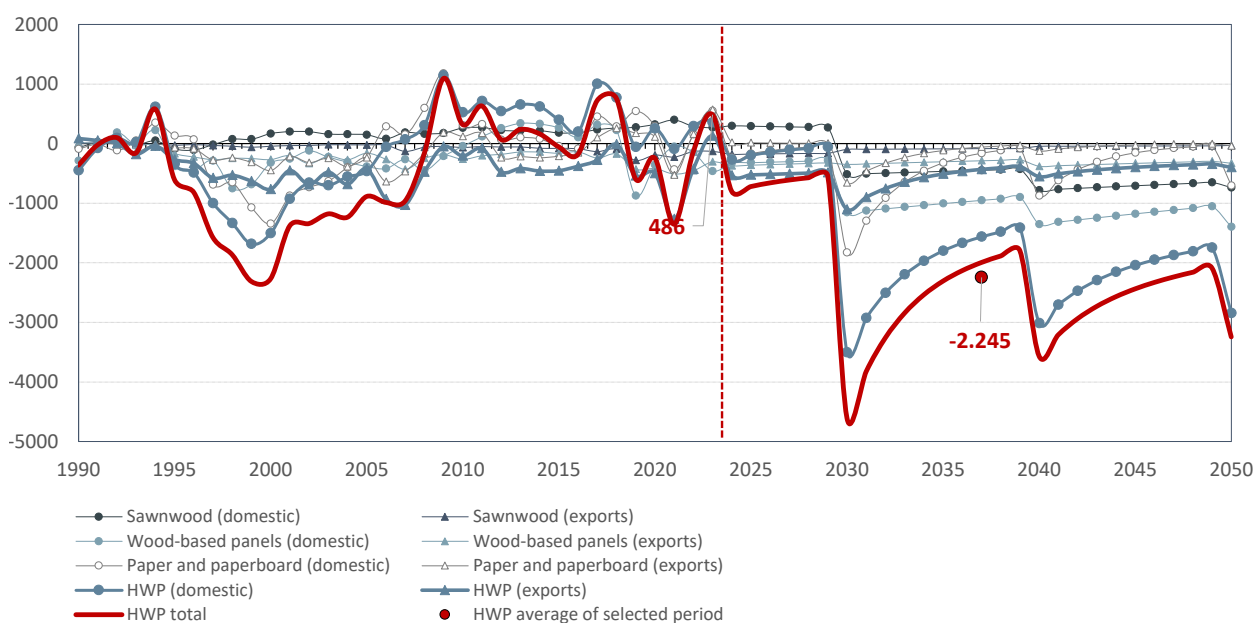


Figure IT-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Italy [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Italy applying the “baseline” scenario (RCP1p9_12) in Figure IT-E.

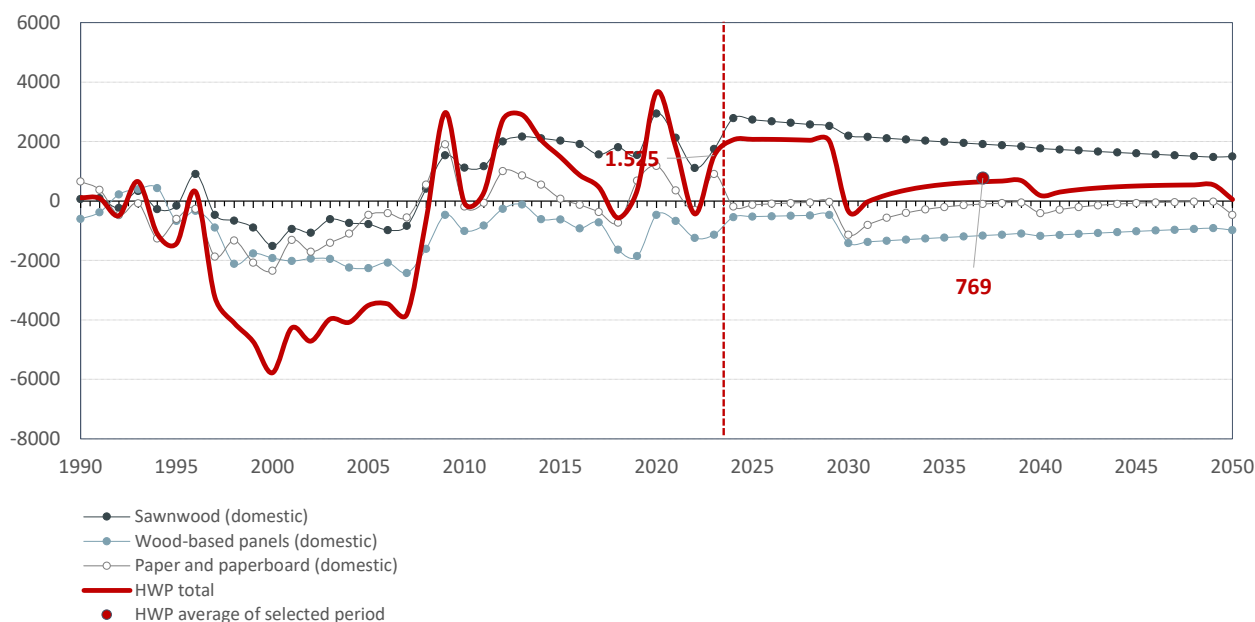


Figure IT-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Italy [in kt CO₂]

Lithuania (LT)

For Lithuania, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1992 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure LT-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

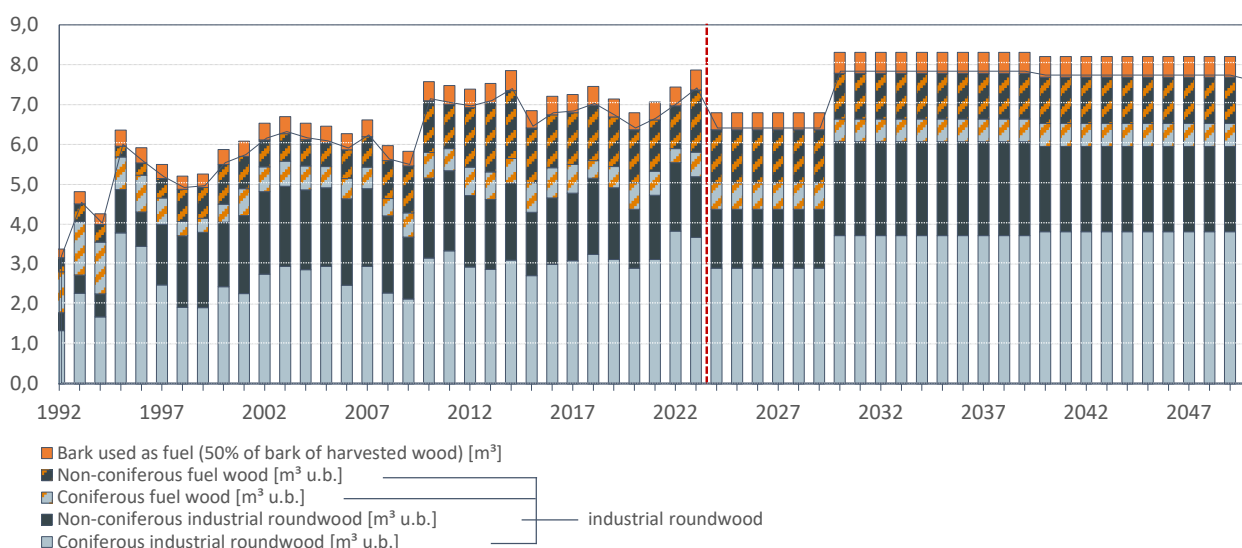


Figure LT-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Lithuania [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood Figure LT-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} its assumed future development for the “baseline” scenario (RCP1p9_12).

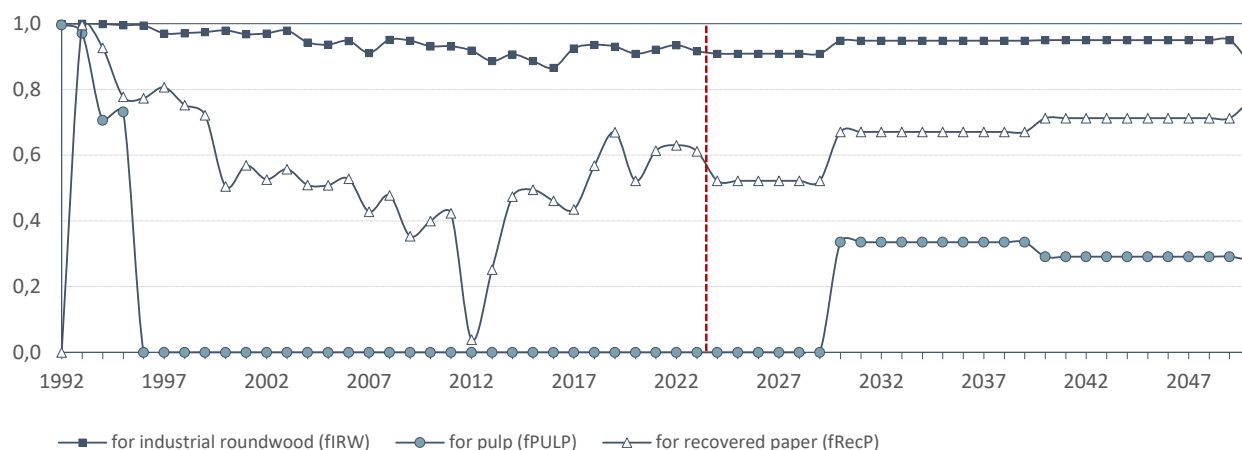


Figure LT-B: Historic and future development of the applied domestic feedstock factors for Lithuania

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure LT-C shows the results for the “baseline” scenario (RCP1p9_12).

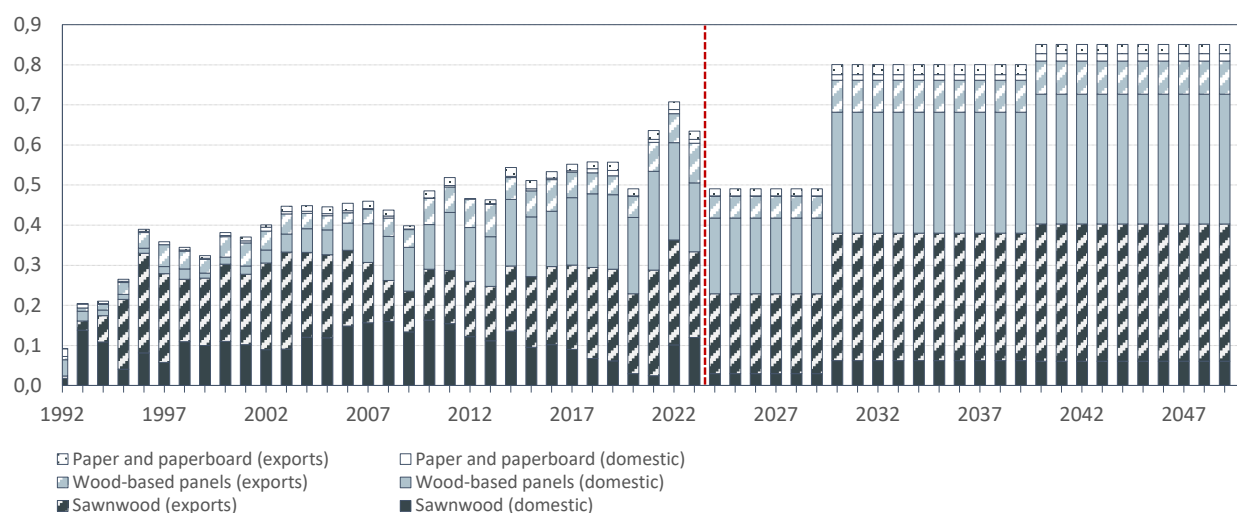


Figure LT-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Lithuania [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

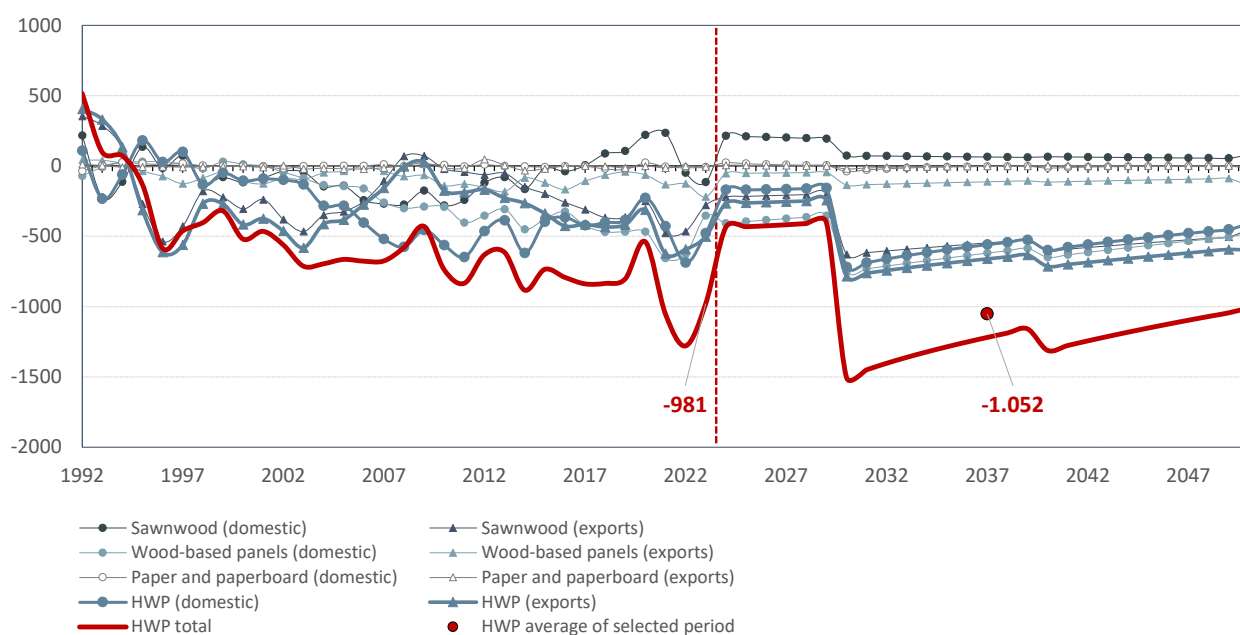


Figure LT-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Lithuania [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Lithuania applying the “baseline” scenario (RCP1p9_12) in Figure LT-E.

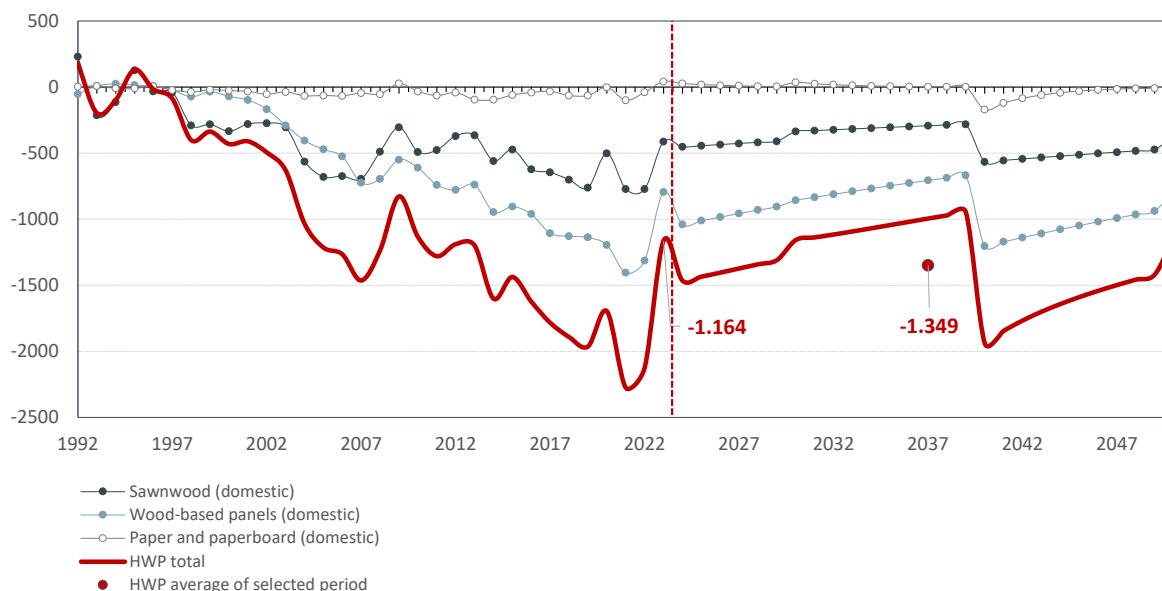


Figure LT-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Lithuania [in kt CO₂]

Latvia (LV)

For Latvia, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1992 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure LV-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

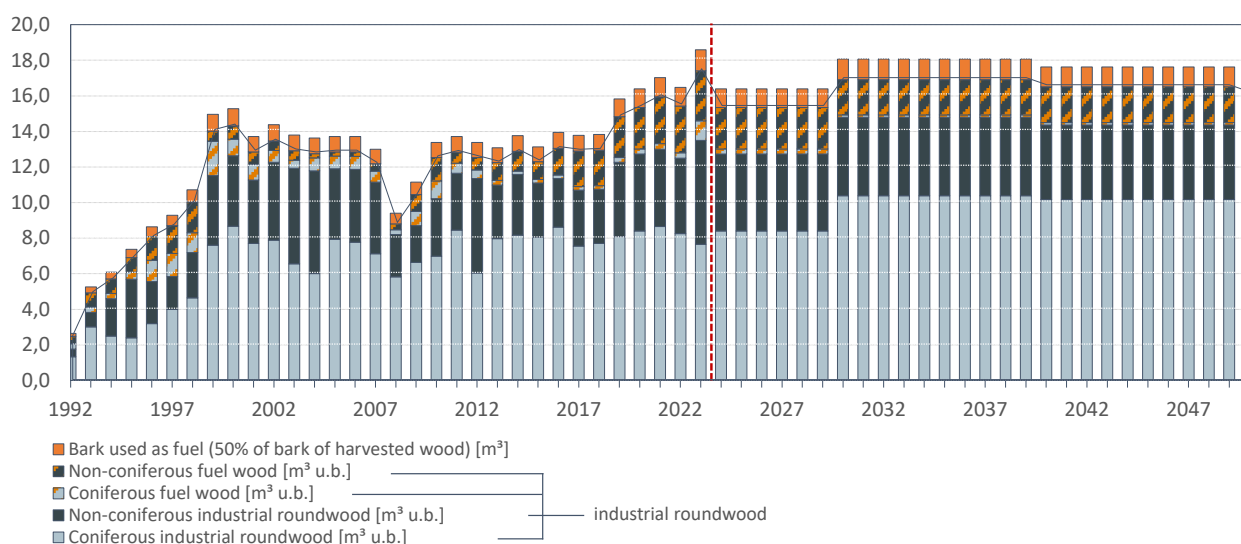


Figure LV-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Latvia [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure LV-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

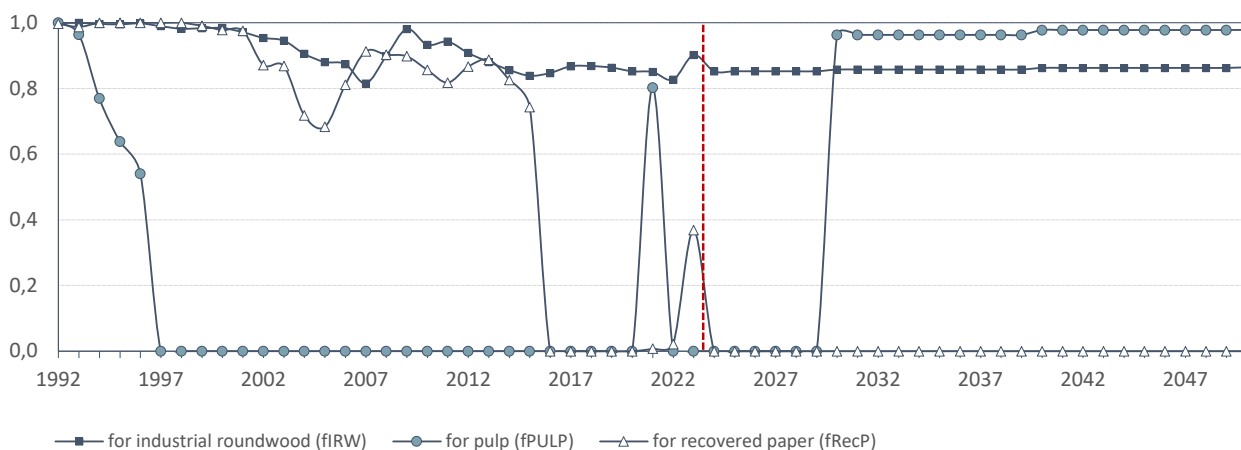


Figure LV-B: Historic and future development of the applied domestic feedstock factors for Latvia

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure LV-C shows the results for the “baseline” scenario (RCP1p9_12).

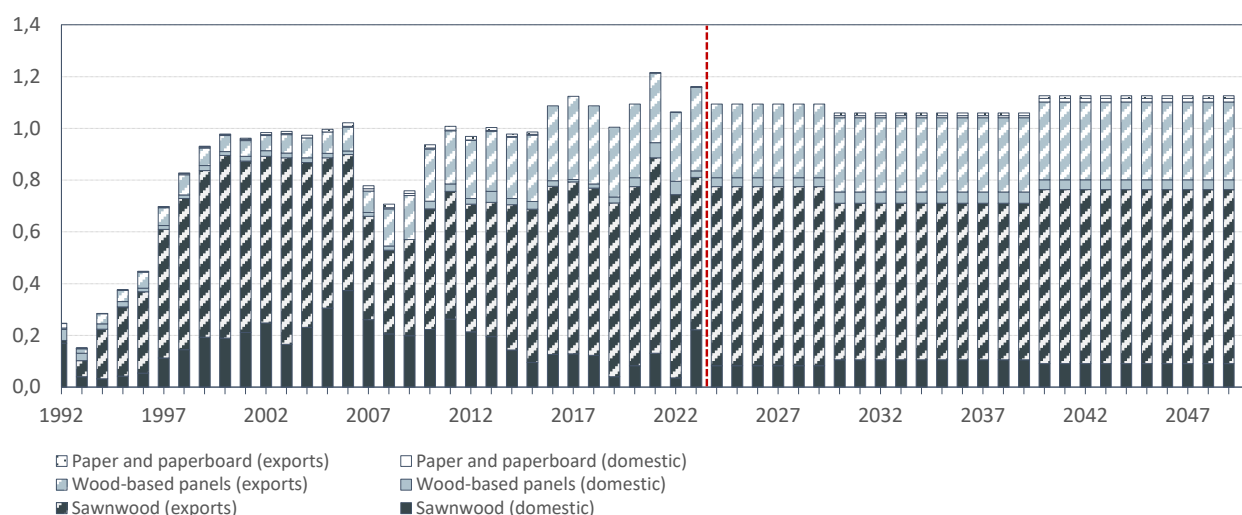


Figure LV-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Latvia [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

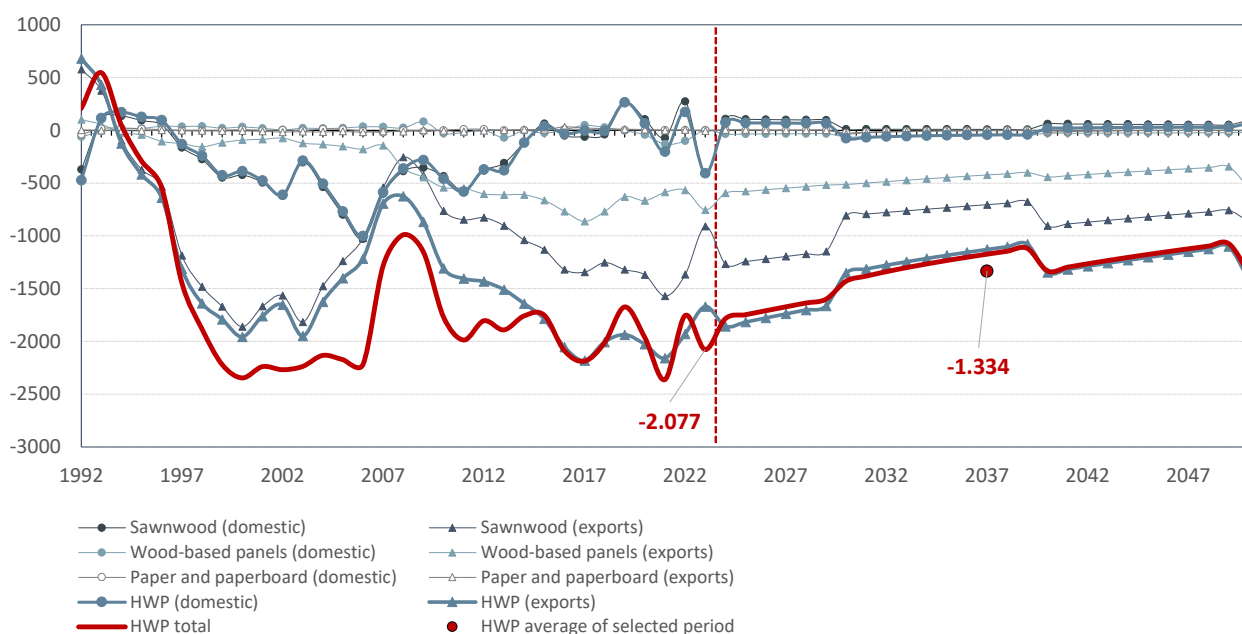


Figure LV-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Latvia [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Latvia applying the “baseline” scenario (RCP1p9_12) in Figure LV-E.

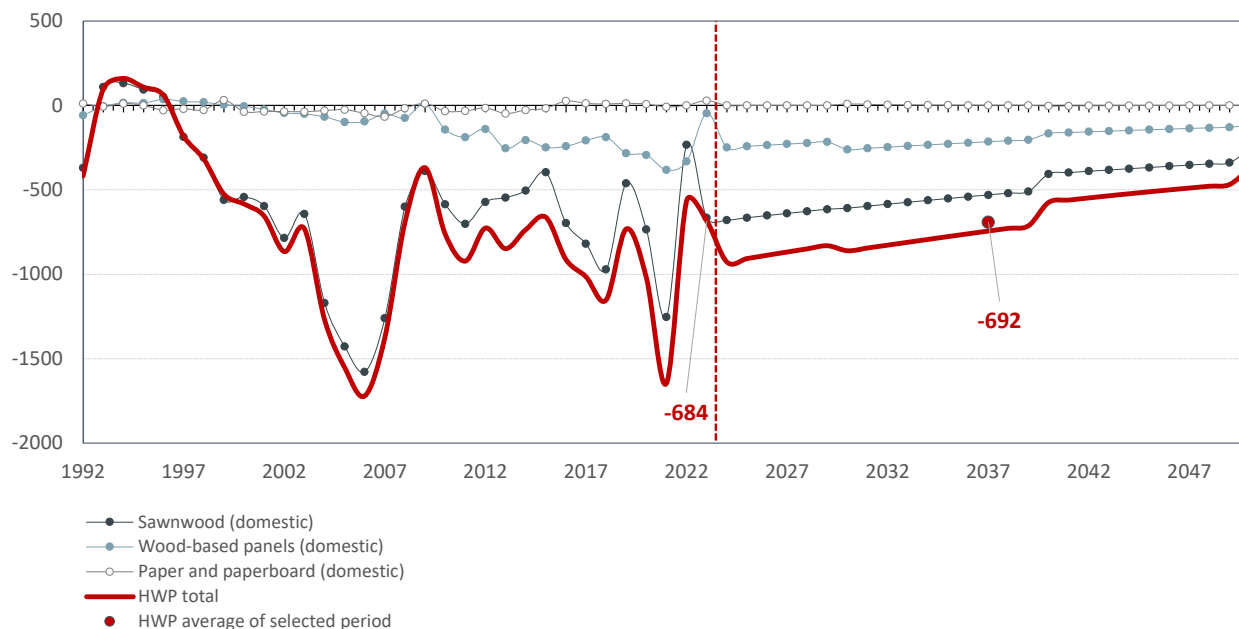


Figure LV-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Latvia [in kt CO₂]

The Netherlands (NL)

For the Netherlands, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure NL-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

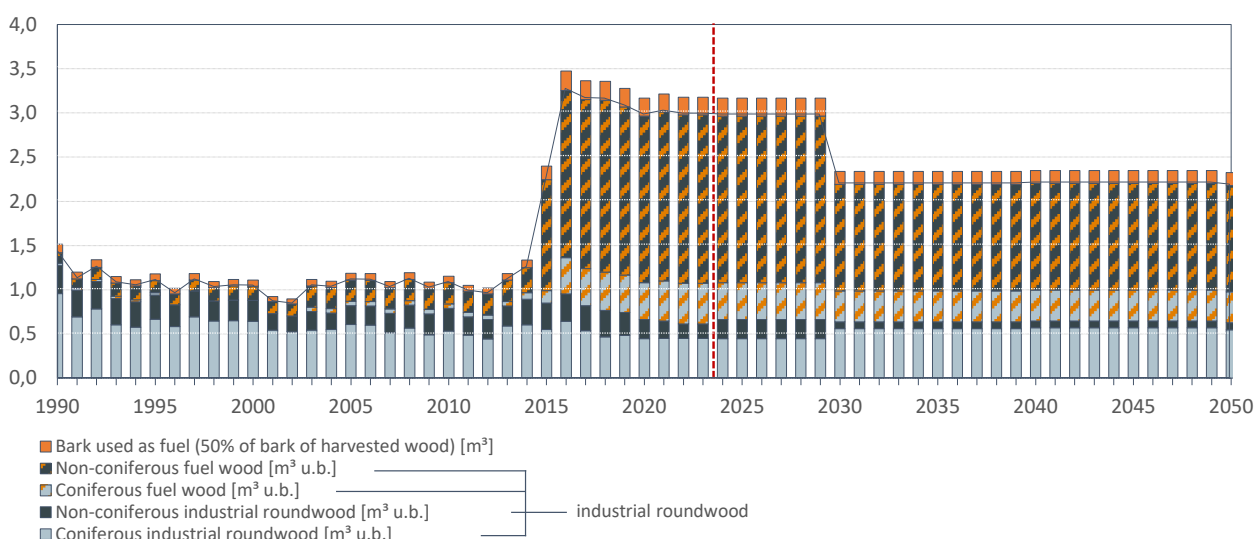


Figure NL-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in the Netherlands [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure NL-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} its assumed future development for the “baseline” scenario (RCP1p9_12).

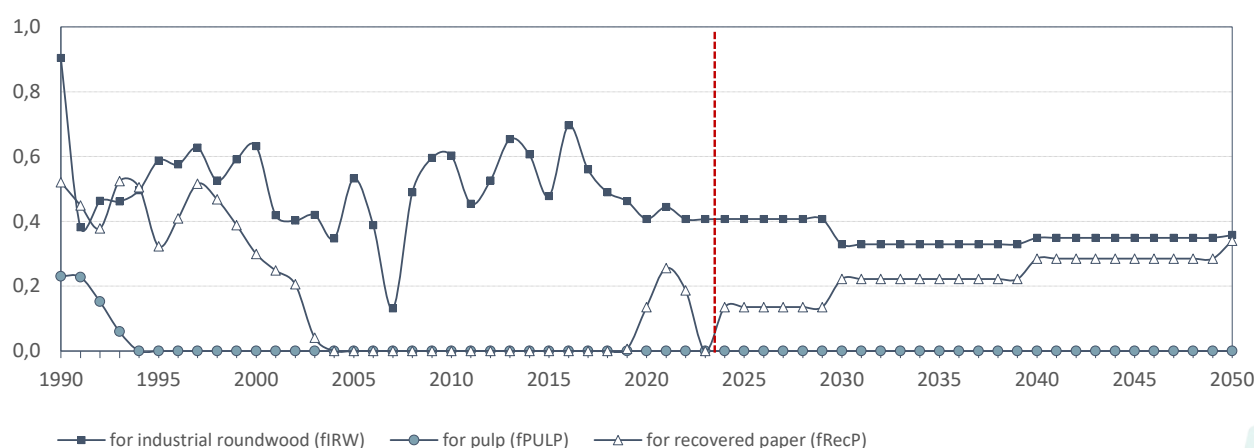


Figure NL-B: Historic and future development of the applied domestic feedstock factors for the Netherlands

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure NL-C shows the results for the “baseline” scenario (RCP1p9_12).

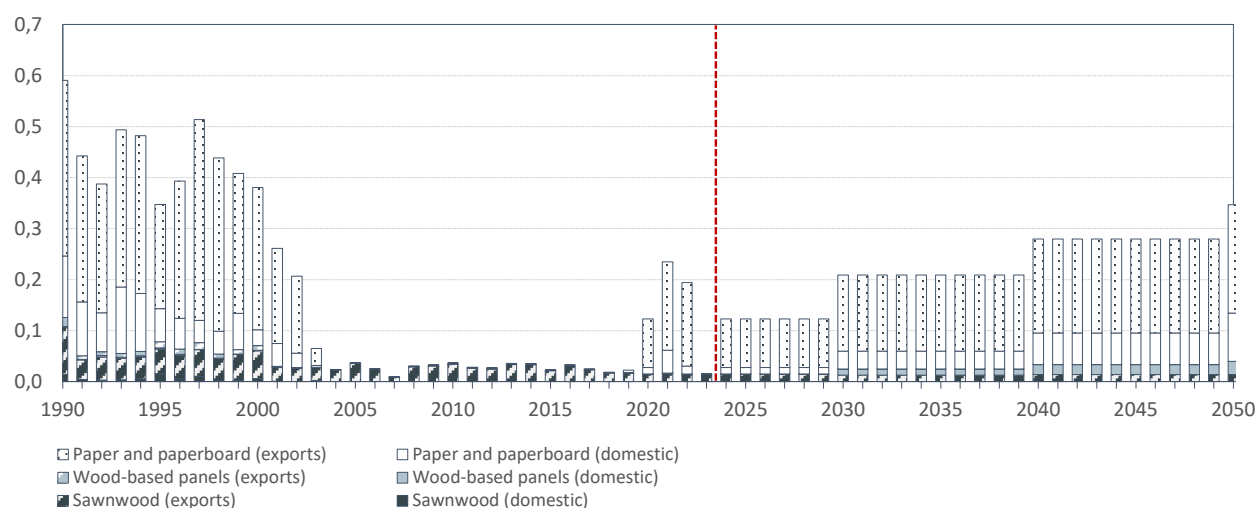


Figure NL-C: Calculated historic and future carbon inflow on the basis of to the HWP pool applying the production approach for the Netherlands [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

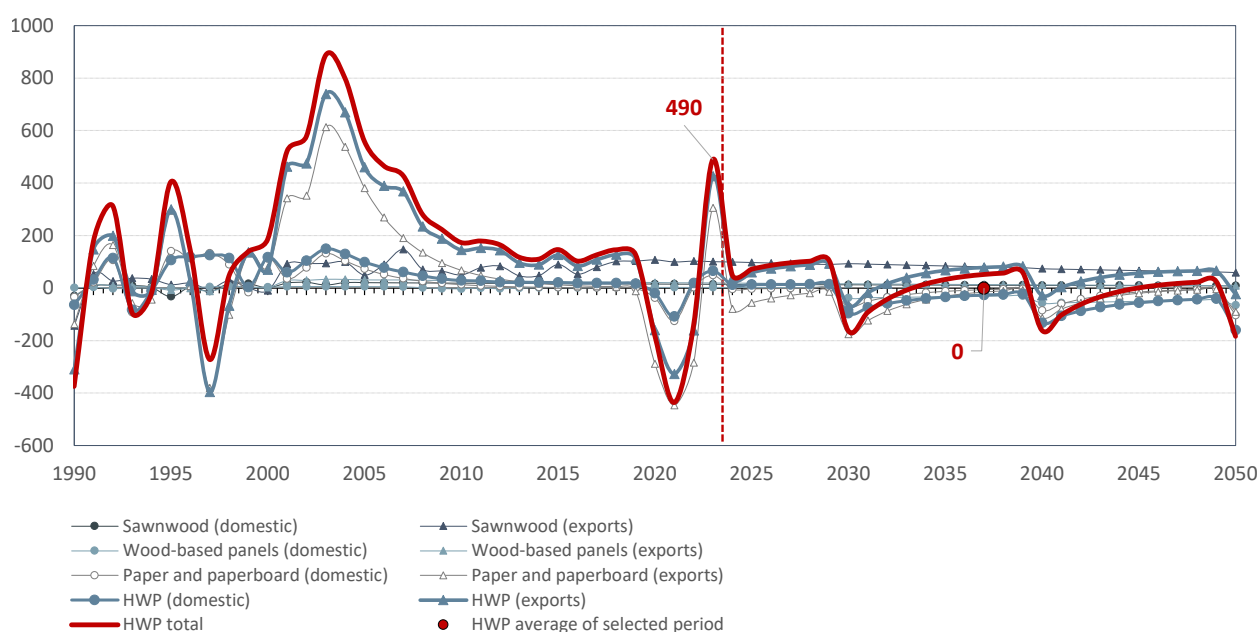


Figure NL-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for the Netherlands [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for the Netherlands applying the “baseline” scenario (RCP1p9_12) in Figure NL-E.

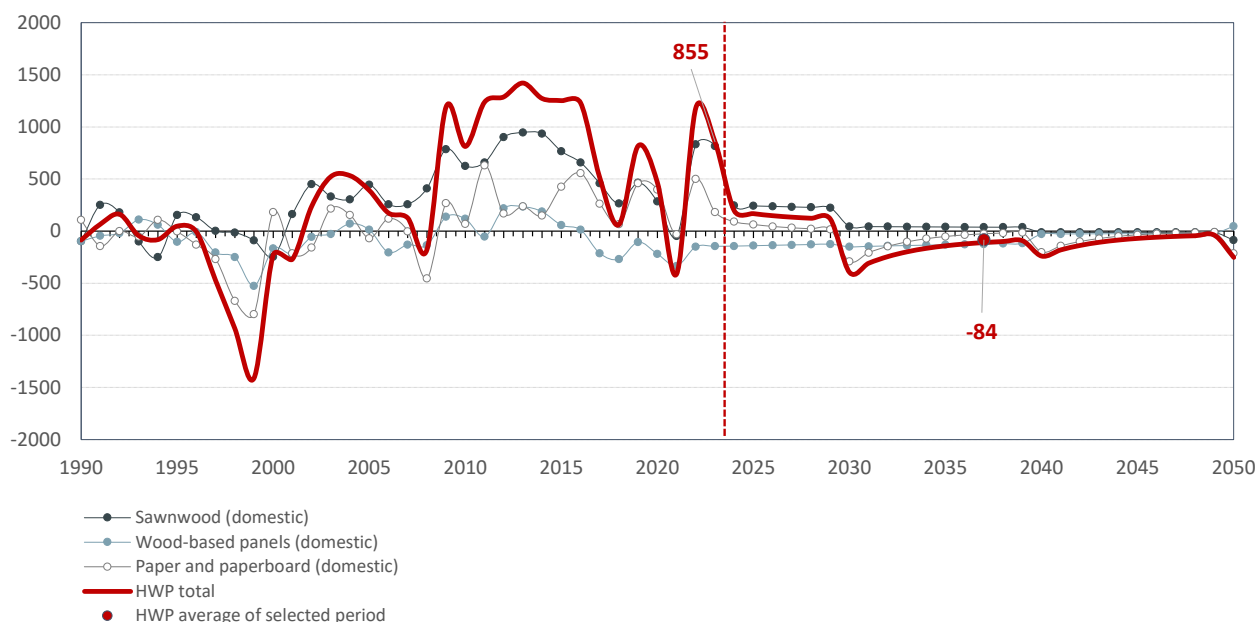


Figure NL-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for scenario RCP1p9_12 following the stock-change approach for the Netherlands [in kt CO₂]

Poland (PL)

For Poland, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure PL-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

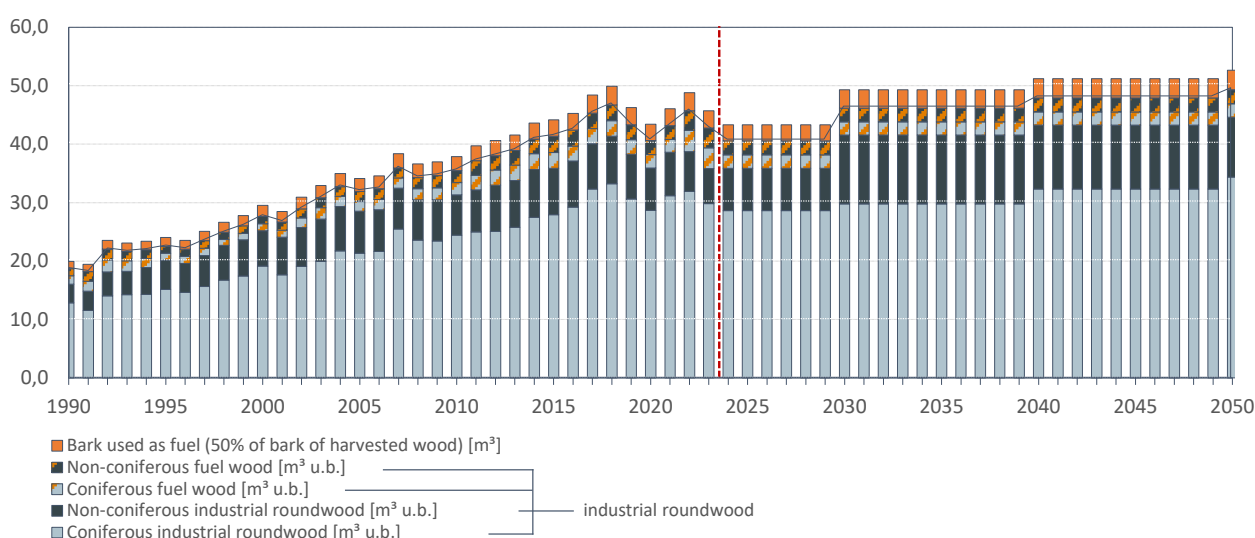


Figure PL-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Poland [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure PL-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} its assumed future development for the “baseline” scenario (RCP1p9_12).

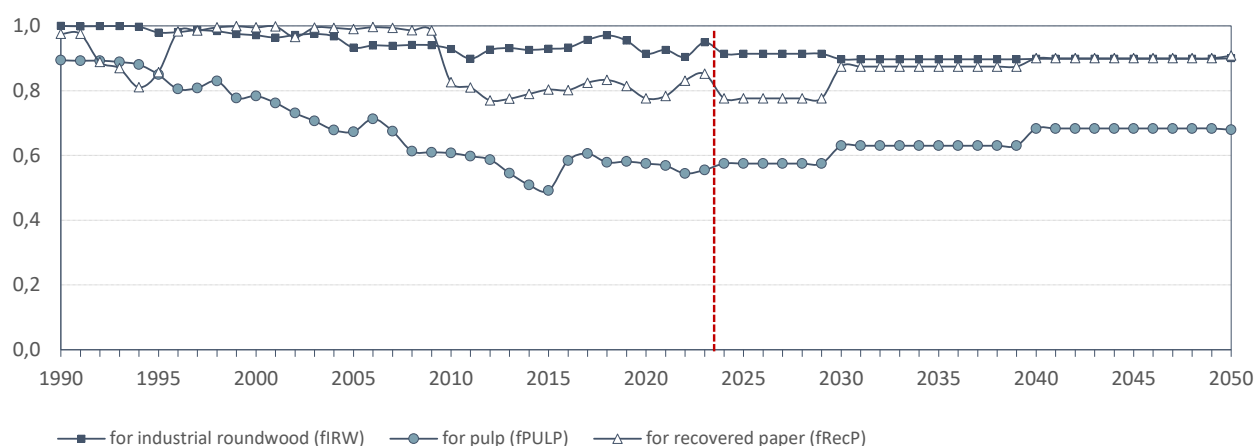


Figure PL-B: Historic and future development of the applied domestic feedstock factors for Poland

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure PL-C shows the results for the “baseline” scenario (RCP1p9_12).

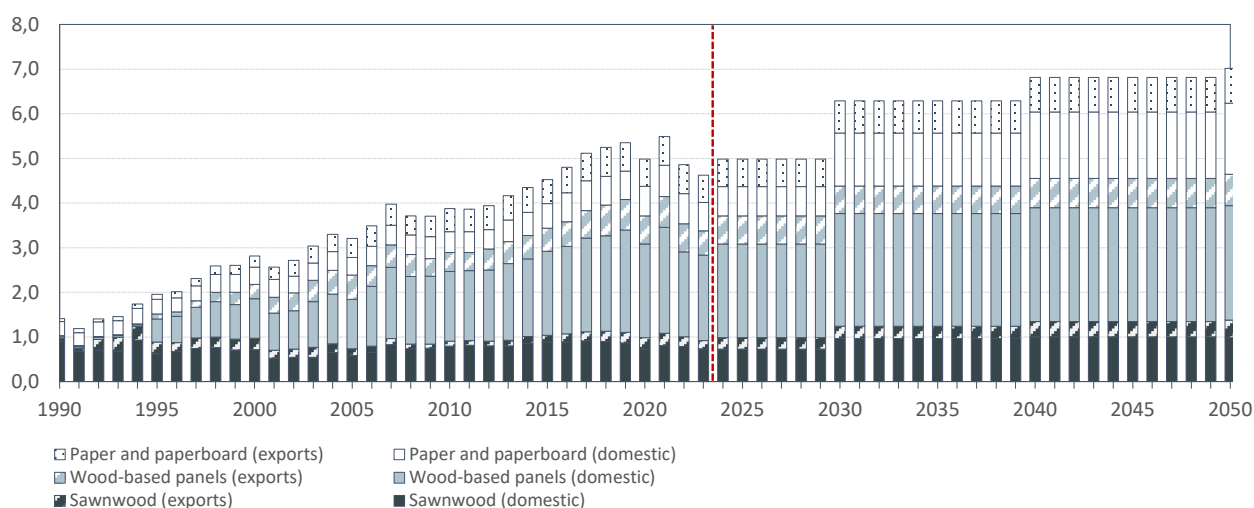


Figure PL-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Poland [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

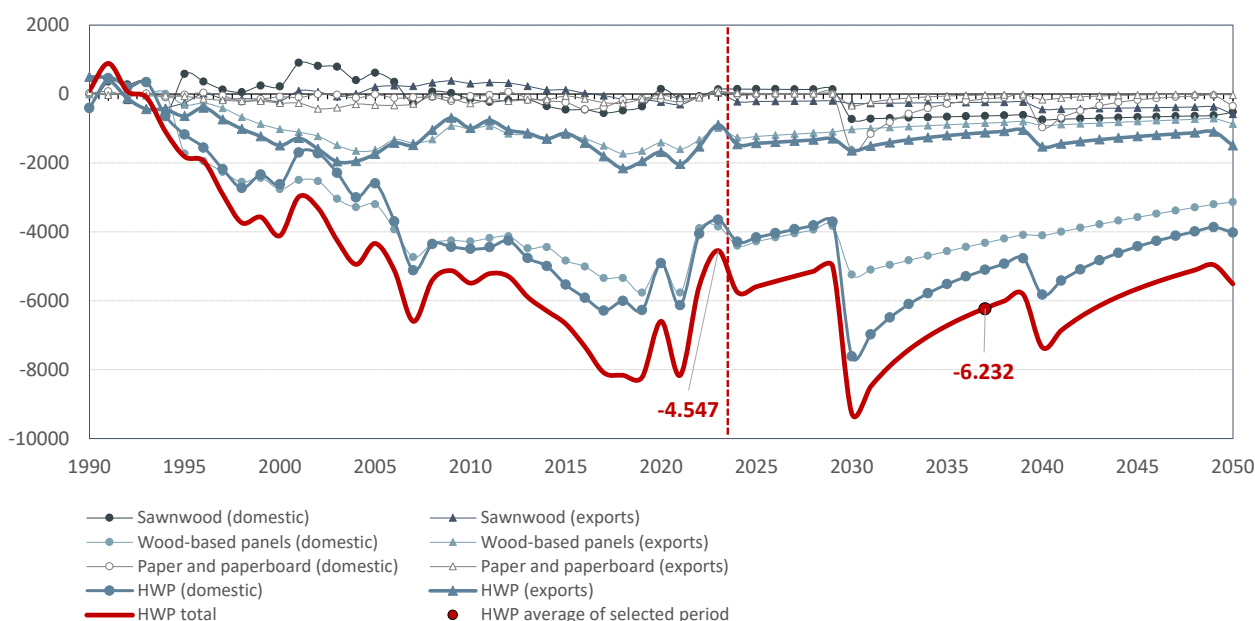


Figure PL-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Poland [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Poland applying the “baseline” scenario (RCP1p9_12) in Figure PL-E.

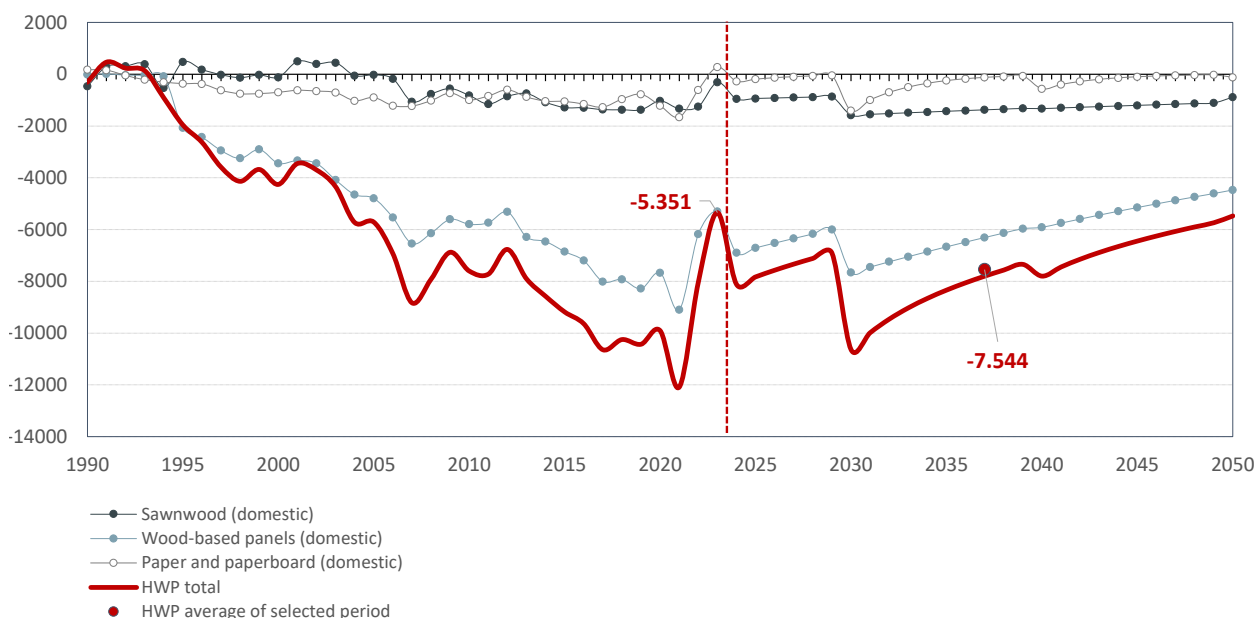


Figure PL-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Poland [in kt CO₂]

Portugal (PT)

For Portugal, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure PT-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

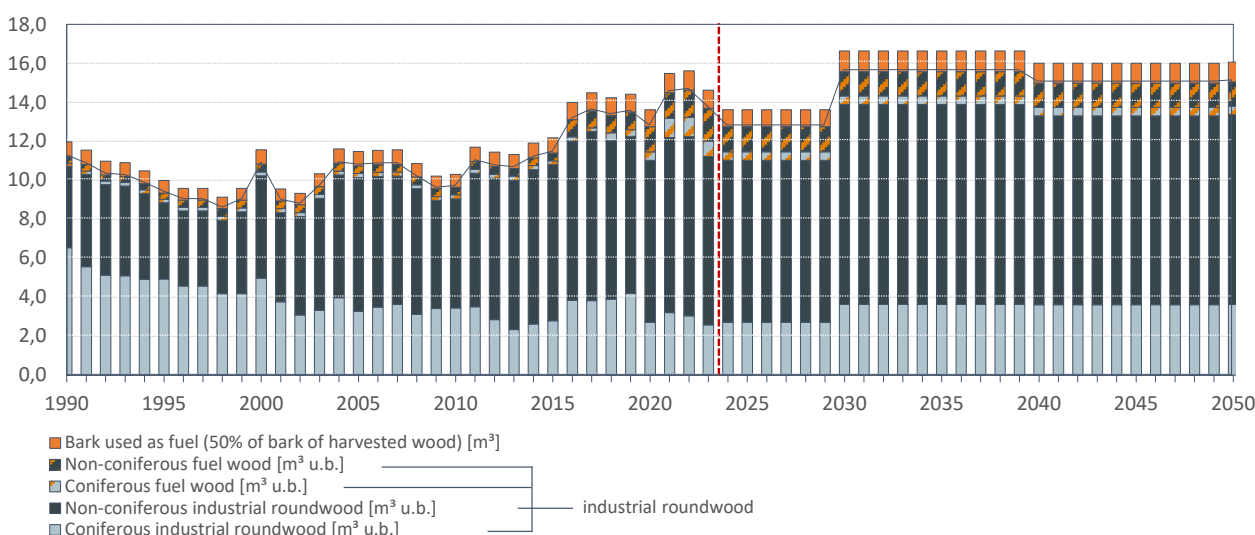


Figure PT-A: Historic and future harvest acc. to scenario RCP1p9_12 for industrial roundwood and fuel wood in Portugal [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure PT-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

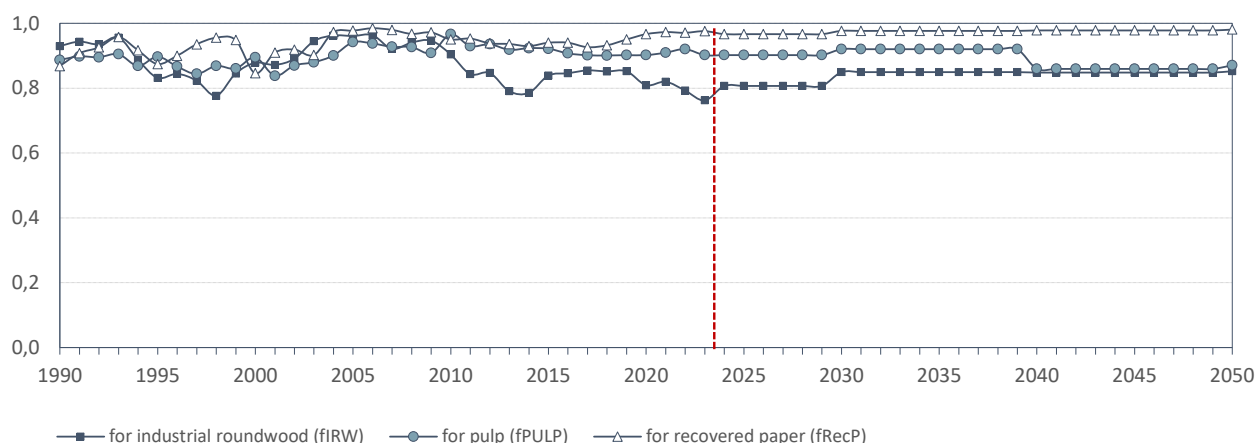


Figure PT-B: Historic and future development of the applied domestic feedstock factors for Portugal

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure PT-C shows the results for the “baseline” scenario (RCP1p9_12).

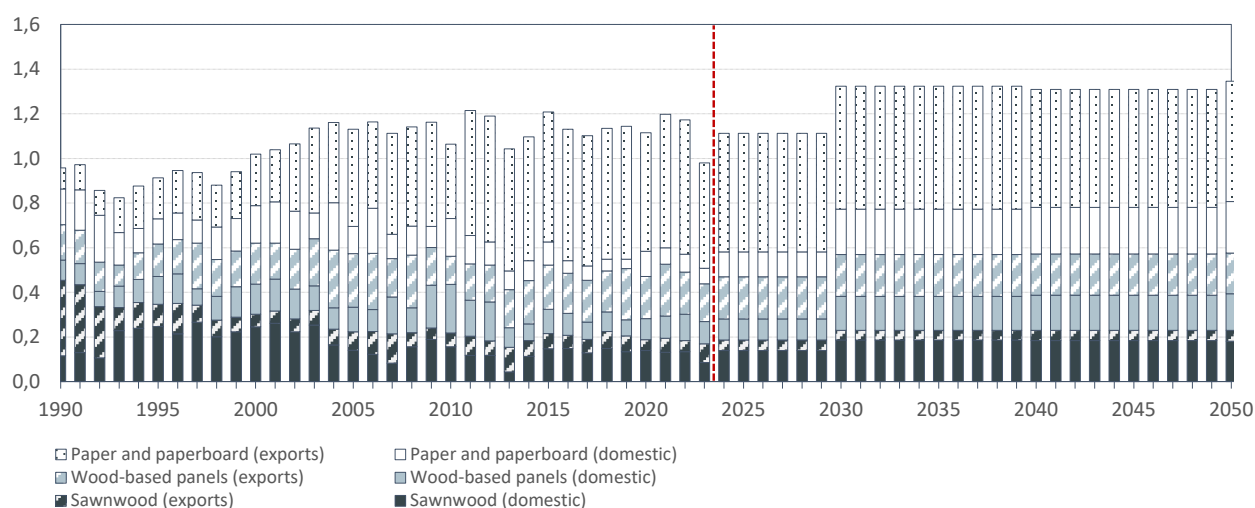


Figure PT-C: Calculated historic and future carbon inflow on the basis of to the HWP pool applying the production approach for Portugal [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

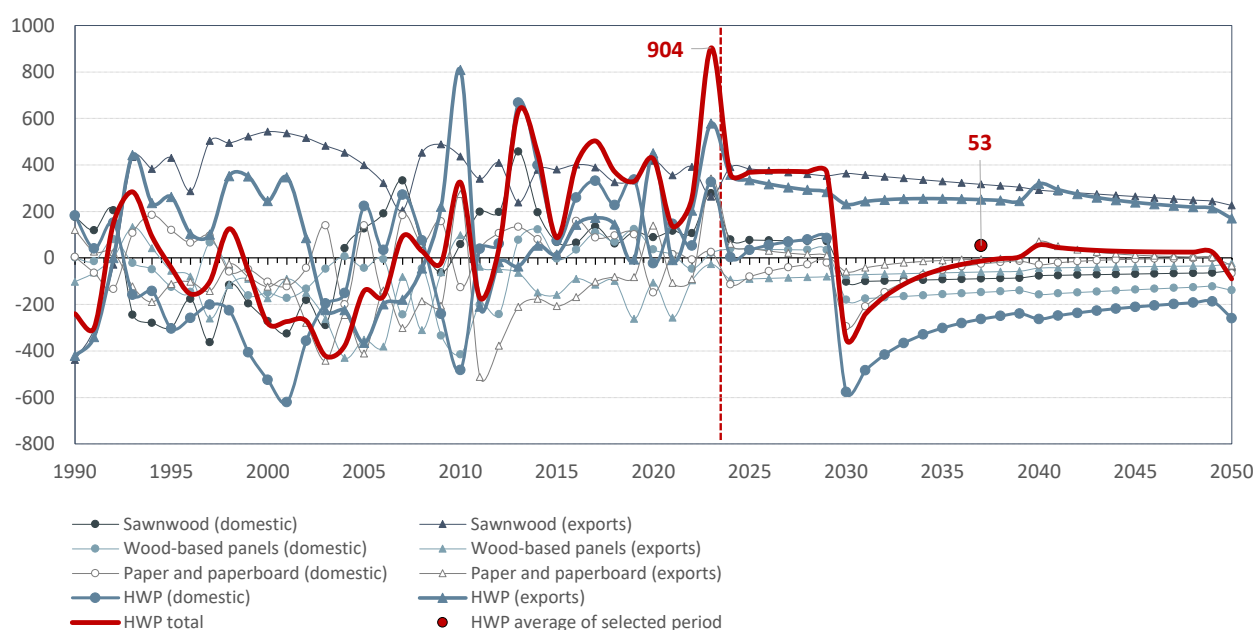


Figure PT-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Portugal [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Portugal applying the “baseline” scenario (RCP1p9_12) in Figure PT-E.

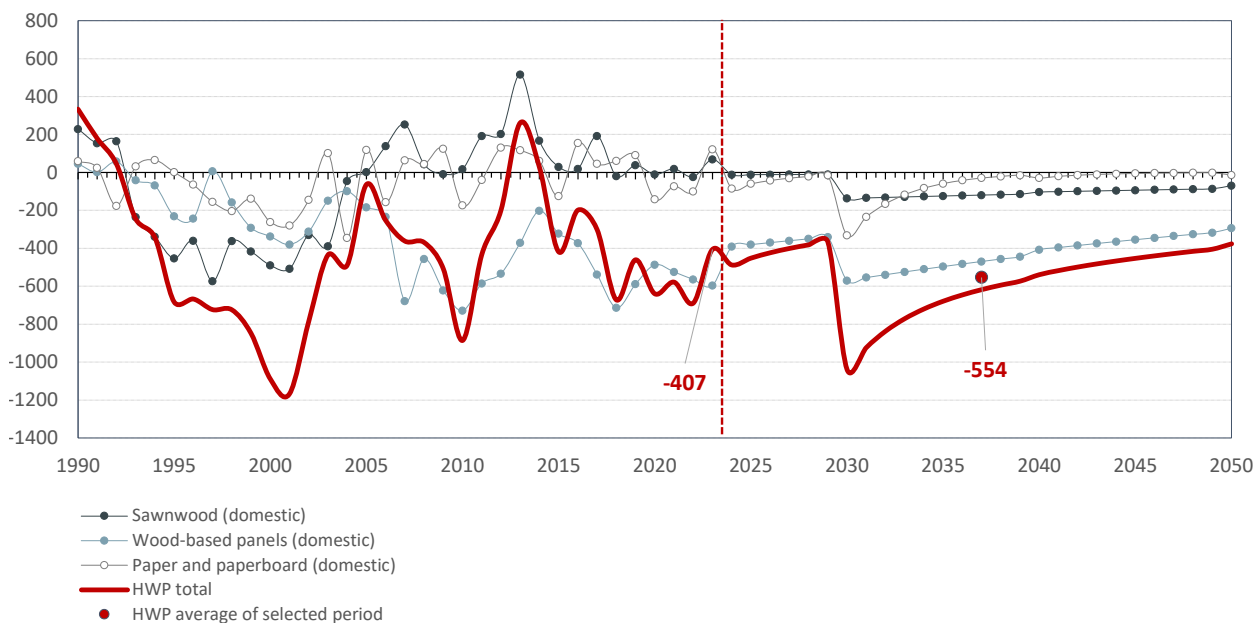


Figure PT-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Portugal [in kt CO₂]

Romania (RO)

For Romania, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure RO-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

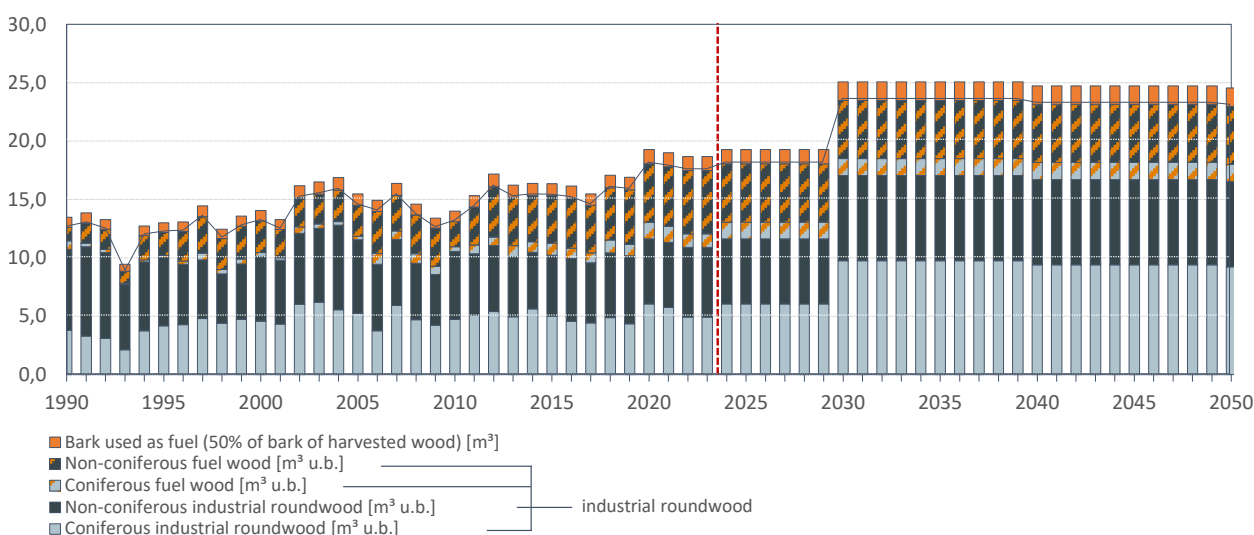


Figure RO-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Romania [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure RO-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

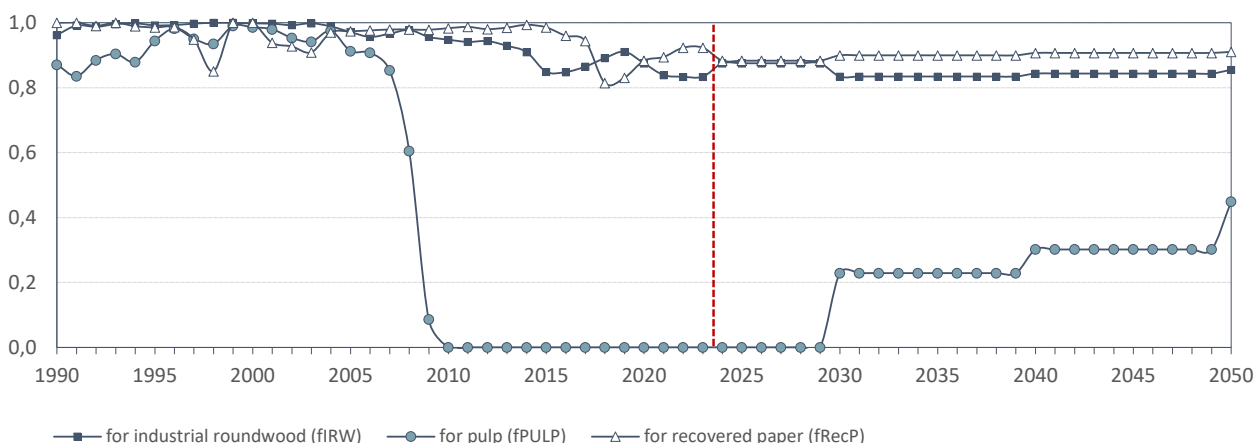


Figure RO-B: Historic and future development of the applied domestic feedstock factors for Romania

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure RO-C shows the results for the “baseline” scenario (RCP1p9_12).

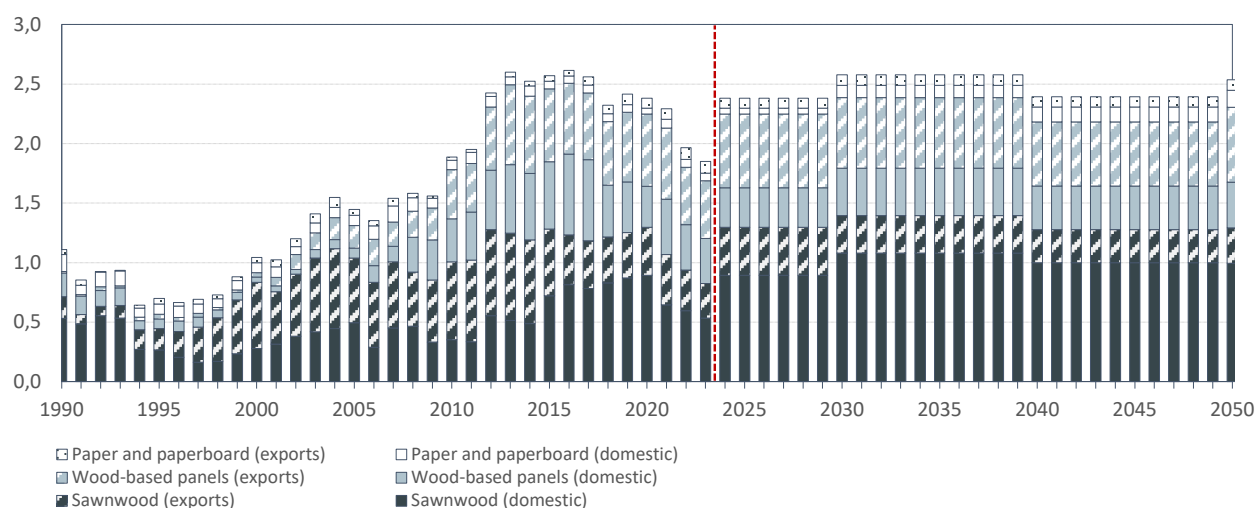


Figure RO-C: Calculated historic and future carbon inflow on the basis of to the HWP pool applying the production approach for Romania [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

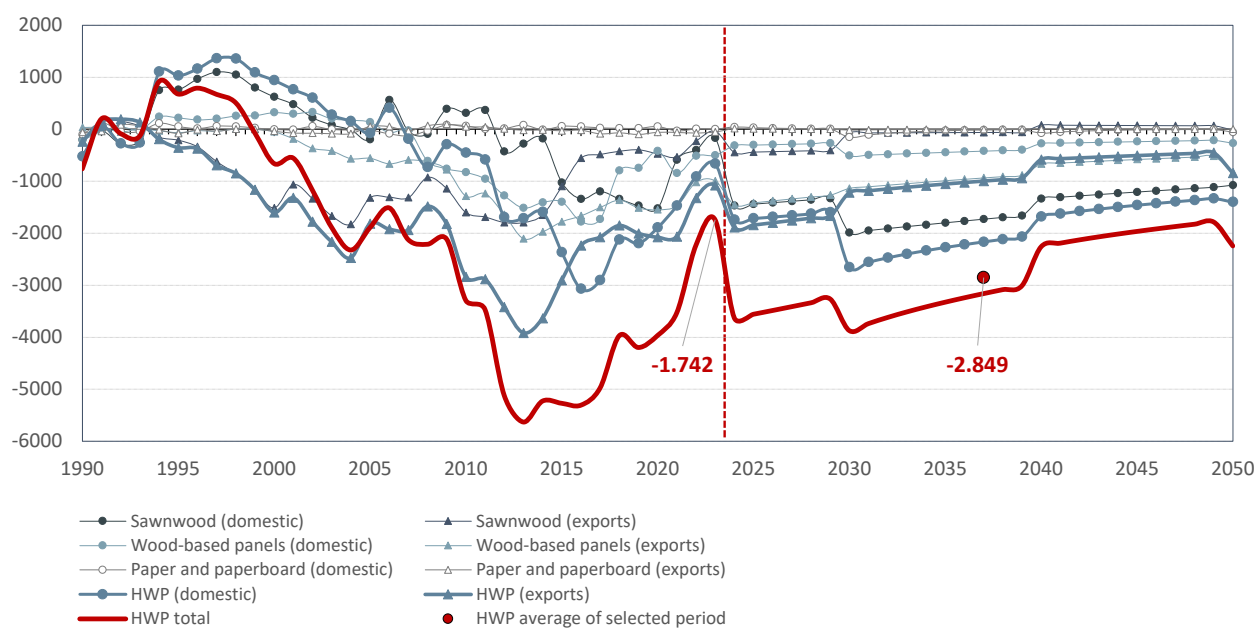


Figure RO-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Romania [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Romania applying the “baseline” scenario (RCP1p9_12) in Figure RO-E.

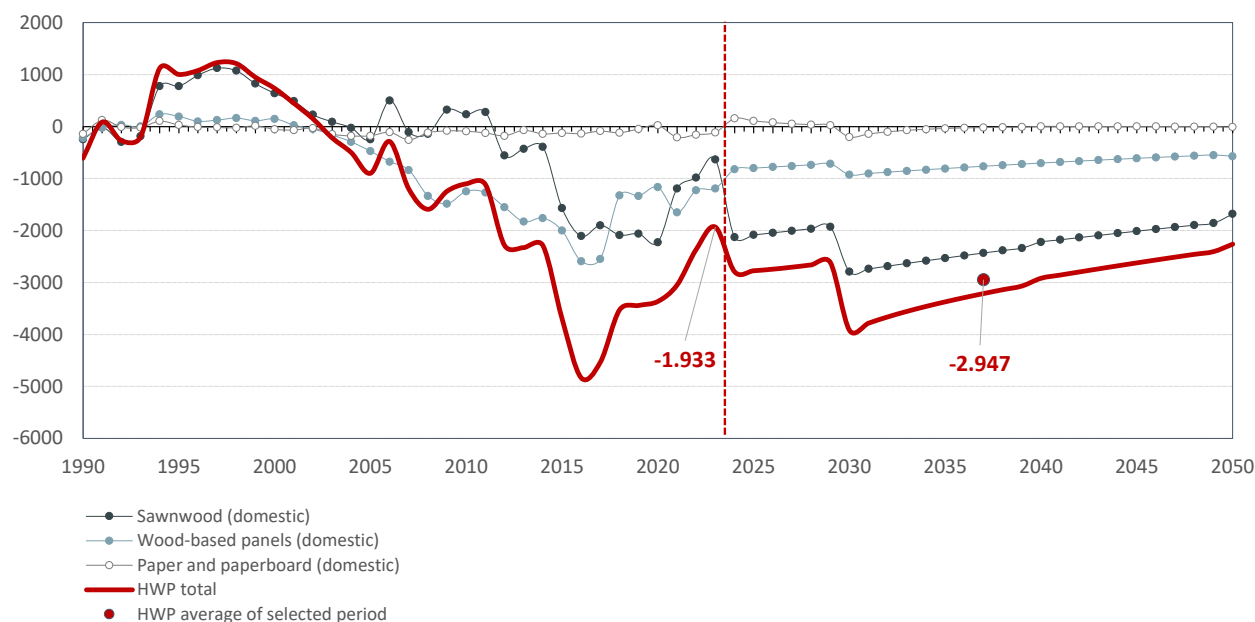


Figure RO-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Romania [in kt CO₂]

Sweden (SE)

For Sweden, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1961 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure SE-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

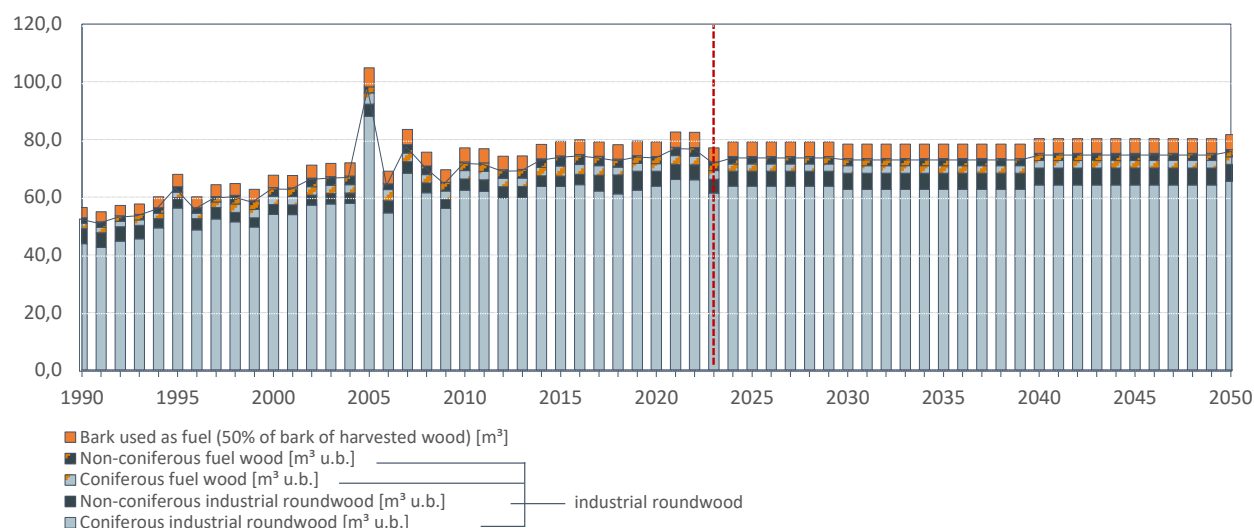


Figure SE-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Sweden [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure DE-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

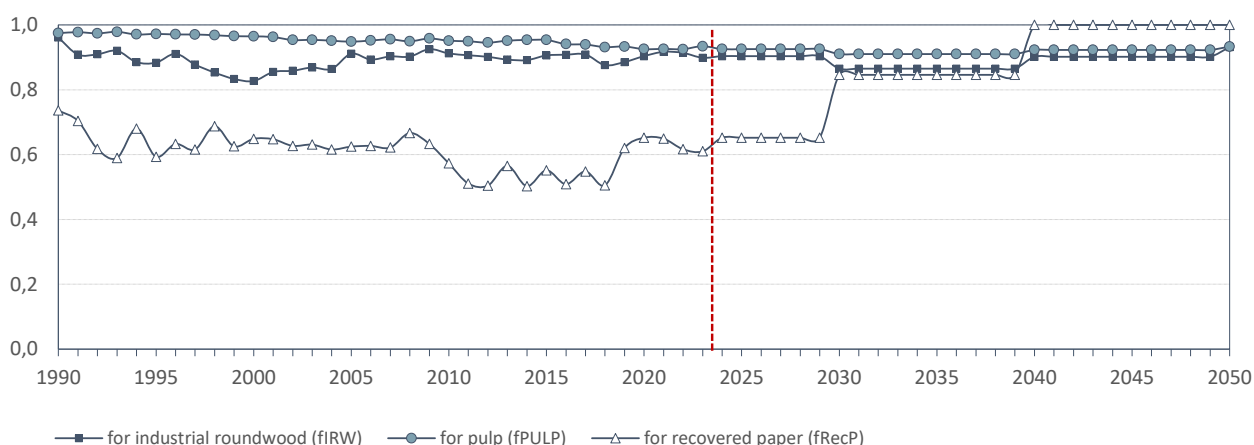


Figure SE-B: Historic and future development of the applied domestic feedstock factors for Sweden

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure SE-C shows the results for the “baseline” scenario (RCP1p9_12).

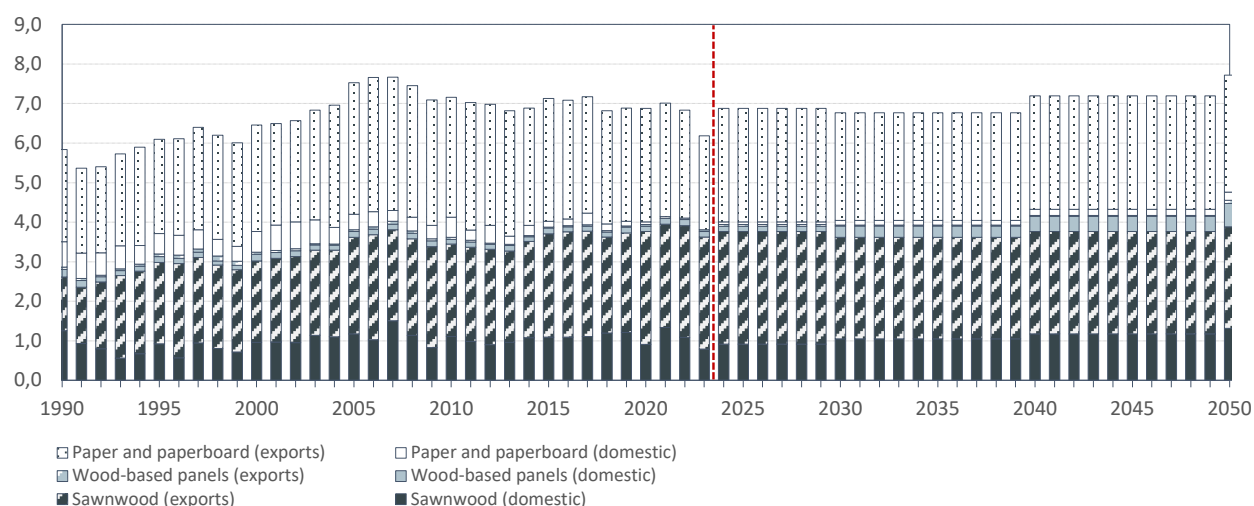


Figure SE-C: Calculated historic and future carbon inflow on the basis of to the HWP pool applying the production approach for Sweden [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

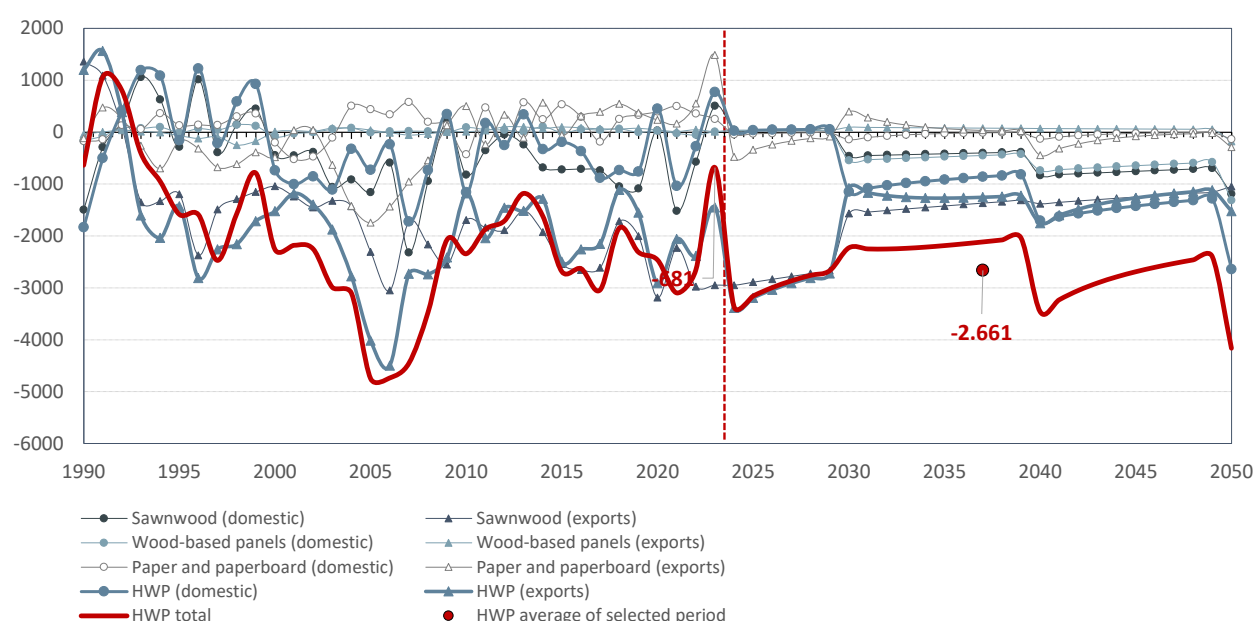


Figure SE-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Sweden [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Sweden applying the “baseline” scenario (RCP1p9_12) in Figure SE-E.

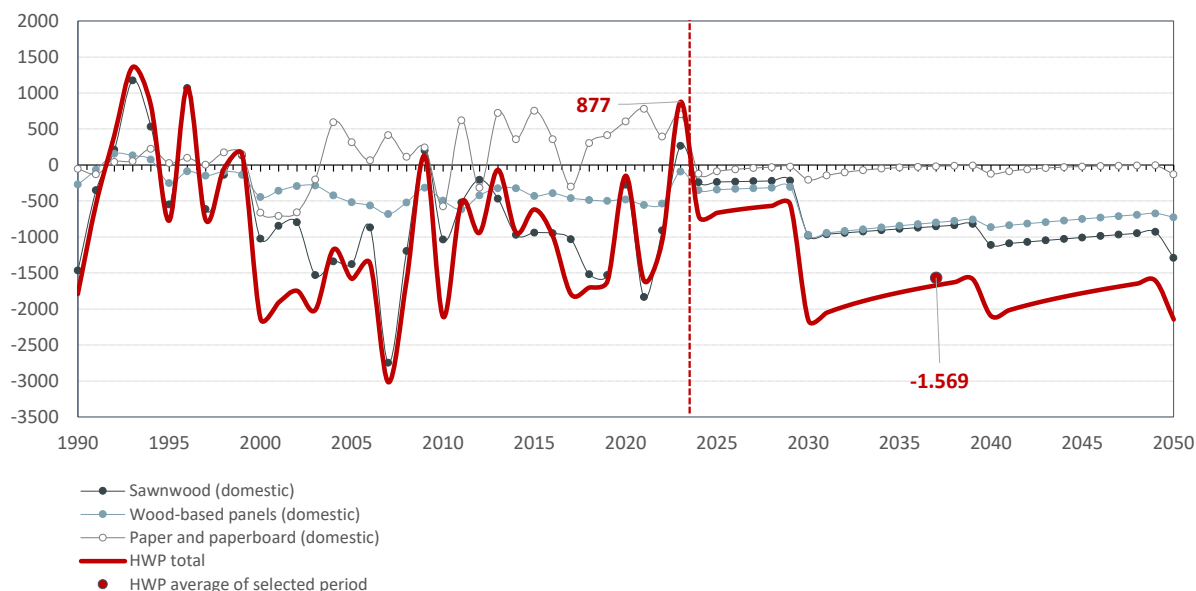


Figure SE-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Sweden [in kt CO₂]

Slovenia (SL)

For Slovenia, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1992 to 2023.

For the updated “baseline scenario” (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure SL-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

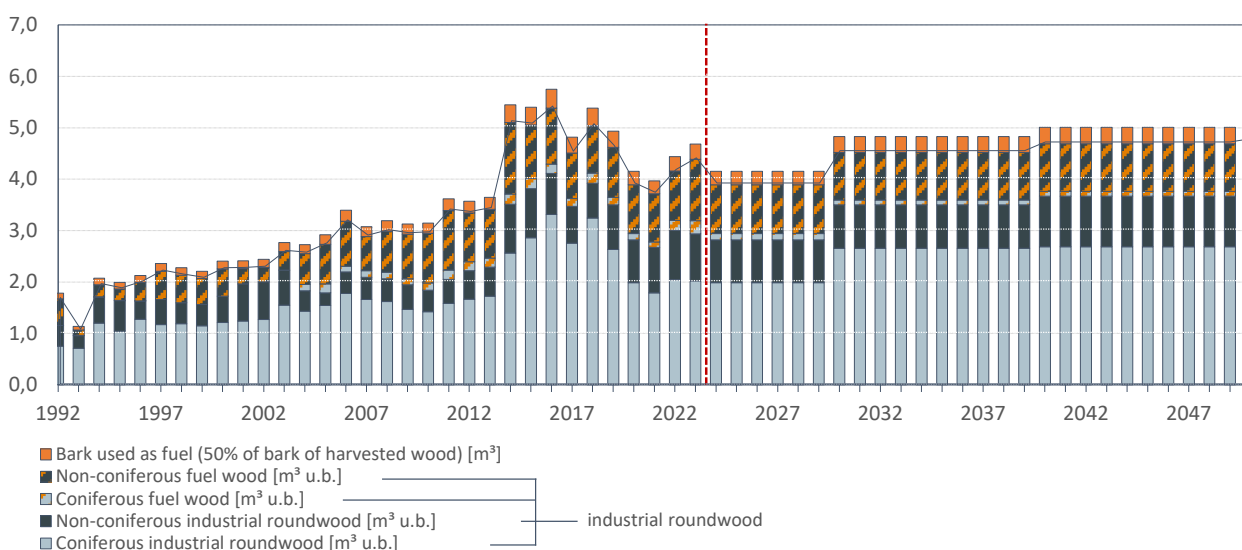


Figure SL-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Slovenia [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure SL-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

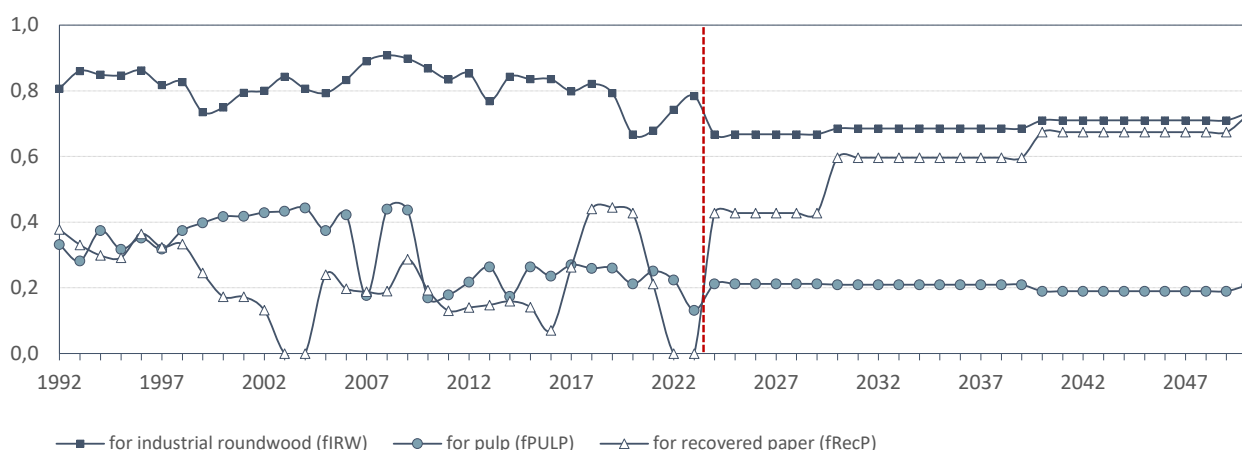


Figure SL-B: Historic and future development of the applied domestic feedstock factors for Slovenia

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure SL-C shows the results for the “baseline” scenario (RCP1p9_12).

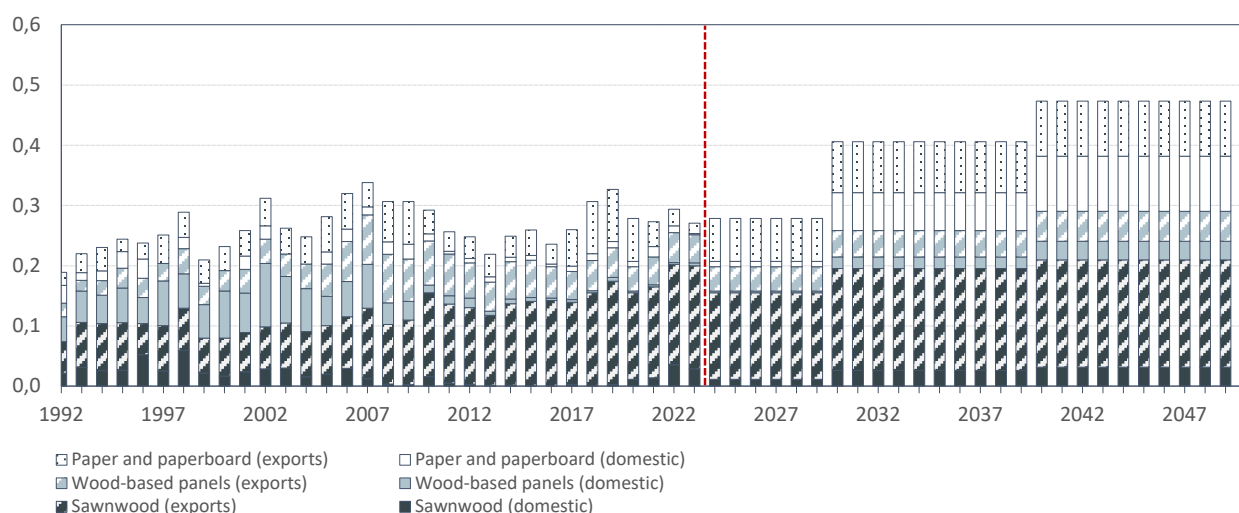


Figure SL-C: Calculated historic and future carbon inflow on the basis of to the HWP pool applying the production approach for Slovenia [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

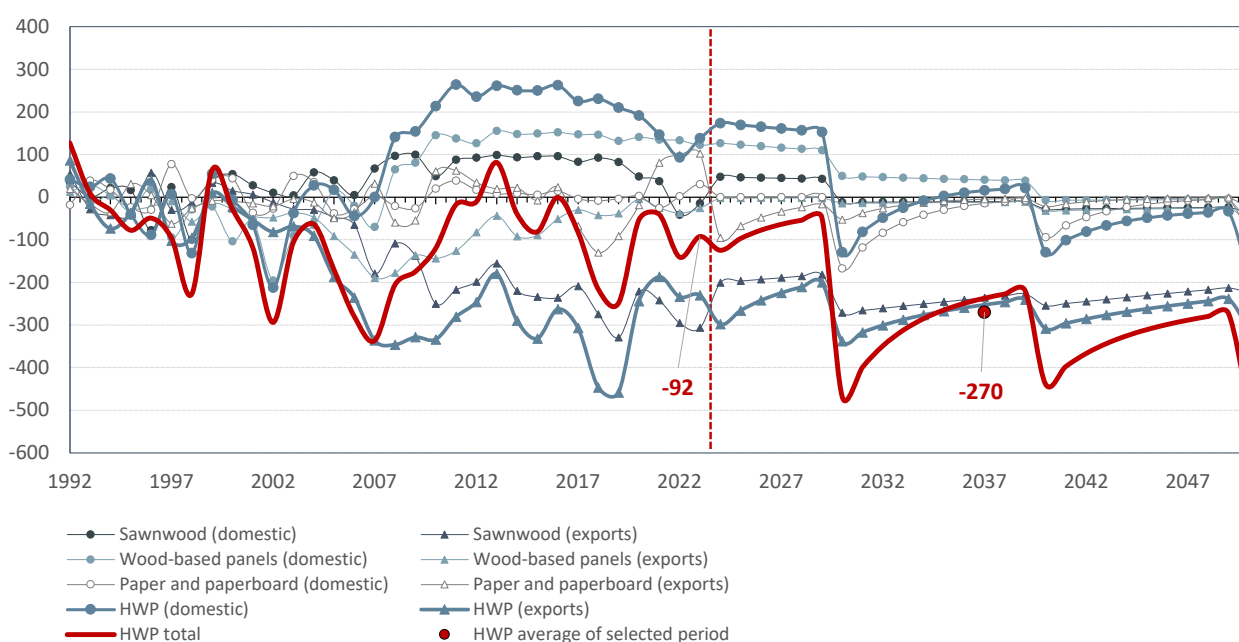


Figure SL-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Slovenia [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Slovenia applying the “baseline” scenario (RCP1p9_12) in Figure SL-E.

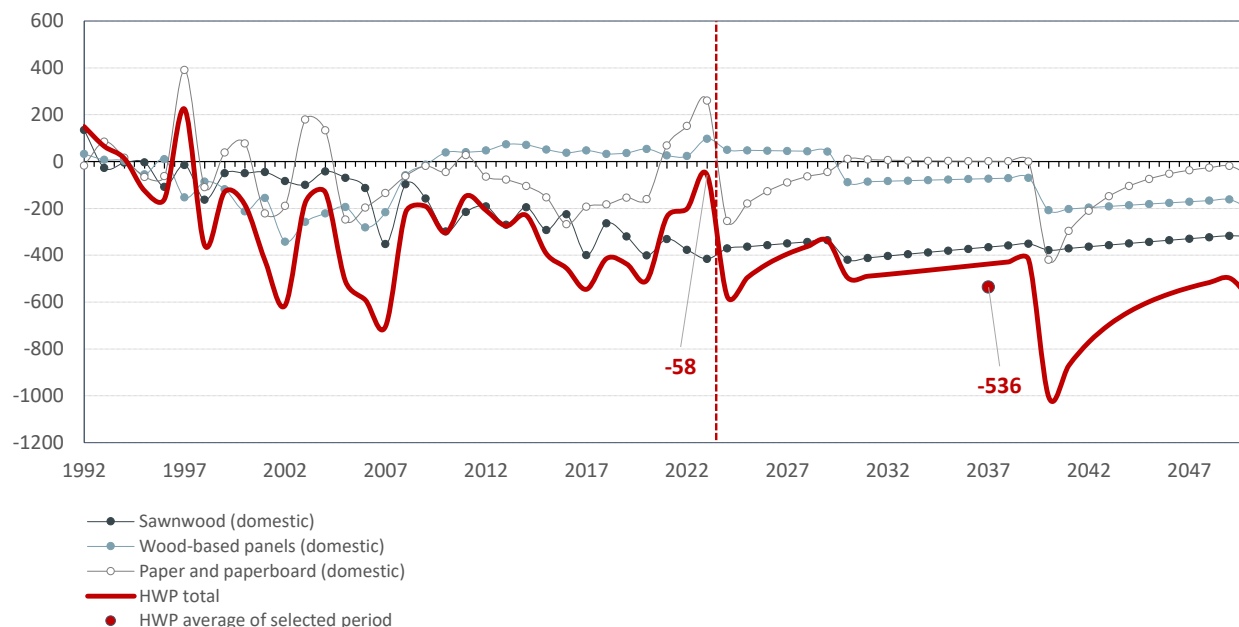


Figure SL-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the stock-change approach for Slovenia [in kt CO₂]

Slovakia (SK)

For Slovakia, the relevant activity data for HWP are available from the FAOSTAT database (FAO 2024) for the years 1993 to 2023.

For the updated “baseline” scenario (RCP1p9_12), the historic and projected harvest amounts, relevant for the calculation of the share of wood biomass originating from domestic origin applied in the **production approach**, are illustrated in Figure SK-A. The time series of annual roundwood production is broken down into coniferous and non-coniferous industrial roundwood used for the subsequent manufacturing of the semi-finished wood product commodities (HWP) and fuel wood.

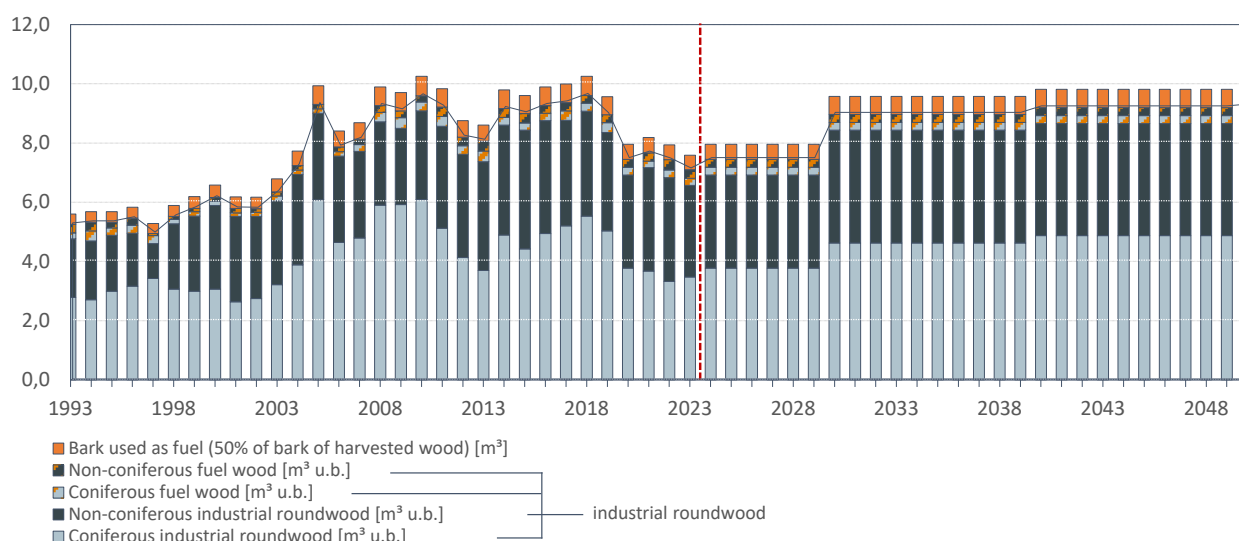


Figure SK-A: Historic and future harvest acc. to the baseline scenario for industrial roundwood and fuel wood in Slovakia [in Mm³]

Based on the values for the production and the domestic consumption of woody feedstock for the subsequent processing of semi-finished products deemed for the material use of wood, Figure SK-B shows the historic time series of relevant domestic feedstock factors f_{INDRW} , f_{PULP} and f_{RecP} and its assumed future development for the “baseline” scenario (RCP1p9_12).

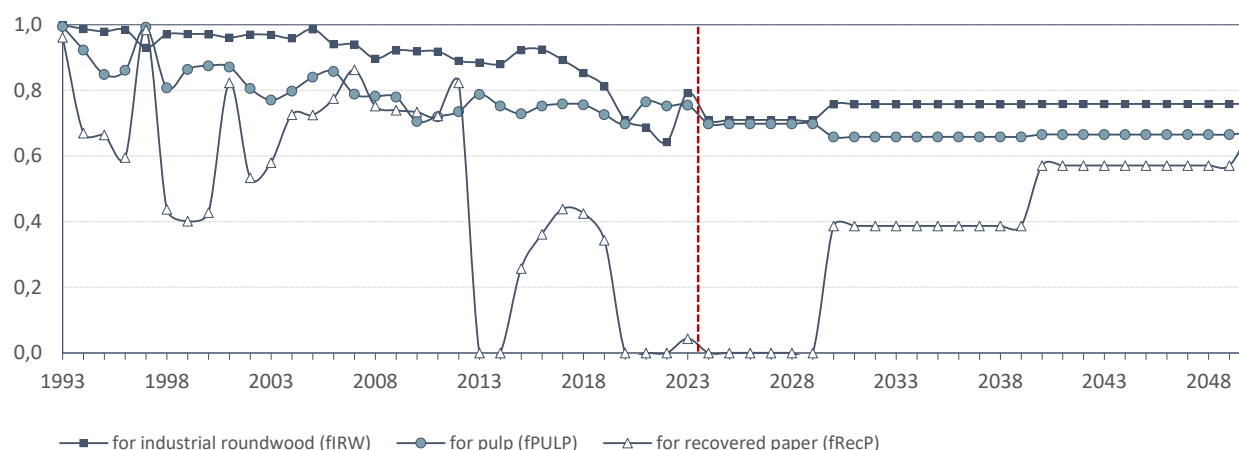


Figure SK-B: Historic and future development of the applied domestic feedstock factors for Slovakia

As a result of combining the data on the annual production of the relevant HWP commodities with these feedstock factors, the carbon inflow to the HWP pool following the production approach is calculated. Figure SK-C shows the results for the “baseline” scenario (RCP1p9_12).

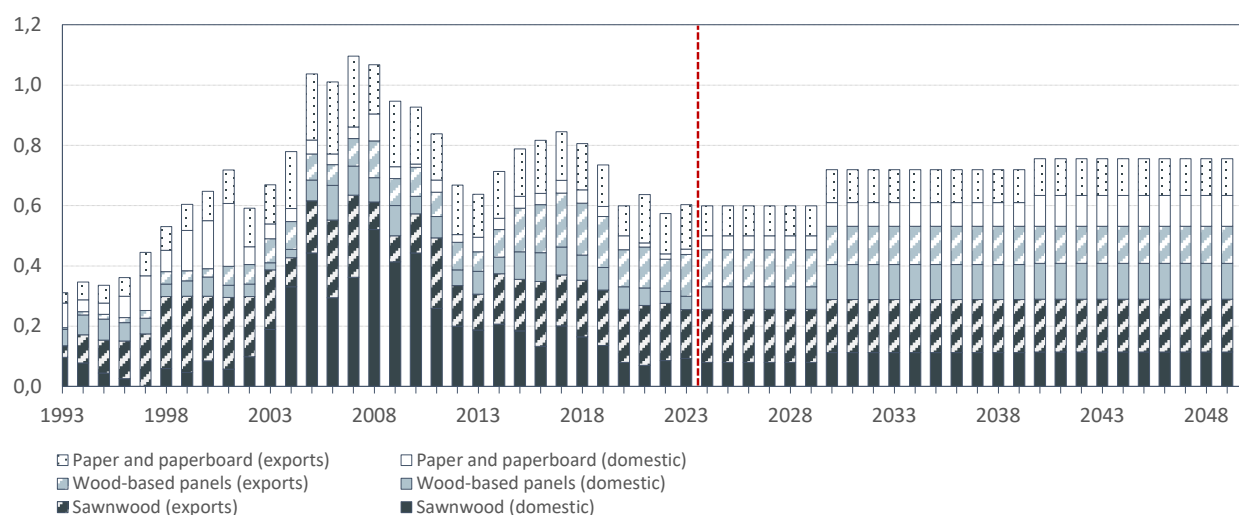


Figure SK-C: Calculated historic and future carbon inflow on the basis of the HWP pool applying the production approach for Slovakia [in kt C]

Subsequently, the historical and projected biogenic CO₂ emissions and removals associated with the HWP pool were calculated using the methods following the production approach.

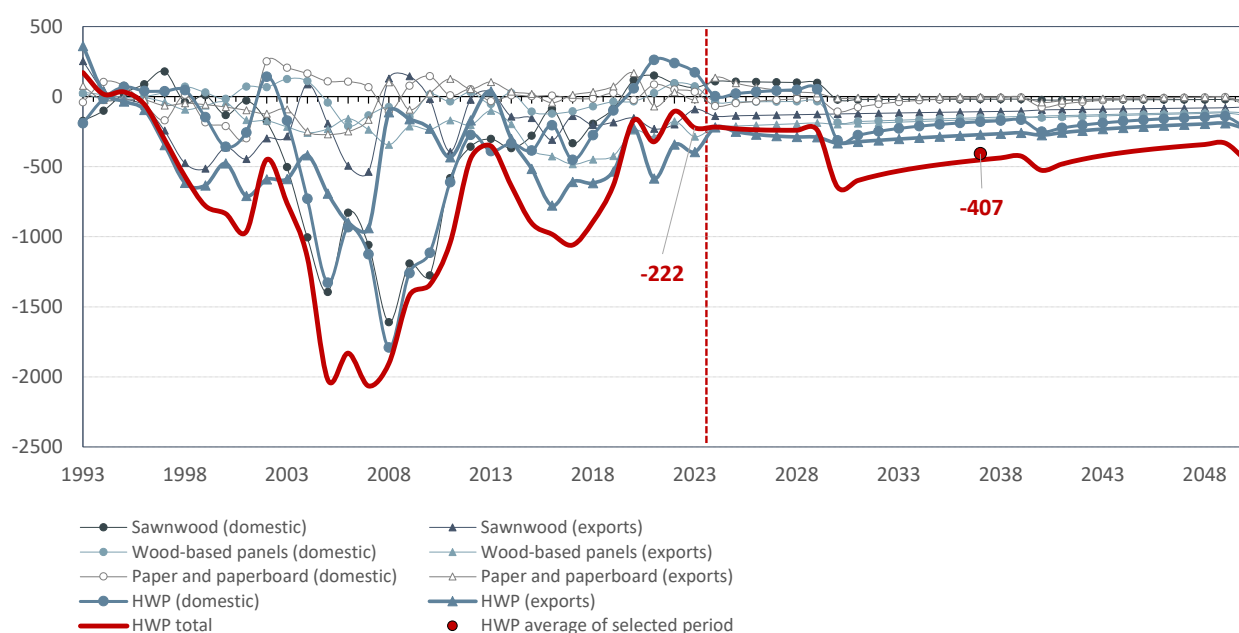


Figure SK-D: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for the baseline scenario following the production approach for Slovakia [in kt CO₂]

The results for biogenic CO₂ emissions and removals associated with the entire calculated domestic consumption of all semi-finished wood products – regardless of the country of origin of their woody feedstock (i.e. including imported and excluding exported HWP) – are determined using the **stock-change approach** and are shown for Slovakia applying the “baseline” scenario (RCP1p9_12) in Figure SK-E.

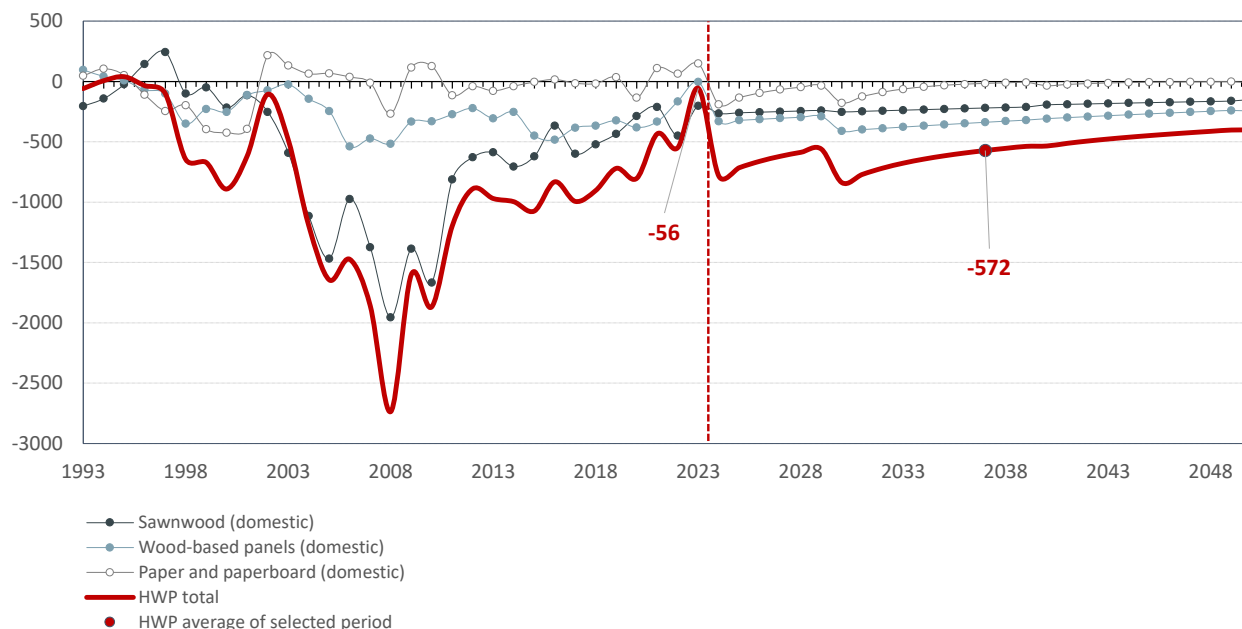


Figure SK-E: Historic and projected biogenic CO₂ emissions and removals associated with the HWP pool for scenario RCP1p9_12 following the stock-change approach for Slovakia [in kt CO₂]