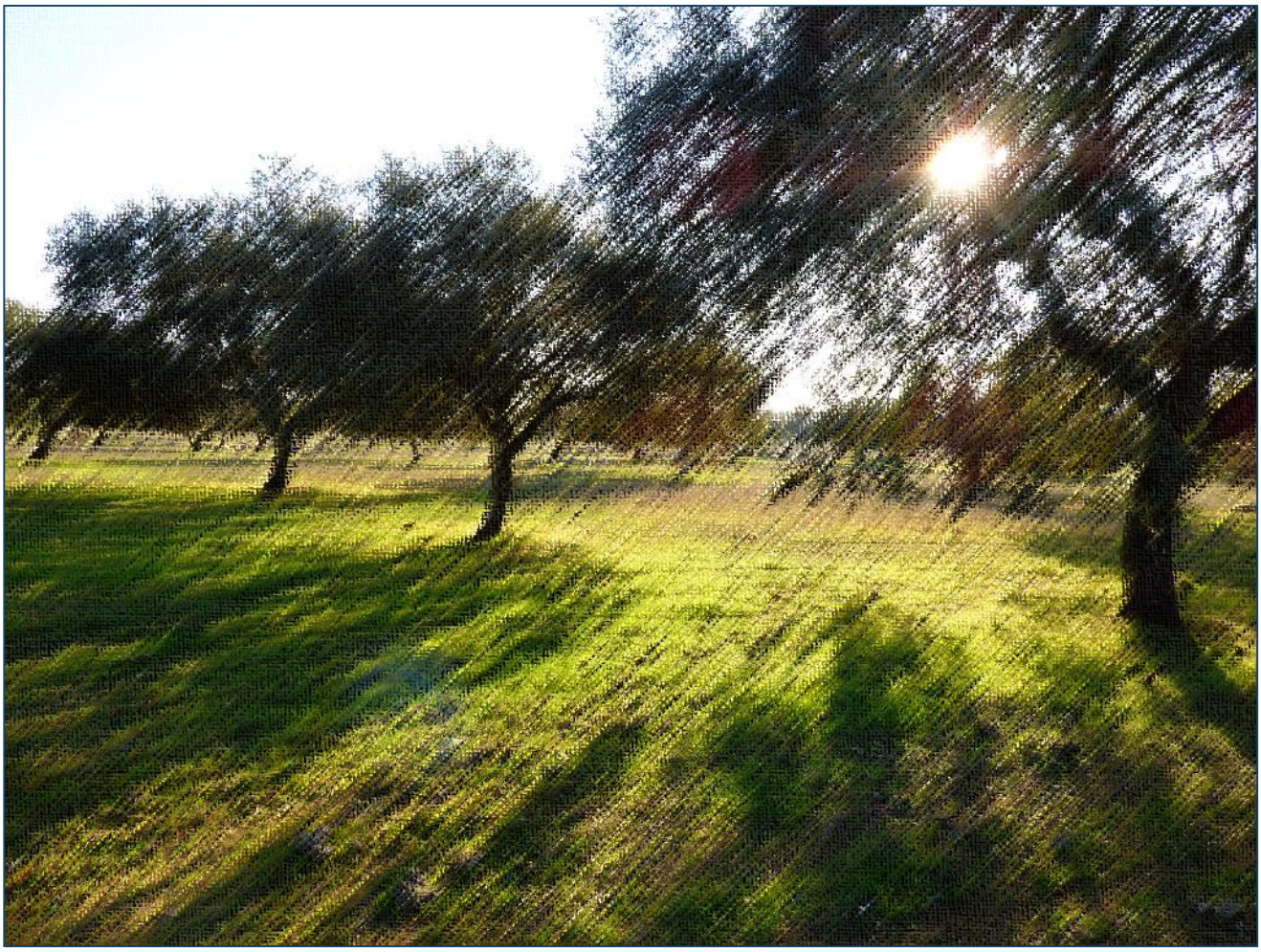
National Forestry Accounting Plan
Portugal 2021-2025



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1 Introduction

The 2030 climate and energy framework includes EU-wide targets and policy objectives for the period from 2021 to 2030. It's key targets for 2030 are:

- At least 40% cuts in greenhouse gas emissions (from 1990 levels)
- At least 32% share for renewable energy
- At least 32.5% improvement in energy efficiency

In order to achieve the emission reduction cuts of 40%, several legal instruments have been agreed, including a Regulation on the contribution of the land-sector to this overall target.

Regulation (EU) 2018/841 sets out the commitments of EU Member States for the land use, land use change and forestry (LULUCF) sector that contribute to achieving the objectives of the Paris Agreement and meeting the greenhouse gas emission reduction target of the Union for the period from 2021 to 2030.

The Regulation also lays down the rules for the accounting of emissions and removals from LULUCF and for checking the compliance of Member States with those commitments.

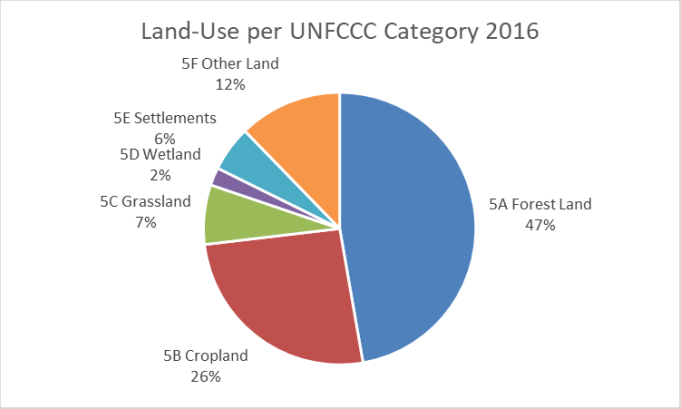
Its article 8 determines that accounting for the emissions and removals resulting from managed forest land, is to be calculated as the emissions and removals in the periods from 2021 to 2025 and from 2026 to 2030 minus the value obtained by multiplying by five of the forest reference level (FRL).

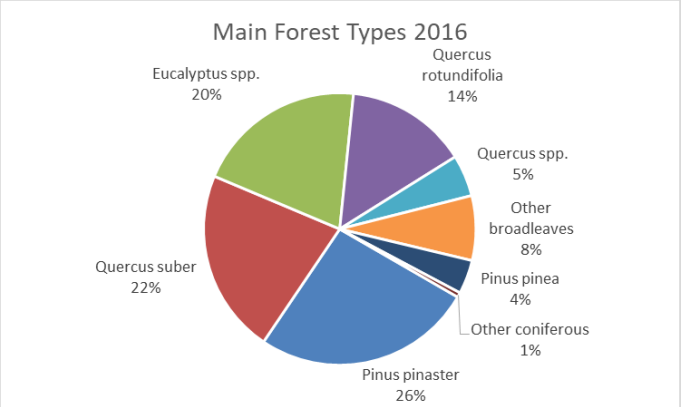
The 'Forest Reference Level' is defined as an estimate, expressed in tonnes of CO_2 equivalent per year, of the average annual net emissions, and is to be based on the criteria set out in Section A of Annex IV of the Regulation. The FRL is proposed by each Member State in a National Forestry Accounting Plan, which contains all the elements listed in Section B of Annex IV of the Regulation.

This document presents the Portuguese National Forestry Accounting Plan and the proposal for a "Forest Reference Level" to be used for accounting of managed forests in Portugal and in the period 2021-2025.

Land and forests are an integral part of the Portuguese strategy on addressing the challenges of climate change, and this much has been reflected in the recently submitted National Energy and Climate Plan 2030 and the National Long-Term Strategy RNC2050.

2 Forests in Portugal





Forests are the main land-use in Portugal. In the Mainland forests are dominated by indigenous species, namely several oaks (including cork oak and holm oak "montados") and pine trees. Eucalyptus (mainly Tasmanian blue gum and shinning gum) represent a large share of the forest area and the remaining area is occupied by less common species (including sweet chestnut, carob tree, acacia, poplar, riparian and other species). In the islands of the Azores there is a predominance of sweet pittosporum, formations of laurissilva and cedar, Japanese red-cedar, blackwood, eucalyptus and firetree. In the islands of Madeira laurissilva is the main forest type, followed by eucalyptus, maritime pine and blackwood and other acacias.

During the last century, there were significant changes in land use and forest cover in the Mainland. In the first half of the 20th century, there was a significant increase in agriculture and forest areas, at the expense of the area of shrubs and spontaneous ("uncultivated") pastures; since the 1950s, the area under cultivation has substantially decreased. Regarding forest cover, after the growth of the maritime pine area, reaching its maximum in the 1980s, there was a significant decrease in its area, in parallel with the rapid increase of eucalyptus (since the 1960s).

2.1 Forest governance and main instruments

The Parliament has the competence regarding elaboration of legislation acts, according to the 1976 Constitution. The definition and implementation of forest policy is carried out by the Ministry of Environment and Climate Action and, in the Autonomous Regions, the Regional Secretariat of Agriculture and Forestry (in the Azores) and the Regional Secretariat of Environment and Natural Resources (in Madeira). The Institute for Nature Conservation and Forests (ICNF) is the national forest authority and, simultaneously, the national authority for nature conservation and biodiversity.

The Forest Policy Act establishes the framework for the use of forest areas with a view of a sustainable and sustained production of forest goods and services. The development of the sector follows the Government programme and the National Strategy for Forests (approved in 2006 and updated in 2015), which is implemented by regional forest programs (PROF), covering all the Mainland (7 PROF, after a revision finalised in February 2019) and the Autonomous Region of Madeira (1 PROF).

The National Forest Strategy (NFS) has been updated (RCM 6-B/2015) with a view to integrate the outcome of the evaluation study of its implementation, as well as to incorporate guidance from the Forest Health and Vitality Operational Programme (which deals with the phytosanitary issues of the main forest species).

Simultaneously, the NFS update also took into account the efforts carried out within the framework of both the National Strategy for Climate Change Adaptation and the National Action Programme to Combat Desertification and considered measures to contribute to those processes.

The EU Forest Strategy's concerns and orientations together with the ones from the EU Biodiversity Strategy and from the "Europe 2020: A European strategy for smart, sustainable and inclusive growth" particularly in

relation to Green Economy were also taken into account. In addition, the reinforcement of the sustainable forest management guidance, as a result of Forest Europe and United Nations Forum on Forests commitments and outcomes, was also incorporated.

Finally, the revised NFS seized the opportunity of investment provided by the Rural Development Programmes 2020.

Following the adoption of the updated NFS, the PROF were also updated (a process finalised in early 2019), in order to take consider the revised NFS, thus assuring the development of its options and objectives and defining the implementation guidelines at regional level, and establishing the necessary format of articulation with the other relevant land planning instruments.

It should be highlighted that PROFs are sectoral land planning instruments foreseen since the Forest Policy Act (Law 33/96, 17 August).

2.2 Forest management practices and context

Portugal is *sui generis* with regard to forest ownership. In fact, only about 3% of the forest land is owned by the State and other Public Administration agencies, the remainder being held by local communities (the so-called "commons", "baldios" in Portuguese), with about 6%, largely subject to the compulsory Forest Regime Act, and by private owners (92%, 4% of which are managed by industrial companies). The family forest holdings number several hundred thousand. These numbers are in strike contrast with the remaining EU Members. At European level, (EU-28) 40% of the forest is owned by public agencies, ranging from 19% in Austria, to 86% in Bulgaria.

There are 11.7 million rural properties inscribed in the Ministry of Finance tax registry and 1,107 commons. Only 46% of the forest properties have an official land registry title. It is estimated that more than 20% of the total forest area has no owner, or its owner is unknown or are not registered due several generations of successions or disputes related with inherences. There are also significant country asymmetries, with holdings of tens to thousands of hectares being common in the South and micro holdings being a common feature in the North, Centre, and Islands.

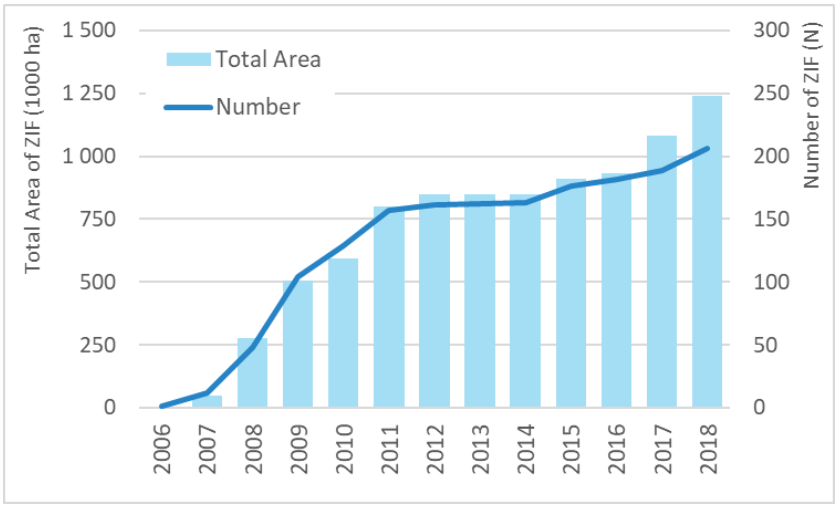
The promotion of sustainable forest practices in this context is particularly challenging, but has been one of the priorities for the forest policy.

The first core strategy consists on the promotion of associations of private owners of natural and/or forest resources. Currently, 135 forest owners' organisations are registered in the ICNF, which include associations of forest owners and producers, forest cooperatives or cooperatives with a forest section, and their federations, 77% having a municipal level. In 2005, a particular type pf association was created, to promote the expansion of the cooperative management of the forest lands through the "forest intervention zones" (ZIF), which currently (end 2018) cover 1.2 Mha and include more than 25 000 forest owners and are managed by more than 70 different entities (including forest owners' associations, cooperatives and companies). ZIFs have, amongst others, the following objectives:

1. Promote the sustainable management of its forests
2. Plan and coordinate the protection of forest and natural areas
3. Reduce the conditions for forest fire ignitions and fire propagation
4. Coordinate the recovery of burnt areas
5. Provide territorial coherence and efficacy to the actions of local and central administrations and other actors on forest management

The first ZIF was approved in 2006, and ZIFs have been gaining relevance since their creation (Figure 1).

Figure 1: Evolution of the Number and Total Area of "Forest Intervention Zones" (ZIF)



Recently (2017) a regulatory framework was created to support the recognition of two other types of "associations": Forest Management Entities (EGF); and Forest Management Units (UGF). These have the aim of promoting the adoption of models for the joint management of forest areas and at the enhancement of forestry, as well as increasing the revenue for forest owners and producers.

- Forest Management Entity (EGF) can be one of several types of entities: a legal entity under private law, under the terms of the Cooperative Code or the Civil Code; an association with legal personality; a Commercial Company under the Civil Code, in the form of a limited liability company; a public limited company. They should have as their corporate purpose forestry, forest management and exploitation and, in the case of associations, the provision of services to its members in those areas;

The EGF aims to promote and facilitate the joint management of forest areas, preferably smallholdings, in accordance with the principles of sustainable forest management, through the creation of exploitation areas that provide adequate valuation and profitability of assets.

- Forest Management Unit (UGF) is a legal person under private law, incorporated under the Cooperative Code or the Civil Code, in the form of an association with legal personality, manager of continuous rural holdings, with an area not exceeding 50 hectares each, with a minimum territorial area of 100 hectares and a maximum of 5000 hectares.

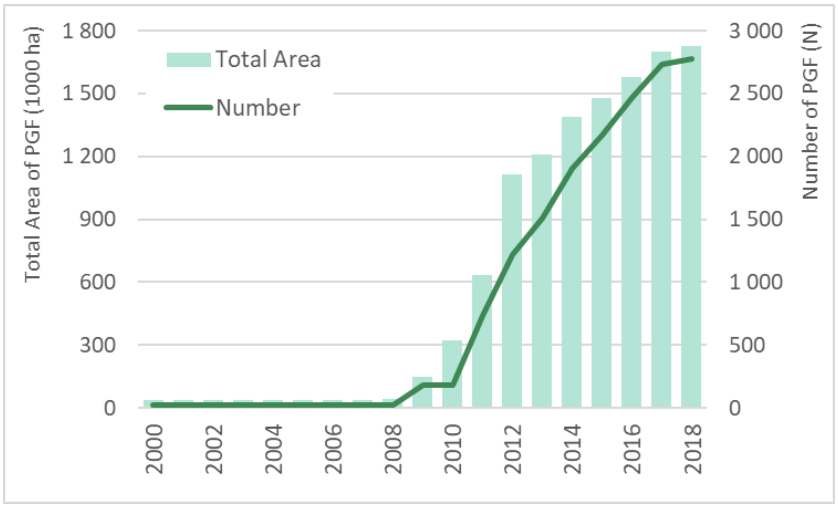
The UGF aims to promote and facilitate the joint management of continuous forest areas, preferably smallholdings and by the owners themselves aggregated in cooperatives or associations, according to the principles of sustainable forest management, in areas that allow for the adequate valuation and profitability of assets.

At this date, only one EGF is recognised by the ICNF and no UGF yet.

The second core strategy consists on the improvement of planning and implementation of Forest Management Plans. It has to be noticed that since the middle of the 19th century public areas under the "forest regime" already had forest management plans. However, these covered only a limited area and it was foreseen in 1996 Forest Policy Act a new type of forest management plans (PGF) with requirements and elements were further detailed in specific subsequent legislation. These plans are now mandatory for all public and communal forest, for the ZIF, EGF, UGF, and also for forest owners which have properties above a certain area threshold. Where mandatory, the PGFs have to be in line with the PROF (regional forest plan) and should include the elements specified in the legislation, namely Decree-Law N.16/2009. ICNF provides a guidance document to facilitate their elaboration. The minimum threshold is defined for each region in order to reflect the different ownership patterns in the country. The first generation of PROF was concluded in 2007, and most of these new PGFs came into existence after 2007. After the approval of the revised PROF, early in 2019, forest owners will now have a

period of 3 years to revise/update their PGF in order to have it in line with the new guidelines. In the Mainland, FMP approved (2018) correspond roughly to 30% of the forest total area. Stone pine, cork oak and eucalyptus stands, which are typical of larger forest holdings, have a PGF coverage rate above the national average.

Figure 2: Evolution of the Number and Total Area of Forest Management Plans (PGF)



Despite the fact that these type of PGFs are relatively recent, active management activities have been carried out for many generations. The following sections outline the main characteristics of the management objectives and practices of each the main species.

2.2.1 Cork Oak Forests

Cork oak forests are relatively open forests, managed mostly as agro-forestry systems. In these systems, trees are grown in combination with pastures, or (less commonly) with crops (typically cereals). The low density of trees combined with a pruning system designed to open tree crowns to maximise fruit production gives these trees their characteristic vase shape.

The main product is cork, the bark of the cork tree. Cork is extracted from the oaks every nine years, after which a new layer is regenerated. Another important product is meat, mostly cows, sheep and Iberian pigs, fed on the understory pastures and the acorns from the cork oaks.

Felling of cork oaks for wood production is prohibited by law, and the only wood extraction from these forests comes from pruning (included in the GHG Inventory under "Other Wood Uses") and the felling of dead and sick trees (included in the GHG Inventory under "Natural Mortality"). Young stands, planted with higher densities may require thinning to lower tree density to the required levels.

Its main species is Quercus suber, often as pure stands, but the occurrence of mixed forests with other species may also occur, notably with Quercus rotundifolia, Pinus pinea and Pinus pinaster.

The area of Cork Oak forests has increased from 829kha in 1990 to 933kha in 2017. Most Cork Oak forests have an irregular age class. Where age is known, most forests are concentrated in older age classes, which reflects the fact that harvesting is forbidden and that these trees are managed for cork and acorn production, and tree size is responsible for higher productions.

Figure 3: Area and Age-class Structure of Cork Oak Forests

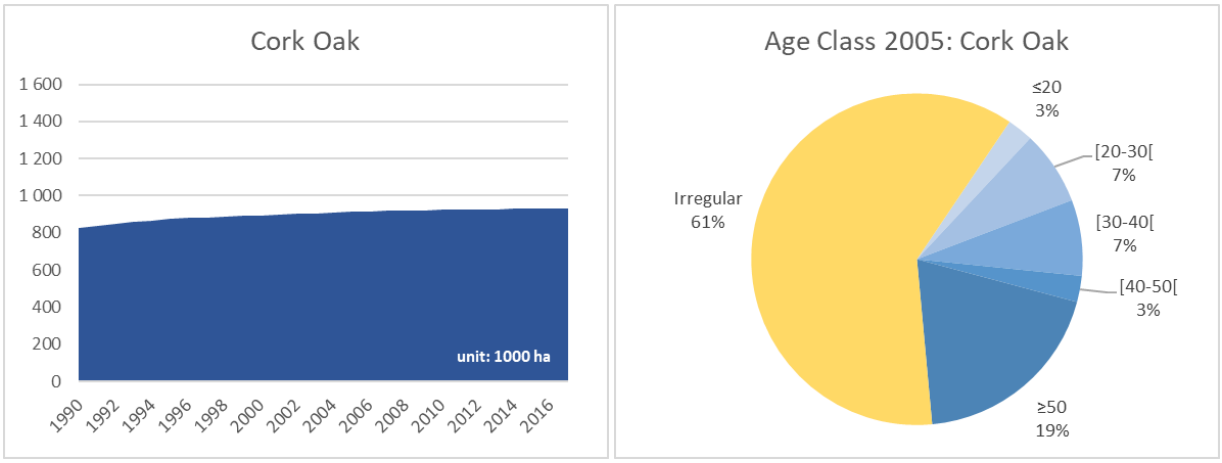
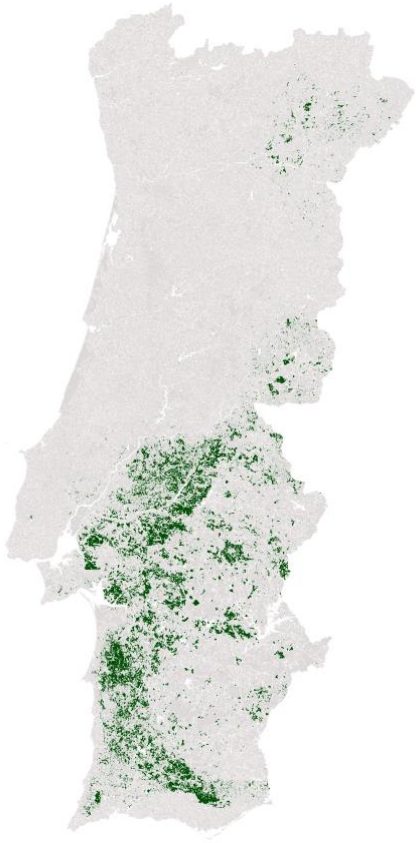


Figure 4: Distribution of Cork Oak Forests in Mainland Portugal (COS 2007)



2.2.2 Holm Oak Forests

Holm oak forests are similar to cork oak forests in structure and production objectives, the main difference being that this species is not able to produce cork.

Felling of holm oaks for wood production is prohibited by law, and the only wood extraction from these forests comes from pruning (included in the GHG Inventory under "Other Wood Uses") and the felling of dead and sick trees (included in the GHG Inventory under "Natural Mortality"). Young stands, planted with higher densities may require thinning to lower tree density to the required levels.

Its main species is Quercus rotundifolia, often as pure stands, but the occurrence of mixed forest with other species may also occur, notably with Quercus suber and other Quercus or other broadleaves.

The area of Holm Oak forests has decreased from 708kha in 1990 to 600kha in 2017. Most Holm Oak forests have an irregular age class. Where age is known, most forests are concentrated in older age classes, which reflects the fact that harvesting is forbidden and that these trees are managed for acorn production, and tree size is responsible for higher productions.

Figure 5: Area and Age-class Structure of Holm Oak Forests

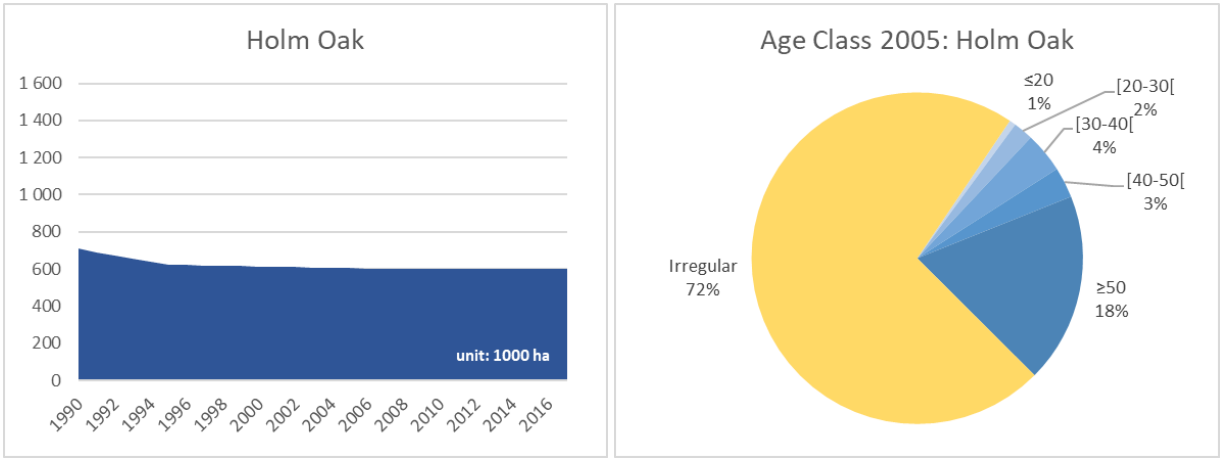
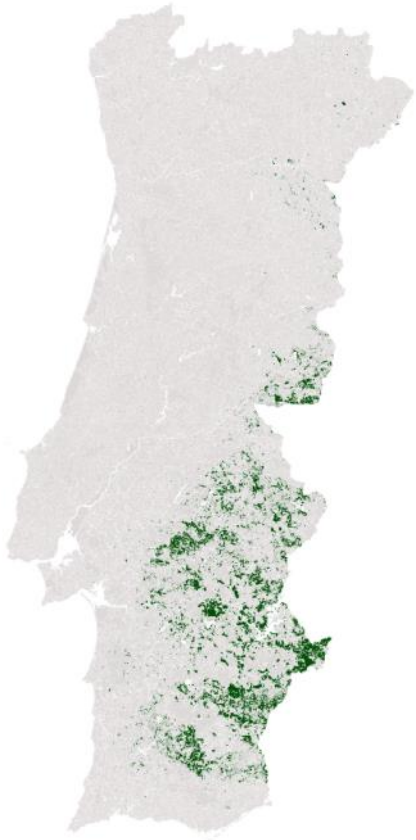


Figure 6: Distribution of Holm Oak Forests in Mainland Portugal (COS 2007)



2.2.3 Other Oaks

Oaks are the natural vegetation in most of Mainland Portugal. Cork and Holm oaks (see previous sections) are the most important species, but other species are also common, particularly Common Oak (Quercus robur), Pyrenean Oak (Q. pyrenaica), Portuguese Oak (Q. faginea), Kermes Oak (Q. coccifera), Lusitanian Oak (Q. lusitanica), Algerian Oak (Q. canariensis), Downy Oak (Q. pubescens). An introduced species may also be found, the Northern Red Oak (Q. rubra), although it's area is not significant.

Many of these forests constitute natural habitats[1] and hence, are included in Natura 2000 sites and managed bearing in mind their conservation. Limited areas are managed for wood production, usually with Q. robur or Q. rubra. Industrial wood production from Quercus spp. is residual due to limited areas managed for wood production and the effect of forest fires (see section 2.3 Forest Management, Fires and Other Natural Disturbances below). The most common use of these forests is firewood production, usually for domestic

[1] Mostly Habitats 9230 Galicio-Portuguese oak woods with Quercus robur and Quercus pyrenaica; 9240 Quercus faginea and Quercus canariensis Iberian woods; 9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli; 91F0 Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris); 5330 Thermo-Mediterranean and pre-desert scrub

purposes and harvested in an informal manner, i.e. without responding to formal management plans (included in the GHG Inventory under "Other Wood Uses").

The area of Other Oak forests has increased from 194kha in 1990 to 213kha in 2017. Most Other Oak forests have an irregular age class. Where age is known, almost half of the forests are under 30 years.

Figure 7: Area and Age-class Structure of Other Oak Forests

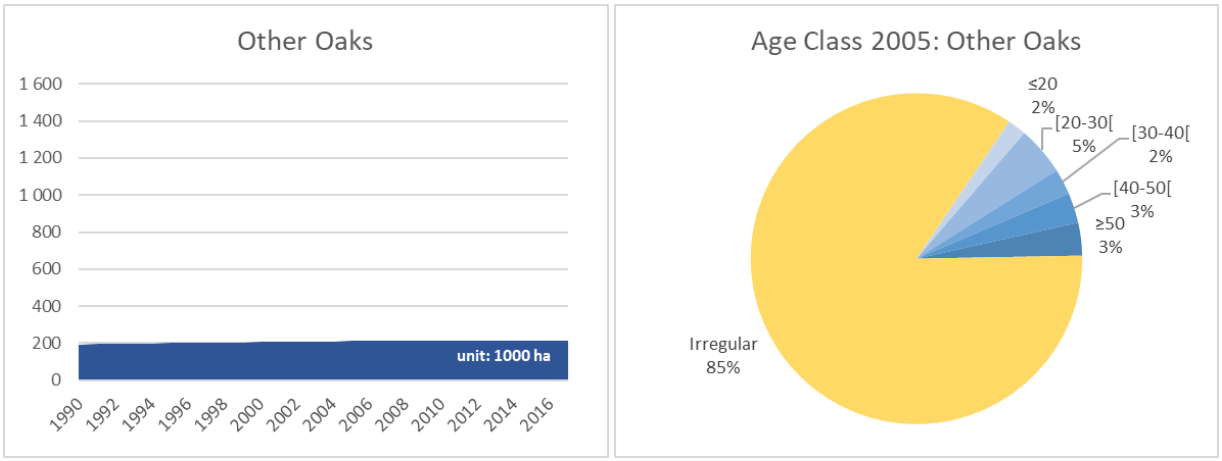
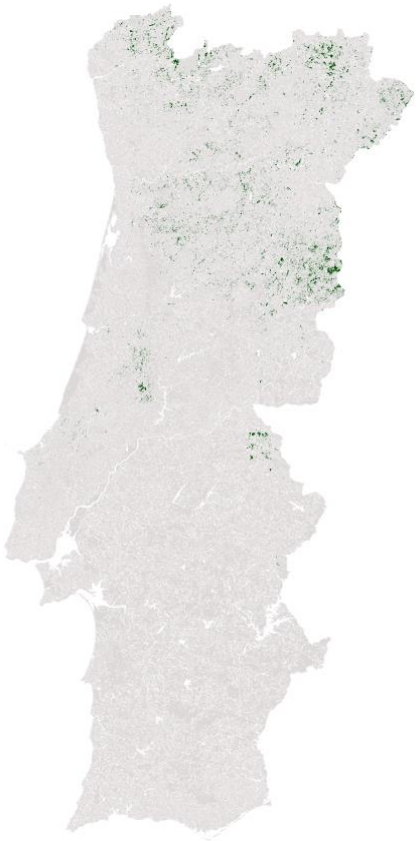


Figure 8: Distribution of Other Oaks Forests in Mainland Portugal (COS 2007)



2.2.4 Eucalyptus

Eucalypt forests are plantation forests managed in coppice systems for wood production. In this system, trees are planted and grow for about 12 years (but in drier areas up to 15 years), after which they are clear felled. New sprouts will grow from the stumps, and after about 2 years, 2 or 3 stems per stump will be selected and a new harvest will be conducted after 12 (to 15) years. This cycle will be repeated for about 2 or 3 times, after which the plantation cycle is reinitiated with the plantation of new trees.

The wood from these forests is mostly used in the pulp and paper production, but significant amounts are also consumed by the wood panel industry. The remains of harvesting (tree tops, branches, bark and – occasionally – the stumps) are increasingly being used for bioenergy production.

Its main species is Eucalyptus globulus, or Eucalyptus camaldulensis (in drier areas), often as pure stands, but the occurrence of mixed forest with other species may also occur, notably with Maritime Pine and Other Broadleaves and Cork Oak.

The area of Eucalyptus forests has increased significantly from 531kha in 1990 to 861kha in 2017. The age class structure of Eucalypt forests reflects the above management system, with about the same area in each age class below 12 years. The irregular area reflects cases of areas affected by fires and/or abandoned, where trees which survived fires co-exist with the regeneration of other trees.

Figure 9: Area and Age-class Structure of Eucalypt Forests

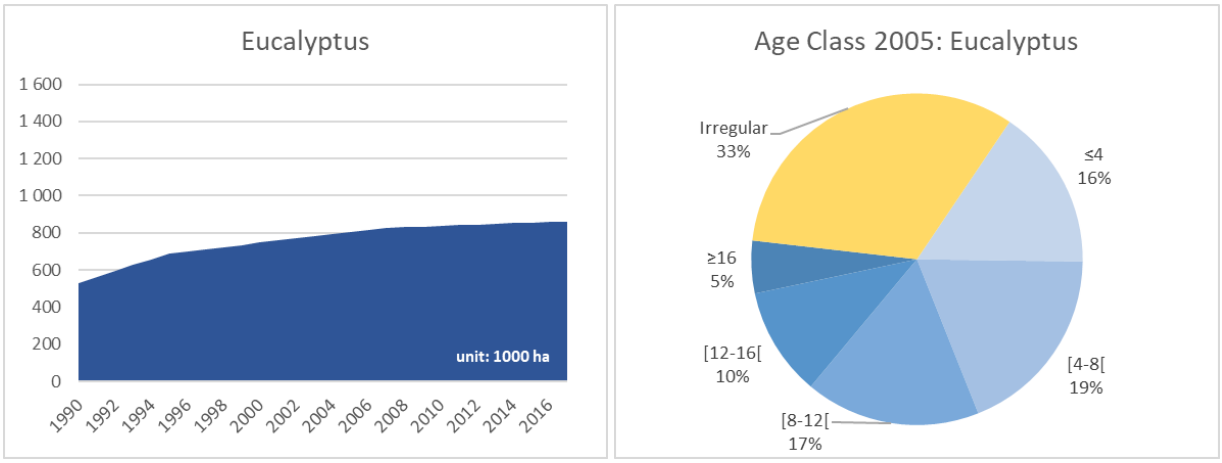
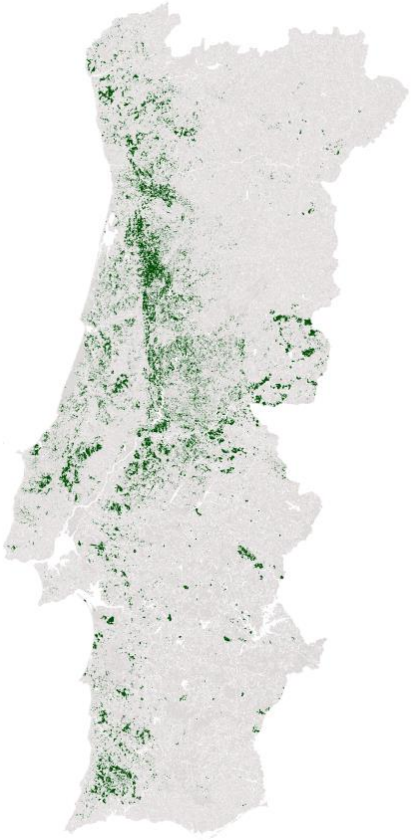


Figure 10: Distribution of Eucalyptus Forests in Mainland Portugal (COS 2007)



2.2.5 Other Broadleaves

Other broadleaves are a rather diverse group, which includes:

- Forests managed mostly for fruit production, e.g. Chestnut trees (Castanea sativa), Common Walnut (Juglans regia), Carob trees (Ceratonia siliqua) and Strawberry Tree (Arbutus unedo)
- Riparian forests, e.g. Common Alder (Alnus glutinosa), Willows (Salix spp.), Narrow-Leaf Ash (Fraxinus angustifolia)
- Laurissilva forests (in the Islands of Azores and Madeira)
- Forests dominated by invasive species, e.g. Silver Wattle (Acacia mimosa), Long-leaved Wattle (Acacia longifolia), Australian Blackwood (Acacia melanoxylon), Tree of Heaven (Ailanthus altissima), and, in the Azores, Sweet Pittosporum (Pittosporum undulatum)
- Plantations of broadleaves for wood production, e.g. Narrow-Leaf Ash (Fraxinus angustifolia), Chestnut trees (Castanea sativa), Poplars (Populus spp.), Wild Cherry (Prunus avium), Common Walnut (Juglans regia), Black Walnut (Juglans nigra).

In the areas managed for fruit production, wood production is residual and mostly limited to pruning (included in the GHG Inventory under "Other Wood Uses").

Some of these forests constitute natural habitats and hence, are included in Natura 2000 sites and managed bearing in mind their conservation.

Limited areas are managed for wood production, but industrial wood production from other broadleaves is residual due to limited areas managed for this purpose and the effect of forest fires (see section 2.3 Forest Management, Fires and Other Natural Disturbances below).

The area of Other Broadleaf forests has increased from 238kha in 1990 to 348kha in 2017. Most Other Broadleaf forests have an irregular age class. Where age is known, almost half of the forests are under 20 years.

Figure 11: Area and Age-class Structure of Other Broadleaves Forests

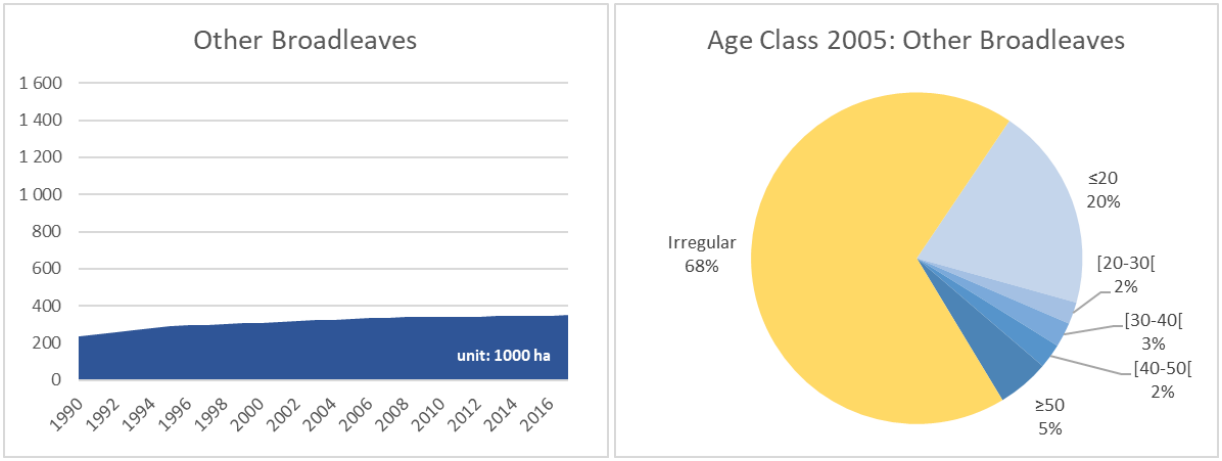


Figure 12: Distribution of Other Broadleaves Forests in Mainland Portugal (COS 2007)

2.2.6 Maritime Pine

Maritime pine is widespread in the country, and is mostly used for wood production, although some areas serve mainly protection functions, such as the Maritime Pine forests in sand dunes along the coast.

Where used for wood production, most areas are planned as even aged plantations (1200 to 1500 plants/ha) or natural regeneration stands. Thinning is practiced to reduce tree density to about (300 to 500 plants/ha) for a rotation length of 40 to 70 years. However, this general plan is often interrupted by forest fires, leading to irregular age classes and mixed forests (see section 2.3 Forest Management, Fires and Other Natural Disturbances below).

The wood from these forests is used by multiple forest industries, usually depending on tree size. The products include: poles, wood panel, pulp and paper, sawn wood. The remains of harvesting (tree tops, branches, bark and – occasionally – the stumps) are increasingly being used for bioenergy production.

The area of Maritime Pine forests has strongly decreased from 1453kha in 1990 to 1175kha in 2017. Most of the lost areas were converted to other forest types, namely eucalypt and other oaks, but some was also converted (degraded) into shrublands, often following abandonment after repeated fires. The appearance and spreading of the Pine Wood Nematode (Bursaphelenchus xylophilus) in 1999, and the actions taken to contain and control its spreading also contributed to a loss of interest of forest owners in this species.

Its main species is Pinus pinaster, often as pure stands, but the occurrence of mixed forest with other species may also occur, notably with Eucalyptus and Other Quercus and Other Broadleaves.

Almost half of the Maritime Pine forests have an irregular age class. Where age is known, about half of the area is under 20 years, which reflects the impact of forest fires in these type of forests.

Figure 13: Area and Age-class Structure of Maritime Pine Forests

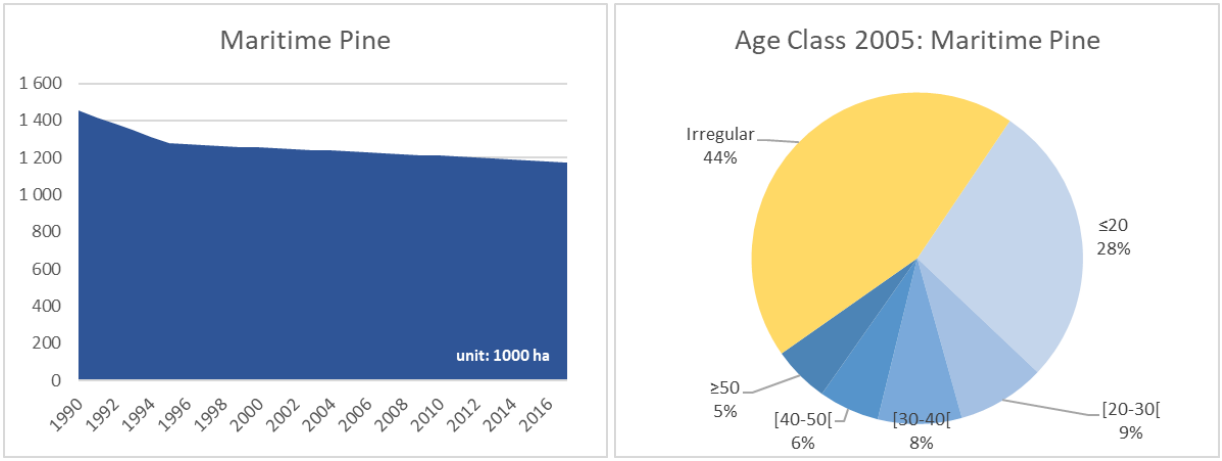
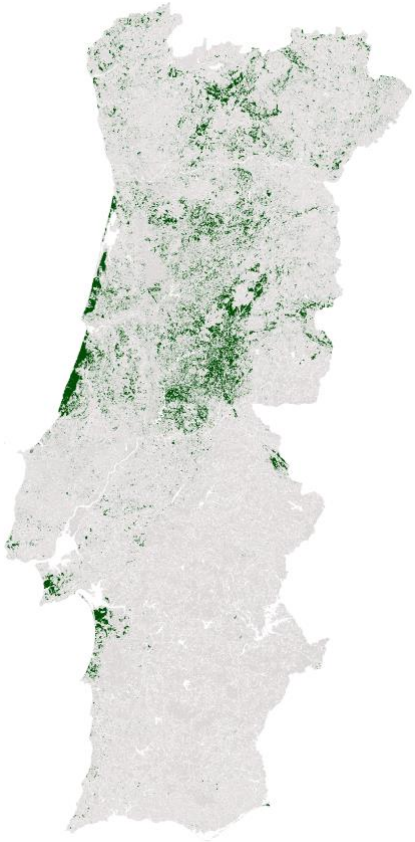


Figure 14: Distribution of Maritime Pine Forests in Mainland Portugal (COS 2007)



2.2.7 Umbrella Pine

Umbrella pine forests are managed mostly for pine nut production. Trees are sometimes grafted to ensure that the quality of pine nuts will achieve the necessary quality and to speed up the starting of the production phase. Pruning and thinning may also occur to, respectively, improve tree shape for pine nut production, and reduce tree density from plantation density to final density (100 to 400 trees/ha).

The area of Umbrella Pine forests has increased from 121kha in 1990 to 209kha in 2017. Half of the Umbrella Pine forests have an irregular age class. Where age is known, most of the forests are under 40 years.

Figure 15: Area and Age-class Structure of Umbrella Pine Forests

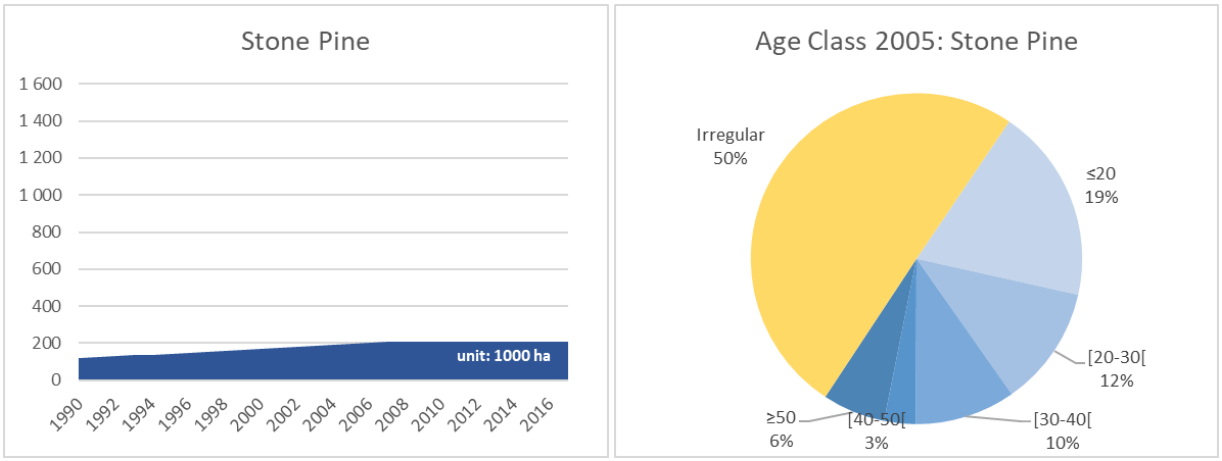
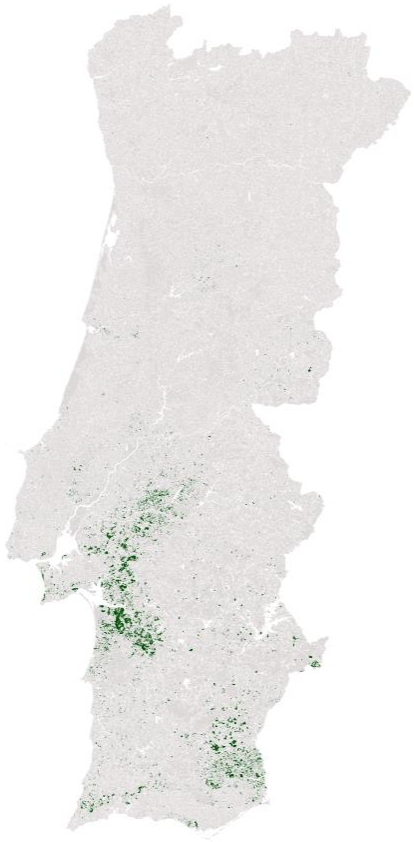


Figure 16: Distribution of Umbrella Pine Forests in Mainland Portugal (COS 2007)



2.2.8 Other Coniferous

Other coniferous forests are not particularly common in Portugal, except in the Azores Islands, where Japanese Cedar (Cryptomeria japonica) is locally one of the most important species. In Mainland Portugal and Madeira, other coniferous include other pines, such as the Scots Pine (Pinus sylvestris) and Aleppo Pine (Pinus halepensis), and other species such as Cypresses (Cupressus spp.) and Douglas Fir (Pseudotsuga menziesii). These species are used mostly for wood production, but industrial wood production from other coniferous is residual due to reduced presence of forest industries in the Azores, the limited areas managed for this purpose and the effect of forest fires (see section 2.3 Forest Management, Fires and Other Natural Disturbances below).

The area of Other Coniferous forests has increased from 22kha in 1990 to 26kha in 2017. 43% of the Other Coniferous forests have an irregular age class. Where age is known, most of the forests are under 30 years.

Figure 17: Area and Age-class Structure of Other Coniferous Forests

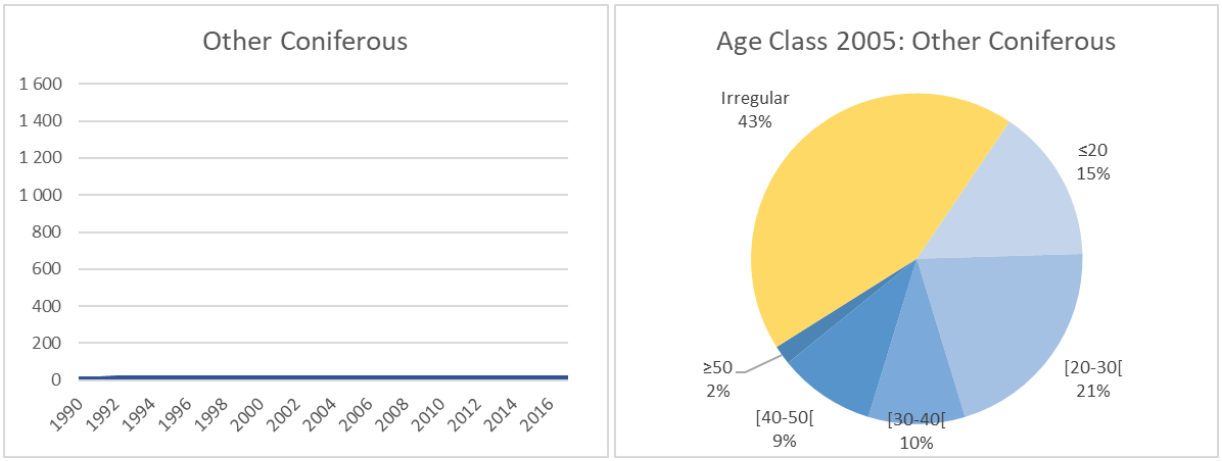


Figure 18: Distribution of Other Coniferous Forests in Mainland Portugal (COS 2007)

2.3 Forest Management, Fires and Other Natural Disturbances

Forest fires, storms, droughts, pests and invasive alien species are the main natural factors that threaten the sustainability of forests in Portugal. In mainland Portugal and Madeira, recurrent fires and pests (affecting mainly pine, eucalyptus and oaks) are the cause of the largest losses of forest area and productivity, with 85,000 ha of forest stands burned annually in the last decade (average). In the Azores, storms and alien plant invasions are the main limiting factors.

Wildfires are the most important natural disturbance in the Mediterranean context. Fire behaviour in forests depends on numerous factors including:

- Topographic factors, mostly slope and orientation
    - The mountainous regions of Centre and North (and the Island of Madeira) are the most affected
- Climatic and meteorological factors, mostly precipitation, temperature, wind and relative humidity
    - The worst situations being related with high levels of fine vegetation (usually associated with warm and wet Springs) combined with hot, dry and windy Summers
- Land-use and vegetation, mostly the presence or absence in forest areas of fine and easily combustible biomass, such as of forbs and herbs, shrubs, and young trees
    - The areas most affected are shrublands, followed by biomass dense forest areas
- Landscape mosaic, mostly the presence or absence of more fire resistant land-uses integrated into forest areas and the presence of absence of firefighting infrastructure, such as forest roads, firebreaks and low biomass areas and access of water sources to supply firefighting airplanes, helicopters and fire trucks.
- Human and cultural factors, such as the concentration of roads and urban areas, and of human activities, namely those that increase the risk of fires, such as agriculture, tourism, grazing, etc.

Figure 19: Average Annual Burning Intensity (burnt area of land-use / total area of land-use) per Land-use Type (1990-2017)

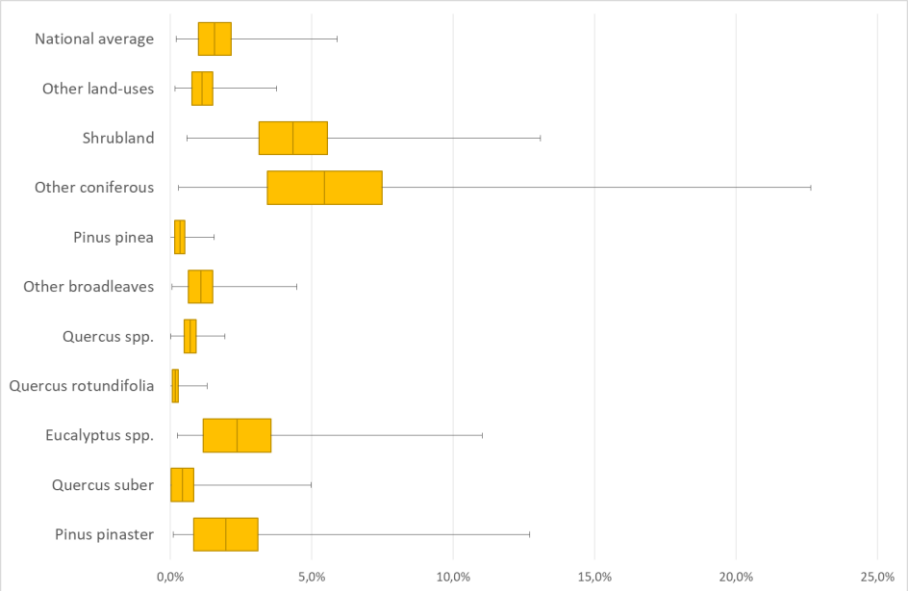
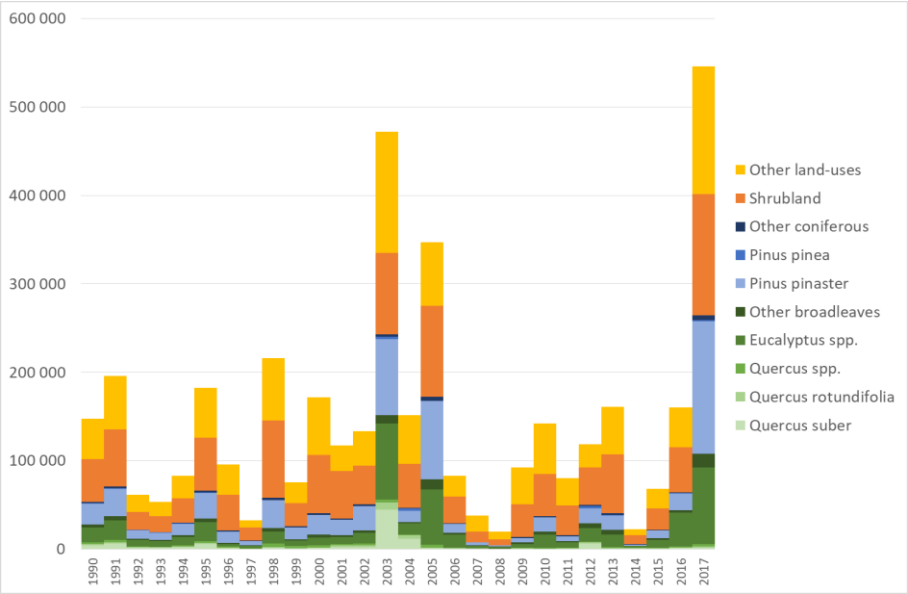


Figure 20: Inter-annual variability in Burnt Areas in the period 1990-2017



Portuguese forest types (and Mediterranean vegetation in general) have evolved in the presence of fires and have different strategies to resist to fire and/or to recover after the fire. Therefore, the effects of fire on forest area are not very significant and a forest land-use usually persists after fire. Exceptions may include areas where the recurrence of more than one fire over short periods leads to tree mortality and loss of the seed banks, leading, in the absence of management, to a conversion of forests to shrubs.

However, even if the effects of forest fires on forest area are not significant, the same cannot be said of its effects on growing stocks, age class and other forest attributes.

The first and most visible effect of fire is on tree mortality. However, tree mortality does not usually affect 100% of the trees. Post fire management involves removing dead trees, keeping the surviving trees, and renovating the areas where mortality was strongest through plantation or natural regeneration. This is in part responsible for the large shares of "irregular age class" shown for all forest types in the sections above and for a predominance of young age classes in the forest types most affected by fires.

The natural regeneration of burnt areas will use the seed bank available *in situ*, which sometimes leads to the establishment of mixed forests, e.g. of the presence of Maritime Pine in Eucalypt plantations, or of Other Oaks in Eucalyptus or Pine forests. Unfortunately, it may also promote the expansion of invasive (and fire dependent) tree species, such as Acacia spp. or Hakea spp.

Another effect of fire, particularly important in the FRL context, is impact on wood availability for harvest. In fact under "no fire" conditions, forest harvesting age is predictable given a certain age class distribution of forests and an expected rotation length. Fire will disturb this general pattern by anticipating harvesting of burnt (mostly dead) trees years (sometimes decades) before rotation length. This harvesting may have commercial values (included in the GHG Inventory under "salvage wood"), but may also include tree biomass without commercial value (included in the GHG Inventory under "fire emissions").

2.4 Forest Management and Biodiversity

The National Forest Strategy was first adopted by the Resolution of the Council of Ministers 114/2006. It was recently revised by the Resolution of the Council of Ministers 6-B/2015. It integrates a response to a number of EU and national Policy Instruments, including those related to Forests, Biodiversity and Climate Change.

Portugal's National Forest Strategy is framed around the following strategic objectives[2]:

A. Minimizing Risk of Fire and Harmful Biotic Agents
B. Specialisation of the Territory
    1. Plan the Regional Approach
    2. **Preserve soil and water in areas that are susceptible to desertification**
    3. **Ensure the protection of priority forest areas for biodiversity conservation**
        1. **Support for the conservation and restoration of high natural value forest / forest habitats**
        2. **Ensure the active management of forest areas that are habitats of protected species**
        3. **Maintenance and Recovery of Riparian Forests**
        4. **Typification and Qualification of Bushes and Shrubs of Forest Areas**
    4. Promote the protection of coastal areas
    5. Preserve the water regime
    6. **Adapt the species to the characteristics of the stand**
    7. **Increasing the contribution of Forests to climate change mitigation**
    8. **Promote forest resilience**
    9. Develop the importance of forests as components of the Green Infrastructure
C. Improving Forest Management and Forest Productivity
D. Internationalisation and Increase in Product Value
E. General Improvement of Sector Efficiency and Competitiveness
F. Rationalisation and Simplification of Policy Instruments

Conservation of biodiversity and the sustainable use of natural resources is subject of an extensive framework, including at EU level that is respected by Portugal and regularly reported to the EU Commission, in particularly the EU Biodiversity Strategy (specially Target 3b), but also under the Natura2000 Directive.

The contribution of forests to this aim is, therefore, achieved by both forest and nature conservation legislation and programs.

The content of the Forest Management Plans (PGF) includes a mandatory "management programme" specifically addressing the management of biodiversity whenever the forest holding is located within a "classified area" for nature conservation ("classified area" includes protected areas under different legal regimes, e.g. Natura 2000 and/or Sites of Community interest and/or under the Ramsar Convention).

[2] Each "strategic objective" is further detailed into "specific objectives" and "operational objectives". For the purposes of this document, the later are only presented for Strategic Objective B and Specific Objective B.3. For the full list please refer to the text of the strategy available at https://dre.pt/application/file/a/66432612

The Sectorial Plan of Natura 2000, approved by Resolution of the Council of Ministers n. º 15-A/2008, defines for each Natura 2000 site which are the practices and interventions (including in forestry) compatible with the protection of the natural values that led to its classification. In addition, protected areas under other regimes have specific and mandatory plans that have also to be considered, which also address forestry activities compatible with the preservation of natural values.

Roughly, around 25% of the all Forest Management Plans (FMPs) fall within the national system of classified areas (protected areas and/or Natura 2000 sites) and therefore have a programme for managing biodiversity. The FMPs for the territories with special status of protection include measures for the recovery and enhancement of biodiversity values and of both forest and non-forest species. In general, FMPs also address silvicultural measures to recover degraded forest. Also, nearly 30% of forest land (forest, shrubs, natural and spontaneous vegetation) in Portugal fall within one or more protection regime (nature legislation or protected areas) and so forestry activities in those areas, even if not covered by a FMP, have to be in line with requisites established for those areas. New afforestation activities need to be pre-communicated or authorized (for certain cases) by the national forest authority and may even require a full environmental impact assessment (e.g. establishment of Eucalyptus plantations in certain conditions) according to EU Directives and national legislation.

Forest owners also make use of voluntary certification instruments, like the internationally recognized certification systems Forest Stewardship Council / FSC Portugal[3] and the Programme for the Endorsement of Forest Certification / PEFC Portugal[4]), or adopt practices consistent with "codes of good practices for sustainable forest management". The Portuguese Standard NP 4406/2003 - Sustainable Forest Management System[5] applies the pan-European criteria for sustainable forest management and operational level guidelines and is used as the national standard for PEFC. Currently, there are 278 kha of PEFC certified forests and 424 kha of FSC certified forests.

2.5 Forests and biomass for energy

Forests and the products that result from the processing of wood and cork are an important source of energy in Portugal. However, information on the use of forest biomass for energy is challenging in Portugal for multiple reasons:

- The use of biomass in the housing sector is often based on an informal wood market or on low scale self-supply, which is hard to capture in official statistics and, hence, the consumption in this sector is estimated and not "measured" directly. Wood collected and consumed for this purpose includes the felling of individual trees (i.e. below the threshold for communication of harvesting), but also the pruning of both forest (particularly cork and holm oak trees) and agriculture trees (such as olive or fruit trees).
- Industries transforming agricultural or forest products tend to use preferably the biomass sources from their own activities, e.g., black liquor and tree bark in the pulp industries, wood dust, tree bark and wood particles in the wood industries, cork dust in cork products industries, olive pits in the olive oil industry, almond, nut or pine nut shells in the nuts industries, etc. Some industries, particularly the larger ones (e.g. in the pulp sector) may also use agriculture residues (e.g. pruning residues), biomass from forestry operations (e.g. tree tops and branches) or biomass wastes/by-products from other industries. The environmental reporting obligations of these industries and its enforcement provides estimates of biomass consumption which are considered accurate as to the total amount of biomass energy used, but less on the specifics of which type of biomass is used.
- The production of electricity uses as raw material residual forest biomass (e.g. tree tops, branches and shrubs) and not whole trees. Portugal possesses a reasonable capacity of forest industries capable of using relatively small diameters (pulp and wood panels), thus creating a market for (smaller) whole trees which is not competitive for electricity producers. Further, the incentives in place for the production of electricity

[3] https://pt.fsc.org/pt-pt

[4] https://www.pefc.pt/

[5] http://www2.icnf.pt/portal/florestas/gf/norm-gf/norma-gf

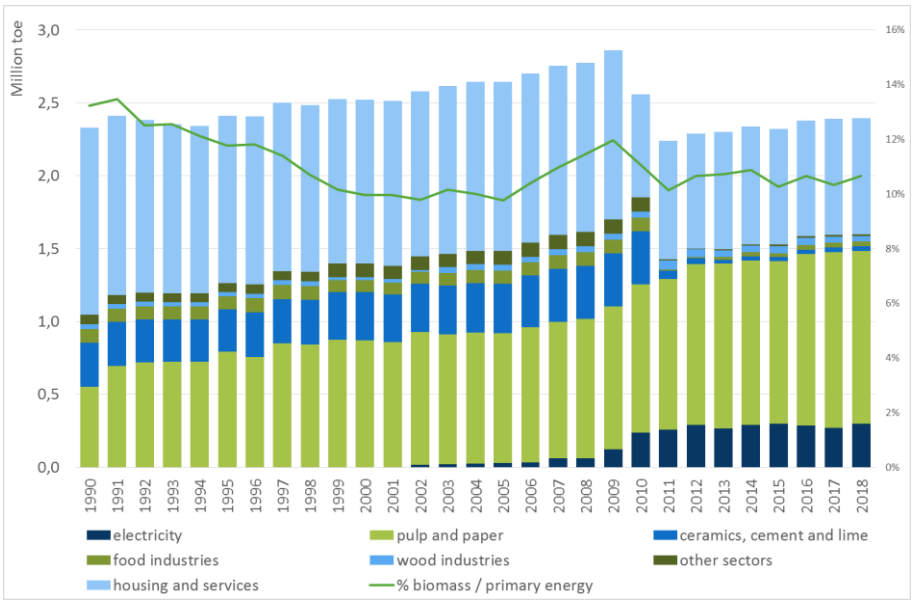
from biomass tend to favour the use of Combined Heat and Power (CHP), usually located next to forest industries, and, for dedicated power plants, the legislation favours the use of agriculture and forestry residues, rather than the use of whole trees. A new programme will support the establishment of new smaller scale biomass power plants, as part of a strategy to reduce the fuel load of forests (consumption of shrubs, non-commercial wood, tree tops and branches resulting from harvesting and fruit tree, vineyard and olive tree pruning wastes), and thus contribute to reducing the area of forest fires. Due to the nature of the targeted fuels, this is expected to increase the consumption of biomass, but not to increase harvesting as a whole.

Despite these difficulties in data gathering and compilation, there are two official data sources that provide some insight on the amounts of biomass used for energy in Portugal: the National Energy Balance; and the UNECE/FAO Timber Database.

According to the National Energy Balance[6] produced by the General Directorate of Energy and Geology (DGEG) the consumption of biomass for energy purposes has been relatively constant at around 2.5 million tons of oil equivalent[7], which amounts to about 10% of the Total Primary Energy Consumption (Figure 11). The main users are the domestic and services sector and the pulp and paper sector. Electricity production from biomass is more recent and has stabilised in recent years.

For the reasons listed above, data quality varies with user sector, and in this regard it should be noted the impact of a change in methodologies in the Energy Balance introduced in 2010, which makes the analysis of the full time series more challenging.

Figure 21: Primary Energy Consumption of Biomass
(forest and agriculture residues + by-products and wastes from the pulp, cork, wood and food industries)



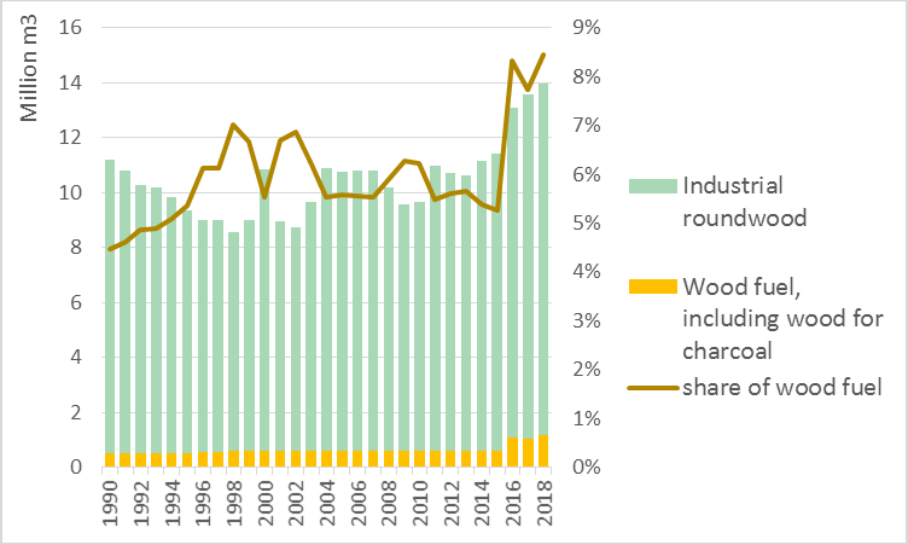
The UNECE/FAO Timber Database includes estimates of removals for industry (industrial roundwood) and for wood fuel, which place the later at 6.0% of total wood removals in the period 1990-2018 (5.5% in the period 1990-1999; 6.0% in 2000-2009 and 6.5% in the period 2010-2018). However, while industrial roundwood removals are estimated from industry questionnaires on wood consumption, the values for wood fuel are an estimate (with almost no changes in annual figures in the period 1971-2015), which reflects the difficulty in having proper estimations of figures on harvesting for energy. It should also be highlighted that "wood fuel"

[6] Available from http://www.dgeg.gov.pt/

[7] These figures do not include biogas and liquid biofuels. These represented an additional 362 thousand tons of oil equivalent in 2018.

and "biomass for energy" are not the equivalent variables, as the later includes non-forest sources of biomass and the wastes/by-products of transformation of industrial roundwood.

Figure 22: Wood Removals in Portugal in the UNECE/FAO Timber Database



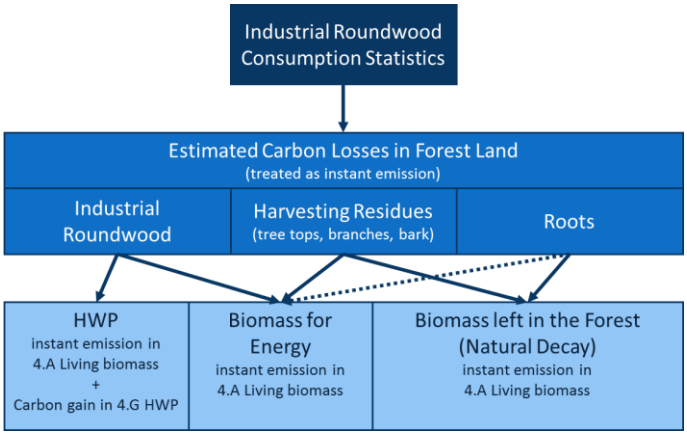
2.5.1 Treatment of biomass for energy in the GHG Inventory

Emissions from the use of biomass for energy are reported in the Energy sector in the sector where it is used. As per IPCC and UNFCCC reporting guidance and rules, Methane and Nitrous Oxide from biomass burning are included in National totals, while Carbon dioxide emissions are included as a "memo item". Emission estimates are based on the values from the Energy Balance, with a correction introduced to improve the time series consistency. This approach follows the requirement to avoid double counting and the rule that CO2 emissions from biomass should be reported and count towards the totals of the LULUCF Sector and not those of the Energy sector.

In the LULUCF sector, different losses of carbon are considered (see also section 3.4 CRF 4.A Living Biomass Pool / CO2 Emissions). These relate to bioenergy in the following manner:

- To overcome the lack of reliable official data of biomass consumption in the housing sector, the carbon losses associated with this type of consumption are estimated in the LULUCF sector not on the basis of official wood removals statistics, but rather as a share of annual growth (see section "3.4.2 Other Wood Uses" for more details). The Carbon losses associated with this methodology result in a more conservative (i.e. higher) estimate of forest emissions than would result from the use of the "Wood Fuel" removals from the UNECE/FAO Timber Database.
- In Industry and electricity production, the estimates for biomass consumption are considered reliable and accurate, but from the outline above, it is possible to conclude that most biomass consumed for energy does not usually originate from the felling and burning of whole trees, but rather from the burning of the wastes/by-products that result from the processing of industrial wood and cork, or from the processing of non-forest biomass. Since the GHG inventory treats the cutting of "industrial roundwood" as an "instant emission" of the whole tree (and not just the components incorporated in forest products), it follows that CO2 emissions from burning residues and by-products of wood processing industries are included in the losses from harvesting (see section 3.4.1 Harvesting for Industry), i.e. include the emissions from "biomass for energy" (see Figure 23 below).

Figure 23: Illustration on how Industrial Roundwood Statistics are used in the GHG Inventory



2.6 Economic relevance of forests

The production function is the most significant contributor to forest gross value, with its associated 876 M€. This is followed by the protection function 136 M€, the conservation function 66 M€ and to the function of silvopastoralism, hunting and fishing in the inland waters, which accounts for 312 M€. Expenditure on forest fires, phytosanitary measures and control of alien invasive species amounts a negative value of -394 M€ per year. Traditional forest related activities (forestry, hunting, fishing and forest industries) are responsible for about 80 000 jobs, particularly in economically depressed and depopulated regions.

Trees in the Portuguese forest represent a total volume of 186 million m3, and on average produce annually 11.5 million m3 of wood, mainly log of eucalyptus and pinewood, and 100 kt of cork, representing 50% of world cork production. The production of resin (8 kt), pine nuts (70 kt of umbrella pine cones) and chestnut (25 kt) is also relevant, as well as numerous other non-wood forest products, which are the raw material of several industries.

The Gross Value Added (GVA) of forestry and forest industries is about 800 million euros and represents 0.6% of the national GVA (2014, main products), while the forest sector is worth an estimated 2.5% of the national GDP. Forest products account for an average of 10% of exports (in value), with a high national incorporation rate (71%) and its value is of the same order of magnitude as the entire Portuguese food trade deficit.

Forest biomass is one of the main sources of energy currently used in Portugal and (among renewable energy sources) is the most easily used at any time of the year. A recent assessment estimated the potential availability of biomass for energy production (from forest and wood processing industry sources) at 2.2 Mt/year. About 2.7 ktoe comes from biomass, which corresponds to about 10% of the country's total final energy consumption. The installed capacity for electricity production is 553 MW, of which 123 MW without cogeneration (9 dedicated plants). Firewood and charcoal are very relevant for mostly domestic consumption, with coal production rising to an average of 16,800 tons per year in the last decade. The Portuguese production of pellets is also significant, with 1.1 million tons per year, of which 80% is destined for export.

Most of the forest areas have silvopastoral uses, either under tree cover (mainly in the "montado") or in improved pastures (eg. in the Azores), or in shrublands and spontaneous pastures, representing 2.3 million ha. The main autochthonous breeds, including the black pig, several mountain cattle breeds or the fighting bull, depend on forest areas. On the other hand, according to 2016 data, 87% of the territory is managed for hunting and over 114 thousand hunting licenses were issued. In relation to inland waters fishing there are already 313 fishing concessions and over 166 thousand fishing licenses issued, with 8 State aquaculture stations or fish hatcheries and 30 private fish farms in fresh water. There are hundreds of thousands of people involved in hunting and fishing, including tourists.

Forests are among the most important national tourism resources, sometimes associated with monuments (eg. Buçaco National Forest or Pena Park). Some case studies show the dimension of this value: the Laurissilva Forest of Madeira makes possible a touristic offer that is worth more than 140 M€/year [Rego, 2012].

In the Azores there is a network of 26 forest recreation reserves, and in Madeira a network of 7 forest parks and 23 recreational and leisure areas. In the Mainland, in the areas subject to the forest regime (forest perimeters and national forests) there are 231 forest recreation facilities, in addition to 14 urban/peri-urban forest parks managed by ICNF.

3 Description of the Forest Reference Level

3.1 Approach to FRL Construction

Portugal adopted a relatively simple approach to the construction of its Forest Reference Level (FRL).

The FRL is totally based on the National Inventory Report and the structure and contents of the respective Common Reporting Tables. The FRL refers to the UNFCCC category "4.A.1 Forest Land Remaining Forest Land" and results from the sum of the following quantities:

- Living Biomass Gains (CRF 4.A)
- Living Biomass Losses (CRF 4.A)
- Dead Wood Net-Emissions (CRF 4.A)
- Litter Net-Emissions (CRF 4.A)
- Mineral Soil Net-Emissions (CRF 4.A)
- Organic Soil Net-Emissions (CRF 4.A)
- Harvested Wood Products Net-Emissions (CRF 4.G)
- Emissions from Nitrogen Inputs to Managed Soils (CRF 4(I))
- Drainage and Rewetting of Soils (CRF 4(II))
- Direct N2O Emissions from N Mineralization associated with Loss of Soil Organic Carbon (CRF 4(III))
- Indirect N2O Emissions (CRF 4(IV))
- Biomass Burning Emissions (CRF 4(V))

Each of these quantities was estimated for the commitment period 2021-2025 bearing in mind the obligations under Article 8, paragraph 5 of Regulation (EU) 2018/841, which requires that the FRL to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data".

The general approach to implement this requirement was to find in the period 2000-2009 one or more relevant "intensity indicators" which could then be used to characterise the same "management intensity" during the FRL period 2021-2025.

Regulation (EU) 2018/841 further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land". This requirement is naturally ensured by using the NIR calculation model to calculate the emission estimates in the FRL period 2021-2025. This approach ensures full estimation consistency and will also allow for future recalculations to be done in a transparent and accurate manner.

The following sections detail the approach used for each of the above mentioned quantities.

3.2 General Assumptions and Coverage

3.2.1 Definition of Forest and Application of the Managed Land Proxy

Portugal has adopted a forest definition consisting of the following parameters:

- Minimum land area: 1 ha
- Minimum tree cover: 10%
- Minimum tree height: 5 m
- Minimum width: 20 m

Consistent with national definitions, agri-forest systems (mostly of cork-oak and holm-oak) were included as forests whenever the tree cover exceeded 10%. Where the tree cover is below 10%, the areas are classified according to the dominant land-cover, most commonly as cropland, pastures or shrublands.

Also consistent with national definitions, some woody perennial crops like olive groves, vineyards and fruit production orchards are included as cropland, even if the characteristics of the vegetation would reach the forest thresholds mentioned above.

These parameters and definition were elected in Portugal's Initial Report to the 1st Commitment Period, confirmed for the 2nd Commitment Periods of the Kyoto Protocol and are within the agreed values in decisions 16/CMP.1 and 2/CMP.7, respectively. These parameters are also consistent with the values contained in Annex V of Decision 529/2013/EU and Annex II of Regulation (EU) 2018/841.

This definition was applied in the Portuguese GHG Inventory, in KP reporting and accounting, and will be maintained and applied for the implementation Regulation (EU) 2018/841.

This definition is to be applied consistently both in the reference period 2000-2009 and in the compliance period 2021-2025.

All lands, including forest land, are considered managed in the Portuguese LULUCF GHG Inventory.

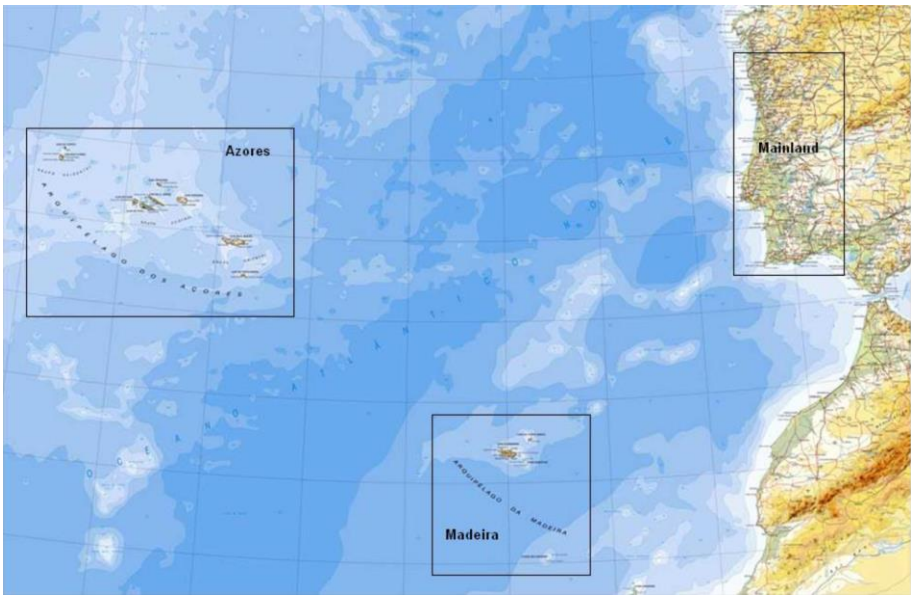
This assumption is to be applied consistently in both the reference period 2000-2009 and in the compliance period 2021-2025.

3.2.2 Geographical Coverage

Portugal has 9 239 318 ha, divided by the Mainland with 8 927 540 ha (96.6%), the Archipelago of Azores with 231 676 ha (2.5%) and Archipelago of Madeira with 80 102 ha (0.9%).

All lands in these three territories are considered and included in the Portuguese GHG Inventory.

This geographical coverage is to be applied consistently and is reflected in both in the reference period 2000-2009 and in the compliance period 2021-2025.



3.2.3 Conversion Period for Land-Use Changes

All land-use conversions in the Portuguese LULUCF GHG Inventory consider the IPCC default conversion period of 20 years. This includes all land-use transitions to and from forest land, as well as changes within forest land (e.g. changes in trees species).

Portugal will not apply the derogation foreseen in paragraph 2 of Article 6 of Regulation (EU) 2018/841 and consequently, land is shifted from the UNFCCC reporting category "A.2 Land Converted to Forests" (LF) to the category "A.1 Forest Land Remaining Forest Land" (FF) 20 years after the year of conversion.

This conversion period is applied consistently and is reflected in both in the reference period 2000-2009 and in the compliance period 2021-2025.

3.2.4 Stratification of Forest Land and other Land-uses

For the purposes of the Portuguese National GHG Inventory, land-use is stratified into 19 different classes, out of which forest lands are stratified according to eight classes.

All possible 19x19 land-use transitions are considered in PT NIR 2018.

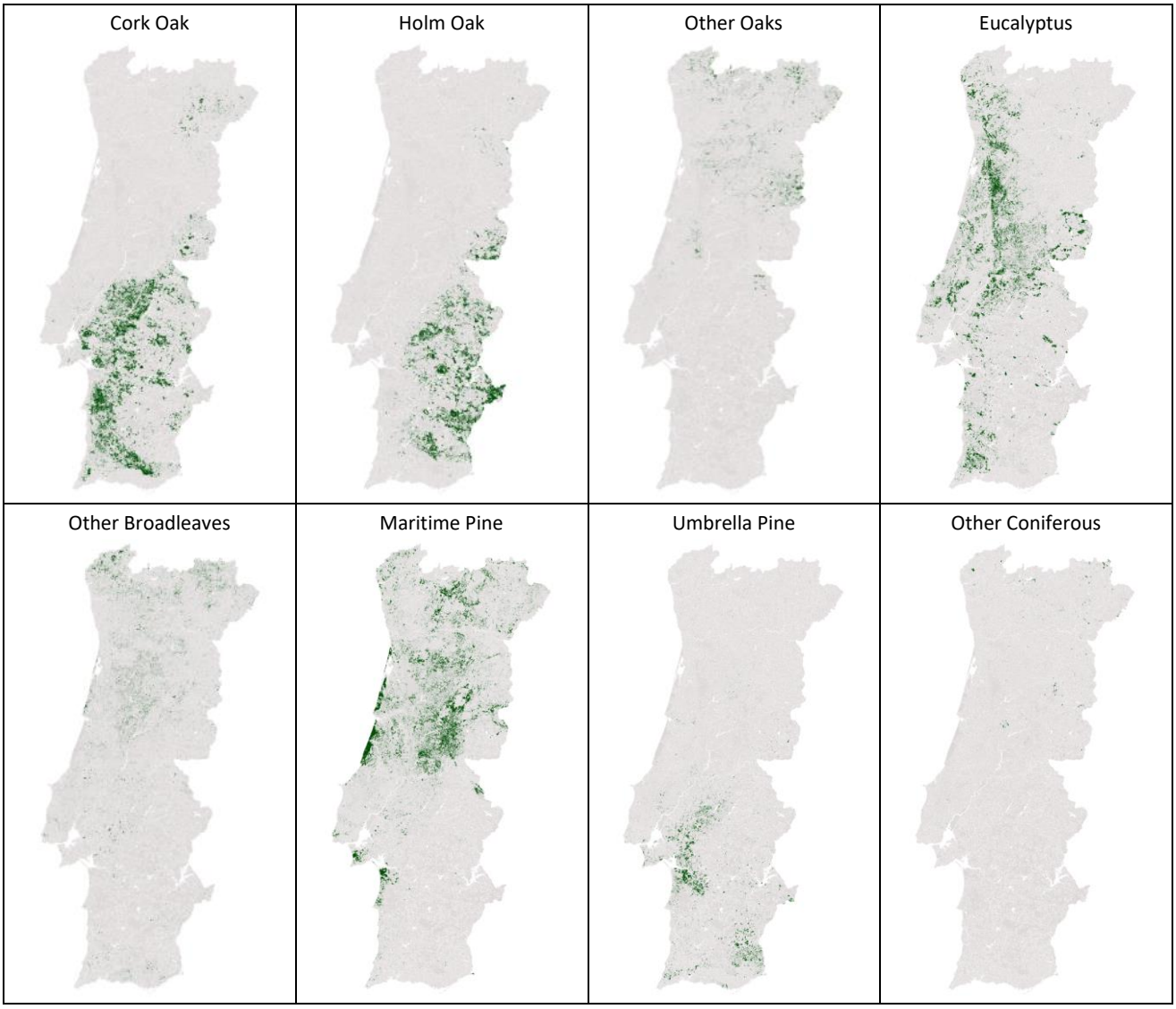
UNFCCC Category	Land-use Category Name	Description
Forest Land	Pinus pinaster	Forests dominated by maritime pine
	Quercus suber	Forests dominated by cork oak
	Eucalyptus spp.	Forests dominated by eucalypt species
	Quercus rotundifolia	Forests dominated by holm oak
	Quercus spp.	Forests dominated by other oaks
	Other broadleaves	Forests dominated by any other broadleaf species
	Pinus pinea	Forests dominated by umbrella pine
	Other coniferous	Forests dominated by any other coniferous species
Cropland	Rain-fed annual crops	Includes all land cultivated with annual crops without irrigation Includes fallow-land integrated into crop-rotations
	Irrigated annual crops	Includes all land cultivated with annual crops that is under irrigation (except rice) and greenhouses
	Rice paddies	Includes all land prepared for rice cultivation
	Vineyards	Includes all areas used for cultivation of table and/or wine grapes
	Olive groves	Includes all areas used for cultivation of Olea europea[8]
	Other permanent crops	Includes all areas used for cultivation of all other species of woody crops, including fruit orchards[9]
Grassland	All grasslands	Includes all lands covered in permanent herbaceous cover
Wetlands	Wetlands	Includes all lands permanently or temporarily covered in water, such as natural wetlands, water reservoirs and inland natural lagoons, lakes and estuaries
Settlements	Settlements	Includes all artificial territories, including cities and villages, industry, roads and railway, ports and airports
Other Land	Shrubland	Includes all lands covered in woody vegetation that do not meet the forest or permanent crop definitions
	Other land	Includes all lands that do not meet the previous definitions, such as lands covered in rocks, sand dunes, etc.

This stratification also reflects implicitly a climate stratification, since the main forest types are present in different climate/soil combinations (see Figure 24).

[8] Olive trees used for the production of olive oil and/or olives. The Wild Olive Tree (sub-species *Olea europea sylvestrys*) is reported as Forest Land / Other Broadleaves

[9] Except Sweet Chestnut (*Castanea sativa*), Carob Trees (*Ceratonia siliqua*) and Umbrella Pines (*Pinus pinea*), which are reported to FAO as forest land, even though their main production objective is the respective fruit.

Figure 24: Stratification of Forest Land and their Distribution in Mainland Portugal (2007)



This stratification is applied consistently and is reflected in both in the reference period 2000-2009 and in the compliance period 2021-2025.

3.2.4.1 Recalculations

Recalculations may be required during the Commitment Period in the event of changes in the stratification which affect relevant land-uses for the calculation of the FRL.

3.2.5 Forest Land and Area per Forest Stratum

In the Portuguese National GHG Inventory, the area of "Forest Land Remaining Forest Land" (FL↔FL) in year X is calculated as:

- the area of FL↔FL in year X-1

minus

- the area of "Forest Land converted to Other Land Uses" (FL→L) in year X

plus

- the area of "Other Land Uses converted to Forests" (L→FL) in year X-20.

Keeping unchanged the most recent trends in land-use changes (latest data available = LUC between 2007 and 2010) would lead to a stabilisation of the total forest area in Portugal (+0.05% by 2050 compared with estimate for 2016).

However, the area of Forest Land Remaining Forest Land (FL↔FL) is expected to increase by 5.49% by 2050 compared with estimate for 2016, as land afforested more than 20 years ago is moved from the reporting category L→FL into FL↔FL and deforestation (FL→L) is reduced from an annual average of 10.1kha in the period 2000-2009 to an average of 6.2kha in 2021-2025.

Table 1: Area of Forest Land Remaining Forest Land in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**3 633**	**3 638**	**3 643**	**3 648**	**3 653**	**3 671**	**3 689**	**3 732**	**3 755**	**3 787**	**3 685**
Pinus pinaster	1 186	1 171	1 155	1 139	1 124	1 108	1 092	1 086	1 079	1 071	1 121
Quercus suber	811	810	809	808	807	811	815	822	827	833	815
Eucalyptus spp.	502	519	536	553	570	594	618	644	662	685	588
Quercus rotundifolia	604	601	598	595	592	589	585	583	582	582	591
Quercus spp.	180	182	185	187	189	190	190	192	192	192	188
Other broadleaves	224	227	229	231	234	239	245	253	259	265	241
Pinus pinea	106	109	112	116	119	122	124	132	134	137	121
Other coniferous	19	19	19	19	19	19	19	20	20	21	20

unit: 1000ha

Table 2: Area of Forest Land Remaining Forest Land Considered in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**4 118**	**4 142**	**4 166**	**4 191**	**4 215**	**4 166**
Pinus pinaster	1 064	1 069	1 073	1 077	1 081	1 073
Quercus suber	899	903	908	913	918	908
Eucalyptus spp.	838	843	849	854	860	849
Quercus rotundifolia	583	583	584	585	585	584
Quercus spp.	203	204	205	206	207	205
Other broadleaves	326	330	333	337	341	333
Pinus pinea	186	190	195	200	205	195
Other coniferous	20	20	19	19	18	19

unit: 1000ha

For information only: changes in total forest area

Table 3: Area of Forest Land in the Reference Period 2000-2009

4.A Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**4 219**	**4 239**	**4 258**	**4 278**	**4 297**	**4 317**	**4 337**	**4 356**	**4 357**	**4 358**	**4 302**
Pinus pinaster	1 254	1 250	1 246	1 241	1 237	1 233	1 228	1 224	1 219	1 214	1 235
Quercus suber	894	898	901	905	908	912	916	919	921	922	910
Eucalyptus spp.	747	758	770	781	793	805	816	828	831	834	796
Quercus rotundifolia	613	611	609	608	606	604	603	601	601	601	606
Quercus spp.	206	207	208	209	210	211	212	214	214	214	210
Other broadleaves	310	313	317	321	325	329	333	336	338	339	326
Pinus pinea	169	174	179	184	190	195	200	206	206	206	191
Other coniferous	27	28	28	28	28	28	29	29	29	28	28

unit: 1000ha

Table 4: Area of Forest Land Considered in the Period 2021-2025

4.A Forest Land	2021	2022	2023	2024	2025	FRL
Total	**4 367**	**4 367**	**4 368**	**4 368**	**4 368**	**4 368**
Pinus pinaster	1 156	1 151	1 146	1 141	1 136	1 146
Quercus suber	939	940	942	943	945	942
Eucalyptus spp.	873	875	878	881	884	878
Quercus rotundifolia	600	600	600	599	599	600
Quercus spp.	213	213	213	213	213	213
Other broadleaves	353	355	356	357	358	356
Pinus pinea	211	211	212	212	212	212
Other coniferous	23	22	22	21	20	22

unit: 1000ha

For information only: changes in land converted to forest land

Table 5: Area of Land Converted to Forest Land in the Reference Period 2000-2009

4.A.2 Land Converted to Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**586**	**600**	**615**	**629**	**644**	**645**	**647**	**625**	**602**	**572**	**616**
Pinus pinaster	68	79	91	102	113	124	136	138	140	143	113
Quercus suber	83	87	92	97	101	101	101	97	94	89	94
Eucalyptus spp.	244	239	234	228	223	211	198	183	169	149	208
Quercus rotundifolia	9	10	11	13	14	16	17	18	18	19	15
Quercus spp.	26	25	24	22	21	22	22	22	22	21	23
Other broadleaves	85	87	88	90	91	89	88	83	79	73	85
Pinus pinea	63	65	67	69	71	73	76	74	72	69	70
Other coniferous	8	8	9	9	9	9	9	9	8	8	9

unit: 1000ha

Table 6: Area of Land Converted to Forest Land Considered in the FRL 2021-2025

4.A.2 Land Converted to Forest Land	2021	2022	2023	2024	2025	FRL
Total	**250**	**225**	**201**	**177**	**153**	**201**
Pinus pinaster	91	82	73	64	55	73
Quercus suber	40	37	34	30	27	34
Eucalyptus spp.	35	32	29	27	24	29
Quercus rotundifolia	17	16	16	15	14	16
Quercus spp.	11	10	9	7	6	9
Other broadleaves	27	25	22	20	17	22
Pinus pinea	25	21	17	12	8	17
Other coniferous	3	3	2	2	2	2

unit: 1000ha

3.2.5.1 Recalculations

Recalculations will be required to reflect the observed total areas and areas of land-use changes that occur during the Commitment Period.

3.2.6 Carbon Pools and Gases

Portugal currently reports CO2 in the carbon pools referred to in Table 7. In addition, other emission sources and GHG gases mentioned in tables CRF 4(I) to 4(V) as detailed in Table 8. The FRL 2021-2025 considers the exact some coverage.

Table 7: Carbon Pools considered in the reporting of CO_2 emissions and removals in Portugal 1990-2016 and in the FRL 2021-2025

Table 4.A	Living Biomass			Dead Organic Matter		Soils	
CO_2	Gains	Losses	Net-change	Dead wood	Litter	Mineral	Organic
Forest Land	Reported	Reported	Reported	Included elsewhere	Reported	Reported	Not occurring

Table 8: Other GHG gases and sources considered in the reporting of emissions and removals in Portugal 1990-2016 and in the FRL 2021-2025

CRF Table	CO_2	CH_4	N_2O
4(I) N inputs to soils Forest Land remaining Forest Land			Included elsewhere
4(II) Drainage and rewetting Forest Land remaining Forest Land	Not occurring	Not occurring	Not occurring
4(III) N mineralisation / loss of SOC Forest Land remaining Forest Land			Reported
4(IV) Indirect N_2O emissions Forest Land remaining Forest Land			Reported
4(V) Biomass burning Forest Land remaining Forest Land	Reported	Reported	Reported

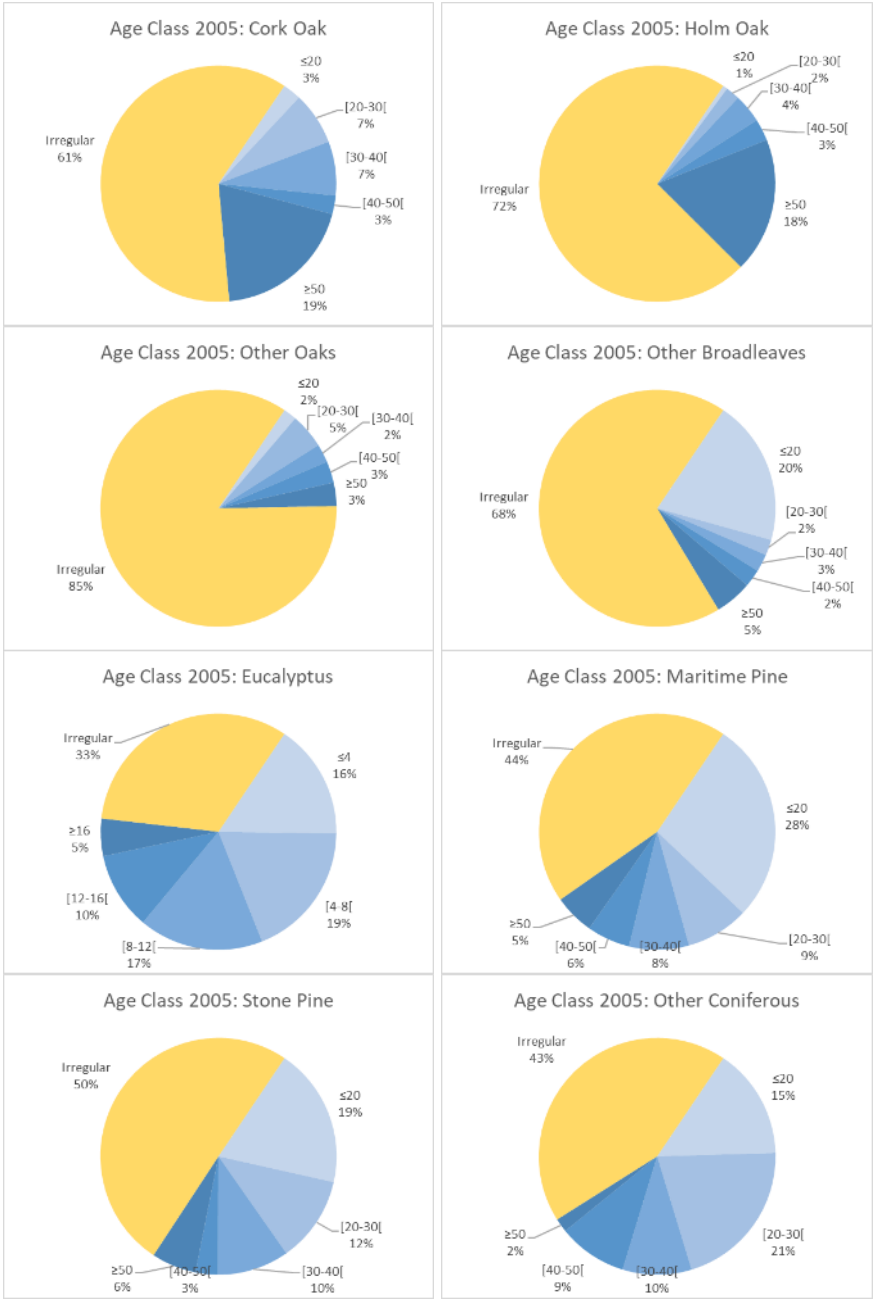
3.2.6.1 Recalculations

Recalculations may be required during the Commitment Period in the event of increases in the coverage of pools and/or gases.

3.2.7 Age Structure of Main Strata and Rotation Length

The age class for the main forest types in Portugal is described in section "2.2 Forest management practices and context" and presented in Figure 25.

Figure 25: Age-Class Structure of Portuguese Forests in 2005, per forest type



Where forests are managed for wood production with limited mortality or natural disturbances, age-class structure, combined with rotation age, is usually a good proxy for estimating harvesting expectations (and carbon losses) in the future.

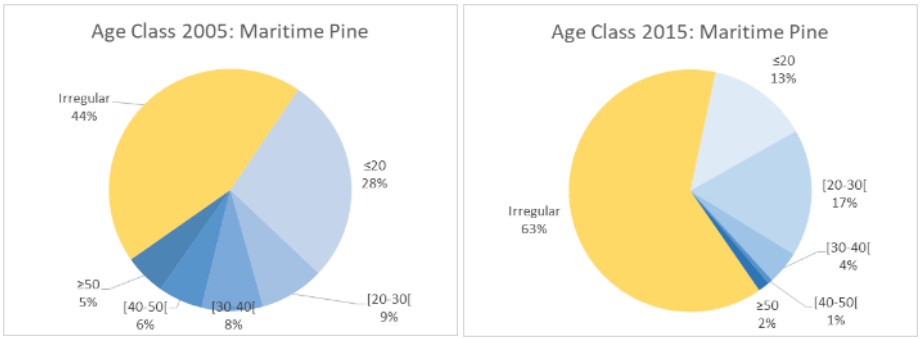
However, and as outlined in section "2.2 Forest management practices and context" many forests in Portugal are not managed with wood production as the main forest product, and/or have a significant impact from natural disturbances and therefore age class is not considered a good proxy for estimating future carbon losses.

- Cork oak forests are managed for cork and agri-pasture-forestry systems. Harvesting of whole trees is prohibited by law and cork harvesting increases with tree size (age). Carbon losses are therefore not

associated with final or selective felling of whole trees, but rather by natural mortality, losses by pruning to improve tree shape for acorn production and losses by forest fires. These are included in the GHG Inventory as, respectively, "Natural Mortality" and "Other Wood Uses". Losses from fires are included in "Biomass Burning". Losses from "Harvesting for Industry" are assumed zero.

- Holm oak forests are managed in similar manner as cork-oak forests, with the exception that they don't produce cork. Their management is even more focused on acorn production for animal grazing, which also improves with tree size (age). Harvesting of whole trees is also prohibited and therefore carbon losses originate in natural mortality, losses by pruning to improve tree shape for acorn production and losses by forest fires. These are included in the GHG Inventory as, respectively, "Natural Mortality" and "Other Wood Uses". Losses from fires are included in "Biomass Burning". Losses from "Harvesting for Industry" are assumed zero.
- Other oak and Other broadleaves forests are semi-natural forests subject to relatively high disturbances (mostly fires and but also clearing for grazing), and therefore marked by a predominantly irregular structure and younger age classes. Production of industrial wood would require the absence of natural disturbances for long periods (several decades) and therefore industrial wood production is residual in these forests. Carbon losses originate from natural mortality and firewood production, which are included in the GHG Inventory as, respectively, "Natural Mortality" and "Other Wood Uses". Losses from fires are included in "Biomass Burning". Losses from "Harvesting for Industry" are assumed zero.
- Eucalyptus forests are plantation forests managed mostly for wood production. Their fast rotation (12 year cycles), explains why 50% of the area (or 78% excluding irregular aged forests) is under 12 years of age. Irregular and mixed forests usually have their origins in post fire recovery and often are associated with abandoned areas or areas with low management intensity. Forest fires affect Eucalyptus forests and their main effect is to "reset" the plantation age before the 12 year cycles are completed, but they usually persist after fire and the production cycle is reinitiated after fire. This means that both over a 10 year reference period (2000-2009) and compliance period (2021-2030) almost all actively managed Eucalyptus plantations will be harvested once. Carbon losses originate from natural mortality and industrial wood production, which are included in the GHG Inventory as, respectively, "Natural Mortality" and "Harvesting for Industry". Losses from fires are included in "Biomass Burning". Losses from "Other Wood Uses" are assumed included in "Harvesting for Industry".
- Maritime pine forests are mostly managed for industrial wood production, although significant areas are also associated with protection forests, especially those located along the Atlantic coast and sand dunes. The wood from Maritime Pine is extremely versatile and its uses range from fence poles (thinning at ages 10-15), pulpwood and wood panels (thinning at ages 15-30), to construction and furniture wood (final felling at ages >30 years). Irregular and mixed forests usually have their origins in post fire recovery and often are associated with abandoned areas or areas with low management intensity. These forests are very prone to forest fires and post-fire recovery is ensured by natural regeneration (soil seed bank), or by artificial seeding and/or plantation. Forest fires and, more recently, new pests have reduced the interest of forest owners in this species, which contributes to the observed loss of area (conversion to other forest species or to shrublands) but also to an increase in irregular stands and abandoned forests. Carbon losses originate from natural mortality and industrial wood production, which are included in the GHG Inventory as, respectively, "Natural Mortality" and "Harvesting for Industry". Losses from fires are included in "Biomass Burning". Losses from "Other Wood Uses" are assumed included in "Harvesting for Industry".

Figure 26: Age-class structure in Maritime Pine Forests in 2005 and 2015



- Umbrella pine forests are mostly managed for the highly valued pine nuts production. Fruit production increases with tree age, and final felling for industrial wood production is residual. Carbon losses are therefore not associated with final or selective felling of whole trees, but rather by natural mortality, losses by thinning or pruning to improve tree shape for acorn production and losses by forest fires. These are included in the GHG Inventory as, respectively, "Natural Mortality" and "Other Wood Uses". Losses from fires are included in "Biomass Burning". Losses from "Harvesting for Industry" are assumed zero.

For the reasons outlined above, age class structure was not considered explicitly as a main driver for the prediction of Carbon Losses in the Portuguese Forest Reference Level.

3.2.8 Biomass Conversion and Expansion Factors, Root-do-Shoot Factors, Carbon Fractions

The Biomass Conversion and Expansion Factors (BCEF), Root-do-Shoot Factors (RtS) and Carbon Fractions (CF) used in the PT NIR 2018 are described in section 6.1.3.1.

They are constant per each forest type over the entire time series, including the reference period 2000-2009. The FRL 2021-2025 uses the same values.

Table 9: Biomass Conversion and Expansion Factors, Root-do-Shoot Factors, Carbon Fractions considered in the reporting of emissions and removals in Portugal 1990-2016 and in the FRL 2021-2025

Forest Species	BCEF	RtS	CF (tree)	CF (litter)
Pinus pinaster	0,528	0,118	0,51	0,37
Quercus suber	1,239	0,147	0,48	0,37
Eucalyptus spp.	0,630	0,234	0,48	0,37
Quercus rotundifolia	0,797	0,587	0,48	0,37
Quercus spp.	0,900	0,295	0,48	0,37
Other broadleaves	0,825	0,433	0,48	0,37
Pinus pinea	1,166	0,078	0,51	0,37
Other coniferous	0,532	0,121	0,51	0,37

3.2.8.1 Recalculations

Recalculations may be required during the Commitment Period in the event of revision of these values.

3.2.9 Natural Disturbances – Background Level and Margin

Natural disturbances are an important feature and emission driver in Portuguese forests. They are characterised by a strong inter-annual variability and unpredictability.

The most important type of natural disturbances affecting forests in Portugal are forest fires, and their emissions are currently reported under CRF table 4(V), using the methodologies described in PT NIR 2018 section 6.13.

Although other natural disturbances also occur, notably wind damage, drought and insects, there is currently no estimation of emissions and removals associated with these types of natural disturbances. This is due to a lack of data to characterise the annual impact of such disturbance types and a lack of methodologies to estimate the corresponding annual emissions and removals.

Therefore, the contribution of natural disturbances for the FRL was made equal to the background level for natural disturbances, calculated following the methodology described in Annex VI of Regulation (EU) 2018/841 and considering only the emissions from forest fires. As showed in the table below, the iteration process foreseen in the referred methodology was stopped at the 2nd iteration.

Table 10: Calculation of the background level for Natural Disturbances in forest land remaining forest land

Estimation of Background Level and Margin of Natural Disturbances		Average	Standard deviation	Exclusion criteria	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
A.1. Forest land remaining Forest land	$GgCO_{2eq}$	1 536	1 832	> than	1 096	1 655	6 479	1 098	5 533	803	234	149	410	1 168	461	1 452	1 319	139	708	1 868	*NA*	*NA*	*NA*	*NA*
1st iteraction				5 199	keep	keep	excl.	keep	excl.	keep	keep	keep	keep	keep	keep	keep	keep	keep	keep	keep	*NA*	*NA*	*NA*	*NA*
A.1. Forest land remaining Forest land	$GgCO_{2eq}$	897	569	> than	1 096	1 655		1 098		803	234	149	410	1 168	461	1 452	1 319	139	708	1 868	*NA*	*NA*	*NA*	*NA*
2nd iteraction				2 034	keep	keep	excl.	keep	excl.	keep	keep	keep	keep	keep	keep	keep	keep	keep	keep	keep	*NA*	*NA*	*NA*	*NA*
Background level FL↔FL	**$GgCO_{2eq}$**	**897**																						
Margin FL↔FL	**$GgCO_{2eq}$**	**569**																						

Using the average of burnt areas per forest type as a reference, and excluding the same years, the burnt areas per forest type implicit for the period 2021-2025 are the ones presented in the table below. These areas are used to estimated volumes of salvage wood (see section 0) and Indirect N2O emission (see section 3.13)

Table 11: Historical 2001-2020 annual burnt areas per forest stratum and implicit FRL 2021-2025 annual burnt areas

Activity data - Annual Burnt Area A.1. Forest land remaining Forest land		FRL 2021-2025	Historical average	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Pinus pinaster	ha	10 247	18 871	16 018	25 226	78 938	11 451	79 536	8 832	2 410	1 688	3 960	13 900	4 619	15 000	14 606	1 161	7 915	16 678	*NA*	*NA*	*NA*	*NA*
Quercus suber	ha	1 982	4 329	2 550	2 228	40 195	10 409	1 315	891	319	76	496	391	337	6 273	980	874	512	1 414	*NA*	*NA*	*NA*	*NA*
Eucalyptus spp.	ha	9 398	14 917	5 290	8 627	61 004	8 990	46 097	11 285	1 852	1 622	3 173	12 321	5 416	13 865	13 155	2 086	7 907	35 981	*NA*	*NA*	*NA*	*NA*
Quercus rotundifolia	ha	857	1 273	1 449	1 771	7 751	3 920	610	417	481	0	555	104	584	864	306	523	645	381	*NA*	*NA*	*NA*	*NA*
Quercus spp.	ha	807	1 065	1 482	1 735	2 864	830	2 880	486	338	114	786	1 141	715	893	893	46	634	1 210	*NA*	*NA*	*NA*	*NA*
Other broadleaves	ha	1 845	2 535	1 698	1 927	6 449	1 234	8 272	1 201	916	454	1 670	2 849	1 184	4 112	4 202	172	1 724	2 491	*NA*	*NA*	*NA*	*NA*
Pinus pinea	ha	404	481	340	220	1 806	1 731	235	196	165	0	83	382	37	1 888	57	108	129	318	*NA*	*NA*	*NA*	*NA*
Other coniferous	ha	661	881	524	1 290	1 916	482	2 911	508	243	60	863	612	724	850	1 630	121	692	662	*NA*	*NA*	*NA*	*NA*
A.1. Forest land remaining Forest land	**ha**	**26 202**	**44 351**	**29 349**	**43 023**	**200 924**	**39 047**	**141 857**	**23 816**	**6 724**	**4 015**	**11 587**	**31 699**	**13 617**	**43 746**	**35 828**	**5 091**	**20 158**	**59 134**	***NA***	***NA***	***NA***	***NA***

3.2.9.1 Recalculations

Regulation (EU) 2018/541 requires that the background level of emissions from natural disturbances is to be calculated on the basis of real data for the period 2001-2020. At the time of this submission, data is only available for the period 2001-2016. A recalculation of the background level will be made as new data is made available. Future changes in the methodologies for estimating fire emissions affecting the period 2001-2020 will also trigger recalculations. Finally, additional recalculations may be required in case methodologies for estimating the emission impacts of other types of disturbances are developed and implemented during the commitment period.

3.3 CRF 4.A Living Biomass Pool / CO2 Removals

Article 8, paragraph 5 of Regulation (EU) 2018/841 requires that the Forest Reference Level to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data". If further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land".

In the case of Forest Annual Growth this is ensured by:

- Using the average growth rates (m^3/ha), average BCEF and RTS factors per forest type in the period 2000-2009 and applying them to the areas per forest type in the period 2021-2025
- Using the same calculation methods and factors described in the National Inventory Report of 2018 (please refer to PT NIR 2018, section 6.2.1.2.1)

The historical growth rates per unit of area are shown in Table 12 (above ground) and in Table 14 (below ground) for the reference period 2000-2009 and in Table 13 (above ground) and in Table 15 (below ground) for the forest reference level 2021-2025.

Table 12: Forest Annual Growth Rates in Above Ground Biomass per Unit of Area Considered in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total											
Pinus pinaster	2,03	2,02	2,02	2,01	2,01	2,00	2,00	2,00	2,00	2,00	2,01
Quercus suber	0,59	0,59	0,58	0,58	0,57	0,56	0,56	0,56	0,56	0,56	0,57
Eucalyptus spp.	3,02	3,02	3,02	3,02	3,02	3,02	3,02	3,02	3,02	3,02	3,02
Quercus rotundifolia	0,29	0,28	0,27	0,27	0,26	0,25	0,25	0,25	0,25	0,25	0,26
Quercus spp.	1,64	1,63	1,62	1,61	1,60	1,59	1,59	1,59	1,59	1,59	1,60
Other broadleaves	1,80	1,80	1,79	1,79	1,78	1,78	1,78	1,78	1,78	1,78	1,79
Pinus pinea	3,54	3,53	3,52	3,51	3,51	3,50	3,50	3,50	3,50	3,50	3,51
Other coniferous	1,49	1,49	1,48	1,47	1,47	1,46	1,46	1,46	1,46	1,46	1,47

unit: GgC.ha^{-1}.year^{-1}

Table 13: Forest Annual Growth Rates in Above Ground Biomass per Unit of Area Considered in the Forest Reference Level 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total						
Pinus pinaster	2,01	2,01	2,01	2,01	2,01	2,01
Quercus suber	0,57	0,57	0,57	0,57	0,57	0,57
Eucalyptus spp.	3,02	3,02	3,02	3,02	3,02	3,02
Quercus rotundifolia	0,26	0,26	0,26	0,26	0,26	0,26
Quercus spp.	1,60	1,60	1,60	1,60	1,60	1,60
Other broadleaves	1,79	1,79	1,79	1,79	1,79	1,79
Pinus pinea	3,51	3,51	3,51	3,51	3,51	3,51
Other coniferous	1,47	1,47	1,47	1,47	1,47	1,47

unit: GgC.ha^{-1}.year^{-1}

Table 14: Forest Annual Growth rates in Below Ground Biomass per unit of area considered in the reference period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total											
Pinus pinaster	0,30	0,30	0,29	0,29	0,29	0,29	0,29	0,29	0,29	0,29	0,29
Quercus suber	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08
Eucalyptus spp.	0,69	0,69	0,69	0,69	0,69	0,69	0,69	0,69	0,69	0,69	0,69
Quercus rotundifolia	0,12	0,12	0,12	0,12	0,12	0,12	0,12	0,12	0,12	0,12	0,12
Quercus spp.	0,47	0,47	0,46	0,45	0,44	0,44	0,44	0,44	0,44	0,44	0,45
Other broadleaves	0,59	0,60	0,61	0,62	0,62	0,63	0,63	0,63	0,63	0,63	0,62
Pinus pinea	0,29	0,29	0,29	0,29	0,29	0,29	0,29	0,29	0,29	0,29	0,29
Other coniferous	0,25	0,24	0,23	0,22	0,20	0,19	0,19	0,19	0,19	0,19	0,21

unit: GgC.ha^{-1}.year^{-1}

Table 15: Forest Annual Growth rates in Below Ground Biomass per unit of area considered in the Forest Reference Level 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total						
Pinus pinaster	0,29	0,29	0,29	0,29	0,29	0,29
Quercus suber	0,08	0,08	0,08	0,08	0,08	0,08
Eucalyptus spp.	0,69	0,69	0,69	0,69	0,69	0,69
Quercus rotundifolia	0,12	0,12	0,12	0,12	0,12	0,12
Quercus spp.	0,45	0,45	0,45	0,45	0,45	0,45
Other broadleaves	0,63	0,63	0,63	0,63	0,63	0,63
Pinus pinea	0,29	0,29	0,29	0,29	0,29	0,29
Other coniferous	0,20	0,20	0,20	0,20	0,20	0,20

unit: GgC.ha^{-1}.year^{-1}

The application of the above mentioned factors to the areas described in section 3.2.5 results in the annual gains shown in Table 16, for reference period 2000-2009, and in Table 17, for the Forest Reference Level period of 2021-2025. The average for the period 2021-2025 equals 8 436 ktC.year^{-1}, and therefore the contribution of this variable for the Forest reference Level 2021-2025 is +30 932 $ktCO_{2eq}$.year^{-1} (= 8 436 ktC.year^{-1} x 44/12).

Table 16: Forest Gains considered in the reference period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**6 776**	**6 802**	**6 827**	**6 853**	**6 879**	**6 937**	**7 016**	**7 154**	**7 231**	**7 331**	**6 981**
Pinus pinaster	2 756	2 713	2 669	2 626	2 583	2 540	2 504	2 489	2 473	2 456	2 581
Quercus suber	548	542	536	530	524	522	524	529	532	536	532
Eucalyptus spp.	1 866	1 928	1 990	2 052	2 114	2 201	2 289	2 387	2 455	2 539	2 182
Quercus rotundifolia	250	244	238	232	226	221	220	219	218	218	229
Quercus spp.	380	382	384	385	387	384	385	388	389	390	385
Other broadleaves	537	543	549	556	562	577	590	610	623	639	579
Pinus pinea	406	417	428	440	451	461	472	499	508	519	460
Other coniferous	34	33	33	32	31	32	32	33	33	34	33

unit: GgC

Table 17: Forest Gains considered in the Forest Reference Level 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**8 311**	**8 374**	**8 436**	**8 498**	**8 561**	**8 436**
Pinus pinaster	2 450	2 460	2 469	2 479	2 488	2 469
Quercus suber	587	590	593	596	599	593
Eucalyptus spp.	3 108	3 129	3 149	3 170	3 190	3 149
Quercus rotundifolia	226	226	227	227	227	227
Quercus spp.	415	417	419	422	424	419
Other broadleaves	787	796	805	814	823	805
Pinus pinea	705	723	742	760	778	742
Other coniferous	34	33	32	31	31	32

unit: GgC

3.3.1 Recalculations

Recalculations will be required in the event of changes to the historical growth rates per unit of area, in the methodologies and/or in the expansion factors affecting any of the years in the period 2000-2009. Recalculations will also be necessary as the forest area is replaced from the estimates presented in section 3.2.5 with their final values.

3.4 CRF 4.A Living Biomass Pool / CO2 Emissions

As explained in the PT NIR 2018 (please refer to table 6.23, page 6-32), Carbon losses are estimated as the sum of: Industrial harvest; Other wood uses; Salvage wood; Forest conversion; and Natural Mortality.

Table 18: Summary of types of losses in living biomass considered in the estimations of emissions and removals in forest land

Type of C loss	Definition / data source	Allocation L->FL and FL->FL
Industrial harvest	Industry wood consumption. Hardwoods fully allocated to Eucalyptus spp. and softwoods fully allocated to Pinus pinaster as these are the main tree species used by industry; estimates include the loss of biomass from the entire tree (AG and BG biomass) at the year of harvest / INE	L->FL = only eucalyptus has harvesting before the end of the transition period. Allocated based on share of L->Eucalyptus / total Eucalyptus area FL->FL = total – L->FL
Other wood use	Wood uses for un-declared purposes (small industry or households), pruning and non-industrial thinning; estimated as 25% of mean annual increment / Expert judgment[130]	L->FL = allocation based on area per forest type FL->FL = allocation based on area per forest type
Salvaged wood	Wood with industry or household use resulting from forest fires; estimates include the loss of biomass from the entire tree (AG and BG biomass) at the year of fire / Expert judgment	L->FL = allocation based on area per forest type FL->FL = allocation based on area per forest type
Forest conversion	Losses from converting one forest type into another forest type (change in dominant species); estimated based on loss of standing volume of previous forest type; estimates include the loss of biomass from the entire tree (AG and BG biomass) at the year of conversion / IFN (2005)	L->FL = not applicable FL->FL = based on land-use change areas in reporting year
Natural mortality (non-fire related)	Natural mortality and self-thinning of trees; estimated based on percentage of number of non-burnt dead trees and assuming all standing dead trees died over the past 3 years / IFN (2005)	L->FL = allocation based on area per forest type FL->FL = allocation based on area per forest type
Conversion to forest (afforestation)	Losses from converting a non-forest land-use type into a forest type; estimated based on loss of living biomass of previous land-use type / EEA and Spanish NIR	L->FL = allocation based on area per previous land-use per new forest type FL->FL = not applicable
Non-salvaged wood	Wood with industry or household use resulting from forest fires; estimates include the loss of biomass from the entire tree (AG and BG biomass) at the year of fire / Expert judgment	Reported as "fire emissions" not as "losses" L->FL = allocation based on area per forest type FL->FL = allocation based on area per forest type
Deforestation	Losses from converting one forest type into another land-use; estimated based on loss of standing volume of previous forest type; estimates include the loss of biomass from the entire tree (AG and BG biomass) at the year of deforestation / IFN (2005)	Reported as "losses" from FL->L in the respective land-use and not as Forest land emissions

3.4.1 Harvesting for Industry

As outlined in PT NIR 2018 (section 6.2.1.2.2):

"*Emissions from industrial harvesting were estimated from domestic industrial wood consumption statistics (collected by INE, the National Statistics Office) for the main forest types with industrial use and allocated to the categories "Pinus pinaster" and "Eucalyptus spp.". Eucalyptus plantations are harvested in a rotation period of 12 years, i.e., before the 20 years conversion period is completed. In this case, harvesting was further divided into harvesting in "Forest remaining Forest" and "Land converted to Forest". The harvesting under lands converted to forest was estimated based share of lands converted to eucalyptus to total eucalyptus area, the remaining of the industrial consumption of eucalyptus wood was assumed to come from forest land remaining forest land.*"

Article 8, paragraph 5 of Regulation (EU) 2018/841 requires that the Forest Reference Level to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data". If further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land".

In the case of Harvesting for Industry, this is ensured by:

- Using the average industrial harvest rates (m^3/ha), average BCEF and RTS factors per forest type in the period 2000-2009 and applying them to the areas per forest type in the period 2021-2025
- Using the same calculation methods, factors and allocation criteria described in the National Inventory Report of 2018 (please refer to PT NIR 2018, section 6.2.1.2.2)

Industrial harvesting has varied between 2.7 and 4.2 m3/ha in the reference period 2000-2009 for pine[10] and between 6.1 and 8.6 m3/ha for eucalyptus[11]. The average intensity for the reference period 2000-2009 was also used to estimate harvesting in the period 2021-2025.

Table 19: Industrial Harvest Intensity Implicit in the Reference Period 2000-2009

4.A Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total											
Pinus pinaster	4,20	3,21	2,67	2,92	3,54	2,95	3,20	3,35	2,89	3,19	3,21
Quercus suber											
Eucalyptus spp.	7,03	6,05	6,57	7,35	7,93	8,55	8,21	7,96	7,77	6,65	7,41
Quercus rotundifolia											
Quercus spp.											
Other broadleaves											
Pinus pinea											
Other coniferous											

unit: $m^3.ha^{-1}$

[10] Estimated as total industrial wood from conifers divided by area of pine forest under forest land remaining forest land. PT NIR 2018 assumes that industrial harvest from conifers is not possible in areas included under land converted to forest.

[11] Estimated as total industrial wood from broadleaves divided by the total national area of eucalyptus. PT NIR 2018 assumes that industrial harvest from eucalyptus is possible in eucalyptus areas under both land converted to forests and forest land remaining forest land.

Table 20: Industrial Harvest Intensity Considered in the Period 2021-2025

4.A Forest Land	2021	2022	2023	2024	2025	FRL
Total						
Pinus pinaster	3,21	3,21	3,21	3,21	3,21	3,21
Quercus suber						
Eucalyptus spp.	7,41	7,41	7,41	7,41	7,41	7,41
Quercus rotundifolia						
Quercus spp.						
Other broadleaves						
Pinus pinea						
Other coniferous						

unit: $m^3.ha^{-1}$

The application of the above intensities to the areas per forest stratum presented in section 3.2.5, results in the total industrial harvest estimates presented in Table 21 and Table 22.

Table 21: Total Industrial Harvest Considered in the Reference Period 2000-2009

4.A Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total											
Pinus pinaster	4 982	3 758	3 085	3 332	3 977	3 268	3 501	3 637	3 116	3 419	3 608
Quercus suber											
Eucalyptus spp.	5 249	4 588	5 057	5 741	6 292	6 878	6 704	6 586	6 453	5 545	5 909
Quercus rotundifolia											
Quercus spp.											
Other broadleaves											
Pinus pinea											
Other coniferous											

unit: m^3

Table 22: Total Industrial Harvest Considered in the Period 2021-2025

4.A Forest Land	2021	2022	2023	2024	2025	FRL
Total						
Pinus pinaster	3 420	3 433	3 446	3 460	3 473	3 446
Quercus suber						
Eucalyptus spp.	6 462	6 484	6 505	6 527	6 548	6 505
Quercus rotundifolia						
Quercus spp.						
Other broadleaves						
Pinus pinea						
Other coniferous						

unit: m^3

Applying the same allocation criteria of total harvest to the Forest Land Remaining Forest Land as described in PT NIR 2018, section 6.1.3.2, results in the harvest levels presented in Table 23 and Table 24.

Table 23: Industrial Harvest Considered in Forest Land Remaining Forest Land Areas Considered in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total											
Pinus pinaster	4 982	3 758	3 085	3 332	3 977	3 268	3 501	3 637	3 116	3 419	3 608
Quercus suber											
Eucalyptus spp.	3 532	3 142	3 522	4 064	4 523	5 077	5 074	5 126	5 144	4 552	4 376
Quercus rotundifolia											
Quercus spp.											
Other broadleaves											
Pinus pinea											
Other coniferous											

unit: m^3

Table 24: Industrial Harvest Considered in Forest Land Remaining Forest Land Areas Considered in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total						
Pinus pinaster	3 420	3 433	3 446	3 460	3 473	3 446
Quercus suber						
Eucalyptus spp.	6 206	6 247	6 288	6 328	6 369	6 288
Quercus rotundifolia						
Quercus spp.						
Other broadleaves						
Pinus pinea						
Other coniferous						

unit: m^3

The average emissions from industrial harvesting for the period 2000-2009 equal 2 770 ktC.year^{-1} and are estimated for the period 2021-2025 at 3 187 ktC.year^{-1}. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is -11 685 $ktCO_{2eq}$.year^{-1} (= -3 187 ktC.year^{-1} x 44/12).

Table 25: Emissions from Industrial Harvest Considered in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**-2 836**	**-2 326**	**-2 274**	**-2 561**	**-2 936**	**-2 945**	**-3 021**	**-3 087**	**-2 942**	**-2 774**	**-2 770**
Pinus pinaster	-1 499	-1 131	-928	-1 002	-1 197	-983	-1 053	-1 094	-937	-1 029	-1 085
Quercus suber											
Eucalyptus spp.	-1 337	-1 196	-1 346	-1 558	-1 740	-1 962	-1 968	-1 993	-2 004	-1 745	-1 685
Quercus rotundifolia											
Quercus spp.											
Other broadleaves											
Pinus pinea											
Other coniferous											

unit: GgC

Table 26: Emissions from Industrial Harvest Considered in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**-3 157**	**-3 172**	**-3 187**	**-3 202**	**-3 217**	**-3 187**
Pinus pinaster	-1 029	-1 033	-1 037	-1 041	-1 045	-1 037
Quercus suber						
Eucalyptus spp.	-2 128	-2 139	-2 150	-2 161	-2 172	-2 150
Quercus rotundifolia						
Quercus spp.						
Other broadleaves						
Pinus pinea						
Other coniferous						

unit: GgC

3.4.2 Other Wood Uses

As outlined in PT NIR 2018 (section 6.2.1.2.2):

"*There are no statistics for harvesting from other wood use (domestic use of biomass for energy, thinning with no industrial use, and pruning). In those cases, it was assumed (expert judgement) that 25% of the mean annual increment was harvested every year, which is believed to be an overestimation of the actual wood harvested for those purposes and, therefore, a conservative estimate.*"

Article 8, paragraph 5 of Regulation (EU) 2018/841 requires that the Forest Reference Level to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data". If further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land".

In the case of Other Wood Uses, this is ensured by:

- Using the average other wood use harvest rates (m^3/ha), average BCEF and RTS factors per forest type in the period 2000-2009 and applying them to the areas per forest type in the period 2021-2025
- Using the same calculation methods, factors and allocation criteria described in the National Inventory Report of 2018 (please refer to PT NIR 2018, section 6.2.1.2.2)

The average emissions from other wood use for the period 2000-2009 equal 690 ktC.year^{-1} and are estimated for the period 2021-2025 at 723 ktC.year^{-1}. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is -2 653 $ktCO_{2eq}$.year^{-1} (= -723 ktC.year^{-1} x 44/12).

Table 27: Emissions from Other Wood Use Considered in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**-697**	**-700**	**-674**	**-678**	**-681**	**-683**	**-691**	**-698**	**-699**	**-700**	**-690**
Pinus pinaster	-63	-63	-44	-44	-44	-36	-35	-35	-35	-35	-43
Quercus suber	-144	-145	-140	-138	-138	-139	-140	-140	-140	-141	-140
Eucalyptus spp.	-8	-8	0	0	0	-5	-5	-5	-5	-5	-4
Quercus rotundifolia	-65	-63	-63	-61	-57	-55	-55	-55	-55	-55	-58
Quercus spp.	-97	-95	-94	-93	-93	-92	-92	-93	-93	-93	-93
Other broadleaves	-152	-154	-157	-161	-163	-166	-168	-170	-170	-171	-163
Pinus pinea	-156	-161	-164	-169	-174	-179	-184	-189	-189	-189	-175
Other coniferous	-12	-11	-12	-11	-12	-11	-12	-12	-12	-11	-12

unit: GgC

Table 28: Emissions from Other Wood Use Considered in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**-722**	**-723**	**-723**	**-724**	**-725**	**-723**
Pinus pinaster	-40	-40	-40	-40	-40	-40
Quercus suber	-145	-145	-145	-145	-146	-145
Eucalyptus spp.	-4	-4	-4	-4	-4	-4
Quercus rotundifolia	-58	-58	-58	-58	-58	-58
Quercus spp.	-94	-94	-94	-94	-94	-94
Other broadleaves	-178	-178	-179	-180	-180	-179
Pinus pinea	-194	-194	-195	-195	-195	-195
Other coniferous	-9	-9	-9	-8	-8	-9

unit: GgC

3.4.3 Salvage Wood

As outlined in PT NIR 2018 (section 6.2.1.2.2):

"*Emissions from salvaged wood are considered in addition to emissions from industrial harvesting, which again is considered a conservative estimate, since salvaged wood has, by definition, industrial use.*"

Article 8, paragraph 5 of Regulation (EU) 2018/841 requires that the Forest Reference Level to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data". If further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land".

In the case of Salvaged Wood, this is ensured by:

- Using the average mortality and salvage wood rates factors per forest type in the period 2000-2009 (please refer to PT NIR 2018, section 6.13.6) and applying them to the areas per forest type in the period 2021-2025
- Using the average burnt area per forest stratum implicit in the Background Level of Natural Disturbances (see Table 11 in section 3.2.9)
- Using the same calculation methods, factors and allocation criteria described in the National Inventory Report of 2018 (please refer to PT NIR 2018, section 6.2.1.2.2)

The average emissions from salvage wood for the period 2000-2009 equal 332 ktC.year^{-1} and are estimated for the period 2021-2025 at 150 ktC.year^{-1}. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is -550 ktCO$_{2eq}$.year^{-1} (= -150 ktC.year^{-1} x 44/12).

Table 29: Emissions from Salvage Wood Considered in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**-232**	**-186**	**-285**	**-1 160**	**-193**	**-979**	**-148**	**-39**	**-26**	**-68**	**-332**
Pinus pinaster	-173	-133	-209	-651	-94	-652	-72	-20	-14	-32	-205
Quercus suber	-4	-7	-6	-114	-30	-4	-3	-1	0	-1	-17
Eucalyptus spp.	-31	-28	-46	-330	-49	-253	-62	-10	-9	-17	-84
Quercus rotundifolia	0	-2	-2	-9	-4	-1	0	-1	0	-1	-2
Quercus spp.	-7	-4	-5	-9	-2	-9	-1	-1	0	-2	-4
Other broadleaves	-11	-9	-10	-35	-7	-48	-7	-5	-3	-10	-14
Pinus pinea	0	-1	-1	-5	-5	-1	-1	0	0	0	-1
Other coniferous	-4	-2	-5	-8	-2	-13	-2	-1	0	-4	-4

unit: GgC

Table 30: Emissions from Salvage Wood Considered in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**-148**	**-149**	**-150**	**-151**	**-152**	**-150**
Pinus pinaster	-78	-78	-79	-80	-80	-79
Quercus suber	-5	-5	-5	-5	-5	-5
Eucalyptus spp.	-49	-49	-49	-49	-50	-49
Quercus rotundifolia	-1	-1	-1	-1	-1	-1
Quercus spp.	-2	-2	-2	-2	-2	-2
Other broadleaves	-9	-9	-10	-10	-10	-10
Pinus pinea	-1	-1	-1	-1	-1	-1
Other coniferous	-2	-2	-2	-2	-2	-2

unit: GgC

3.4.4 Forest Conversions

As outlined in PT NIR 2018 (section 6.2.1.2.2):

"*Emissions from forest conversion are associated with changes in species, which may happen following final felling followed by a reforestation using a different species or by more subtle changes in dominant species (which lead to a change in forest type classification). Forest conversions are not deforestation (because a forest type is followed by another forest type), but the emissions from conversion are calculated in a similar manner as deforestation, i.e., it consists on the emission of all the living biomass carbon present in the previous forest type.*"

Article 8, paragraph 5 of Regulation (EU) 2018/841 requires that the Forest Reference Level to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data". If further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land".

In the case of Forest Conversions, this is ensured by:

- Using the average land-use (i.e. forest type) changes in the period 2000-2009 and applying them to the areas per forest type in the period 2021-2025
- Using the same calculation methods, factors and allocation criteria described in the National Inventory Report of 2018 (please refer to PT NIR 2018, section 6.2.1.2.2)

The average emissions from forest conversions for the period 2000-2009 equal 473 ktC.year^{-1} and are estimated for the period 2021-2025 at 351 ktC.year^{-1}. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is -1 289 ktCO_{2eq}.year^{-1} (= -351 ktC.year^{-1} x 44/12).

Table 31: Emissions from Forest Conversion Considered in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**-528**	**-528**	**-528**	**-528**	**-528**	**-528**	**-529**	**-343**	**-344**	**-344**	**-473**
Pinus pinaster	-51	-52	-52	-53	-54	-55	-55	-50	-50	-50	-52
Quercus suber	-28	-28	-28	-28	-28	-28	-28	-31	-31	-31	-29
Eucalyptus spp.	-345	-343	-342	-341	-339	-338	-338	-186	-187	-187	-295
Quercus rotundifolia	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
Quercus spp.	-16	-16	-16	-16	-16	-16	-16	-5	-5	-5	-13
Other broadleaves	-52	-52	-53	-53	-54	-54	-55	-37	-38	-38	-48
Pinus pinea	-24	-24	-24	-24	-24	-23	-23	-19	-19	-19	-22
Other coniferous	-3	-3	-3	-3	-3	-3	-3	-4	-4	-4	-3

unit: GgC

Table 32: Emissions from Forest Conversion Considered in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**-350**	**-351**	**-351**	**-352**	**-353**	**-351**
Pinus pinaster	-49	-49	-49	-49	-49	-49
Quercus suber	-31	-31	-31	-31	-31	-31
Eucalyptus spp.	-190	-190	-190	-190	-190	-190
Quercus rotundifolia	-10	-10	-10	-10	-10	-10
Quercus spp.	-5	-5	-5	-5	-5	-5
Other broadleaves	-42	-43	-43	-44	-44	-43
Pinus pinea	-20	-20	-20	-20	-20	-20
Other coniferous	-4	-4	-4	-4	-4	-4

unit: GgC

3.4.5 Natural Mortality

As outlined in PT NIR 2018 (section 6.2.1.2.2):

"*Emissions from natural mortality include emissions from trees that die from natural causes (self-thinning, pests and diseases) but excludes forest fires mortali (since these emissions are reported in Table 4(V)). These are estimated from the number of dead trees from causes other than fire, assuming that all dead trees present at any point in time died in the past 3 years. This information is collected in the National Forest Inventory.*"

Article 8, paragraph 5 of Regulation (EU) 2018/841 requires that the Forest Reference Level to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data". If further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land".

In the case of Natural Mortality, this is ensured by:

- Using the percentage of number of non-burnt dead trees in the period 2000-2009 and applying the same percentages to the areas per forest type in the period 2021-2025
- Using the same calculation methods, factors and allocation criteria described in the National Inventory Report of 2018 (please refer to PT NIR 2018, section 6.2.1.2.2)

The average emissions from natural mortality for the period 2000-2009 equal 759 ktC.year^{-1} and are estimated for the period 2021-2025 at 866 ktC.year^{-1}. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is -3 174 ktCO_{2eq}.year^{-1} (= -866 ktC.year^{-1} x 44/12).

Table 33: Emissions from Natural Mortality Considered in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**-742**	**-736**	**-741**	**-753**	**-750**	**-761**	**-766**	**-775**	**-781**	**-788**	**-759**
Pinus pinaster	-290	-274	-271	-271	-264	-261	-257	-255	-254	-252	-265
Quercus suber	-168	-167	-167	-167	-167	-168	-169	-170	-171	-172	-169
Eucalyptus spp.	-84	-89	-92	-97	-100	-106	-111	-115	-119	-123	-104
Quercus rotundifolia	-65	-65	-63	-63	-59	-59	-58	-58	-58	-58	-61
Quercus spp.	-34	-34	-34	-35	-35	-36	-36	-36	-36	-36	-35
Other broadleaves	-88	-93	-100	-104	-111	-119	-122	-126	-128	-132	-112
Pinus pinea	-10	-11	-11	-11	-11	-10	-10	-11	-11	-11	-11
Other coniferous	-3	-3	-3	-3	-3	-3	-3	-4	-4	-4	-3

unit: GgC

Table 34: Emissions from Natural Mortality Considered in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**-855**	**-860**	**-866**	**-871**	**-876**	**-866**
Pinus pinaster	-251	-252	-253	-254	-255	-253
Quercus suber	-186	-187	-188	-189	-190	-188
Eucalyptus spp.	-147	-148	-149	-150	-151	-149
Quercus rotundifolia	-60	-60	-60	-60	-60	-60
Quercus spp.	-38	-38	-38	-38	-39	-38
Other broadleaves	-152	-154	-156	-158	-160	-156
Pinus pinea	-17	-17	-18	-18	-19	-18
Other coniferous	-3	-3	-3	-3	-3	-3

unit: GgC

3.4.6 Recalculations

Recalculations may be required during the Commitment Period in the event of revision of input values affecting the reference period 2000-2009, or if the methodologies for estimating forest losses are revised and improved.

3.5 CRF 4.A Dead Wood Pool / Net-CO2 Emissions

As mentioned in PT NIR 2018 section 6.1.3.6:

"*Dead organic matter (other than litter) is considered to be "Included Elsewhere". The two main sources for dead wood are harvesting residues (included and reported as losses in living biomass, that include the emission of the whole tree) and dead trees from fire (included and reported as indirect emissions from fire, that include the emission of the whole tree). Other dead wood sources are considered negligible compared to these two sources or included in harvesting and are not reported separately.*"

Consistently, emissions and removals from the dead wood pool are considered to the "Included Elsewhere" and are not considered or estimated separately in the FRL.

3.5.1 Recalculations

Recalculations may be required during the Commitment Period in case an explicit methodology to address emissions and removals from dead wood is developed and implemented in the PT NIR.

3.6 CRF 4.A Litter Pool / Net-CO2 Emissions

In Forest Land Remaining Forest Land, litter emissions and removals are estimated only for changes in forest type (forest conversions). The methodology is common to all land-use changes and is described in PT NIR 2018 in section 6.1.3.4.

Article 8, paragraph 5 of Regulation (EU) 2018/841 requires that the Forest Reference Level to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data". If further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land".

In the case of litter emissions and removals, this is ensured by:

- Using the annual emission/sequestration factors of PT NIR 2018 table 6.18 (see section 6.1.3.4) in the period 2000-2009 and applying the same factors to the areas under forest conversion in the period 2021-2025

The average net-emissions from litter for the period 2000-2009 equal -13 ktC.year^{-1} and are estimated for the period 2021-2025 at -7 ktC.year^{-1}. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is -26 ktCO_{2eq}.year^{-1} (= -7 ktC.year^{-1} x 44/12).

Table 35: Net-Emissions from Litter Considered in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**-13**	**-14**	**-14**	**-15**	**-14**	**-14**	**-13**	**-12**	**-12**	**-11**	**-13**
Pinus pinaster	1	1	1	1	1	1	1	2	2	2	1
Quercus suber	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Eucalyptus spp.	-10	-10	-11	-11	-11	-11	-11	-10	-10	-10	-11
Quercus rotundifolia	0	0	0	0	0	0	0	0	0	0	0
Quercus spp.	0	0	0	0	0	0	0	0	0	0	0
Other broadleaves	-3	-3	-3	-3	-3	-3	-2	-2	-2	-2	-3
Pinus pinea	0	0	0	0	0	0	0	0	0	0	0
Other coniferous	0	0	0	0	0	0	0	0	0	0	0

unit: GgC; positive number denotes removals; negative numbers denote emissions

Table 36: Net-Emissions from Litter Considered in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**-8**	**-7**	**-7**	**-7**	**-6**	**-7**
Pinus pinaster	2	2	2	2	2	2
Quercus suber	0	0	0	0	0	0
Eucalyptus spp.	-8	-7	-7	-7	-7	-7
Quercus rotundifolia	0	0	0	0	0	0
Quercus spp.	0	0	0	0	0	0
Other broadleaves	-2	-1	-1	-1	-1	-1
Pinus pinea	0	0	0	0	0	0
Other coniferous	0	0	0	0	0	0

unit: GgC; positive number denotes removals; negative numbers denote emissions

3.6.1 Recalculations

Recalculations may be required during the Commitment Period in the event of revision of input values affecting the reference period 2000-2009, or if the methodologies for estimating litter emissions are revised and improved.

3.7 CRF 4.A Mineral Soil Pool / Net-CO2 Emissions

In Forest Land Remaining Forest Land, soil emissions and removals are estimated only for changes in forest type (forest conversions). The methodology is common to all land-use changes and is described in PT NIR 2018 in section 6.1.3.5.

Article 8, paragraph 5 of Regulation (EU) 2018/841 requires that the Forest Reference Level to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data". If further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land".

In the case of litter emissions and removals, this is ensured by:

- Using the annual emission/sequestration factors of PT NIR 2018 table 6.22 (see section 6.1.3.5) in the period 2000-2009 and applying the same factors to the areas under forest conversion in the period 2021-2025

The average net-emissions from soil for the period 2000-2009 equal +12 ktC.year^{-1} and are estimated for the period 2021-2025 at -24 ktC.year^{-1}. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is -87 ktCO_{2eq}.year^{-1} (= -24 ktC.year^{-1} x 44/12).

Table 37: Net-Emissions from Soil Considered in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**31**	**26**	**22**	**17**	**13**	**9**	**6**	**2**	**-2**	**-5**	**12**
Pinus pinaster	3	3	3	4	4	5	5	6	6	7	4
Quercus suber	-68	-70	-71	-72	-74	-68	-62	-57	-52	-48	-64
Eucalyptus spp.	71	69	66	64	61	55	48	41	35	30	54
Quercus rotundifolia	-2	-2	-2	-2	-3	-3	-3	-3	-4	-4	-3
Quercus spp.	0	0	0	0	0	0	0	0	0	0	0
Other broadleaves	27	26	25	24	24	21	18	16	13	11	20
Pinus pinea	0	0	0	0	0	0	0	0	0	0	0
Other coniferous	0	0	0	0	0	0	0	0	0	0	0

unit: GgC; positive number denotes removals; negative numbers denote emissions

Table 38: Net-Emissions from Soil Considered in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**-23**	**-23**	**-24**	**-24**	**-24**	**-24**
Pinus pinaster	10	10	10	10	10	10
Quercus suber	-34	-34	-34	-35	-35	-34
Eucalyptus spp.	6	6	6	6	6	6
Quercus rotundifolia	-7	-7	-7	-7	-7	-7
Quercus spp.	0	0	0	0	0	0
Other broadleaves	1	1	1	1	1	1
Pinus pinea	0	0	0	0	0	0
Other coniferous	0	0	0	0	0	0

unit: GgC; positive number denotes removals; negative numbers denote emissions

3.7.1 Recalculations

Recalculations may be required during the Commitment Period in the event of revision of input values affecting the reference period 2000-2009, or if the methodologies for estimating soil emissions are revised and improved.

3.8 CRF 4.A Organic Soil Pool / Net-CO2 Emissions

As mentioned in section 3.2.6 above, organic soils are reported as "Not Occurring". Consistently the FRL does not consider any emissions from Organic Soils.

3.8.1 Recalculations

Recalculations may be required during the Commitment Period in case organic soils are identified in Portugal and an explicit methodology to address emissions and removals from organic soils is developed and implemented in the PT NIR.

3.9 CRF 4.G Wood Use and Harvested Wood Products

Article 8, paragraph 5 of Regulation (EU) 2018/841 requires that the Forest Reference Level to be "based on the continuation of sustainable forest management practices, as documented in the period 2000-2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data". If further states that "Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land", and that "a constant ratio between solid and energy use of forest biomass as documented in the period from 2000 to 2009 shall be assumed;". The current GHG Inventory implements the "production Approach" to HWP and this was kept in the construction of the FRL.

In the case of HWP net-emissions and removals, this is ensured by:

- Using the average industrial harvest rates (m^3/ha) in the period 2000-2009 and applying them to the areas per forest type in the period 2021-2025 (see section 3.4.1 above)

- Calculating "intensity indicators" for wood imports and wood exports in the period 2000-2009 and applying them to the industrial wood production in the period 2021-2025
  - "intensity indicator for wood imports" is defined as the average of $\frac{wood\ imports_{year\ X}}{industrial\ wood\ production_{year\ X}}$ for all years in the period 2000-2009 (7.1%, see Table 39)
  - "intensity indicator for wood exports" is defined as the average of $\frac{wood\ exports_{year\ X}}{industrial\ wood\ production_{year\ X}}$ for all years in the period 2000-2009 (10.8%, see Table 39)

- Calculating "intensity indicators" for pulp production, wood panel production and sawnwood production in the period 2000-2009 and applying them to the apparent wood consumption in the period 2021-2025
  - "intensity indicator for wood pulp production" is defined as the average of $\frac{pulp\ production_{year\ X}}{apparent\ wood\ consumption_{year\ X}}$ for all years in the period 2000-2009 (0.218 t/m^3, see Table 41)
  - "intensity indicator for wood panels production" is defined as the average of $\frac{panel\ production_{year\ X}}{apparent\ wood\ consumption_{year\ X}}$ for all years in the period 2000-2009 (0.143 m^3/m^3, see Table 43)
  - "intensity indicator for sawnwood production" is defined as the average of $\frac{sawnwood\ production_{year\ X}}{apparent\ wood\ consumption_{year\ X}}$ for all years in the period 2000-2009 (0.130 m^3/m^3, see Table 43)

- Calculating "intensity indicators" for wood pulp imports and wood pulp exports in the period 2000-2009 and applying them to the wood pulp production in the period 2021-2025
  - "intensity indicator for wood pulp imports" is defined as the average of $\frac{wood\ pulp\ imports_{year\ X}}{wood\ pulp\ production_{year\ X}}$ for all years in the period 2000-2009 (5.4%, see Table 41)
  - "intensity indicator for wood pulp exports" is defined as the average of $\frac{wood\ pulp\ exports_{year\ X}}{wood\ pulp\ production_{year\ X}}$ for all years in the period 2000-2009 (49.4%, see Table 41)

- Calculating "intensity indicators" for paper and board production in the period 2000-2009 and applying them to the apparent pulp consumption in the period 2021-2025
  - "intensity indicator for wood pulp production" is defined as the average of $\frac{paper\ production_{year\ X}}{apparent\ pulp\ consumption_{year\ X}}$ for all years in the period 2000-2009 (141.5 t/t, see Table 41)

- Using the same calculation methods, factors and allocation criteria between the UNFCCC categories "land converted to forests" and "forest land remaining forest land" described in the National Inventory Report of 2018 (please refer to PT NIR 2018, section 6.8)

Table 39: Industrial Wood Production, Imports, Exports and Apparent Wood Consumption in the Reference Period 2000-2009

4.A Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Industrial wood production	10 231	8 346	8 142	9 073	10 269	10 146	10 205	10 223	9 569	8 964	9 517
Wood production L->FL	1 717	1 446	1 535	1 677	1 769	1 801	1 629	1 460	1 309	992	1 534
Share of wood from L->FL	16,8%	17,3%	18,8%	18,5%	17,2%	17,7%	16,0%	14,3%	13,7%	11,1%	16,1%
Wood imports	1 340	1 109	901	468	364	362	335	746	521	473	662
Imports / production	13,1%	13,3%	11,1%	5,2%	3,5%	3,6%	3,3%	7,3%	5,4%	5,3%	7,1%
Wood exports	557	809	820	1 018	1 009	1 274	1 422	1 526	1 345	602	1 038
Exports / production	5,4%	9,7%	10,1%	11,2%	9,8%	12,6%	13,9%	14,9%	14,1%	6,7%	10,8%
Apparent wood consumption	11 015	8 646	8 223	8 523	9 624	9 234	9 118	9 443	8 745	8 835	9 141
Wood from domestic production	87,8%	87,2%	89,0%	94,5%	96,2%	96,1%	96,3%	92,1%	94,0%	94,6%	92,8%

unit: 1000m³

Table 40: Industrial Wood Production, Imports, Exports and Apparent Wood Consumption in the FRL 2021-2025

4.A Forest Land	2021	2022	2023	2024	2025	FRL
Industrial wood production	9 882	9 917	9 952	9 986	10 021	9 952
Wood production L->FL	256	237	218	198	179	218
Share of wood from L->FL	2,6%	2,4%	2,2%	2,0%	1,8%	2,2%
Wood imports	702	704	707	709	712	707
Imports / production	7,1%	7,1%	7,1%	7,1%	7,1%	7,1%
Wood exports	1 072	1 075	1 079	1 083	1 087	1 079
Exports / production	10,8%	10,8%	10,8%	10,8%	10,8%	10,8%
Apparent wood consumption	9 512	9 546	9 579	9 613	9 646	9 579
Wood from domestic production	92,6%	92,6%	92,6%	92,6%	92,6%	92,6%

unit: 1000m³

Table 41: Industrial Wood Pulp Production, Imports, Exports and Apparent Pulp Consumption in the Reference Period 2000-2009

4.A Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Wood pulp production	1 774	1 806	1 929	1 935	1 949	1 990	2 065	2 092	2 022	2 182	1 974
Pulp production / apparent wood consumption	16,1%	20,9%	23,5%	22,7%	20,3%	21,6%	22,6%	22,2%	23,1%	24,7%	21,8%
Wood pulp imports	94	163	145	133	112	76	68	82	85	92	105
Imports / production	5,3%	9,0%	7,5%	6,9%	5,7%	3,8%	3,3%	3,9%	4,2%	4,2%	5,4%
Wood pulp exports	969	980	962	961	933	762	1 038	1 040	945	1 149	974
Exports / production	54,6%	54,3%	49,9%	49,7%	47,9%	38,3%	50,3%	49,7%	46,8%	52,7%	49,4%
Apparent pulp consumption	899	989	1 112	1 107	1 128	1 304	1 095	1 135	1 161	1 125	1 105
Pulp from domestic production	89,5%	83,5%	87,0%	88,0%	90,1%	94,2%	93,8%	92,7%	92,7%	91,8%	90,3%
Paper production	1 290	1 419	1 537	1 530	1 664	1 570	1 644	1 644	1 662	1 634	1 559
Paper production / apparent wood pulp consumption	143,5%	143,5%	138,3%	138,2%	147,5%	120,4%	150,1%	144,9%	143,1%	145,2%	141,5%

unit: 1000m³ (wood); 1000t (pulp and paper)

Table 42: Industrial Wood Pulp Production, Imports, Exports and Apparent Pulp Consumption in the FRL 2021-2025

4.A Forest Land	2021	2022	2023	2024	2025	FRL
Wood pulp production	2 070	2 077	2 084	2 092	2 099	2 084
Pulp production / apparent wood consumption	21,8%	21,8%	21,8%	21,8%	21,8%	21,8%
Wood pulp imports	112	112	112	113	113	112
Imports / production	5,4%	5,4%	5,4%	5,4%	5,4%	5,4%
Wood pulp exports	1 022	1 026	1 030	1 033	1 037	1 030
Exports / production	49,4%	49,4%	49,4%	49,4%	49,4%	49,4%
Apparent pulp consumption	1 159	1 163	1 167	1 171	1 175	1 167
Pulp from domestic production	90,4%	90,4%	90,4%	90,4%	90,4%	90,4%
Paper production	1 639	1 645	1 651	1 657	1 663	1 651
Paper production / apparent wood pulp consumption	141,5%	141,5%	141,5%	141,5%	141,5%	141,5%

unit: 1000m^3 (wood); 1000t (pulp and paper)

Table 43: Wood Panel Production and Apparent Wood Consumption in the Reference Period 2000-2009

4.A Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Wood panel production	1 293	1 243	1 250	1 215	1 323	1 306	1 306	1 337	1 352	1 385	1 301
Panel production / apparent wood consumption	11,7%	14,4%	15,2%	14,3%	13,7%	14,1%	14,3%	14,2%	15,5%	15,7%	14,3%
Sawnwood production	1 427	1 492	1 298	1 383	1 060	1 010	1 010	1 011	1 010	1 093	1 179
Sawnwood production / apparent wood consumption	13,0%	17,3%	15,8%	16,2%	11,0%	10,9%	11,1%	10,7%	11,5%	12,4%	13,0%

unit: 1000m^3

Table 44: Wood Panel Production and Apparent Wood Consumption in the FRL 2021-2025

4.A Forest Land	2021	2022	2023	2024	2025	FRL
Wood panel production	1 361	1 366	1 371	1 375	1 380	1 371
Panel production / apparent wood consumption	14,3%	14,3%	14,3%	14,3%	14,3%	14,3%
Sawnwood production	1 235	1 240	1 244	1 248	1 253	1 244
Sawnwood production / apparent wood consumption	13,0%	13,0%	13,0%	13,0%	13,0%	13,0%

unit: 1000m^3

The average net-removals from harvested wood products for the period 2000-2009 equal 191 ktC.year^{-1} and are estimated for the period 2021-2025 at 166 ktC.year^{-1}. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is +609 $ktCO_{2eq}$.year^{-1} (= 166 ktC.year^{-1} x 44/12).

Table 45: Harvested Wood Products Net-Emissions in the Reference Period 2000-2009

4.A Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Sawnwood	3	13	-20	15	-50	-61	-59	-67	-62	-41	-33
L->FL	1	5	3	8	-7	-8	-11	-16	-17	-20	-6
FL<->FL	2	9	-23	7	-43	-53	-48	-51	-45	-22	-27
Wood panels	188	169	172	177	205	195	190	178	184	189	185
L->FL	31	30	35	34	35	35	28	21	20	12	28
FL<->FL	157	140	138	143	170	160	162	157	164	178	157
Paper and Board	75	59	93	93	121	78	77	28	34	15	67
L->FL	10	10	22	19	18	14	5	-9	-7	-18	6
FL<->FL	65	49	71	73	103	65	72	36	41	33	61
HWP Total	**266**	**242**	**246**	**285**	**276**	**213**	**208**	**138**	**156**	**163**	**219**
L->FL	**43**	**44**	**59**	**61**	**46**	**41**	**22**	**-4**	**-3**	**-26**	**28**
FL<->FL	**223**	**197**	**187**	**223**	**230**	**171**	**186**	**142**	**160**	**189**	**191**

unit: GgC; positive number denotes removals; negative numbers denote emissions

Table 46: Harvested Wood Products Net-Emissions in the FRL 2021-2025

4.A Forest Land	2021	2022	2023	2024	2025	FRL
Sawnwood	-5	-4	-3	-2	-1	-3
L->FL	-32	-32	-32	-31	-31	-32
FL<->FL	27	28	29	30	31	29
Wood panels	131	129	126	124	122	126
L->FL	-15	-16	-16	-16	-16	-16
FL<->FL	146	144	142	140	138	142
Paper and Board	-22	-14	-8	-4	-2	-10
L->FL	-6	-5	-5	-4	-4	-5
FL<->FL	-16	-9	-4	0	2	-5
HWP Total	**104**	**111**	**115**	**118**	**120**	**114**
L->FL	**-54**	**-53**	**-52**	**-52**	**-52**	**-52**
FL<->FL	**158**	**164**	**168**	**170**	**171**	**166**

unit: GgC; positive number denotes removals; negative numbers denote emissions

3.9.1.1 Recalculations

Recalculations may be required during the Commitment Period in the event of revision of input values affecting the reference period 2000-2009, if new harvested wood products categories are added or the existing categories redefined, or if the methodologies for estimating harvested wood products are revised and improved.

3.10 CRF 4(I) Emissions from Nitrogen Inputs to Managed Soils

As explained in PT NIR 2018, section 6.9, these emissions are considered to be "Included Elsewhere" and are reported in the agriculture sector (CRF 3.D).

Consistently, emissions from N inputs to soils are considered to the "Included Elsewhere" and are not considered or estimated separately in the FRL.

3.10.1.1 Recalculations

Recalculations may be required during the Commitment Period in case an explicit methodology to address emissions from N input to soils in non-agricultural soils is developed and implemented in the PT NIR.

3.11 CRF 4(II) Drainage and Rewetting of Soils

As explained in PT NIR 2018, section 6.10, these emissions are considered to be "Not Occurring" and are reported in the agriculture sector (CRF 3.D).

Consistently, emissions and removals from drainage and rewetting soils are considered to be "Not Occurring" and are not considered or estimated separately in the FRL.

3.11.1 Recalculations

Recalculations may be required during the Commitment Period in case these activities are detected in Portugal and an explicit methodology to address emissions from drainage and rewetting soils is developed and implemented in the PT NIR.

3.12 CRF 4(III) Direct N2O Emissions from N Mineralization associated with Loss of Soil Organic Carbon

As explained in PT NIR 2018, section 6.11, these emissions are estimated whenever the soil emission factor of a particular land-use change is negative (i.e. loss of SOC). The emission estimations were made consistently with the methods described in PT NIR 2018 section 6.11.2.
In Forest Land Remaining Forest Land, these C losses include forest conversions that involve a carbon loss in soils.

The input data is presented in Table 47 and Table 48, respectively for the reference period 2000-2009 and the FRL period 2021-2025.

Table 47: Area of Forest Land Remaining Forest Land undergoing Soil Carbon Losses in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**31**	**32**	**32**	**33**	**34**	**32**	**30**	**27**	**25**	**24**	**30**
Pinus pinaster	0	0	0	0	0	0	0	0	0	0	0
Quercus suber	30	31	31	32	33	30	28	26	23	22	29
Eucalyptus spp.	0	0	0	0	0	0	0	0	0	0	0
Quercus rotundifolia	1	1	1	1	1	1	2	2	2	2	1
Quercus spp.	0	0	0	0	0	0	0	0	0	0	0
Other broadleaves	0	0	0	0	0	0	0	0	0	0	0
Pinus pinea	0	0	0	0	0	0	0	0	0	0	0
Other coniferous	0	0	0	0	0	0	0	0	0	0	0

unit: 1000ha

Table 48: Area of Forest Land Remaining Forest Land undergoing Soil Carbon Losses in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**20**	**20**	**20**	**21**	**21**	**20**
Pinus pinaster	0	0	0	0	0	0
Quercus suber	16	16	17	17	17	17
Eucalyptus spp.	0	0	0	0	0	0
Quercus rotundifolia	4	4	4	4	4	4
Quercus spp.	0	0	0	0	0	0
Other broadleaves	0	0	0	0	0	0
Pinus pinea	0	0	0	0	0	0
Other coniferous	0	0	0	0	0	0

unit: 1000ha

The estimated emissions are presented in Table 49 and Table 50, respectively for the reference period 2000-2009 and the FRL period 2021-2025.

The average N2O emissions from soil carbon losses for the period 2000-2009 equal 21 $ktC_{2eq}.year^{-1}$ and are estimated for the period 2021-2025 at 13 $ktCO_{2eq}.year^{-1}$. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is -13 $ktCO_{2eq}.year^{-1}$.

Table 49: Direct N2O Emissions from Soil Carbon Losses in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**-21,74**	**-22,27**	**-22,81**	**-23,34**	**-23,88**	**-22,18**	**-20,48**	**-18,91**	**-17,34**	**-16,40**	**-20,94**
Pinus pinaster	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Quercus suber	-21,25	-21,70	-22,16	-22,61	-23,06	-21,28	-19,50	-17,82	-16,13	-15,09	-20,06
Eucalyptus spp.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Quercus rotundifolia	-0,49	-0,57	-0,65	-0,73	-0,81	-0,90	-0,98	-1,09	-1,20	-1,32	-0,87
Quercus spp.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Other broadleaves	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Pinus pinea	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Other coniferous	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

unit: GgCO2eq.; positive number denotes removals; negative numbers denote emissions

Table 50: Direct N2O Emissions from Soil Carbon Losses in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**-12,65**	**-12,78**	**-12,91**	**-13,04**	**-13,17**	**-12,91**
Pinus pinaster	0,00	0,00	0,00	0,00	0,00	0,00
Quercus suber	-10,54	-10,64	-10,74	-10,83	-10,93	-10,74
Eucalyptus spp.	0,00	0,00	0,00	0,00	0,00	0,00
Quercus rotundifolia	-2,11	-2,14	-2,17	-2,21	-2,24	-2,17
Quercus spp.	0,00	0,00	0,00	0,00	0,00	0,00
Other broadleaves	0,00	0,00	0,00	0,00	0,00	0,00
Pinus pinea	0,00	0,00	0,00	0,00	0,00	0,00
Other coniferous	0,00	0,00	0,00	0,00	0,00	0,00

unit: GgCO2eq.; positive number denotes removals; negative numbers denote emissions

3.12.1 Recalculations

Recalculations will be required in the event of changes to the historical time series, in the methodologies and/or emission factors affecting any of the years in the period 2000-2009. Recalculations will also be necessary as the forest area is replaced from the estimates presented in section 3.2.5 with their final values.

3.13 CRF 4(IV) Indirect N2O Emissions

As explained in PT NIR 2018, section 6.12, these emissions are estimated in relation to:

- Indirect emissions from leaching and runoff resulting from the loss of SOM (CRF 4(III))
- Indirect emissions from atmospheric deposition resulting from emissions of NOx and NH3 from forest fires (CRF 4(V))

The estimated emissions are presented in Table 51 and Table 52, respectively for the reference period 2000-2009 and the FRL period 2021-2025.

The average N_2O emissions from soil carbon losses for the period 2000-2009 equal 21 $ktC_{2eq}.year^{-1}$ and are estimated for the period 2021-2025 at 13 $ktCO_{2eq}.year^{-1}$. Therefore, the contribution of this variable for the Forest reference Level 2021-2025 is -13 $ktCO_{2eq}.year^{-1}$.

Table 51: Indirect N_2O Emissions from Atmospheric Deposition and Nitrogen Leaching and Run-Off in the Reference Period 2000-2009

4.A.1 Forest Land Remaining Forest Land	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-2009
Total	**4**	**3**	**5**	**16**	**3**	**14**	**2**	**1**	**1**	**1**	**5**
Atmospheric deposition	3	3	4	16	3	14	2	1	0	1	5
Nitrogen leaching and run-off	0	0	0	1	1	0	0	0	0	0	0

unit: GgCO2eq.; positive number denotes removals; negative numbers denote emissions

Table 52: Indirect N_2O Emissions from Atmospheric Deposition and Nitrogen Leaching and Run-Off in the FRL 2021-2025

4.A.1 Forest Land Remaining Forest Land	2021	2022	2023	2024	2025	FRL
Total	**2**	**2**	**2**	**2**	**2**	**2**
Atmospheric deposition	2	2	2	2	2	2
Nitrogen leaching and run-off	0	0	0	0	0	0

unit: GgCO2eq.; positive number denotes removals; negative numbers denote emissions

3.14 CRF 4(V) Biomass Burning Emissions

Biomass burning emissions included in FRL are addressed and described in section 3.2.9 "Natural Disturbances – Background Level and Margin" above.

4 Proposed Forest Reference Level

The FRL is totally based on the National Inventory Report and the structure and contents of the respective Common Reporting Tables. The FRL refers to the UNFCCC category "4.A.1 Forest Land Remaining Forest Land" and results from the sum of the following quantities:

- Living Biomass Gains (CRF 4.A)
- Living Biomass Losses (CRF 4.A)
- Dead Wood Net-Emissions (CRF 4.A)
- Litter Net-Emissions (CRF 4.A)
- Mineral Soil Net-Emissions (CRF 4.A)
- Organic Soil Net-Emissions (CRF 4.A)
- Harvested Wood Products Net-Emissions (CRF 4.G)
- Emissions from Nitrogen Inputs to Managed Soils (CRF 4(I))
- Drainage and Rewetting of Soils (CRF 4(II))
- Direct N2O Emissions from N Mineralization associated with Loss of Soil Organic Carbon (CRF 4(III))
- Indirect N2O Emissions (CRF 4(IV))
- Biomass Burning Emissions (CRF 4(V))

Based on the methodologies, data and assumptions described in section 3 "Description of the Forest Reference Level" above, the FRL is estimated at 11 165 $GgCO_{2eq}.year^{-1}$ (including the contribution of Harvested Wood Products under the "production approach") or at 10 556 $GgCO_{2eq}.year^{-1}$ (including the contribution of Harvested Wood Products under the "instantaneous oxidation approach"). The contribution of each variable is presented in Table 53.

Table 53: Estimated annual emissions or removals for each FRL component

FRL component	Average 2000-2009	FRL (w/HWP) 2021-2025	FRL (inst. ox) 2021-2025
4.A.1 Forest Land Remaining Forest Land - Net CO2 emissions	**7 215**	**11 468**	**11 468**
Living Biomass - CO2 gains	25 596	30 932	30 932
Living Biomass - CO2 losses	-18 421	-19 351	-19 351
Industrial harvest	-10 157	-11 685	-11 685
Other wood use	-2 531	-2 653	-2 653
Salvaged wood	-1 216	-550	-550
Forest conversion	-1 733	-1 289	-1 289
Natural mortality	-2 784	-3 174	-3 174
Dead Wood - Net CO2 emissions	IE	IE	IE
Litter - Net CO2 emissions	-49	-26	-26
Mineral Soils - Net CO2 emissions	89	-87	-87
Organic Soils - Net CO2 emissions	NO	NO	NO
4.G Harvested Wood Products	**700**	**609**	**0**
4(I) N inputs to managed soils - N2O emissions	**IE**	**IE**	**IE**
4(II) Drainage and rewetting of soils - CO2, CH4, N2O emissions	**NO**	**NO**	**NO**
4(III) N mineralisation from the loss of SOC - N2O emissions	**-21**	**-13**	**-13**
4(IV) Indirect N2O emissions	**-5**	**-2**	**-2**
4(V) Forest fires - CO2, CH4, N2O emissions	**-1 536**	**-897**	**-897**
Net-emissions	**6 353**	**11 165**	**10 556**

Notes:

(1) Positive numbers denote Sequestration; Negative numbers denote Emissions;

(2) Values in annual average for the respective period;

(3) All values in $GgCO_{2eq.}$

4.1 Stakeholder Consultation

The text version of January 2019 was presented to the stakeholders referred to in Table 54[12], in a meeting that took place on the 7th of February 2019.

The agenda of the meeting was as follows:

1. Context: the EU Climate and Energy Package 2030
    a. EU climate targets
    b. Main policy instruments
2. The LULUCF Regulation
    a. Summary of rules applicable to each applicable land-use
3. The PT proposal for the FRL
    a. Methodology and assumptions
    b. Results
    c. Proposed FRL

A period of comments was opened, following which 2 comments were received:

- UNAC: requesting the consideration of Cork products as HWP
- Centro Pinus: requesting that the Greenhouse Gas Inventory activity data be based on the Forest Inventory area data, rather than the Land-Use Cartography (COS)

APA and ICNF consider these requests to be related to possible improvements to the National Inventory Report of GHG Emissions and Removals and do not trigger changes to the current FRL proposal.

This is due to the fact that the FRL proposal needs to be consistent with previously submitted NIRs, which did not consider Cork Products as HWP and use COS as a basis for land-use change area reporting.

Both topics might be elaborated further as part of the future improvements of the NIR and, if considered in the future, could trigger changes to both the NIR and, for technical consistency, to the FRL.

Table 54: Stakeholders and participants in the meeting of 2019/02/07

Institution Institution type	Representative	invited	participated
AIFF – Associação para a Competitividade da Indústria da Fileira Florestal Association: Forest industries	-	☑	☒
AJAP – Associação de Jovens Agricultores de Portugal Association: Farmers	-	☑	☒
AIMMP - Associação das Indústrias de Madeira e Mobiliário de Portugal Association: Forest industries	-	☑	☒
Altri Florestal Company: Forest owner / Paper industry	Luís Leal	☑	☑
AMORIM Company: Cork industry	-	☑	☒
ANEFA – Associação Nacional de Empreiteiros Florestais e Agrícolas Association: Forest contractors	-	☑	☒
APCOR – Associação Portuguesa da Cortiça Association: Cork industry	-	☑	☒
CAP – Confederação dos Agricultores de Portugal Association: Farmers and Forest Owners	João Soveral	☑	☑

[12] The table is inserted for information on the institutions and representatives that participated in the meeting. This table should not be understood as a formal endorsement of this document by any of the institutions or individuals mentioned.

Institution Institution type	Representative	invited	participated
CELPA – Associação da Indústria Papeleira Association: Paper industry	-	☑	☒
Centro Pinus – Associação para a Valorização da Floresta de Pinho Association: Pine Forests Value Chain	Pedro Teixeira	☑	☑
CNA – Confederação Nacional da Agricultura Association: Farmers and Forest Owners	-	☑	☒
Companhia das Lezírias Company: Forest owner	Rui Alves	☑	☑
CONFAGRI - Confederação Nacional das Cooperativas Agrícolas e do Crédito Agrícola de Portugal Association: Farmer Cooperatives	-	☑	☒
DGADR – Direcção Geral de Agricultura e Desenvolvimento Rural Public Administration: Ministry of Agriculture	-	☑	☒
DGT – Direção Geral do Território Public Administration: Land-use planning	Mário Caetano	☑	☑
EUROPAC Company: Paper industry	-	☑	☒
Floresta Atlântica - Sociedade Gestora de Fundos de Investimento Imobiliário Company: Forest fund	-	☑	☒
FNAPF – Federação Nacional das Associações de Proprietários Florestais	-	☑	☒
FORESTIS – Associação Florestal de Portugal Association: Forest Owners	Rosário Alves	☑	☑
GPP – Gabinete de Planeamento, Políticas e Administração Geral Public Administration: Ministry of Agriculture	Clara Lopes João Paulo Marques	☑	☑
ICNF – Instituto de Conservação da Natureza e Florestas Public Administration: Ministry of Agriculture / Forest Authority	Conceição Ferreira José Sousa Uva	☑	☑
INIAV – Instituto Nacional de Investigação Agrária e Veterinária Public Administration: Ministry of Agriculture	-	☑	☒
ISA – Instituto Superior de Agronomia University: Forestry	Margarida Tomé	☑	☑
IST – Instituto Superior Técnico University: Environment	-	☑	☒
LPN – Liga para a Protecção da Natureza NGO: Environment	-	☑	☒
Navigator Company Company: Forest owner / Paper Industry	José Luís Carvalho	☑	☑
Quercus – Associação Nacional Conservação da Natureza NGO: Environment	Domingos Patacho	☑	☑
SONAE Arauco Company: Wood Panel Industry	Nuno Calado	☑	☑
UNAC – União das Organizações de Agricultorespara o Desenvolvimento da Charneca Association: Forest Owners	Ana Paiva Brandão	☑	☑

Institution Institution type	Representative	invited	participated
Zero – Associação Sistema Terrestre Sustentável NGO: Environment	-	☑	☒
APA – Agência Portuguesa do Ambiente Public Administration: Ministry of Environment / Implementing Agency	Eduardo Santos Ana Daam José Paulino Joana Veloso Paulo Canaveira	☑	☑

4.2 Document publicity

This document is publically available at the website of the Portuguese Environment Agency at:

http://apambiente.pt/index.php?ref=16&subref=81&sub2ref=117&sub3ref=1542

Annex 1: Consideration to the criteria as set in Article 8, paragraph 5 and Annex IV of the LULUCF Regulation

The LULUCF Regulation provides guidance on how the Forest Reference Level should be designed, in particular Aricle 8, paragraph 5, sub-paragraphs 1 to 3 and Annex IV.

Below is a description on how each element was taken into account in Portugal's FMAP and FRL.

LULUCF Regulation: Article 8 Accounting for Managed Forest Land

§5.1 The forest reference level shall be based on the continuation of sustainable forest management practice, as documented in the period from 2000 to 2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data.

The general approach to implement the Forest Reference Level of Portugal was to find in the period 2000-2009 one or more relevant "intensity indicators" for each driver of emissions and removals, which were then used to characterise the same "management intensity" during the FRL period 2021-2025 and the period since the GHG inventory and the beginning of the commitment period, i.e. 2017-2020.

Activity data and emissions estimations methodologies and factors are the same as the ones used in the National Inventory Report of Portugal under the UNFCCC and reflect the best available data at this point in time.

§5.2 Forest reference levels (…) shall take account of the future impact of dynamic age-related forest characteristics in order not to unduly constrain forest management intensity as a core element of sustainable forest management practice, with the aim of maintaining or strengthening long-term carbon sinks.

Age-class was not a driver in the PT FRL, or similarly, the implicit assumption is that age-class distribution in the commitment period 2021-2025 will not be significantly different from the one in the reference period 2000-2009. This assumption was made because of the large amounts of irregular age stands and the impacts of fire on age-class, which makes it very complex and uncertain to model explicitly. Section 3.2.7 Age Structure of Main Strata and Rotation Length details the reasons why age class was not considered and adequate predictor of Carbon Losses in the case of Portuguese Forests.

Instead, forest management activities under business as usual are described in terms of their statistical consequences in the reference period (usually expressed on a per hectare basis; e.g. wood harvested/ha/stratum, increment/ha/stratum).

An explicit management sequence for each stratum related to age or dimeter class (e.g, planting, thinnings at ages X and Y, final feeling at age Z) was not considered because of limitations with data from the National Forest Inventory, and the characteristics of forest structure, which result from a combination of past management decisions and forest fires.

Forest fires are particularly relevant in Portugal and affect forest in different levels. Post fire management will include, depending on fire intensity, from full artificial regeneration and replacement of previous stand (i.e. "final felling" before rotation age) in the most serious case where the growing potential is destroyed, to the selective logging of affected trees (i.e. leading to an irregular age stand) in less severe cases. Therefore, the irregularity and unpredictability of forest fires (area and intensity) and the interaction between fire and management is extremely difficult to model explicitly.

It is also assumed that the use of modelled harvesting rates at the levels of 2000-2009 will not unduly constrain future harvest.

§5.3 Member States shall demonstrate consistency between the methods and data used to determine the proposed forest reference level in the national forestry accounting plan and those used in the reporting for managed forest land.

The FRL was constructed using the GHG Inventory model. This ensures full comparability and numerical consistency between the FRL and the GHG Inventory, e.g. by ensuring that the same methodologies, conversion factors and emissions factors are used for both purposes.

It will also allow accurate (and automatic) technical corrections to the FRL to occur, should changes in the relevant variables in the period 2000-2009 occur and/or as real land-use change areas post 2016 are known.

LULUCF Regulation: Annex IV National Forestry Accounting Plan Containing a Member State's Forest Reference Level

A. Criteria and guidance for determining forest reference level

(a) the reference level shall be consistent with the goal of achieving a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, including enhancing the potential removals by ageing forest stocks that may otherwise show progressively declining sinks.

This is a global objective, established under the Paris Agreement of the UNFCCC, which is applied in aggregate for all countries in the World and in the second half of the century and not on a country by country basis. This balance cannot, therefore, be ensured by any single country. Additionally, this balance will depend on how forest and other natural sinks will evolve over time, but also, and maybe more importantly, on how emissions from other sectors will be reduced.

In the PT FRL, forests are not only projected to remain a sink but even to increase the net-sink value compared to the reference period, and this will arguably contribute to this objective. Please refer also to the explanations and data on projections presented below under point (g).

(b) the reference level shall ensure that the mere presence of carbon stocks is excluded from accounting;

Using the Forest Reference Level as an accounting method to evaluate the contribution of managed forests, as required by the LULUCF regulation, will only allow for the accounting the deviations between real emissions in the commitment period from the level foreseen in the FRL. Therefore, the mere presence of Carbon stocks will not be accounted for in PT.

(c) the reference level should ensure a robust and credible accounting system that ensures that emissions and removals resulting from biomass use are properly accounted for;

Following IPCC reporting guidance, PT reports and accounts for harvesting as an emission from the living biomass pool. This means that any use of biomass, including use of biomass for energy, will be reported as an emission. The only exception to this general principle is the use of biomass for the production of Harvested Wood Products, where emissions are delayed to the point in time where they actually occur. Since biomass for energy is not an HWP category, all emissions resulting from that activity are reported at the time of harvest. Please refer also to section "2.5.1 Treatment of biomass for energy in the GHG Inventory" and in particular to Figure 23 for more details.

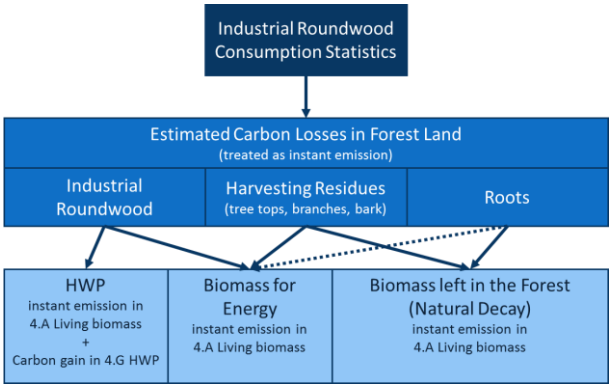
(d) the reference level shall include the carbon pool of harvested wood products, thereby providing a comparison between assuming instantaneous oxidation and applying the first-order decay function and half-life values;

The production approach to HWP was used. The assumptions and methodologies on harvested wood products are provided in section 3.9 CRF 4.G Wood Use and Harvested Wood Products. The FRL is presented with HWP (i.e. using the first order decay function) and without HWP (i.e. using instant oxidation of HWP) in Table 53: Estimated annual emissions or removals for each FRL component.

(e) a constant ratio between solid and energy use of forest biomass as documented in the period from 2000 to 2009 shall be assumed;

The assumptions and methodologies on harvested wood products are provided in section 3.9 CRF 4.G Wood Use and Harvested Wood Products. As demonstrated in that section the ratio of wood use in the different HWP categories / industrial roundwood consumption is fixed and based on the values observed in the period 2000-2009. The ratio between solid and energy is not presented explicitly (because it has no implications in the FRL calculations), but given the methodology on HWP it can be concluded that this ratio is also fixed.

Figure 23: Illustration on how Industrial Roundwood Statistics are used in the GHG Inventory



(f) the reference level should be consistent with the objective of contributing to the conservation of biodiversity and the sustainable use of natural resources, as set out in the EU forest strategy, Member States' national forest policies, and the EU biodiversity strategy;

Please refer to section 2.4 Forest Management and Biodiversity for a description on how this is addressed in Portugal's Forest Strategy.

(g) the reference level shall be consistent with the national projections of anthropogenic greenhouse gas emissions by sources and removals by sinks reported under Regulation (EU) No 525/2013;

Projections on future emissions and removals from forests are available in two data sources: (1) the submission of projections under Regulation 525/2013; and (2) the National Long Term GHG Development Strategy.

The latest submission of projections under Regulation 525/2013 was submitted on the 26th of March 2019 and is available from the EIONET Central Data Repository at:

https://cdr.eionet.europa.eu/pt/eu/mmr/art04-13-14_lcds_pams_projections/projections/envxjt3jw/

There are some differences between the projections presented under Regulation 525/2013 and the FRL, namely:

- Projections are available for Forest Land as a whole (CRF 4.A) and not for Forest Land Remaining Forest Land (CRF 4.A.1), while the FRL refers only to 4.A.1.;
- Projections do not include CRF tables 4.G and 4(I), 4(II), 4(III), 4(IV), 4(V), while the FRL includes all CRF tables;
- Projections are available only for scenarios: WEM (with existing measures) and WAM (with additional measures)[13], but not for WOM (without measures). The FRL is based on the continuation of management intensities of 2000-2009; We note that the assumptions and methodologies for both exercises are different;
- Projections provide data for 2020 and 2025; the FRL refers to the average 2021-2025.

It is therefore quite natural that the estimated final net-sink for 2025 do not match perfectly, but it should be noted that they are of the same order of magnitude. It should also be noted that the estimation methodologies and emission factors are the same in both exercises.

Portugal submitted to the UNFCCC its National Long Term GHG Development Strategy[14] on the 20th September 2019.

The commitment to reach carbon neutrality by 2050 means achieving a neutral balance between GHG emissions and carbon sequestration, for which substantial reductions in emissions and/or substantial increases in national carbon sinks will be required, which will have to materialise between today and 2050.

In order to achieve this goal, the 2050 Carbon Neutrality Roadmap (RNC2050) has been developed, identifying the main decarbonisation vectors in all sectors of the economy, the policy and measures options and the emission reduction path to achieve this end, in different scenarios of socioeconomic development. All sectors must contribute to reducing emissions, increasing efficiency and innovation, promoting improvements, notably in buildings, agriculture and forestry, waste management and industry, with the energy system making the greatest contribution.

SCENARIOS CONSIDERED IN THE 2050 CARBON NEUTRALITY ROADMAP

For RNC2050, 3 scenarios were built:

Scenario Off-Track: Scenario that retains the essentials of the economic structure and current trends as well as the decarbonisation policies already adopted or in force.

Scenario Peloton: Scenario of socioeconomic developments compatible with carbon neutrality with the development and application of new technologies that, however, do not significantly change either the production structures or the population's lifestyles. It foresees a modest incorporation of circular economy models and the maintenance of population concentration in the Metropolitan Areas.

Scenario Yellow Jersey: Scenario of socioeconomic evolution compatible with carbon neutrality, characterised by a structural and transverse change in production chains, made possible by the combination of a series of technologies of the 4th Industrial Revolution. It foresees a more effective incorporation of circular economy models and greater growth of the importance of medium-sized cities.

For forests, the RNC2050 is based on a reduction in the annual average burned area, through improvements in land management and planning and greater investment in the management of stands, in particular in fire prevention and fighting. New afforestation and reforestation are mostly implemented with production species (cork oak, pine and eucalyptus) or with protection and conservation species (native hardwoods), respectively

[13] There are no additional measures in "forest land" foreseen, and so the final results for scenarios WEM and WAM are the same in this sector.

[14] Available from the UNFCCC website at: https://unfccc.int/sites/default/files/resource/RNC2050_EN_PT%20Long%20Term%20Strategy.pdf

in the Peloton and Yellow Jersey scenarios. Also, in the context of the definition and implementation of investment support policies, it is recommended to reinforce the distribution of support for ecosystem services and the maintenance of forest biodiversity.

It will therefore be necessary to ensure a large reduction in burned areas by about 60%, to adopt proper fire prevention and post-fire management, reducing both the number and areas affected by fires, improving the suitability of the species used in reforestation, reducing the deforestation induced by fires (i.e. forests converted into shrublands) and making greater use of fire prevention techniques, including increased use of small ruminants to reduce combustible material.

On the other hand, a series of actions will aim at improving forest management and achieve the consequent increases in average productivity, such as improving management and increasing fire prevention, using more productive and better adapted varieties and increasing density, of either production or protection species. Finally, it will be necessary to increase the rate of afforestation to 8,000 ha/year and to reduce the rate of expansion of other land uses, particularly from urbanised areas, flooded areas (including dams) and shrublands.

The recently submitted National Energy and Climate Plan 2030 Portugal (PNEC) provided projections for forest land, which are based on the RNC2050. PNEC's scenario WAM corresponds to RNC2050 "Platoon with Carbon Neutrality Scenario" and WEM to "Platoon without Carbon Neutrality Scenario". Please note that there are no differences in policies considered for "forest land" in the RNC2050, and so the values for the 2 scenarios are, for this subsector, the same[15].

Table 55: Estimated net-sinks in Forests under different projection exercises

	2025	2021/25	2030	2050
Regulation 525/2013 | 4.A Forest Land / WOM	NA			
Regulation 525/2013 | 4.A Forest Land / WEM	-9,850			
Regulation 525/2013 | 4.A Forest Land/ WAM	-9,850			
Long-term Strategy | 4.A Forest Land / "Yellow Jersey with Carbon Neutrality" Scenario			-13,509	-16,455
Long-term Strategy | 4.A Forest Land / "Platoon with Carbon Neutrality" Scenario			-12,697	-15,397
Long-term Strategy | 4.A Forest Land / "Off-Track without Carbon Neutrality" Scenario			-8,118	-7,169
National Energy and Climate Plan 2030 Portugal | 4.A Forest Land / WEM			-12,697	
National Energy and Climate Plan 2030 Portugal | 4.A Forest Land / WAM			-12,697	
Regulation 841/2018 FRL | 4.A.1 Forest Land remaining Forest Land		**-11,165**		
Unit: 1000 ton CO2eq.				

[15] There are however different LULUCF totals for WAM and WEM scenarios. These differences come from changes in the effects of cropland and grassland policies and their impacts on the areas of organic farming, precision farming and biodiverse pastures installed in both scenarios.

Table 56: Harvesting Levels considered in the FRL and in the RNC2050

	2021/25	2030	2050
Long-term Strategy | 4.A Forest Land / "Yellow Jersey with Carbon Neutrality" Scenario		9,558	8,693
Long-term Strategy | 4.A Forest Land / "Platoon with Carbon Neutrality" Scenario		10,157	10,406
Long-term Strategy | 4.A Forest Land / "Off-Track" Scenario		8,354	5,802
Regulation 841/2018 FRL | 4.A.1 Forest Land remaining Forest Land	**9,951**		
Unit: 1000m³			

(h) the reference level shall be consistent with greenhouse gas inventories and relevant historical data and shall be based on transparent, complete, consistent, comparable and accurate information. In particular, the model used to construct the reference level shall be able to reproduce historical data from the National Greenhouse Gas Inventory.

The FRL was constructed using the GHG Inventory model. This ensures full comparability between the FRL and the GHG Inventory, e.g. by ensuring that the same activity data, methodologies, conversion factors and emissions factors are used for both purposes.

It will also allow accurate (and automatic) technical corrections to the FRL to occur, should changes in the relevant variables in the period 2000-2009 occur and/or as real land-use change areas post 2016 are known.

B. Elements of the national forestry accounting plan

(a) a general description of the determination of the forest reference level and a description of how the criteria in this Regulation were taken into account;

A general description of the approach to the FRL is provided in section 3.1 - Approach to FRL Construction.

A description of how the criteria in this Regulation were taken into account is provided for in this Annex.

(b) identification of the carbon pools and greenhouse gases which have been included in the forest reference level, reasons for omitting a carbon pool from the forest reference level determination, and demonstration of the consistency between the carbon pools included in the forest reference level;

The Carbon pools, gases and CRF tables considered are the same in the National Inventory Report and in the construction of the FRL.

A full description of the elements included and excluded can be found in section 3.2.6 Carbon Pools and Gases.

(c) a description of approaches, methods and models, including quantitative information, used in the determination of the forest reference level, consistent with the most recently submitted national inventory report, and a description of documentary information on sustainable forest management practices and intensity as well as of adopted national policies;

All aspects that were considered in the construction of the FRL are described in section 3 Description of the Forest Reference Level. Please refer in particular to section 3.1 Approach to FRL Construction, which contains a description of the general approach and section 3.2 General Assumptions and Coverage, which describes some of the main assumptions. Details on how each relevant emission source/pool was calculated is provided in sections 3.3 through 3.14.

(d) information on how harvesting rates are expected to develop under different policy scenarios;

Please refer to Annex 1, Part A, criterion (g) above.

This information was not used in the preparation of the FRL.

(e) a description of how each of the following elements were considered in the determination of the forest reference level: (i) the area under forest management;

The assumptions and methodologies on forest area are provided in section 3.2.5 Forest Land and Area per Forest Stratum. It is based on the most recent trends in land-use change reported in the NIR (land-use maps of 2007 and 2010). However, we note that this assumption will be progressively replaced by real data and, once the appropriate technical corrections are carried out, will have no influence in the accounted values.

(e) a description of how each of the following elements were considered in the determination of the forest reference level: (ii) emissions and removals from forests and harvested wood products as shown in greenhouse gas inventories and relevant historical data;

The assumptions and methodologies to determine emissions and removals from forests and harvested wood products, including GHG inventory and relevant historical data, are presented, per relevant CRF Table, in sections 3.3 through 3.14.

(e) a description of how each of the following elements were considered in the determination of the forest reference level: (iii) forest characteristics, including dynamic age-related forest characteristics, increments, rotation length and other information on forest management activities under 'business as usual';

Please refer to Annex 1, LULUCF Regulation, Paragraph 5.2 above.

(e) a description of how each of the following elements were considered in the determination of the forest reference level: (iv) historical and future harvesting rates disaggregated between energy and non-energy uses.

Historical and future harvest rates are presented in section 3.4 CRF 4.A Living Biomass Pool / CO2 Emissions. For future harvesting rates, please refer to Annex 1, Part A, criterion (g) above.

Annex 2: Reply to the Technical Recommendations Contained in SWD (2019) 213 final

Technical recommendations on Article 8(5) Principles

1) Demonstrate that the approach used in the determination of the FRL ensures the continuation of forest management practices as documented in the period 2000-2009, and revise the FRL if applicable. Demonstrate how dynamic age-related forest characteristics have been taken into account and revise the FRL, if applicable.

A new section detailing the management objectives per forest stratum was added. Please refer to section 2.2 Forest management practices and context. These are considered to be the same as in the compliance period 2021-2025. The indicators used to ensure that the management intensity remains unchanged per emission source are presented in sections 3.3 to 3.14.

2) If no dynamic age characteristics were used, provide evidence that such information has no impact on the FRL and long term carbon sinks will be maintained or enhanced.

The text under section 3.2.7 Age Structure of Main Strata and Rotation Length was extensively revised, including the addition of quantitative data on age class structure. However, sections 2.2.1 to 2.2.8 explain why age class structure is not considered a good predictor of Carbon Losses in the case of Portuguese Forests.

Further, in Annex 1, text was added under Part A, point (g), containing data on projections from the Portuguese Long-Term Strategy on Carbon Neutrality of the Portuguese Economy by 2050, which shows that the long-term carbon sinks will be maintained or enhanced.

Technical recommendations on Annex IV, Section A Criteria

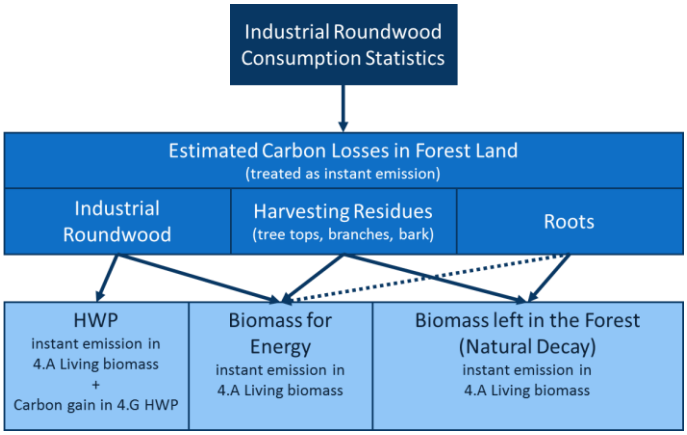
a) Given the absence of age-related characteristics in the FRL modelling, demonstrate how the goal of achieving a balance between anthropogenic emissions and removals will be achieved in the second half of the century. Provide qualitative and quantitative information until at least 2050 consistent with the long-term strategy required under Regulation (EU) 2018/1999.

Please refer to Annex 1, where text was added under Part A, point (g), containing data on projections from the Portuguese Long-Term Strategy on Carbon Neutrality of the Portuguese Economy by 2050, which shows that the long-term carbon sinks will be increased.

c) Provide data on harvest for solid biofuel production, and clarify how wood removals are derived from the industrial roundwood statistics and thus how all harvests are included (i.e. wood removals, solid wood and wood for bioenergy) in the estimate of carbon stock change in the FRL.

A new section on the use of biomass for energy was added. Please refer to section 2.5 Forests and biomass for energy. In particular, Figure 23 (reproduced below) was added to clarify "how wood removals are derived from the industrial roundwood statistics".

Figure 23: Illustration on how Industrial Roundwood Statistics are used in the GHG Inventory



e) Provide a ratio between solid and energy use of forest biomass as documented in the period from 2000 to 2009 used for the estimation of the forest reference level and demonstrate it remains constant throughout the projection. Evaluate whether the HWP pool needs to be recalculated (and subsequently, the FRL).

As explained in section 2.5, most all of the biomass used for energy results from forestry and industry wastes or by-products, and not from "wood removals" made specifically for that effect.

However, and as explained in section "3.9 CRF 4.G Wood Use and Harvested Wood Products", the indicator used to "predict" the evolution of the HWP pool in the FRL period is the share of HWP/unit of industrial roundwood removed from the forests, which means that there is no change in how wood is used (i.e. how much biomass is used for HWP versus other uses) in the FRL period compared to the reference period.

f) Confirm the information provided showing that the reference level is consistent with the objective of contributing to the conservation of biodiversity and the sustainable use of natural resources.

A new section "2.4 Forest Management and Biodiversity" has been inserted and the text on links between forest policy and biodiversity now provides more detail and provides these explanations.

g) Demonstrate the consistency with the national projections of anthropogenic greenhouse gas emissions reported under Regulation (EU) No 525/2013. Provide explanations for possible differences between national projections and the proposed FRL.

Please refer to Annex 1, where text was added under Part A, point (g), which provides these explanations.

h) Estimate the FRL based on the area under forest management as indicated in Annex IV, Part B (e) i. Demonstrate the ability of the model used to construct the FRL to reproduce historical data from the national GHG inventory. Provide (numerical) information for the period 2010-2016 demonstrating that the modelling approach used to construct the FRL is comparable and consistent (i.e., showing justified differences) with the national GHG inventory.

The FRL uses the GHG Inventory model, i.e., the same activity data, emission factors and data handling techniques. Hence there is a perfect match in historical data. As the projection for the FRL starts in 2017, this "perfect match" is valid also for the period 2010-2016.

Technical recommendations on Annex IV, Section B Elements

c) Explain how the requirement to consider age-class dynamic is considered in the applied approaches, methods and models, and provide explicit information on forest management practices including references to data sources and background information, used for expert judgements cited in the NFAP.

A new section "2.2 Forest management practices and context" was added providing information on the most common management practices in each forest stratum. Section "3.2.7 Age Structure of Main Strata and Rotation Length" was redrafted to include quantitative information on age class distribution in each forest stratum, but also to explain further why age class is not considered a good predictor of future carbon losses in Portugal.

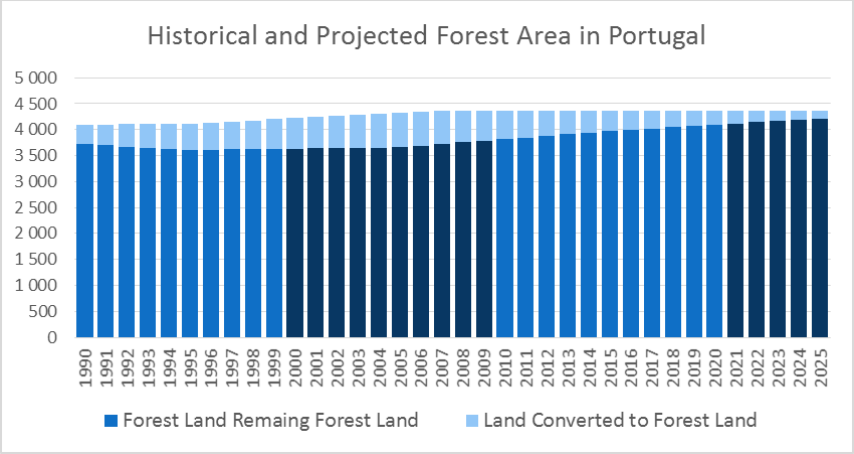
d) Provide information on harvesting rates for at least one different policy scenario.

Please refer to Annex 1, where Table 56 was added under Part A, point (g), providing the harvesting rates considered in both the FRL and the Portuguese Long-Term Strategy RNC2050.

e) i Provide the area under forest management consistent with Table 4.A ("Forest land remaining Forest land") from the latest national GHG inventory using the year preceding the starting point of the projection. Given the use of the dynamic area approach, provide a detailed disaggregated calculation of the managed forest land area at annual time steps for the entire time series since, at least, year 2000.

The area in the reference period and in the FRL area presented, respectively in Table 1and Table 2. For information only and to improve transparency the total area of "forest land" and the area of "land converted to forest" is also presented in Table 3 to Table 6, although these values are not used in the construction of the FRL.

The full time series 1990-2016 and the projection for the years 2017-2025 is presented in the figure below.



e) ii Clarify the estimation of HWP, the computation of GHG emissions and removals using the production approach and how double counting of harvest is avoided considering that different sources are used for estimating industrial harvest, salvage logging and information related to burned area and forest conversion.

As described in section "3.9 CRF 4.G Wood Use and Harvested Wood Products", HWP is estimated using the "production approach". The activity data for that estimation of HWP is only the harvest described in section "3.4.1 Harvesting for Industry". There is no double counting since the Carbon losses related to "Other Wood Uses", "Salvage Wood", "Forest Conversions" and "Natural Mortality" are all additional to the Carbon losses from "Harvesting for Industry".

e) iii Provide additional information on dynamic age-characteristics and rotation length.

This has been provided in section "3.2.7 Age Structure of Main Strata and Rotation Length". Additional data and information of forest management practices per forest stratum can be found in the new sections 2.2.1 through 2.2.8.

e) iv Provide historical and future harvesting rates disaggregated between energy and non-energy uses.

Please refer to the explanations provided in the Technical recommendations on Annex IV, Section A Criteria, points c) and e).