National Forestry Accounting Plan of France including the Forest Reference Level (FRL) for the 2021-2025 and 2026-2030 periods

English version

December 2019 amended in June 2020

Projections & modelling, living biomass

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Calculations and projections for all pools and establishment of the FRL

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Drafting of the National Forestry Accounting Plan

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December 2019

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1 GENERAL INTRODUCTION

In accordance with Regulation (EU) 2018/841 on the inclusion of greenhouse gas emissions and absorption from land use, land use change and forestry (LULUCF) under the 2030 climate and energy policy framework, the Member States of the European Union account for emissions and absorption from managed forest land for the 2021-2025 and 2026-2030 commitment periods on the basis of a Forest Reference Level (FRL). Member States submit their National Forestry Accounting Plans (NFAP) containing a proposed FRL to the European Commission before 31 December 2018 for the 2021-2025 period and before 30 June 2023 for the 2026-2030 period.

During the two commitment periods, a comparison of total emissions and absorption from managed forest land as estimated in the national inventory and the FRL will be used to calculate an accounting debit or accounting credit, calculated for each commitment period. Elaboration of the NFAP (National Forestry Accounting Plans) containing the proposed FRL must comply with certain rules and criteria as set out in Article 8 and Appendix IV of Regulation 2018/841.

This document was drawn up on the basis of the provisions stipulated in Regulation 2018/841 and of the recommendations set out in the “guidelines on the development and reporting of forest reference levels in accordance with (EU) Regulation 2018/841” (Forsell, et al. 2018) drawn up for the European Commission.

For this accounting year, implemented in November-December 2019, the proposed forest reference level (FRL) was calculated for the two periods, 2021-2025 and 2026-2030, for the European part of France, i.e. mainland France, as well as the 5 outermost regions (DROM): Guadeloupe, French Guiana, Martinique, Mayotte and La Réunion.

Since the FRL must be based on the pursuit of sustainable forest management practices as documented over the period between 2000 and 2009, the FRL is a calculation derived from a theoretical projection intended only to assess the accounting credit or debit of emissions and absorption from managed forest land. The FRL is an accounting instrument and is not a climate and/or forest policy. In particular, it is not a benchmark of management practices that it would be desirable to achieve.

In terms of climate policy, the reference texts in force are the Energy Transition for Green Growth Act (LTECV) published in the Official Journal of 18 August 2015, and the 1st national low-carbon strategy (SNBC), approved by Decree N° 2015-1491 of 18 November 2015 and the Energy and Climate Act published in the Official Journal of 9 November 2019. The draft of the 2nd national low-carbon strategy (SNBC 2) was made public on 6 December 2018 and its adoption is planned for the start of 2020.

In terms of forest policy, the reference texts in force are the Future of Agriculture, Food and Forests Act (LAAAF) of 13 October 2014 and the 2016-2026 National Forest and Wood Programme approved by Decree N° 2017-155 of 8 February 2017.

1.1 GENERAL DESCRIPTION OF THE FRENCH FOREST REFERENCE LEVEL

1.1.1 Description of the French forest reference level

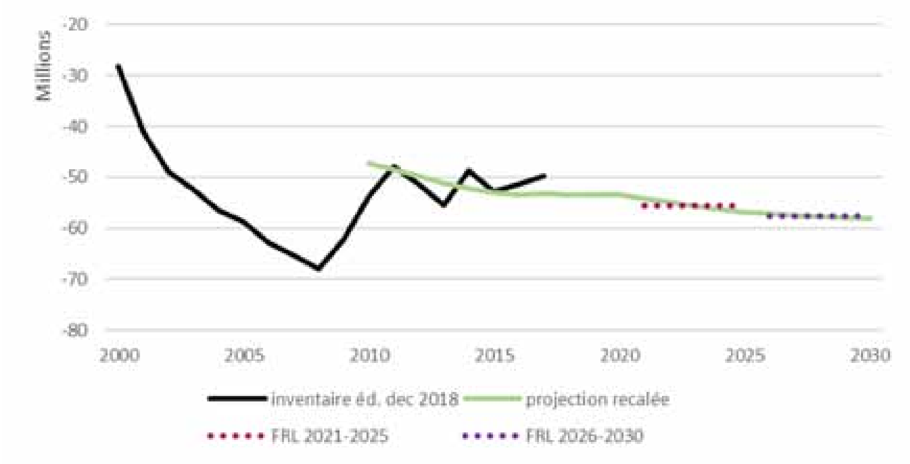
The French forest reference level (FRL) is broken down by regions: mainland France and the outermost regions. For mainland France, the National Institute of Geographic and Forest Information (IGN) produces a forest inventory used as a basis for the national greenhouse gas inventories. To calculate the FRL, a forest growth model named MARGOT (see section 3.3) was used. This model is based on data from this same forest inventory. It has been calibrated to simulate changes in forests (growth, mortality, extractions) from 2010 based on continuation of forest management practices as documented for the reference period (2000-2009). According to the results of this simulation, the net growth of living biomass is increasing over the projected period (2010-2030) despite the accompanying increase in extraction. However, a significant deviation from the level and the trend is observed over the 2010-2017 period, between this modeling and the sink actually measured and reported in the national GHG inventory. As the model cannot reproduce the actual level of the sink observed between 2010 and 2017, a readjustment was carried out (see section 4.2) in order to make the level of the FRL consistent again.

The FRL of the whole of France is set out in the table below:

FRL (tCO2e/year)	Mainland	French outermost régions	All of France (Mainland and outermost régions)
2021-2025	-55,581,825	182,535	-55,399,290
2026-2030	-57,711,441	182,535	-57,528,906

Detailed results by region and by sub-fund are set out in section 4.2

Figure 1 Presentation of the FRL compared with the projection and the historical inventory, in tCO_2e (mainland France)



1.1.2 Differences between the FRL and the FMRL (Forest Management Reference Level)

For information, this FRL (reported in the context of EU regulation 2018/841) differs from the FMRL (see box below) reported under the Kyoto Protocol. The estimated FMRL under the regulations regarding the LULUCF accounting rules for the 2013-2020 period is -45,615 kt CO_2e. It was - 67,410 kt CO_2e in 2015, when it was subject to a technical correction of 21,795 kt CO_2e.

Differing approaches between the FMRL and the FRL

The Forest Management Reference Level (FMRL) for France and for many Member States of the European Union was calculated by the Joint Research Centre (JRC). To determine it, the JRC used two approaches: a forest growth model based on the forest inventories of the Member States and the IPCC gains-losses method based on historical data of forest characteristics. This FMRL of France, submitted in 2011, is available on the UNFCCC website[1]. Information on the calculation method and the parameters are set out in the 2011 Assessment Report (TAR[2]).
The FMRL is based on forest modelling data differing from the forest data used in the inventory. However, a *post-adjustment* or calibration procedure has been used to align the historical FM with the FMRL. This approach is mentioned in the technical assessment report (TAR[3]) of the French FMRL (paragraphs 9 and 10) [4].
The FRL calculated here, on the other hand, uses a French model developed by the IGN, the organization responsible for forest inventories in France (see chapter 3).

1.2 CONSIDERATIONS ON THE CRITERIA AND GUIDELINES SPECIFIED IN APPENDIX IV-A OF REGULATION 2018/84

Appendix IV-A of Regulation N° 2018/841 lays down the criteria and guidelines for determining FRLs:

1.2.1 Compatibility of the FRL with the neutrality objective

"a) the reference level shall be consistent with the goal of achieving a balance between anthropogenic emissions by sources and anthropogenic absorption by greenhouse gas sinks in the second half of this century, including enhancing the potential absorption by ageing forest stocks that may otherwise gradually decline as sinks".

The scenario proposed for calculation of the forest reference level of France, based on continuation of the sustainable forest management practices identified for the 2000-2009 period until 2030 may be regarded as compatible with the target set by the Paris Agreement to achieve a balance between anthropogenic emissions by sources and absorption by greenhouse gas sinks during the second half of this century. With the forest management practices integrated in the scenario, the FRL projects an enhancement of the forest sink compared to currently observed levels. Forest management dynamics take into account wood extraction policies and the renewal of old and poorly managed forest land to avoid the phenomenon of declining ageing forest sinks.

Between 2000 and 2009, sustainable forest management practices in France were integrated into the first climate policy instruments. In 2004, France adopted its first strategic climate plan, the 2004-2012 Climate Plan, in order to achieve the objectives assigned under the Kyoto Protocol. This plan involved a variety of

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[1] http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_france_2011.pdf
[2] http://unfccc.int/resource/docs/2011/tar/fra01.pdf
[3] http://unfccc.int/resource/docs/2011/tar/fra01.pdf
[4] [Data and models] used for the construction of the FMRL are different from those used in the GHG inventory. (…) In order to make [FMRL] consistent with the historical data, a postadjustment/calibration was applied. Historical data from reporting on forest land remaining forest land under the Convention are used for post-calibration of the model results (…) by using the average of the period 2000 to 2008 from the 2010 national GHG inventory. (§9 and 10 of the TAR).

action in all sectors of the economy aimed at stabilizing greenhouse gas emissions in 2010 at their 1990 level. It also aimed for a fourfold reduction of emissions by 2050. Some action was aimed specifically at forest land, in particular the conservation and enhancement of forest carbon sinks, following the Marrakesh Agreements of the UNFCCC COP 7 in 2001.

The various forestry provisions of the 2004-2012 Climate Plan may be considered to have been included in the sustainable forest management practices used to elaborate the FRL, without this undermining the rule of drafting the FRL on the basis of continuation of the sustainable management practices as documented between 2000 and 2009.

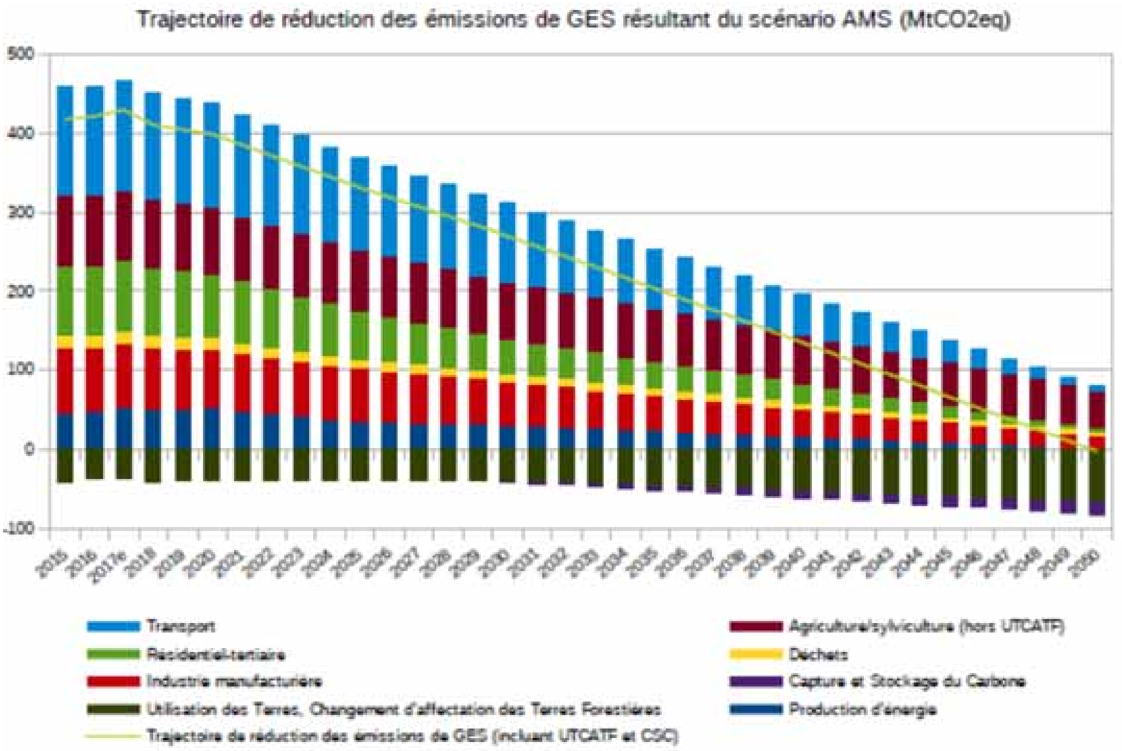
With regard to achieving carbon neutrality by 2050, as France is planning to do in its national strategy, re-positioning is required from a more overall point of view, broadened to cover all the activity sectors and in compliance with the most recent forecasting exercises.

The target of carbon neutrality by 2050, an ambitious reflection of the carbon neutrality target of the Paris Agreement, has been introduced more recently into French climate policy, in particular with the Climate Plan of 6 July 2017. The 2nd national low-carbon strategy (SNBC 2), the draft of which was made public on 6 December 2018, aims to achieve a carbon neutrality target by 2050 in France and provides details of the steps and measures planned by the Government for the environmental and inclusive transition required to reach this target. This draft was submitted in 2019 for the opinion of the Environmental Authority, the High Council for the Climate and the Economic, Social and Environmental Council and will be subject to public consultation in early 2020 before its adoption.

With the Multi-Annual Energy Plan, the 2nd national low-carbon strategy (SNBC 2) constitutes the French integrated national energy and climate plan, a draft of which was submitted to the Commission in February 2019.

In the course of work carried out in 2018 on reviewing the National Low Carbon Strategy, France has projected forecast scenarios. The scenario called “with additional measures” (WAM, i.e. AMS, Avec Mesures Supplémentaires) aims for compliance with France’s self-prescribed energy and climate targets in the short, medium and long term. It outlines a possible trajectory for reducing greenhouse gas emissions until carbon neutrality is achieved by 2050.

This scenario is based on the assumption that greenhouse gas emissions will be reduced dramatically in all sectors (see the diagram and table below). In quantitative terms, the expected emissions reductions from 2015 exceed 90% for the three sectors in transport, construction, the residential/service sector and energy generation. Due to the fact that emissions from the agricultural sector cannot be compressed, the reduction would be the least substantial in this sector (excluding LULUCF).

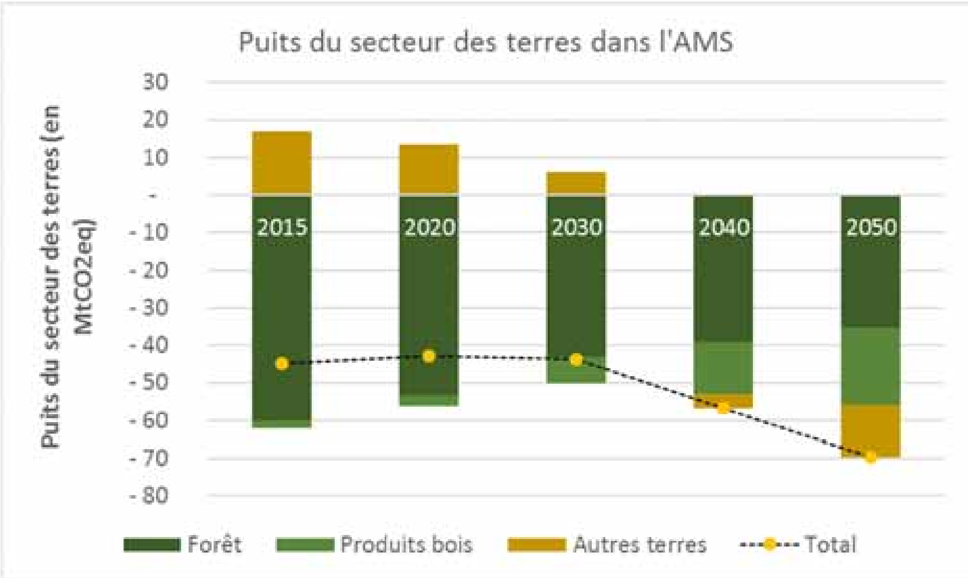


Secteurs	Réduction des émissions par secteur du scénario AMS par **rapport à 2015**
Transports	-97%
Bâtiment	-95%
Agriculture/sylviculture (hors UTCATF)	-46%
Industrie	-81%
Production d'énergie	-95%
Déchets	-66%
Total (hors UTCATF)	-83%
UTCATF	64%

In addition to this emissions reduction, in terms of carbon sinks, the National Low Carbon Strategy 2 seeks to improve the efficiency of the forest-wood sector. Indeed, the latter is strategic because it meets the need to supply the economy with biosourced and renewable energy and products, and at the same time, contributes significantly to the carbon sinks of the land sector through carbon sequestration in forest land and in wood products.

Accordingly, still in the "With Additional Measures" (WAM) scenario, intelligent and sustainable forest management will allow us to progressively increase the carbon pump effect while improving forest resilience to climate risks and better conserving biodiversity. The land area under forests will increase through afforestation. Harvests will rise gradually from 44 Mm³ in 2015 to 59 Mm³ in 2030 and 75 Mm³ in 2050, which will require significant efforts to reverse current trends, particularly in private forest land. Using wood from forest land as a building material is highly recommended in comparison to using it for energy purposes. The production of wood products with long lifespans (particularly for use in construction) will triple between 2015 and 2050, which will increase the carbon sink of wood products. Downstream, improved collection of wood products at the end of their life will improve recovery of this type of biomass, reducing landfill. Finally, the sink in the forest/wood sector will be maintained despite the current decrease in the forest sink caused by an increase in harvests. This will be achieved through the wood product sink and new forests.

The diagram below shows the changes in the land sector sink as a whole, including forest land as well as other land (crops, grassland, developed land etc.). Forest management should enable us to attain the target of zero net development in 2050 and if we account for the carbon stored in agricultural lands, this sink will rise net between 2030 and 2050, after little change between 2015 and 2030.



The forest management envisaged in the national low-carbon strategy (SNBC) is more dynamic than the one envisaged in France's FRL in order, in particular, to renew forest stands by making them more resilient to climate change, by bringing more biosourced materials into the economy taking advantage of the associated effects of temporary storage and replacement of more emitting materials and fossil fuels. It provides better preservation of soils carbon stocks. An increased afforestation and a reduction in deforestation in order to enhance the land sector sink are also considered.

The various guidelines of the new National Low Carbon Strategy (SNBC) for forest land are not integrated into the management practices used to elaborate the FRL because they are, by definition, subsequent to the 2009 date. All these guidelines, however, apply to current forestry guidelines.

Finally, the WAM scenario assumes moderate use of carbon capture and storage (CCS) technology to increase the sink. In 2050, the guidelines will avoid around 6 $MtCO_2$/year in industry and to save around ten $MtCO_2$ of emissions annually with energy production installations using biomass.

All of these assumptions will be developed in grant's national integrated energy and climate plan.

1.2.2 Carbon stocks not taken into account

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

Calculation of the FRL of France is consistent with the calculation principles of the inventory and only takes into account the various flows (gross production, mortality, extraction and decomposition) to arrive at a net result. For all carbon pools, the mere presence of carbon stocks is therefore not taken into consideration when calculating the FRL for France.

1.2.3 Reliability and credibility of the accounting system

"(c) the reference level should ensure a reliable and credible accounting system that ensures that emissions and absorption resulting from biomass use are suitably taken into account"

The FRL is based on an accounting system consistent with the national inventory of France, whose reliability and credibility are assured by compliance with the 2006 IPCC Guidelines and various reviews by experts.

Emissions and absorption resulting from biomass use are taken into account in an appropriate way by using the IGN harvest rates, adjusted to the wood extraction statistics (Annual Sector Surveys - EAB), and by calculation of a module dedicated to harvested wood products.

1.2.4 Taking harvested wood products into account

"(d) the reference level includes 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 pool of harvested wood products is taken into account in calculating the FRL of France. Harvested wood product estimation method are set out in section 3.1.1.6. This method applies a first-order decay function and half-life values (IPCC, 2006) consistently with the wood harvest calculations used in the FRL. The half-life values used are also set out in this section.

Moreover, the tables provided in this section 4.3 set out the results in accordance with two modalities:

- taking Harvested Wood Products into account

- taking the instant oxidation assumption of the latter into account.

1.2.5 Constant ratio between solid use and energy use of wood

"(e) a constant ratio is assumed between solid and energy use of forest biomass as observed in the period from 2000 to 2009"

The following were applied for the FRL projection: (i) the average harvest rate observed for the reference period (excluding the effects of storms, i.e. 2003-2009 without accidental products) and (ii) the ratio of use between lumber and industrial timber (solid use) and fuelwood (energy use) as observed for the reference period (2000-2009).

i) harvest rate

The average harvest rate observed for the reference period was calculated from AGRESTE data (see paragraph 3.2.3.1) – i.e. the same source data as in the GHG national inventory. The rate averages out as the harvest rate excluding exceptional phenomena. Exceptional harvest were excluded in order to keep the harvest levels on a par with forestry management excluding crises during the reference period and to calibrate the model with representative data from current management practices. For the storm of 1999, which gave rise to exceptional windblow harests over several years, the years 2000 to 2002 have simply been excluded from calculations of the average hraves rate over the reference period. For 2009, as the proportion of harvest corresponding to this exceptional windblow was known, only this part was cut out.

A representative harvest rate for the reference period was estimated in this way for each stratum of the forestry model. This rate has remained constant during the projection period. Paragraph 3.2.3.1 set out the method used in more detail. The appendices set out the harvest rate for each stratum.

ii) ratio between solid and energy use of wood

The projection of wood products is calculated directly from the projection of total harvests, thus keeping a constant ratio between solid use and energy use.

The distribution between solid use and energy use of wood is based on the average ratio estimated in the GHG national emissions inventory between harvests of Lumber and Industrial Timber (LIT) and Fuelwood (FW), during the reference period (2000-2009). This average ratio observed during the reference period (2000-2009) stands at 58% for solid used and 42% for energy use. This ratio between solid and energy use is then applied directly to the wood hravest projection as from the year 2000. The appendices set out the historical data and calculation of this ratio.

1.2.6 Compatibility of the FRL with the biodiversity and sustainability objectives (Appendix II)

"(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, the national forest policies of Member States and the EU biodiversity strategy"

Sustainable forest management practices between 2000 and 2009 are largely regulated by the forest policy act[5] published in 2001, making multi-functionality the basic principle of forest policy. It is in line with the international framework of recommendations on sustainable forest management, in particular with regard to the resolutions of ministerial conferences on the protection of forest land in Europe (MCPFE), a process now known under the name of "Forest Europe". This act provided responses to new public expectations in relation to forests, in particular in terms of biodiversity, with the introduction into the Forest Code of the fundamental principles of the forest policy[6] and, in particular, "sustainable management of forests ensures their biological diversity, their productivity, their regenerative capacity, their vitality and their capacity to fulfil relevant economic, ecological and social functions now and in the future at local, national and international levels". The forest policy act was developed in conjunction with the 1st forest strategy of the European Union, of 3 November 1998 and is in fact fully compatible with this strategy.

5 Forest Policy Act N° 2001-602 of 9 July 2001

6 Article 1 of the Forest Policy Act 2001-602

The first national biodiversity strategy 2004-2010 is the implementation of the French commitment under the Convention on Biological Diversity (CBD) ratified by France in 1994 with the objective of "halting the loss of biodiversity by 2010", alongside all European Union Member States. Each essential component of the biosphere was considered for the purposes of meeting this target: genes, species, habitats and ecosystems and their inclusion into an ecological framework. Implementation of the strategy began with the adoption in November 2005 of an initial series of action plans, completed in 2006, by three other action plans including one on forest land and another on French outermost regions. The strategy contained several section regarding forest land including, in particular, the objective of promoting the conservation and appropriate strengthening of biological diversity as an essential part of sustainable forest management at national, regional and global levels.

Operational implementation of the forest policy act took place in particular via the national forest programme (PFN) 2006-2015. This document made the preservation of both remarkable and ordinary forest biodiversity a key issue of the national forest policy. The PFN paid particular attention to forest ecosystems with high biological value, fragile habitats and forest stands with outstanding natural characteristics. The PFN also made biological diversity a key issue for forest land in French outermost regions. Even outside areas dedicated to nature protection, the PFN has led to current forestry management ensuring the preservation of biological diversity.

All provisions relating to sustainability and biological diversity contained in the Forest Policy Act of 9 July 2001 and reincorporated in the PFN 2006-2015 and in the 2004-2010 national biodiversity strategy can be considered to be compatible with the related European strategies of the time. All related measures can be considered to have been included in the sustainable forest management practices used to draw up the FRL, without this undermining the rule of drawing up the FRL on the basis of continuation of the sustainable forest management practices as documented between 2000 and 2009.

After the Forest Policy Act of 9 July 2001, the Future of Agriculture, Food and Forests Act (LAAAF) of 13 October 2014 became the new legal reference framework for French forest policy. Following the PFN of 2006-2015, the National Forest and Wood Programme (PNFB) defines French forestry strategy for the 2016-2026 period. This strategy points out that forest biodiversity, whether classified as "ordinary" or "heritage", is a major asset for sustainable and effective forestry. The PNFB and regional forest and wood programmes (PRFBs, regional subsections of the PNFB) being deployed put forward action to increase knowledge about biodiversity; preservation of biodiversity in forest land and preservation and rehabilitation of ecological forest continuity. More precisely, practices that can the promoted in the PRFBs include the example of leaving stumps and brushwood on the spot; keeping dead wood in forest stands and/or on the ground; creating islets, networks and age continuity; monitoring of the diversity of tree species in stands and/or per forest area. In the outermost regions, new tools have been developed using imaging analysis to maintain a high level of environmental monitoring and forest policing. Restoration by afforestation of degraded sites is encouraged, while the protection of particularly sensitive forest ecosystems, such as mangroves, is reinforced.

The PNFB was drafted in conjunction with the new EU forestry strategy of 20 September 2013 for forest land and the forest sector and is fully compatible with it. In particular, the two documents share the same guiding principles, including that of sustainable forest management and their multifunctional role, reflected in "Forest Europe" principles.

After the first 2004-2010 phase, on the basis of sectoral action plans, the new national biodiversity strategy (SNB) 2011-2020 is now the reference programme text for French biodiversity policy. This strategy, presented on 19 May 2011, is an application of the Aichi targets of the strategic plan of the Biological Diversity Convention and sets out a greater commitment my players in all sectors of activity and on all territorial levels, both in mainland France and the outermost regions. The SNB was also drafted in close interaction with the new European Union Biodiversity Strategy by 2020, following the communication of the European Commission dated 3 May 2011.

The various provisions of the PNFB and the current SNB are not included in the management practices used to develop the FRL because by definition they are subsequent to 2009. However, all these guidelines apply to current forestry guidelines.

1.2.7 Consistency with national projections

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

Methodological consistency

From a methodological point of view, the calculation of projections established under EU Regulation N° 525/2013 differs substantially from the calculation of a forest reference level established under EU Regulation N° 2018/841. The FRL is based on a forestry model. The projections are not based on the results of a forestry model but on the assumptions of experts regarding changes in forest land, forestry practices and the scenarios.

GHG emissions and absorptions projections made within the framework of EU Regulation N° 525/2013 are made according to two scenarios : with existing measures and with additional measures. In both cases the proportion of forest land (different scope from that used for the FRL which only concerns forest land remaining as such) is projected as far as 2035 on the basis of a known starting point in 2015. Accordingly, this starting point is different from that of the FRL (2010).

No forestry model has been used for calculating the projections. By contrast, the baseline data used for the projections and for the FRL are the same: growth, death and sampling data from the IGN.

Consistency of results

In developing forecasts of the reliable assumptions, it has been assumed in particular that gross production and mortality would be stable until 2035. With this choice, it is possible to focus on the effects of harvesting practices. As part of the work on the FRL, the model used by IGN gives a combined increase in gross production and mortality over the period modelled until 2030. Production and mortality dynamics remain uncertain, as they are highly dependent on meteorological conditions that have not been modelled for the purposes of this work. To a large extent, this choice explains the trend towards a reduction in the sink in the predictions, while the sink continues to grow in the FRL.

Subsequently, policies aimed at increasing forest harvests are included in the projection scenario with existing measures. This is not the case for the FRL, in which forestry practices are those observed over the 2000-2009 period. Consequently, the increased harests taken into account in the projections is higher than the hravests modelled in the FRA.

1.2.8 Consistency with the national GHG emissions inventory

“h) the reference level must be consistent with greenhouse gas inventories and relevant historical data and must be based on transparent, comprehensive, consistent, comparable and accurate information. In particular, the model used to produce the reference level must be able to reproduce historical data from the National Greenhouse Gas Inventory."

Methodological consistency

Calculation of the FRL is based on the same methodological approaches (gains and losses method for the forest biomass balance, application of IPCC first order decay for wood products and an assumed stock balance for other pools) and the same data sources (national forest inventory of the IGN, wood harvest data from statistical surveys and readjusted to the IGN overall extraction level) as the national inventory. This report, as well as all the documents and files provided as part of the submission of the national inventory of France, provides all the methodological information for guaranteeing transparency of the calculations and justifying their relevance.

Consistency of results

Nevertheless, for the years from 2010 to 2017, a discrepancy can be observed between the model applied for the FRL and the national inventory. According to the results of this simulation, net life biomass growth is increasing for the projected period (2010-2030), in spite extraction which is also increasing. According to this model, the net profit and loss account for live biomass gives a rising GHG sink between 2010 and 2030. Nevertheless, according to the results of the forest inventory, the sink, as actually observed through field measurements, shows a downward trend from 2010 to 2017. Several possible explanations for this deviation are put forward in section 4.2.

Reset

To make the projection consistent with the national inventory, an adjustment has been made in accordance with the recommendations of the methodological guide (Forsell, et al. 2018) (see section 4.2.1).

2 PREAMBLE FOR THE FOREST REFERENCE LEVEL

2.1 CARBON POOLS AND GREENHOUSE GASES INCLUDED IN THE FRL

2.1.1 Carbon pools

Consistently with the national inventory, the calculation of the FRL for France takes into account flows related to the following carbon pools, in forest land remaining as such:

	above-ground biomass	underground biomass	dead wood	litter	soil organic carbon	harvested wood products
Mainland France	E	E	E	E (0)*	E (0)*	E
French Guiana	E (0)[7]	E (0)*	E (0)*	E (0)*	NE	NE
Guadeloupe	E (0)*	E (0)*	E (0)*	E (0)*	NE	NE
Martinique	E (0)*	E (0)*	E (0)*	E (0)*	NE	NE
Reunion	E (0)*	E (0)*	E (0)*	E (0)*	NE	NE
Mayotte	E (0)*	E (0)*	E (0)*	E (0)*	NE	NE

E = Estimated; NE = Not estimated; E(0) = estimated at zero for the forest biomass balance sheet (production, mortality, extraction), excluding forest fires. See paragraph 3.1.2.1

2.1.2 Greenhouse gas

Calculation of the FRL for France, consistent with the national inventory, estimates the following flows of greenhouse gases:

	Forest balance			Burning of wood harvest residues			Forest fires		
	CO_2	CH4	N2O	CO_2	CH4	N2O	CO_2	CH4	N2O
Mainland France	E	NE	NE	IE	E	E	E	E	E
French Guiana	E (0)*	NE	NE	IE	E	E	E	E	E
Guadeloupe	E (0)*	NE	NE	IE	E	E	E	E	E
Martinique	E (0)*	NE	NE	IE	E	E	E	E	E

[7] A zero estimate means that the variation in stock of this pool is zero and that the carbon gains and losses (emission and sequestration flows) offset each other. This assumption is supported by scientific knowledge and uncertainties about the current data (see Sections 3.1.1.5 and 3.1.2).

Reunion	E (0)*	NE	NE	IE	E	E	E	E	E
Mayotte	E (0)*	NE	NE	IE	E	E	E	E	E

E = Estimated; NE = Not estimated IE = Included elsewhere

2.2 DEMONSTRATION OF THE CONSISTENCY BETWEEN THE POOLS INCLUDED IN THE FRL

Calculation of the FRL takes all the carbon pools into account in a consistent way:

- the above-ground biomass is modelled;
- the underground biomass is calculated directly in proportion to this above-ground biomass;
- dead wood is assumed to be in equilibrium, in line with biomass mortality flows, except for exceptional emissions from dead wood related to decomposition over several years of windblow from storms;
- litter and soil are also assumed to be in equilibrium, consistent with the dead wood assumption and with the national inventory;
- wood products are directly projected according to the modelling of future wood harvests, in accordance with the guide.

The approach of reporting implementation for the FRL calculation applies the same rules and assumption as the national greenhouse gas inventory. Carbon flows are reported for each carbon pool without double counting:

- **Living biomass:** growth, background mortality, exceptional mortality (due to storms and forest fires), extraction (wood harvests and extraction losses).
- **Dead wood:** exceptional gains due to windblow (on the year of the storm); exceptional losses due to decomposition of windblow (losses spread out over several years).
- **Litter and soil:** neutrality assumption: balance between losses and gains.
- **Wood products:** gains attributable to wood harvests and losses due to the end of life of the products.

2.3 DESCRIPTION OF THE LONG-TERM FOREST STRATEGY

2.3.1 General description of forest land and forest management in France and the national policies adopted

2.3.1.1 Mainland

With 10% of the EU forest land area, the forested area of mainland France is in fourth place behind Sweden, Finland and Spain. Taking the volume of standing wood into account, it ranks in third place with 2.5 billion m^3 behind Germany (3.6 billion) and Sweden (2.9 billion). It currently covers 16.5 million hectares in mainland France (i.e. 30% of the area). Forest land is thus a substantial part of our landscapes. In mainland France, they are mainly located around the Mediterranean coastline, in the Landes forest area, in the east of the country and in the mountain regions.

French forest land has three important characteristics:

- diversity: they have a variety of ecosystems (humid, mountain and tropical forests). Mainly composed of broadleaf trees in mainland France (two-thirds of forest land), while conifers predominate in mountain areas and on poor soils.

- In mainland France, ¾ of them belong to private owners. Although there are more than 3 million French owners, 2.2 million of them own less than one hectare, whereas approximately 380,000 own more than 4 hectares, totalling 76% of the privately owned forest land area. The 50,000 owners who own more than 25 hectares account for approximately 52% of the private forest land area and provide ¾ of the wood sold from private forest land. Publicly owned forest land (state and municipal) accounts for ¼ of forest land in mainland France and plays a special role in services for public benefit and visitor access. These forests account for almost 40% of the wood harvest;
- they are in a capitalization phase in younger stands, not yet mature, but also structurally under-exploited, in particular in their least productive or less accessible parts and in many stands that have reached the renewal stage. Accordingly, although the commercial harvest has been stable since the end of the 1980s, biological wood production in forest land has increased during this same period. On average, extraction in Mainland France over the 2005-2013 period amounted to approximately 50% of net biological production (not including dead wood). However, the situation by regions is very different and is linked to the length of time agricultural and rural land has been abandoned, the relief, the type of ownership, the age of the stands and their species.

Pursuant to the Future of Agriculture, Food and Forests Act (LAAAF) of 13 October 2014 and the 2016-2026 National Forest and Wood Programme approved by Decree N° 2017-155 of 8 February 2017, the national policy currently adopted to boost forest management focuses on 5 main areas:

- Promoting the grouping of forest land owners (forming economic and environmental forestry interest groups, establishing producer organizations, sharing logging operations between private and public forest land, etc.)
- Improving information sharing using digital technology (development of a computer platform for exchange between economic players in the forest-wood sector: "The Forest is Moving" mechanism)
- Optimizing the effectiveness of sustainable management documents (streamlining management documents to make them more readable and more operational, digitizing felling licence requests, etc).
- Supporting more dynamic forest management practices (developing innovative and more productive silvicultural procedures)
- Improving the accessibility of forest areas (using financial resources to create access roads, promoting innovative logging method, e.g. airships)

With regard to climate policy, the draft revised national low carbon strategy identifies the following main factors for the forest sector:

- Improve the carbon pump through improved forestry management, which will adapt forest land to climate change and preserve carbon stored in the soil. Observation and statistical monitoring of this carbon stored in soils must be ensured and improved. Strengthening the carbon sink in the forest-wood sector will also require the development of afforestation initiatives and a reduction in forest clearance.
- Maximizing the effects of substitution and the storage of carbon in wood products by means of:
    - increased wood harvests (in particular with an increased wood marketing target set by the National Forest and Wood Programme for the 2016-2026 period) while ensuring that biodiversity is preserved;
    - focus on long-term uses (in particular through an intensified use of timber in the construction industry) and development of recycling and energy recovery of end-of-life products.

- Assessing the implementation of the resulting policies, and adjusting them regularly on this basis to ensure that the results are achieved, in particular with regard to biodiversity.

These policies are combined with the French National Forests and Wood Programme (PNFB) which oversees forestry policy for the 2016-2026 period and sets a target for additional use of wood as part of sustainable and multifunctional forest management (involving challenges in terms of protecting biodiversity, soils, water resources and landscapes). One of the characteristics of the sector is its integration into a particularly long time frame: combined action is needed for mitigation purposes and to adapt to climate change and to manage risks linked to natural hazards in forest land in order to meet the various challenges, while at the same time preserving the high economic value of the sector.

2.3.1.2 French outermost régions

Forest land in the outermost French regions covers 8.3 Mha, including 8 Mha in French Guiana (accounting for 96% of the surface area of this country). There are mangroves on the Caribbean coastlines, huge tropical forests in French Guiana and mountain forests on La Réunion and on the volcanic slopes of Martinique and Guadeloupe.

In each of the outermost regions, the climate change mitigation policy requires preserving ecosystems which sequester carbon as far as possible and counteracting their degradation. Territorial development policies are crucial here to control land urbanization. Preservation of these ecosystems must be carefully considered in order to adapt to climate change.

The Ordinance of 28 July 2005 extended the Forest Code to French Guiana, adapting it to the context and issues specific to this outermost Department. Accordingly, the national forest policy is deployed on the basis of the same principles in all outermost departments and regions. Just as in mainland France, the characteristics of outermost forest management systems are taken into account in Regional Forest and Wood Programmes (PRFBs, i.e. regional sub-programmes of the PNFB).

Forest land in French Guiana comprises primary forest, rich or even exceptionally rich in biodiversity, and stores a great deal of carbon (approximately 1000 tCO_2eq/ha stored).

The primary nature of French Guiana forests must be taken into account: biodiversity issues require the sustainability of current ecosystems to be ensured, without replacing them on a large scale with other forest systems.

Accordingly, forest land in French Guiana is managed in a selective and low-impact manner: 5 stems per hectare every 65 years, with approximately 5,000 hectares harvested each year.

Forest management must however reconcile the need to preserve primary forests with the need for development. The demographic situation in French Guiana it is highly dynamic. There is strong and widespread political will to speed up the economic development of the territory, in particular in agriculture, with the ultimate aim of ensuring food self-sufficiency. Since 96% of French Guiana is covered by forest land, this agricultural development cannot take place without some deforestation, which must be taken into consideration in the accounting balance of the land sector.

Deforestation in French Guiana is a multi-factor process, driven by land urbanization, agricultural development, illegal gold placer mining and the gold mining industry. Deforestation takes place in 3000 ha/year (0.0375% of the territory) for farming (60%), infrastructural development (15%) and illegal gold placer mining (25%).

Counteracting illegal deforestation in French Guiana (approximately 800 ha/year) is also a priority.

The specific geographical and climatic characteristics of each territory play an important role in the land sector. French Guiana merits special attention in the analysis as the dynamics are vastly different to those of Mainland France.

2.3.2 Description of future harvest rates for each different policy scenario

The 2nd National Low Carbon Strategy (SNBC 2), in line with the National Forestry and Wood Programme (PNFB), projects a change in the annual extraction rate in comparison with natural growth excluding dead wood from 55% in 2013 to 65% in 2026 and 69% in 2030.

The business-as-usual scenario produced as part of the development of the strategy (the so-called "with existing measures" or WEM scenario, which takes into account all the measures existing in 2017) gives a lower harvest rate at 64% in 2030. In comparison, the National Forestry Accounting Plan takes into account an extraction rate of 48% between 2015 and 2030.

The extraction mentioned above includes harvested above-ground biomass and root biomass and all the extraction losses, including biomass left in the forest.

Note that the assumptions about the development of the scope of managed forest land and biological growth differ between the 2nd National Low Carbon Strategy SNBC 2 scenario, the business-as-usual scenario and the scenario used for the National Forestry Accounting Plan. In particular, since biological growth is sensitive to climate change effects, but with substantial uncertainties at this stage with regard to quantification of these effects, different assumptions have been used according to the scenarios, in connection with more or less proactive climate change adaptation action on forest land. Note also that the forest land area considered also varies between the different scenarios, in connection with more or less proactive afforestation action.

3 DESCRIPTION OF APPROACHES, METHOD AND MODELS

3.1 DESCRIPTION OF THE GENERAL APPROACH APPLIED TO ESTIMATE THE FOREST REFERENCE LEVEL

3.1.1 Mainland France

3.1.1.1 Definition of forest land

In accordance with the Marrakesh Agreements (2001) and with the values shown in Appendix II of Regulation (EU) N° 2018/841, France has adopted the following minimum values for its definition of forest land:

	Ground covered by tree crowns	Area	Height of mature trees	Width
Threshold	10%	0.5 ha	5 m	20 m

A forest may consist either of closed forest stands where trees of various storeys and undergrowth cover a high proportion of the ground, or open forest stands. Young natural stands and all plantations comprising woody species that are likely to reach 5 metres in height on maturity but whose crown does not yet cover 10% of the area are included in the “Forest” category. Similarly, areas that are normally part of forest land but have been temporarily cleared because of human intervention or natural causes and which are expected to become forest again within 5 years of clearing are also included in the “Forest” category. However, trees stands that meet the defined thresholds but are not mainly used for forestry (orchards, urban parks, gardens, etc.) are excluded from the “Forest” category.

3.1.1.2 Definition of managed forest

The FRL is calculated only for managed forest land. For France, forest land is managed according to the UNFCCC’s definition when it is subject to forest management operations aimed at providing its environmental, economic and social functions. The term, “forest management operation” covers felling or forestry work but also forestry planning, providing visitor access to forests and protection of the forest ecosystems. Only forest land subject exclusively to natural processes, in particular due to limited accessibility, is considered as unmanaged. Such unmanaged forest land is estimated from the surface areas of “other forests” defined by the IGN which represent approximately 5% of forest land areas in mainland France.

3.1.1.3 Taking afforestation and deforestation into account

The FRL of mainland France is estimated on the basis of a changing surface area with a dynamic approach, taking into account afforestation occurring during the reference period (2000-2009) which results in an increase in the forest area, these afforested areas of over 20 years old being gradually added each year during the periods from 2011 to 2030. This changing surface area does not include any deforestation, which will be included later as soon as it comes to light through technical corrections.

3.1.1.4 Calculation of the forest carbon balance: living biomass

Living biomass is the main component of the forest carbon balance of the French LULUCF sector and therefore of the FRL calculation. The implemented model is used to project the development of living above-ground biomass and root biomass to estimate gross biological production of the trees, their mortality and wood extraction (see Section 3.2.1.1).

3.1.1.5 Calculation of the forest carbon balance: dead wood, litter and soil

- the **dead wood** pool is estimated to be in equilibrium, in line with the national inventory. The stock is considered to be constant, the incoming flows (mortality) being offset by the outgoing flow (decomposition and transfer to the litter), except for emissions from exceptional dead wood related to the decomposition, over several years, of windblow from storms, for which slight flows of CO_2 are estimated;

- the **litter** pool is estimated to be in equilibrium, in line with the national inventory. The stock is considered constant, the incoming flows (contributions by branches, leaves; mortality) being offset by the outgoing flows (decomposition and transfer to the soil). No CO_2 flow is therefore quantified for this pool;

- the **soil organic carbon** pool is estimated to be in equilibrium, in line with the national inventory. The stock is considered constant, the incoming flows (contributions from litter) being offset by the outgoing flows (mineralization). No flow of CO_2 is therefore quantified for this pool, as it is estimated at 0. The IPCC proposes an estimate of soil carbon stocks on the basis of reference stocks associated with corrective factors related to management. However, no information has been identified that can obtain results from the development of such forest soil management method; soil carbon stocks are therefore stable over time in the absence of a change in land use. It is considered that the carbon stock of this pool does not change over time. The conservative nature of this assumption has been affirmed by a study carried out by the ONF (National Forestry Office) and the university of Louvain (Jonard, et al. 2013) on the plots of the RENECOFOR forest monitoring network. This study was initiated by the French Ministry of agriculture to respond to the Kyoto Protocol reporting requirements on monitoring the various soil carbon pools. This study concludes that French forest soils can be considered as significant carbon sinks even if it does not formulate absorption factors which could have been used in the GHG inventories.

3.1.1.6 Calculation of the forest carbon balance: harvested wood products

The pool of harvested wood products (HWPs) is estimated on the basis of the method developed in the technical guidelines (Forsell, et al. 2018). The total wood harvested over the reference period (in this case 2003-2008, as the harvests of 2000 to 2002 and 2009 were too high due to the effects of the storms of 1999 and 2009 and therefore not representative of a traditional reference level) are directly estimated in the GHG national inventory . An average level is calculated over this period. The extraction levels modelled in the context of the FRL from 2010 to 2030 are compared to the average reference level. The difference, observed for each projected year, from the historical reference value is then applied to the production of the various harvested wood products. For each of these products, stock variations are estimated in accordance with the IPCC method applied to the national inventory.

3.1.1.7 *Calculation of emissions related to burning wood harvest residues on site*

On-site residue burning during wood harvesting is taken into account and generates different greenhouse gases (N2O, CH4) in addition to CO_2. There is scanty knowledge of the volume of wood burned on site: it is therefore estimated using IPCC default data, assuming that 10% of the above-ground biomass is left to decompose and that the rest of the residues are burned, which corresponds to a range of 4% to 15% of the total above-ground biomass depending on the species. These emissions are estimated using the emission factors from the IPCC 2006 guidelines. The projection of these emissions is based on continuation of the average observed over the last 5 years calculated in the inventory (2012 to 2016).

3.1.1.8 *Calculation of emissions related to forest fires*

In mainland France, two major areas are considered separately in order to estimate emissions from forest fires: the Mediterranean area, which is more susceptible to forest fires than the rest of the country and has a lower biomass density, and the rest of France. For the Mediterranean area, annual burned areas are provided by the *Prométhée* (2018) database. For the rest of France, annual burned surfaces are provided by the Ministry of Agriculture (2018).

Burned surface area (ha/year)	**Mediterranean area**	**Rest of the country**	**Total**
2000	18,860	5218	24,078
2001	17,965	2677	20,642
2002	6298	23,871	30,169
2003	61,424	7798	73,000
2004	10,596	1804	13,700
2005	17,356	3144	22,400
2006	5483	1417	7400
2007	6485	1315	8500
2008	3746	640	6006
2009	11,113	4917	17,000
2010	5453	1337	10,300
2011	4492	3808	9400
2012	4392	3208	8600
2013	1922	948	3230
2014	4,113	2227	7440
2015	3111	6474	11,160
2016	12,128	3122	16,100
2017	20,825	2407	24,500

Emissions are estimated using emission factors which are specific to each of these two areas to reflect the differences in vegetation type and density. Since combustion during forest fires is by definition uncontrolled, the representation of the emissions remains imprecise. The equation below, inspired by the IPCC 2.14 equation (2006), is applied:

$$L_{fires} = \sum_i A_{burnt(i)} \times BW_i \times Frac\_burn_i \times CF$$

With:

L_{fires}	=	Annual carbon losses related to fires, t C/year
$A_{burnt(i)}$	=	Surface area burned annually in the geographical area i, ha
i	=	Geographic area (*Mediterranean area* and *Others*)
BW_i	=	Biomass stock on the areas burned the geographical area i, t DM/ha
Frac_burn	=	Biomass fraction actually burned in geographical area i
CF	=	Carbon fraction of the biomass, t C/t DM

The emission factors used for the national inventory and the FRL in Mainland France are as follows:

Parameters	Mediterranean area	Rest of the country
Stock of above-ground biomass (in tDM/ha)	30	150
Combustion efficiency (FRAC_burn)	0.25	0.20

For the projection of years 2021 to 2030, the average of the surface areas observed during the past 5 years calculated in the inventory is used (2012 to 2016).

3.1.2 French outermost regions

3.1.2.1 Calculation of the forest carbon balance: living biomass

In order to maintain consistency with the national inventory, the FRL of French outermost forest land assumes neutrality. Due to the substantial uncertainties regarding French outermost forest land and the absence of monitoring as accurate and complete as the mainland France forest inventory, its carbon balance cannot be properly quantified. In particular, the question of whether forest land in French Guiana (excluding deforestation) is a net sink and, if so, whether it will remain so, is still unclear. Accordingly, in the national inventory, for all pools and for all outermost departments, neutrality or balance assumptions are adopted for all land concerned by the FRL.

(tCO_2e/year)	French Guiana	Guadeloupe	Martinique	Reunion	Mayotte
Living above-ground biomass	0	0	0	0	0

Living underground biomass	0	0	0	0	0

3.1.2.2 Calculation of the forest carbon balance: dead wood, litter and soil

In order to maintain consistency with the national inventory, the projected hypotheses remain the same:

(tCO_2e/year)	French Guiana	Guadeloupe	Martinique	Reunion	Mayotte
Dead wood	0	0	0	0	0
Litter	0	0	0	0	0
Soil	0	0	0	0	0

3.1.2.3 Calculation of the forest carbon balance: harvested wood products

In order to maintain consistency with the national inventory, the projected hypotheses remain the same:

(tCO_2e/year)	French Guiana	Guadeloupe	Martinique	Reunion	Mayotte
Harvested wood products	0	0	0	0	0

There is some forest extraction in these areas, but it is very low and it is assumed to be fully offset by gross production.

3.1.2.4 Calculation of emissions from on-site burning of wood harvest residues

When harvesting, the entire CO_2 emitted is assumed to be offset by gross production. However, non-CO_2 gas emissions are estimated when wood harvest residues are burned on site. This practice is only taken into account in French Guiana.

	French Guiana	Source
Log harvests (m3/year)	249,400	According to Guitet, et al. 2006
Harvest – bio. Above-ground biomass harvest (tC/year)	124,628	Citepa (expansion factors)
Proportion burned on site	41%	According to Guitet, et al. 2006 and IPCC, 2003 (3.187)
Oxidized fraction	30%	IPCC, 2003 (3.93)

For other outermost departments, no emissions are associated with this practice.

3.1.2.5 *Calculation of emissions related to forest fires*

Emissions related to forest fires, unlike other forest losses (mortality, extraction), are assumed not to be offset. They are estimated according to an estimate of the areas burned:

Burned surface area (ha/year)	French Guiana	Guadeloupe	Martinique	Reunion	Mayotte
2000	1000	0	0	10	11
2001	1000	0	0	82	11
2002	1000	0	0	69	11
2003	1000	0	0	1	11
2004	1000	0	0	7	11
2005	1000	0	0	56	11
2006	1000	0	0	70	11
2007	1000	0	0	2	11
2008	1000	0	0	40	11
2009	1000	0	0	34	31
2010	1000	0	0.1	937	51
2011	1000	0	0	2718	11
2012	1661	0	0	154	11
2013	279	0	0	375	77
2014	1318	0	0	245	11
2015	1318	0	0	85	11
2016	1000	0	0	301	11
2017	1000	0	0	83	11
Sources	Pref. of French Guiana and Citepa assumption	BDIFF	BDIFF	BDIFF	BDIFF

The emission factors used are estimated using the same approach as for mainland France. The parameters specifically used for outermost France are set out below:

Parameters	French Guiana	Guadeloupe	Martinique	Reunion	Mayotte
Above-ground biomass stock (in tMS/ha)	350	189	256	103	159
Combustion efficiency (Frac_burn)	0.25	0.25	0.25	0.25	0.25

The projection of the burned areas assumes that the trends observed over the historical period will continue:

Burned surface area (ha/year)	French Guiana	Guadeloupe	Martinique	Reunion	Mayotte
2021-2025	1000	0	0	157	11
2026-2030	1000	0	0	157	11

For La Réunion, the projected value is equal to the average of the historical values excluding 2011, which is considered as exceptional and not representative of a background level.

3.1.2.6 Consistency in processing carbon pools between mainland France and outermost regions.

For outermost regions, the inventory, with the support of experts and scientific literature, assumes neutrality for living biomass, dead wood, litter and soils in forest land remaining as such; apart from exceptional losses linked to forest fires and to burning harvest residues; phenomena for which gases other than CO_2 are also emitted.

In French outermost regions (Kyoto zone), similar results have not been obtained from forest inventories due to the low level of extraction from forest land and the type of forest. Accordingly, estimates have been produced on the basis of default IPCC data on forest growth. These results show growth in excess of the losses in all territories. Accordingly, it has been chosen in a conservative manner, retaining a forest biomass stability assumption in these areas and assuming that growth merely offsets harvests and does not generate any additional sink.

This neutrality assumption is based on the expert knowledge of Guitet et al. (2006) [328]. Accordingly, growth is estimated indirectly on the basis of the extraction rate and amounts to 0.02tC/ha (above-ground and root biomass). For land that was afforested less than 20 years ago, a value of 1tC/ha has been used as in mainland France, consistently with Guitet et al. 2006 (post-harvest growth value between 1.5tC and 2tC/ha).

Uncertainties over the role of forest land in French Guiana as a sink

The carbon balance of the Amazon forest ecosystem is uncertain. Certain studies tend to show that the Amazon rain forest in general may play the role of a sink, while others show that it may rather be a source. These results depend on numerous parameters (scope, measurement or estimation, region, sampling, period, etc.).

Taking into account increased mortality phenomena linked to precipitation and climate variations and to forest degradation (beyond deforestation) results in estimates that occasionally cast doubt on the role of the Amazon rain forest as a carbon sink. Worldwide, using satellite measurements coupled with field data as a starting point, Baccini et al., 2017 conclude that tropical forest areas may be a slight source and not a sink. Growth is not offsetting deforestation, nor degradation and disturbance (69% of losses).

Analysis of historical forestry data show that although Amazonia has a role as a carbon sink, a trend towards a decline in this accumulation has been observed in the long term (Brienen et al., 2015). The above-ground biomass growth rate has diminished by 2/3 between the 1990s and the 2010s. Recently there has been an observable phenomenon of stagnation (levelling off) in growth, while mortality has continued to increase.

According to Philips and Brienen (2017), the Amazon rain forest still represents a sink, although this role has diminished since the 2000s. In French Guiana, this sink is large enough to offset all generated emissions, including those due to deforestation and changes in land occupation. Forest land in French Guiana is not necessarily as sensitive to increased mortality as that in the rest of the Amazon region. This sensitivity is still correlated to the amount of above-ground biomass present (Johnson et al. 2016).

3.2 DOCUMENTATION OF DATA SOURCES USED TO ESTIMATE THE FRL

3.2.1 Documentation of the stratification of managed forest land

3.2.1.1 Mainland France

The French National Institute for Geographic and Forest Information (IGN) is the public institution responsible for producing reference information on the state of French forest land, its dynamics and its diversity [Hervé, 2016; Hervé et al., 2014]. This information is used to establish and assess public policies relating to forest ecosystems.

As such, IGN makes the National Forest Inventory (NFI) a permanent statistical survey of French forest land, which consists of measuring the state of the forest land and changes in terms of area, volume and biological production on national and regional levels according to public and standardized protocols and definitions. Since 2005, an inventory of all public and private forest land in mainland France has been made every year. Each year, a sample of 7,500 new points all over the country is surveyed in forest land available for wood production (equivalent to managed forest land according to the UNFCCC definition).

Modelling has been carried out on the basis of a division of French forests into 56 strata for forestry stands (see annex) and 2 strata for poplar plantations.

The stratification principle is that all stands of the same stratum have similar characteristics and therefore the same growth, mortality and harvest scenarios can be applied to them. Each stratum is composed of at least 200 different inventory points, which can be used to describe the current resource and the natural dynamics with good statistical accuracy.

Strata of poplar plantations distinguish the two large areas of national poplar production, with a “North” area consisting of the main ecological regions (GRECO) B, C, D and E, and a “South and West” area corresponding to GRECOs A, F, G, H, I and J. These two major areas are distinguished primarily by their climatic conditions and by the cultivars of the poplar trees planted.

The 56 forest strata are defined as a cluster of 116 strata initially set out in the previous national studies [Colin & Thivolle-Cazat, 2016; Roux & Dhôte, 2017]. Each stratum groups comparable stands in terms of species, ownership, environmental conditions and management practices. More specifically, these strata are derived from a combination based on expert opinion of the four following factors determined from NFI data:

- Type of forest cover, with a distinction between closed forests (53 strata) and open forests where the rate of tree cover is less than 40% (3 strata);
- Objective species for the managing agent. This is defined by expert opinion. About 20 groups of broadleaf and conifer species are identified. A species is said to be "objective" when its presence it is assumed to determine forestry operations: it is often the species representing the greatest economic interest;
- The ownership category, making a distinction between state, municipal and private forest land;
- The 11 Main Ecological Regions in France (GRECO) (IFN, 2011), distinguished by types of soils, relief and climate in France, i.e. site-specific factors which have an impact on the productivity of forest land.

For more reliable calibration of natural dynamics, the 116 initial strata have been clustered into 56 new strata according to statistical proximity and the similarity of the descriptive criteria of the strata. For example the state-owned beech forests of the Vosges (D) and Jura (E) GRECOs have been merged.

Finally, each NFI plot is assigned to a stratum, and for each stratum the NFI estimators enter the following data:

- status variables such as area, stand density and stock of standing wood per diameter class for the year 2010. The status in 2010 is calculated as the average of the 5 annual NFI surveys, 2008 to 2012, after exclusion in the 2008 survey of windblown trees from the Klaus storm of January 2009;

- dynamics variables required to simulate changes in the resource, such as biological production, natural mortality and number of trees recruited per diameter class. Forest dynamics are also calculated using the same statistical sample as the initial stock (annual NFI surveys 2008 to 2012), which corresponds to the flows occurring during the 2003-2011 period.

3.2.1.2 French outermost regions

For outermost regions, no stratification of managed forests is applied.

3.2.2 Documentation regarding the surface area covered by managed forests

3.2.2.1 Mainland France

The national forest inventory provides an estimate of the forest land area available for wood production at the beginning of 2010. This area includes afforestation of less than 20 years old, which does not meet the UNFCCC definition of managed forest land. For calculation of the FRL, since the projections are made including all the stands of 2010, without any increase or decrease in the forest area, it is necessary to exclude from the 2020 area, afforestation which was less than 10 years old in 2010, from that of 2025 afforestation which was less than 5 years old in 2010, and none for the 2030 area. Specific processing aimed at excluding young afforestation of less than 20 years old from the projected carbon sink has been established.

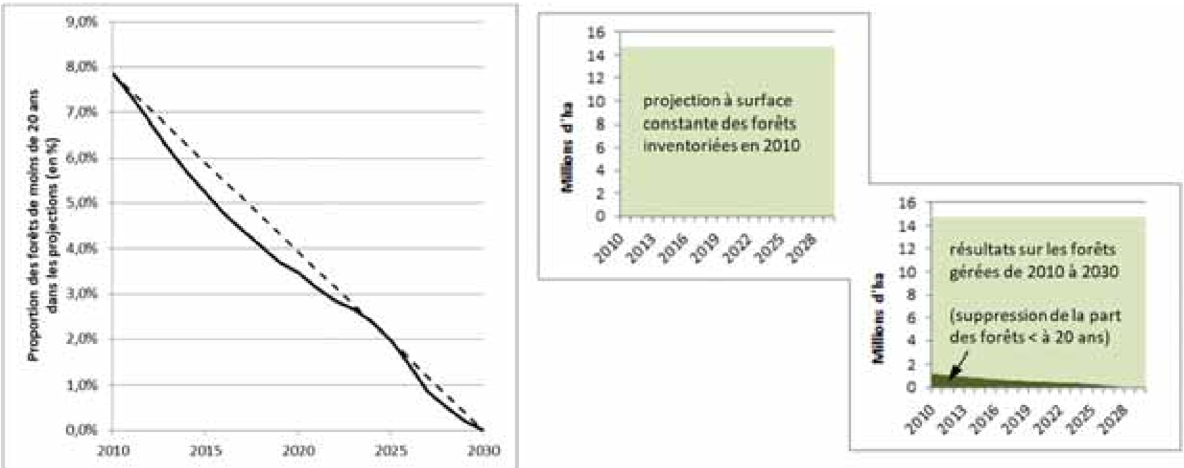


Figure2: Contribution of forests less than 20 years old to the calculation of the projections

The land use annual survey by the Ministry of Agriculture (Teruti-Lucas survey) provides information about the situation of forest land areas, making a distinction between afforestation, forest clearance and forest land remaining as such. This matrix can be used to find out the proportion of afforestation of less than 20 years old in 2010, i.e. all the afforestation which has occurred since 1990, in the Teruti-Lucas 2010 forested area. Young afforestation thus represented 7.9% of the area in 2010.

The Teruti-Lucas matrix also shows changes to forested areas for all the years between 1990 and 2010. The annual surface area of incorporation of afforestation in the category of managed forest land can be derived from it. The solid line on the left-hand graph shows the decline in the surface pool of young afforestation over time.

The contribution of this young afforestation to the CO_2 sink in living biomass is estimated according to the method defined by CITEPA for the France's national UNFCCC inventory report. The difference between production per hectare of recently afforested areas and that of managed forest land is considered stable over the entire period. Given this difference and the annual proportion of recently afforested areas, it is possible to calculate the contribution of this afforestation to total annual production. This contribution of forest land of less than 20 years old at year X is finally subtracted from the total carbon gain projected for this same year X. Concerning carbon losses, the same method is applied for mortality; however, the share of recently afforested areas in harvest figures is considered to be zero in France's GHG inventory (no felling in this type of stand).

		Non-managed forest (unavailable for wood supply)	**Managed forest (in the meaning of the UNFCCC, taken into account in the FRL)**	Afforestation less than 20 years ago	Forest land becoming non-forest land
National GHG inventory	2000	761 873 ha	**13 413 124 ha**	1 213 478 ha	733 718 ha
	2001	761 873 ha	**13 422 079 ha**	1 225 938 ha	728 614 ha
	2002	761 873 ha	**13 431 471 ha**	1 230 535 ha	723 104 ha

	2003	761 873 ha	**13 447 249 ha**	1 220 304 ha	711 241 ha
	2004	761 873 ha	**13 483 619 ha**	1 197 340 ha	697 201 ha
	2005	761 873 ha	**13 488 185 ha**	1 214 210 ha	704 652 ha
	2006	761 873 ha	**13 487 371 ha**	1 244 308 ha	713 530 ha
	2007	761 873 ha	**13 471 799 ha**	1 298 230 ha	732 586 ha
	2008	761 873 ha	**13 467 855 ha**	1 294 220 ha	751 020 ha
	2009	761 873 ha	**13 480 715 ha**	1 277 447 ha	763 291 ha
	2010	761 873 ha	**13 517 020 ha**	1 237 771 ha	760 942 ha
Projection for metropolitan France only	2011	Not estimated in the projection	**13 590 524 ha**	Only the proportion of afforestation prior to 2010 was estimated to deduct it from the projection (afforestation appearing between 2010 and 2030 is not estimated)	Not estimated in the projection
	2012		**13,675,213 ha**		
	2013		**13,764,056 ha**		
	2014		**13,847,257 ha**		
	2015		**13,918,569 ha**		
	2016		**13,989,221 ha**		
	2017		**14,044,367 ha**		
	2018		**14,097,799 ha**		
	2019		**14,153,973 ha**		
	2020		**14,190,274 ha**		
	2021		**14,241,227 ha**		
	2022		**14,284,451 ha**		
	2023		**14,312,971 ha**		
	2024		**14,359,129 ha**		
	2025		**14,422,053 ha**		
	2026		**14,500,655 ha**		
	2027		**14,594,346 ha**		
	2028		**14,645,784 ha**		
	2029		**14,693,461 ha**		
	2030		**14,726,526 ha**		

* In 2010 managed forest (in the meaning of the UNFCC, taken into account in the FRL) represents 8 183 858 ha in outermost regions included in the UE.

3.2.2.2 French outermost Regions

In outermost Regions (Guyana, Guadeloupe, Martinique, Runion, Mayotte), all the area is considered as managed with regards to the UNFCCC definition. In 2010, the total “forest remaining forest” area in outermost regions considered in the NFAP is 8 183 858 ha, amongst which the French Guiana “forest remaining forest” area represents 7 982 688 ha.

3.2.2.3 Surface area covered by managed forests in total

In 2010, the managed “forest remaining forest” area used in the NFAP is 21 700 878 ha. It corresponds to the area reported under the national GHG inventory to the UNFCCC on the Kyoto Protocol perimeter, i.e. mainland France and the outermost regions (which correspond to the part of France included in the EU).

Unmanaged areas are not considered in the NFAP and they are not considered as areas associated with emissions in the GHG inventory reporting.

Forest areas in overseas territories that are not part of the EU (New Caledonia, French Polynesia, French Southern and Antarctic Territories, Wallis and Futuna, Saint-Pierre and Miquelon) are also not considered in the NFAP (these territories represent 982 000 ha of managed forests)."

Forest Areas in 2010 according to UNFCCC GHG inventories (submission March 2019)

			Forest								
			Forest remaining forest			Land converted to forest			Total Forest		
			Managed forest	Unmanaged forest	Total	Managed forest	Unmanaged forest	Total	Managed forest	Unmanaged forest	Total
France	EU	Mainland	13 517 020	761 873	14 278 893	1 237 771	0	1 237 771	14 754 791	761 873	15 516 663
		Outermost regions	8 183 858	0	8 183 858	26 545	0	26 545	8 210 403	0	8 210 403
		Mainland + Outermost regions	21 700 878	761 873	22 462 751	1 264 316	0	1 264 316	22 965 194	761 873	23 727 067
	Non EU	overseas territories	982 000	0	982 000	0	0	0	982 000	0	982 000
		Total EU + Non EU	22 682 878	761 873	23 444 751	1 264 316	0	1 264 316	23 947 194	761 873	24 709 067

(blue)	Values reported under Table4.A in FRK reporting
(green)	Values reported under Table4.A in FRA reporting
(yellow)	Value relevant for FRL

Figure: Comparison between surface area considered in the NFAP and surface area considered in the GHG national inventories

3.2.3 Documentation of sustainable forest management practices applied to estimate the forest reference level

3.2.3.1 Mainland France

The LULUCF regulation specifies that the FRL must be based on continuation of sustainable forest management practices as documented over the 2000 -2009 period. Given the characteristics of the MARGOT model used for the projections, the forest management scenario for the reference period is defined as a rate of harvested number of trees per diameter class.

Since 2010, the IGN measures harvests from forest land available for wood production by reviewing the inventory of all NFI points which were inspected 5 years previously [Hervé et al., 2014]. Harvest rates are known per stratum and per diameter class, and they are consistent with all the other tree measurement estimators of the NFI.

However, these data are not directly usable to define the reference scenario because the first period of direct measurement of wood harvests from French forest land refers to the 2005-2010 period. Moreover, these results are statistically poor because they rely on a single measuring campaign. By contrast, the harvest rates usable by the MARGOT model can be calculated robustly thanks to the NFI observations per stratum and per diameter class over the 2005-2014 period.

A specific method has been developed to define a forest management scenario over the reference period using these NFI data, compatible with the MARGOT model. It consists of using the spatial and temporal changes observed in the AGRESTE data as a proxy to readjust the NFI harvest rates of the 2005-2014 period to the reference period.

Every year since 1948, the Ministry of Agriculture has carried out a forestry extraction survey [Agreste, 2018]. All the logging companies, every year declare the volumes of timber harvested and traded, distinguishing the species, categories of products and regions of origin. These data have been supplemented by a non-traded wood energy value per region and per species derived from comparing AGRESTE data with the total harvest from forest land observed by the IGN. Since 2000, the harvesting of wood energy (traded and non-traded) is estimated to be stable.

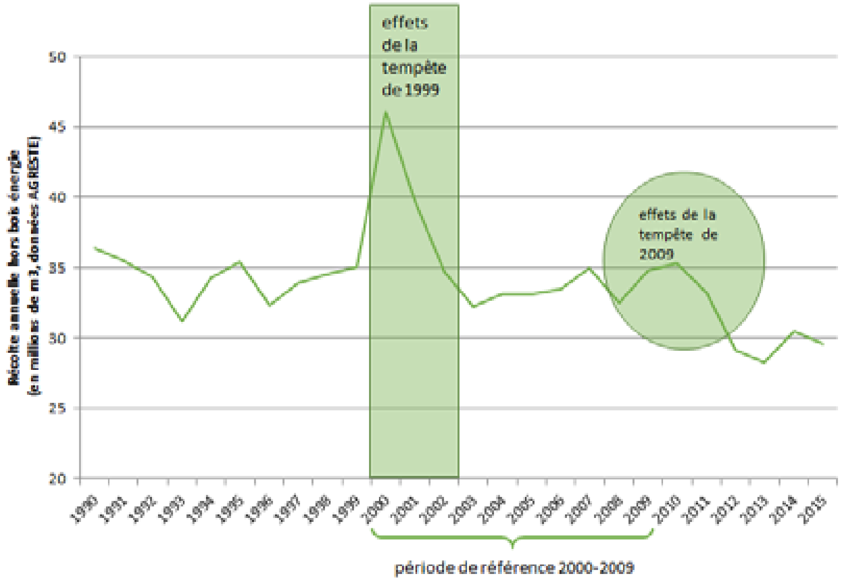
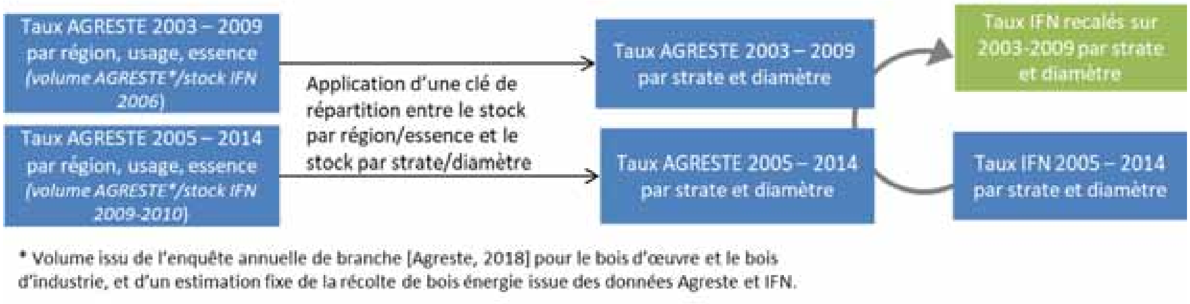


Figure 3: Changes in harvests from 1990 to 2015 according to AGRESTE data (excluding fuelwood)

During the reference period the harvesting of wood on French forest land was severely affected by the Lothar and Martin storms of December 1999. These storms affected nearly all the country and the volume of windblown trees has been estimated at more than 140 million m^3 [IFN, 2003]. Since this weather event of an unprecedented scale had a significant impact on the harvest of 2000, 2001 and 2002, it was decided to exclude these 3 exceptional years from the calculation of total harvests over the reference period. Similarly, in January 2009 the Aquitaine Forest area was again hit by storm Klaus. For this more recent and more localised storm, AGRESTE data make a distinction between volumes obtained from "normal" harvests and those obtained from accidental products. The accidental products were excluded from the extraction rate calculation. This choice was used to define a scenario that reflects the normal management practices over the reference period and not practices related to managing an exceptional crisis.

The harvested volumes observed by AGRESTE over the 2003-2009 and 2005-2014 periods were compared to the stocks measured by the NFI over the same periods (i.e. respectively, the central years 2006 and 2010). In order to make these felling rates as defined using the AGRESTE data comparable to those used as input for the MARGOT model, these rates per region/species/product have been converted into a rate per stratum and diameter class using an allocation key for these various criteria.

Changes in the harvest rates observed with AGRESTE between the 2003-2009 and 2005-2014 periods were finally applied to the harvest rate as measured by the NFI over the 2005-2014 period to estimate the harvest rate over the 2003-2009 reference period. Accordingly, the FRL is based on continuation of the "normal" forestry practices documented for the reference period. These extraction rates are expressed in the number of stems per diameter class and per stratum in relation to the standing stock. They are therefore compatible with the dynamic forestry model and applied as such to the different projection periods.



NB: all the rates (AGRESTE and IFN) excluding harvested volumes due to exceptional storms.

Figure4: Method for compiling the management scenario for the reference period

The sustainability of forest management practices over the reference period has been analyzed on the basis of the "extraction rate" sustainable management indicator [Forest Europe, 2015], obtained by dividing extracted volumes by biological growth excluding dead wood. For all French forest land, this rate is around 50%, and on a stratum scale it is always less than 100%, indicating that harvests do not exceed forest production. The only exception is the North of France poplar stand stratum where it reaches 102%. These stands which represent less than 1% of the national forest area suffer from an imbalance of age classes in favour of the older classes which are currently being felled. The felling scenario for this stratum has been maintained unchanged.

3.2.3.2 French outermost regions

For French outermost regions, the neutrality assumption is justified by sustainable forest management practices, as any extraction is fully offset by the growth of other trees (Guitet, et al. 2006).

3.3 Detailed description of the model applied to estimate the forest reference level

3.3.1.1 Mainland France: forest carbon balance (growth, mortality, extraction)

The MARGOT resource model (*MAtrix model of forest Resource Growth and dynamics On the Territory scale*) used by the IGN for projections of French forest-wood resources [Wernsdörfer *et al.*, 2012; Colin *et al.*, 2017], is the main modelling tool used to simulate the development of the 56 forest strata excluding poplar stands.

It is a dynamic model of the forest resource per diameter class, which iteratively simulates growth, mortality and forest management (harvesting) at the scale of strata and for successive 5-year periods. It is used to estimate the future state of the resource (and of the carbon stock), and to simulate future wood harvesting and mortality.

The model is generic, i.e. it is configurable and applicable regardless of the type of stand. Bu modelling the diameter (a key variable of tree growth and forestry extraction), it can be used both for regular stands (even-aged forest) and for heterogeneous stands (uneven-aged forest), the latter being the most prevalent in France [Morneau *et al.*, 2008].

The model is of a matrix type, in which the resource and the parameters are described by stratum, by class of basal area per hectare and by diameter class. Adjustment of the production, recruitment and mortality by class of basal area means that the effect of the density of the stands on the variation of these parameters is taken into account.

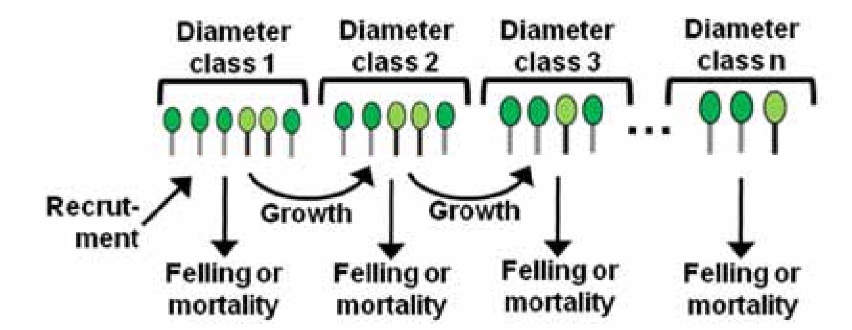


Figure5: Operating principle of an iteration of the MARGOT model (in numbers of trees per diameter class)

For each iteration, the 3 following matrices are combined to calculate the demographic development of each stratum:

- A <u>status matrix</u>, describing the resource per diameter class at the beginning and end of each simulation step. For each diameter class of a width of 5 cm, the matrix contains: (1) a number of trees which develops over time as a function of growth (transferred to the next diameter class) and removals (extraction, mortality); and (2) coefficients to calculate the carbon stock in the biomass of trees in the diameter class (class i stock = numbers in i multiplied by the average stock of a tree in class i).
- A <u>transition matrix</u>, describing the **growth** of the trees. This is expressed in the form of a **growth parameter** corresponding to the probability over 5 years that a tree of diameter class i will move up to diameter class i+1. **Recruitment** corresponds specifically to the number of new trees that grow in the first diameter class, i.e. trees which become eligible for inclusion in the inventory over the period in existing stands (areas undergoing regeneration). This is expressed as the number of stems per hectare.
- A <u>disappearance matrix</u>, representing **natural mortality** and **extraction** related to forest management practices. Mortality is the probability that a tree of a specified diameter class will die during the 5-year period. It is expressed in the form of a **mortality rate**. Extraction in a diameter class is expressed as an extraction **rate**, i.e. the ratio between the number of trees felled and the number of living trees.

The development of the two strata of poplar stands was projected using the forest dynamics by age-class model developed by the IGN (Colin *et al.,* 2017), also using 5-year iterations. This model is particularly well adapted to plantations in which the trees have the same age and show the characteristics of uniform growth. The resource is described per stratum thanks to an average area and volume per hectare by age-class. Forest dynamics are modelled for each age class by a biological production per hectare, a natural mortality per hectare, a volume harvest rate for thinnings and a clear felling rate over the 5-year period.

The values of the parameters of these models are established statistically from data collected by the NFI system, i.e. a very large number of observations. This makes the models highly reliable for short and medium-term projections. The models are adjusted using cross-class data, i.e. where all diameter classes are measured in the same year.

The initial resource was calculated using 5 inventory surveys from 2008 to 2012 corresponding to 2010, the average year. The growth and mortality parameters are based on observations made on this same inventory sample and the extraction rates are calculated over the reference period (excluding exceptional years impacted by storms) according to the method described in paragraph 3.2.3.1. The average values per layer of these different forest dynamics parameters are set out in the Appendix.

The coefficients used to convert the number of stems per diameter class (or the volume per age class for poplar plantations) into a carbon stock in the tree biomass are calculated from the cubic rates and the infra-density values from the CARBOFOR project (Vallet *et al.*, 2006 ; Loustau, 2010). These coefficients differ slightly between standing trees and harvested trees in order to take the "technical effect" into account. For consistency with the methodology adopted in the GHG inventory, the calculation of carbon gains in biomass (production or growth) corresponds to the sum of the production of living trees between two iterations and that of trees harvested between the start of the iteration and their felling date (the production of dead trees is assumed to be zero).

3.3.1.2 Mainland France – Harvested Wood Products (HWP)

General method

Harvested wood products are recorded using a production approach, which takes into account wood products manufactured with the wood from the French harvest, whether intended for the French market or for export. Imports are not taken into account. The activity data (production during the different steps of the production chain) are provided in particular from sector surveys from the Statistics Department and the Ministry of Agriculture forecasts. In order to take into account HWPs before 2000 that are still in the course of decomposition during the years of the projection, HWPs are calculated as from 1900.

Wood products are estimated in the inventory on the basis of the national level specifically for the French GHG inventory and with the aid of the IPCC 2006 directives and the revised 2013 IPCC guidelines. HWPs are recorded using a production approach, which takes into account wood products manufactured with wood harvested in France, whether intended for the French market or for export. Imports are not taken into account. The activity data (production during the different steps of the production chain) are provided in particular from sector surveys from the SSP, of the Ministry of Agriculture.

Reconstitution of input flows

Recovery of available data

Initially, the available input data in the different source databases are directly recopied, using the correct units.

Estimation of unavailable values

Certain values are unavailable. Estimations are made using a development ratio with the help of other data.

Conversion factors and parameters

These source data are combined and converted with different parameters :

- conversion factors (0.675 tonnes of pulpwood/m3 of raw wood; 0.5 t of panels/m^3) [674]

- harvest rate (0.5 m^3 sawn timber/m^3 of round wood with bark; 0.47m^3 of plywood/m^3 of logs; 50% harvest for newsprint and 25% for reamed paper) [674];

- distribution of hardwood and softwood products from sawmilling [674];

- distribution of paper types between newsprint (65%) and reamed paper (35%) [674].

Half life duration

Table 1: Half life of wood products

Category	Half life	Source
Panels	25 years	Decision (EU) N° 529/2013 dated 21/05/2013
Plywood	30 years	IPCC, 2003
Newsprint and reamed paper	7 years	Carbon 4 calculation taking recycling into consideration in accordance with IPCC 2006 and COPACEL
Packaging	3 years	IPCC, 2003
Furnishings	10 years	Carbon 4 in accordance with average lifespan (FCBA 2008)
Interior fitting and joinery	15 years	
Roofing/Frames	50 years	
Parquet/paneling	30 years	

Import and export management

Input flows enable distinction between:

- wood products from wood harvested in France.

- wood products from imported wood.

- exported wood.

Wood harvest statistics deal with all commercially harvested wood including from forest land or from non-forest land. Wood harvest and sawmill statistics are consistent with wood harvest statistics used to estimate extraction from forest land.

Wood product pool projections for the FRL

For the FRL, the difference in extraction between each projected year (2010 to 2030) and the average for the reference period (2000-2009) in the inventory are first calculated. These differences are then applied to estimate incoming wood products starting from 2010.

3.3.1.3 French outermost regions

No model is applied for outermost regions.

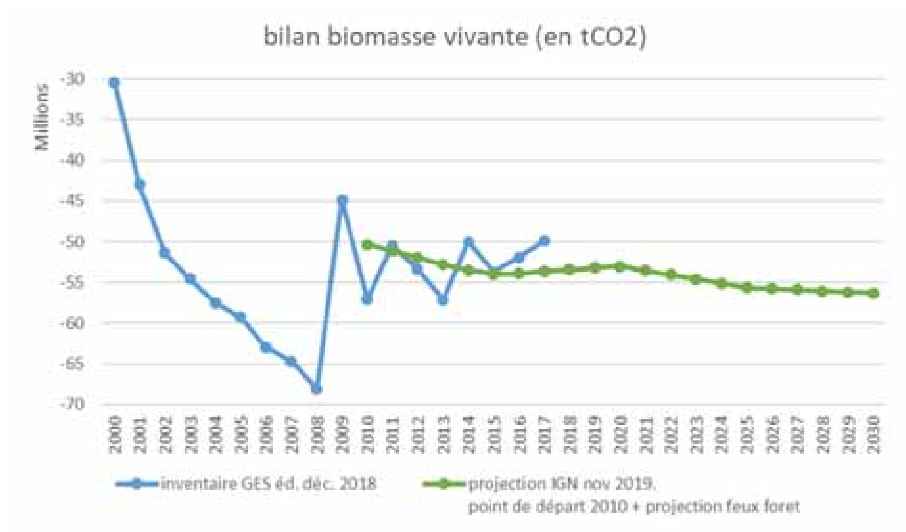
4 FOREST REFERENCE LEVEL

4.1 FRL AND A DETAILED DESCRIPTION OF THE ESTIMATE OF EACH CARBON POOL

4.1.1 Mainland France

4.1.1.1 Living above-ground and underground biomass

The graph below shows the results of modelling after readjustment, for live biomass.



Details of the results are set out in the appendix.

4.1.1.2 Dead wood, litter and soil

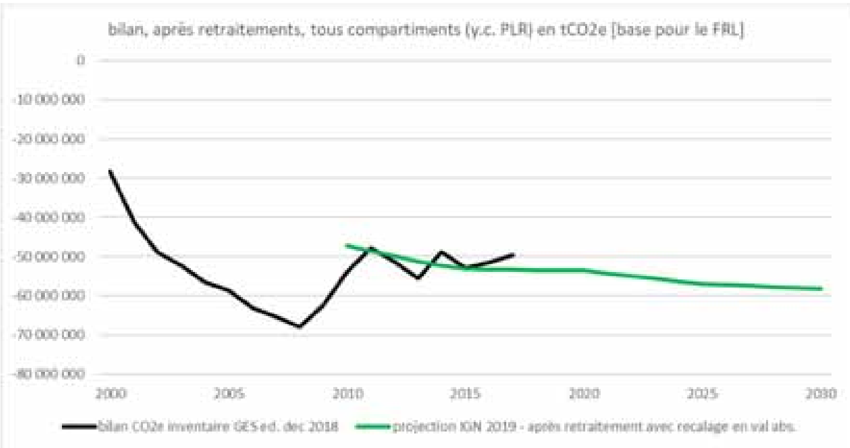
Among these pools, only emissions from exceptional dead wood related to decomposition over several years of windblow from storms are reported. The other pools are estimated to be in equilibrium.

4.1.1.3 Harvested wood products

Harvested wood products represent a net sink during the reference period and the projected period. The projection made for the FRL estimate is based on changes in the overall level of harvested word, with a constant ratio between energy use and solid use. The upward development trend of harvest is applied for the incoming flow in the calculation of the net balance of this pool.

Accordingly, while this balance tends to diminish in the inventory, applying the increase in harvested wood in the model enables simulation of a rise in the net sink of the harvested wood product pool.

4.1.1.4 *Total balance*



4.1.2 French outermost regions

Estimates of the different pools are shown in the tables below:

	Above-ground biomass				
tCO_2e/year	**French Guiana**	**Guadeloupe**	**Martinique**	**Reunion**	**Mayotte**
2021-2025	168,705	0	1	12,970	859
2026-2030	168,705	0	1	12,970	859

	Underground biomass				
	French Guiana	**Guadeloupe**	**Martinique**	**Reunion**	**Mayotte**
2021-2025	0	0	0	0	0
2026-2030	0	0	0	0	0

Dead wood, litter, soil					
	French Guiana	**Guadeloupe**	**Martinique**	**Reunion**	**Mayotte**
2021-2025	0	0	0	0	0
2026-2030	0	0	0	0	0

Harvested wood products					
	French Guiana	**Guadeloupe**	**Martinique**	**Reunion**	**Mayotte**
2021-2025	0	0	0	0	0
2026-2030	0	0	0	0	0

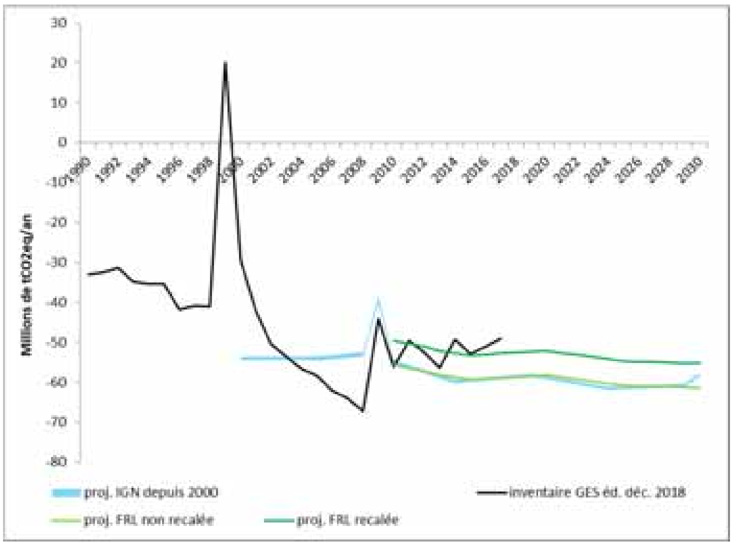
4.2 Consistency between the FRL and the latest national inventory report

4.2.1 Mainland France

4.2.1.1 Analysis of deviation between the FRL Projection and the GHG inventory data.

Over the recent period, projections produced for FRL show deviation from the last GHG inventory report with regard to the forest biomass balance. These differences were analyzed by detailing biomass gains (growth) and losses (mortality and extraction) both for the recent period (2010-2017) and over the reference period (2000-2009). To continue the analysis over this latter period, a specific projection based on reconstitution of the 2000 report (unreliable estimate) was carried out.

Projected and historic living biomass balance (tCO_2eq/year)



Over the reference period (2000-2009), although the projection gives a forest sink more or less equivalent to the historic sink, this average conceals disagreements on the trends in the development of the sink and on the contribution of the different phenomena (growth, mortality and extraction) to this sink in the live biomass.

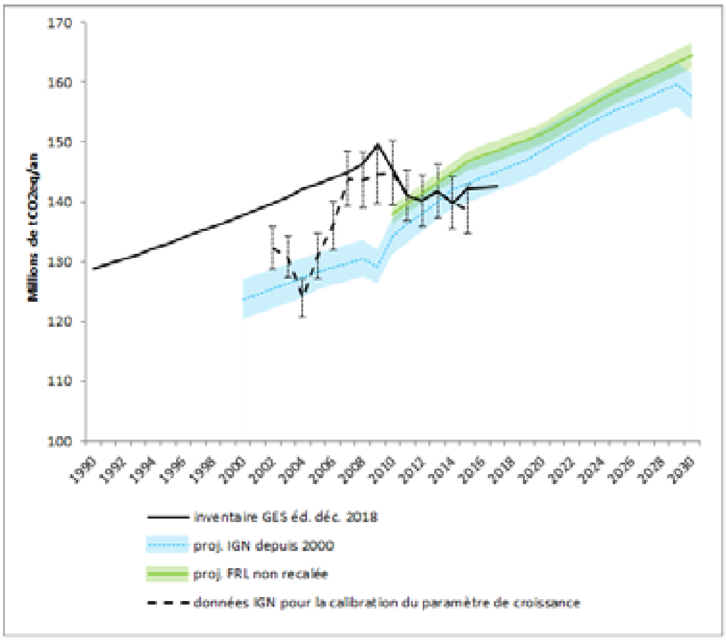
The deviation is essentially due to gains in the live biomass. More specifically, the projected gains are more than 10MtCO_2/year less than those in the historic GHG inventory between 2000-2009. There are numerous assumptions to explain this difference:

- comparison of the results (historic vs. projected) obtained from different samples of the national forest inventory. These differences necessarily entail a purely statistical discrepancy which has proved to be substantial. In particular, the uncertainty related to sampling, assessed on the basis of historical production data and the projection results (using a "bootstrap" approach) is of the order of ± 4MtCO_2/year (see the confidence intervals on the graph below). In projection, an error linked to the effects of modelling forest dynamics parameters would in theory further increase the amplitude of uncertainty around the results.

- the absence of IFN data on the state of forest land in 2000 makes projections done since this starting point particularly unreliable. To carry out this projection, the initial state in the year 2000 was reconstituted from (1) 2005 national forest inventory data, i.e. one inventory survey only (i.e. somewhat out of date, which makes it less reliable). (2) growth measurements for backward extrapolation of diameters and stump observations to determine the number of harvested trees (these observations are highly imprecise and stamps tend to be overlooked) and (3) by making an approximate assessment of forest expansion on the basis of historical information on the population on inventory plots (this information is difficult to assess and tends to underestimate expansion). This reconstitution, carried out in the absence of more suitable and accurate data, makes the starting point of projections and the results for the 2000-2009 period uncertain.

- the historic biomass gains of the GHG inventory are obtained from national forest inventory production data from 2007 and from interpolations for the period between 1990 and 2007. For its part, the growth parameter of the model is calibrated on the basis of national forest inventory data corresponding to the reference period. These IFN data are slightly different from the greenhouse gas inventory before 2007 (see the diagram below), hence also part of the discrepancy between projected production and historical production as described in the greenhouse gas inventory.
- the forest dynamics parameters of the model (in particular the growth parameter) represent an average of the production data over the entire reference period. In addition, the projection provides results by 5-year periods which are subsequently annualized. This projection method tends to smooth out the results mechanically and cannot reproduce variations between years.
- forest expansion was taken into account via a constant area projection from 2010 in the absence of knowledge about actual changes in the forest area by year 2030. By subsequently removing the contribution of recent afforestation, this method makes it possible to approximate the areas of managed forest land taken into account in the greenhouse gas inventory. However, clear felling which will take place between now and 2030 is not reported (it will be reported in subsequent technical corrections) and the method differs slightly from what is traditionally carried out in the greenhouse gas inventory, where the actual changes in forested areas are known. This might have a slight impact, particularly on the trend towards increasing living biomass on the curve.
- the fact of fixing the strata and the growth parameter over time are constraining assumptions of the model which generate a deviation, mainly in the production curve trend. To consider that growth is stable over time for a stratum, a class of diameter and a basal area class is a over-simplification of reality and leads to a discrepancy in the projection. Changes in the climate, fertility conditions, changes in species, etc., also play major roles which cannot be taken into account in the current version of the model in the absence of consolidated knowledge, but which certainly tend to reduce actual production. Research work is currently being undertaken to make these assumptions more flexible and the model is not operational for the time being. This would no doubt require some scenario creation.

Projected and historic gains in living biomass (growth) (tCO_2eq/year)

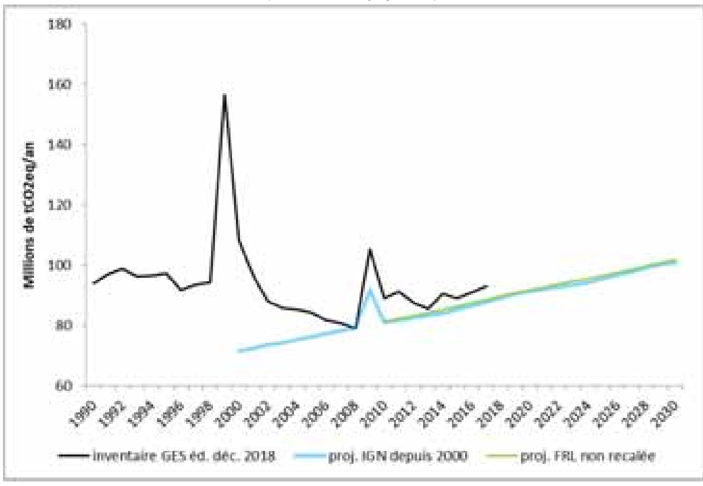


Some of these reasons for the discrepancy are also valid for losses in living biomass (due to mortality and extraction). In particular, the uncertainty related to the use of data obtained from statistical sampling, the unreliability of reconstitution from the starting point in 2000 and the smoothing out of the product by the projection, which works in 5-year periods, are equally important in the discrepancy between projected and historical loss data. In addition to these reasons:

- storms Lothar and Martin in December 1999 were not taken into account. These storms had a major effect on extraction dynamics in the years following the storms (2000 to 2002) with additional harvests arising from this exceptional crisis that increased losses in living biomass. The effect of these storms was not taken into account in the simulation, as the latter is based on a starting point after the storms and the baseline scenario applied to it is calculated without these years. For storm Klaus, exceptional extraction was simulated for the year 2009 of the projection, starting from 2000 only.

- operation of the extraction parameter expressed as a rate in the model. The baseline scenario is expressed in the projection in the form of an extraction rate dependent on the stock. Although standing timber stocks increased over the 2000-2009 period, the observed volumes harvested diminished slightly as the felling was not only related to the available timber stock. Applying a scenario in the form of a fixed extraction rate does not therefore enable the trend in the fluctuation of extraction over the 2000-2009 period to be reproduced.

Projected and historic losses in living biomass (extraction and mortality)
(in tCO_2eq/year)



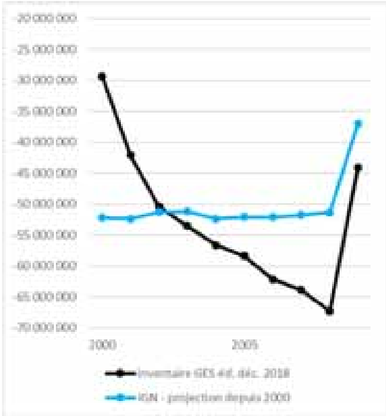
Over the recent period (2010-2017), there is also a deviation between the projections and the GHG inventory, mainly due to gains in living biomass, due to which the trends differ. The projection since 2000 gives results very similar to the projection since 2010 and most of the assumptions explaining this deviation remain valid for this recent period.

This analysis shows that the deviations are not linked to management differences but to the constraints of the modeling exercise. In addition, the lack of reliability and the limits of the projection carried out from 2000 prevent the use of these data in the calculations, in particular for readjustment.

4.2.1.2 Readjustment of the projection for the FRL

The difference between the model results and the national inventory does not reflect differences in forest management, but reflects the calibration of the model. Accordingly, these two results can be made consistent by readjustment. Readjustment is then carried out to bring the results of the projection since 2010 into phase with the greenhouse gas inventory. For this purpose, the readjustment could have been carried out over the periods between 2000 and 2009 or between 2000 and 2017. However, over the 2000-2009 period the two curves, having opposite trends, are too inconsistent to be used as a basis for readjustment. At the start of the period, the model results are lower than the inventory results, then higher. Accordingly, the average difference over the period is offset and is now only 1%, while the two curves do not coincide in reality. It is therefore irrelevant to use this period for readjustment.

Comparison of the living biomass balance
between the projection since 2000 and the inventory
(tCO_2/year)

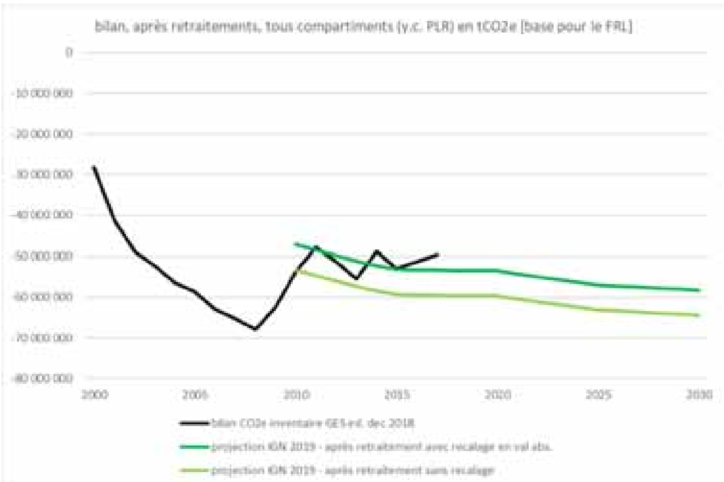


Method used: readjustment over the 2010-2017 period

It was decided to readjust the results of the model on the basis of the deviation observed between it and the national GHG inventory, based on the values observed by the IGN.

The readjustment involves modifying the modelled level of the forest biomass balance from 2010 to 2017 to translate it to a level comparable with that observed over the same period. This readjustment is carried out by calculating the average of the annual deviations over the period in absolute values (in tC/year) and by adding this average differential to all the modelled years from 2010 to 2030. The deviation applied is - 1 672 002 tC/year (i.e. a sink of 6 130 672 $MtCO_2e$/year more).

Impact of the readjustment



The annual values of the balance before and after readjustment are set out in the appendix.

4.2.2 French outermost regions

For forest land in French outermost regions, the same assumptions are applied for calculation of the FRL as for the production of the national inventory, i.e. a neutral greenhouse gas balance for forest land and only emissions from burning wood harvest residues and forest fires.

4.3 FRL ESTIMATED FOR EACH CARBON POOL AND EACH GREENHOUSE GAS

4.3.1 Mainland France

Mainland France									
2021-2025	living above-ground biomass	living underground biomass	total living biomass	dead wood	litter	soil organic carbon	harvested wood products	**FRL**	*FRL with instantaneous oxidation of harvested wood products*
tCO_2	-42,358,495	-12,193,153	-54,551,647	1,106,878	NE	NE	-3,106,740	**-56,551,509**	*-53,444,769*
CH4 (in tCO_2e)	634,745	0	634,745	0	NE	NE	0	**634,745**	*634,745*
N2O (in tCO_2e)	334,940	0	334,940	0	NE	NE	0	**334,940**	*334,940*
total (in tCO_2e)	-41,388,810	-12,193,153	-53,581,963	1,106,878	NE	NE	-3,106,740	**-55,581,825**	*-52,475,084*

Mainland France									
2026-2030	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***
tCO2	-43 497 947	-12 516 519	-56 014 466	671 356	NE	NE	-3 386 830	**-58 729 940**	*-55 343 110*
CH4 (in tCO2e)	666 799	0	666 799	0	NE	NE	0	**666 799**	*666 799*
N2O (in tCO2e)	351 700	0	351 700	0	NE	NE	0	**351 700**	*351 700*
total (in tCO2e)	-42 479 448	-12 516 519	-54 995 967	671 356	NE	NE	-3 386 830	**-57 711 441**	*-54 324 612*

4.3.2 Outermost: Guadeloupe

Guadeloupe									
2021-2025	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***
tCO_2	0	0	0	NE	NE	NE	NE	**0**	*0*
CH4 (in tCO_2e)	0	0	0	NE	NE	NE	NE	**0**	*0*
N2O (in tCO_2e)	0	0	0	NE	NE	NE	NE	**0**	*0*
total (in tCO_2e)	0	0	0	0	0	0	0	**0**	*0*

Guadeloupe									
2026-2030	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***

tCO_2	0	0	0	NE	NE	NE	NE	**0**	*0*
CH4 (in tCO_2e)	0	0	0	NE	NE	NE	NE	**0**	*0*
N2O (in tCO_2e)	0	0	0	NE	NE	NE	NE	**0**	*0*
total (in tCO_2e)	0	0	0	0	0	0	0	**0**	*0*

4.3.3 Outermost: French Guiana

French Guiana									
2021-2025	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***
tCO_2	148,334	0	148,334	NE	NE	NE	NE	**148,334**	*148,334*
CH4 (in tCO_2e)	16,704	0	16,704	NE	NE	NE	NE	**16,704**	*16,704*
N2O (in tCO_2e)	3668	0	3668	NE	NE	NE	NE	**3668**	*3668*
total (in tCO_2e)	168,705	0	168,705	0	0	0	0	**168,705**	*168,705*

French Guiana									
2026-2030	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***
tCO_2	148,334	0	148,334	NE	NE	NE	NE	**148,334**	*148,334*
CH4 (in tCO_2e)	16,704	0	16,704	NE	NE	NE	NE	**16,704**	*16,704*
N2O (in tCO_2e)	3668	0	3668	NE	NE	NE	NE	**3668**	*3668*
total (in tCO_2e)	168,705	0	168,705	0	0	0	0	**168,705**	*168,705*

4.3.4 Outermost: Martinique

Martinique									
2021-2025	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***
tCO_2	1	0	1	NE	NE	NE	NE	**1**	*1*
CH4 (in tCO_2e)	0	0	0	NE	NE	NE	NE	**0**	*0*
N2O (in tCO_2e)	0	0	0	NE	NE	NE	NE	**0**	*0*
total (in tCO_2e)	1	0	1	0	0	0	0	**1**	*1*

Martinique

2026-2030	living above-ground biomass	living underground biomass	total living biomass	dead wood	litter	soil organic carbon	harvested wood products	FRL	*FRL with instantaneous oxidation of harvested wood products*
tCO_2	1	0	1	NE	NE	NE	NE	**1**	*1*
CH4 (in tCO_2e)	0	0	0	NE	NE	NE	NE	**0**	*0*
N2O (in tCO_2e)	0	0	0	NE	NE	NE	NE	**0**	*0*
total (in tCO_2e)	1	0	1	0	0	0	0	**1**	*1*

4.3.5 Outermost: Mayotte

Mayotte									
2021-2025	living above-ground biomass	living underground biomass	total living biomass	dead wood	litter	soil organic carbon	harvested wood products	FRL	*FRL with instantaneous oxidation of harvested wood products*
tCO_2	732	0	732	NE	NE	NE	NE	**732**	*732*
CH4 (in tCO_2e)	52	0	52	NE	NE	NE	NE	**52**	*52*
N2O (in tCO_2e)	76	0	76	NE	NE	NE	NE	**76**	*76*
total (in tCO_2e)	859	0	859	0	0	0	0	**859**	*859*

Mayotte									
2026-2030	living above-ground biomass	living underground biomass	total living biomass	dead wood	litter	soil organic carbon	harvested wood products	FRL	*FRL with instantaneous oxidation of harvested wood products*
tCO_2	732	0	732	NE	NE	NE	NE	**732**	*732*
CH4 (in tCO_2e)	52	0	52	NE	NE	NE	NE	**52**	*52*
N2O (in tCO_2e)	76	0	76	NE	NE	NE	NE	**76**	*76*
total (in tCO_2e)	859	0	859	0	0	0	0	**859**	*859*

4.3.6 Outermost: la Réunion

Reunion									
2021-2025	living above-ground biomass	living underground biomass	total living biomass	dead wood	litter	soil organic carbon	harvested wood products	FRL	*FRL with instantaneous oxidation of harvested wood products*
tCO_2	11,599	0	11,599	NE	NE	NE	NE	**11,599**	*11,599*

CH4 (in tCO_2e)	826	0	826	NE	NE	NE	NE	**826**	*826*
N2O (in tCO_2e)	545	0	545	NE	NE	NE	NE	**545**	*545*
total (in tCO_2e)	12,970	0	12,970	0	0	0	0	**12,970**	*12,970*

Reunion									
2026-2030	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***
tCO_2	11,599	0	11,599	NE	NE	NE	NE	**11,599**	*11,599*
CH4 (in tCO_2e)	826	0	826	NE	NE	NE	NE	**826**	*826*
N2O (in tCO_2e)	545	0	545	NE	NE	NE	NE	**545**	*545*
total (in tCO_2e)	12,970	0	12,970	0	0	0	0	**12,970**	*12,970*

4.3.7 Outermost total

Total for French outermost regions									
2021-2025	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***
tCO_2	160,665	0	160,665	0	0	0	0	**160,665**	*160,665*
CH4 (in tCO_2e)	17,582	0	17,582	0	0	0	0	**17,582**	*17,582*
N2O (in tCO_2e)	4288	0	4288	0	0	0	0	**4288**	*4288*
total (in tCO_2e)	182,535	0	182,535	0	0	0	0	**182,535**	*182,535*

Total for French outermost regions									
2026-2030	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***
tCO_2	160,665	0	160,665	0	0	0	0	**160,665**	*160,665*
CH4 (in tCO_2e)	17,582	0	17,582	0	0	0	0	**17,582**	*17,582*
N2O (in tCO_2e)	4288	0	4288	0	0	0	0	**4288**	*4288*
total (in tCO_2e)	182,535	0	182,535	0	0	0	0	**182,535**	*182,535*

4.3.8 Whole of France (Mainland and Outermost)

Whole of France									
2021-2025	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood produc***
tCO2	-42 197 829	-12 193 153	-54 390 982	1 106 878	0	0	-3 106 740	**-56 390 844**	*-53 284 104*
CH4 (in tCO2e)	652 327	0	652 327	0	0	0	0	**652 327**	*652 327*
N2O (in tCO2e)	339 227	0	339 227	0	0	0	0	**339 227**	*339 227*
total (in tCO2e)	-41 206 275	-12 193 153	-53 399 428	1 106 878	0	0	-3 106 740	**-55 399 290**	*-52 292 549*

Whole of France									
2026-2030	**living above-ground biomass**	**living underground biomass**	**total living biomass**	**dead wood**	**litter**	**soil organic carbon**	**harvested wood products**	**FRL**	***FRL with instantaneous oxidation of harvested wood products***
tCO2	-43 337 282	-12 516 519	-55 853 801	671 356	0	0	-3 386 830	**-58 569 275**	*-55 182 445*
CH4 (in tCO2e)	684 381	0	684 381	0	0	0	0	**684 381**	*684 381*
N2O (in tCO2e)	355 988	0	355 988	0	0	0	0	**355 988**	*355 988*
total (in tCO2e)	-42 296 913	-12 516 519	-54 813 432	671 356	0	0	-3 386 830	**-57 528 906**	*-54 142 076*

APPENDICES

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LIST OF THE 58 FOREST STRATA AND THEIR EXTRACTION RATE

Characteristics, initial resource, baseline scenario parameters

Name	Link with the 116 strata of the previous national studies	Type of forest land	Objective species	Ownership	GRECO	Model used
FEU_01	FF01-FF02	Closed deciduous	Chestnut	Private	A&B&C&D&E&G(East)	by diameter class
FEU_02	FF03	Closed deciduous	Chestnut	Private	F&G (West)	
FEU_03	FF04-FF05-FF06	Closed deciduous	Robinia	Private	A&B&C&D&E&F&G	
FEU_04	FF07-FF08-FF10-FF67	Closed deciduous	Other deciduous	Public	A&B&C&F	
FEU_05	FF09-FF17	Closed deciduous	Other deciduous	Public&Private	D&E	
FEU_06	FF10-FF19-FF66	Closed deciduous	Other deciduous	Public&Private	G	
FEU_07	FF11-FF12-FF20-FF21	Closed deciduous	Other deciduous	Public&Private	H&I	
FEU_08	FF13-FF22-FF44	Closed deciduous	Other deciduous and pubescent oak	Public&Private	J	
FEU_09	FF14-FF15-FF65	Closed deciduous	Other deciduous	Private	A&B (Centre)	
FEU_10	FF15-FF65	Closed deciduous	Other deciduous	Private	B(North)	
FEU_11	FF16-FF65	Closed deciduous	Other deciduous	Private	C	
FEU_12	FF18-FF66	Closed deciduous	Other deciduous	Private	R	
FEU_13	FF23-FF45-FF48	Closed deciduous	All deciduous	Public&Private	K	
FEU_14	FF24-FF25-FF30	Closed deciduous	European & sessile oaks	State-owned	A&B&F&G(except Bourgogne)	
FEU_15	FF26-FF29	Closed deciduous	European & sessile oaks	Public	C&D&E&G (Bourgogne)	
FEU_16	FF27-FF28-FF30	Closed deciduous	European & sessile oaks	Municipal	A&B&F&G(except Bourgogne)	
FEU_17	FF31	Closed deciduous	European & sessile oaks	Private	A	
FEU_18	FF32	Closed deciduous	European & sessile oaks	Private	B (Centre)	
FEU_19	FF33	Closed deciduous	European & sessile oaks	Private	B(North)	
FEU_20	FF34	Closed deciduous	European & sessile oaks	Private	C&D	
FEU_21	FF35-FF38-FF39-FF43	Closed deciduous	European & sessile and pubescent oaks	Private	E&H&I	
FEU_22	FF36	Closed deciduous	European & sessile oaks	Private	R	
FEU_23	FF37	Closed deciduous	European & sessile oaks	Private	G	
FEU_24	FF40-FF42	Closed deciduous	Pubescent oak	Private	A&B&F (North) &G	
FEU_25	FF41	Closed deciduous	Pubescent oak	Private	F (South)	
FEU_26	FF46-FF47	Closed deciduous	Holm oak	Public&Private	G&H&I&J	
FEU_27	FF49-FF50-FF67	Closed deciduous	Common ash	Public&Private	A&B&C	
FEU_28	FF51-FF53	Closed deciduous	Beech	Public	C	
FEU_29	FF52-FF54	Closed deciduous	Beech	Public	D&E	

FEU_30	FF55-FF59	Closed deciduous	Beech	Public&Private	A&B	
FEU_31	FF56-FF62	Closed deciduous	Beech	Public&Private	F&G	
FEU_32	FF57-FF63	Closed deciduous	Beech	Public&Private	H	
FEU_33	FF58-FF64	Closed deciduous	Beech	Public&Private	I	
FEU_34	FF60-FF61	Closed deciduous	Beech	Private	C&D&E	
RES_01	FR01-FR05-FR29	Closed conifer	Other conifers and Scots pine	Public&Private	A&B	by diameter class
RES_02	FR01-FR06-FR27-FR30	Closed conifer	Other conifers and Scots pine	Public&Private	C&D&E	
RES_03	FR01-FR03-FR07-FR10	Closed conifer	Other conifers	Public&Private	F&I	
RES_04	FR01-FR08-FR25-FR28	Closed conifer	Other conifers	Public&Private	G	
RES_05	FR02-FR09-FR17-FR25	Closed conifer	Other conifers	Public&Private	H	
RES_06	FR04-FR11-FR33-FR34	Closed conifer	Other conifers	Public&Private	J&K	
RES_07	FR12-FR13-FR14	Closed conifer	Douglas fir	Public&Private	A&B&C&D&E	
RES_08	FR12-FR15	Closed conifer	Douglas fir	Public&Private	F&G&I	
RES_09	FR18-FR19	Closed conifer	Aleppo pine	Public&Private	H&I&J&K	
RES_10	FR20-FR23	Closed conifer	Laricio and maritime pines	Private	A&B	
RES_11	FR21-FR22-FR26-FR28	Closed conifer	Maritime and Scots pines	Public	A&B&F	
RES_12	FR24	Closed conifer	Maritime pine	Private	R	
RES_13	FR31	Closed conifer	Scots pine	Private	F&G	
RES_14	FR32	Closed conifer	Scots pine	Private	H	
RES_15	FR35-FR36-FR38	Closed conifer	Fir and spruce	Public	D&E	
RES_16	FR37-FR41	Closed conifer	Fir and spruce	Public&Private	A&B&C	
RES_17	FR39-FR44	Closed conifer	Fir and spruce	Public&Private	F&G	
RES_18	FR42-FR43	Closed conifer	Fir and spruce	Private	D&E	
RES_19	FR10-FR16-FR40-FR45-FR46	Closed conifer	Fir and spruce	Public&Private	H&I	
OUV_01	OF01	Open deciduous	Deciduous	Public&Private	A&B&C&F	by diameter class
OUV_02	OF02	Open deciduous	Deciduous	Public&Private	D&E&G&H&I	
OUV_03	OR01	Open conifer	Conifers	Public&Private	A&B&C&D&E&F&G&H&I	
PEU_01		Poplar stand	Poplar	Public&Private	A&F&G&I&J	by age class
PEU_02		Poplar stand	Poplar	Public&Private	B&C&D&E	

Name	**Initial 2010 resource**				**Baseline scenario parameters**				**Projected extraction rate** (in % of production between 2010 and 2030)
	Number of points	**Distribution of points by basal area class** (sub-strata <20 / 20-30 / >30 m²/ha) **	**Volume in 2010** (in thousands of m3 of stem wood)	**Volume distribution by structure** (even aged / uneven aged) ***	**Average production param.** (in % of stems or in m3/ha) *	**Average recruitment param.** (in stems/ha/5years) *	**Average mortality param.** (in % of stems or in m3/ha) *	**Average extraction param.** (in % of stems, volume or surface area) *	
FEU_01	770	29% / 24% / 48%	68,886	42% / 58%	33%	160	4%	4%	50%

FEU_02	653	38% / 25% / 37%	49,376	43% / 57%	36%	234	3%	7%	56%
FEU_03	428	52% / 26% / 22%	26,473	47% / 53%	37%	162	2%	8%	50%
FEU_04	828	57% / 28% / 15%	46,432	54% / 46%	33%	116	1%	9%	65%
FEU_05	368	48% / 26% / 26%	22,899	44% / 56%	33%	149	2%	8%	31%
FEU_06	573	53% / 23% / 24%	34,237	40% / 58%	31%	137	3%	3%	29%
FEU_07	478	52% / 24% / 24%	31 487	47% / 51%	30%	118	4%	1%	9%
FEU_08	735	69% / 20% / 12%	31,519	48% / 48%	22%	79	4%	1%	17%
FEU_09	548	57% / 22% / 22%	27,542	50% / 50%	38%	205	3%	4%	29%
FEU_10	578	55% / 23% / 22%	31,342	56% / 44%	48%	175	1%	5%	32%
FEU_11	531	53% / 24% / 23%	31,811	46% / 53%	41%	141	2%	5%	39%
FEU_12	400	58% / 21% / 21%	20,992	50% / 50%	44%	157	2%	2%	18%
FEU_13	403	53% / 22% / 25%	26,153	39% / 59%	24%	130	3%	0%	7%
FEU_14	618	38% / 37% / 25%	57,039	84% / 16%	34%	94	1%	10%	88%
FEU_15	1350	39% / 40% / 21%	105,673	69% / 31%	32%	90	1%	10%	83%
FEU_16	313	41% / 36% / 22%	24,784	58% / 42%	35%	91	1%	7%	57%
FEU_17	533	41% / 29% / 30%	37,025	64% / 36%	38%	108	2%	4%	36%
FEU_18	1744	42% / 34% / 24%	140794	43% / 57%	35%	91	2%	6%	46%
FEU_19	846	38% / 36% / 26%	71,621	71% / 29%	37%	80	1%	8%	68%
FEU_20	896	39% / 32% / 29%	70,565	59% / 41%	34%	92	1%	5%	45%
FEU_21	516	49% / 29% / 22%	31,166	53% / 47%	28%	80	3%	1%	24%
FEU_22	841	51% / 28% / 22%	59,359	69% / 31%	35%	87	2%	6%	48%
FEU_23	1212	35% / 30% / 35%	101,576	55% / 44%	33%	87	2%	5%	44%
FEU_24	503	57% / 25% / 18%	24640	43% / 57%	19%	79	2%	5%	32%
FEU_25	860	56% / 24% / 20%	49,128	59% / 41%	23%	77	1%	4%	34%
FEU_26	701	71% / 19% / 10%	20,558	65% / 33%	16%	104	1%	1%	21%
FEU_27	803	45% / 28% / 27%	58,099	62% / 38%	41%	141	2%	7%	43%
FEU_28	596	52% / 33% / 15%	41,341	86% / 14%	37%	94	1%	13%	78%
FEU_29	368	36% / 34% / 30%	35,878	86% / 14%	36%	91	1%	13%	84%
FEU_30	375	48% / 30% / 22%	28,805	88% / 12%	44%	66	1%	12%	92%
FEU_31	575	29% / 21% / 50%	62,095	59% / 41%	29%	73	2%	5%	46%
FEU_32	340	21% / 26% / 52%	39,706	69% / 30%	31%	82	3%	2%	23%
FEU_33	406	29% / 30% / 41%	39,795	64% / 35%	27%	67	1%	1%	12%
FEU_34	403	31% / 28% / 41%	41,816	82% / 17%	36%	60	1%	6%	49%
RES_01	390	36% / 24% / 40%	33,197	92% / 8%	46%	83	2%	10%	83%
RES_02	369	34% / 26% / 40%	33,883	91% / 9%	34%	113	2%	8%	77%
RES_03	242	45% / 19% / 36%	16,580	63% / 37%	30%	70	3%	1%	21%
RES_04	313	36% / 22% / 41%	34,023	82% / 18%	36%	78	3%	10%	52%

RES_05	507	45% / 28% / 28%	37,970	74% / 25%	17%	57	3%	1%	24%
RES_06	324	57% / 18% / 25%	24,861	47% / 50%	27%	78	2%	2%	15%
RES_07	332	34% / 24% / 41%	35,077	96% / 4%	59%	86	2%	12%	69%
RES_08	698	41% / 18% / 41%	77,704	93% / 7%	68%	82	2%	10%	58%
RES_09	372	69% / 18% / 12%	16,235	53% / 43%	35%	50	2%	2%	20%
RES_10	451	37% / 29% / 34%	36,680	89% / 11%	47%	86	1%	7%	49%
RES_11	299	56% / 28% / 16%	18,874	94% / 6%	43%	63	1%	10%	70%
RES_12	1133	72% / 17% / 11%	73,471	95% / 5%	48%	55	2%	20%	82%
RES_13	473	40% / 22% / 38%	40,088	87% / 12%	28%	56	2%	5%	44%
RES_14	347	45% / 27% / 27%	21,881	76% / 23%	11%	61	3%	1%	23%
RES_15	593	21% / 22% / 56%	77,640	84% / 16%	50%	110	1%	14%	88%
RES_16	333	29% / 26% / 45%	35,296	93% / 7%	48%	104	2%	14%	77%
RES_17	772	20% / 17% / 63%	114,666	89% / 10%	50%	97	2%	15%	96%
RES_18	388	22% / 17% / 61%	57,997	80% / 20%	51%	109	1%	14%	91%
RES_19	666	16% / 20% / 64%	102,044	63% /37%	38%	88	2%	5%	50%
OUV_01	220	not concerned	2,184	not determined	29%	58	2%	5%	37%
OUV_02	235	not concerned	2136	not determined	16%	45	5%	2%	18%
OUV_03	263	not concerned	4905	not determined	44%	40	2%	4%	35%
PEU_01	387	not concerned	8941	100% / 0%	15 m3/ha/year	not concerned	0.6 m3/ha/year	1% /18%	69%
PEU_02	1011	not concerned	20,619	100% / 0%	14 m3/ha/year	not concerned	1.6 m3/ha/year	11% /29%	102%

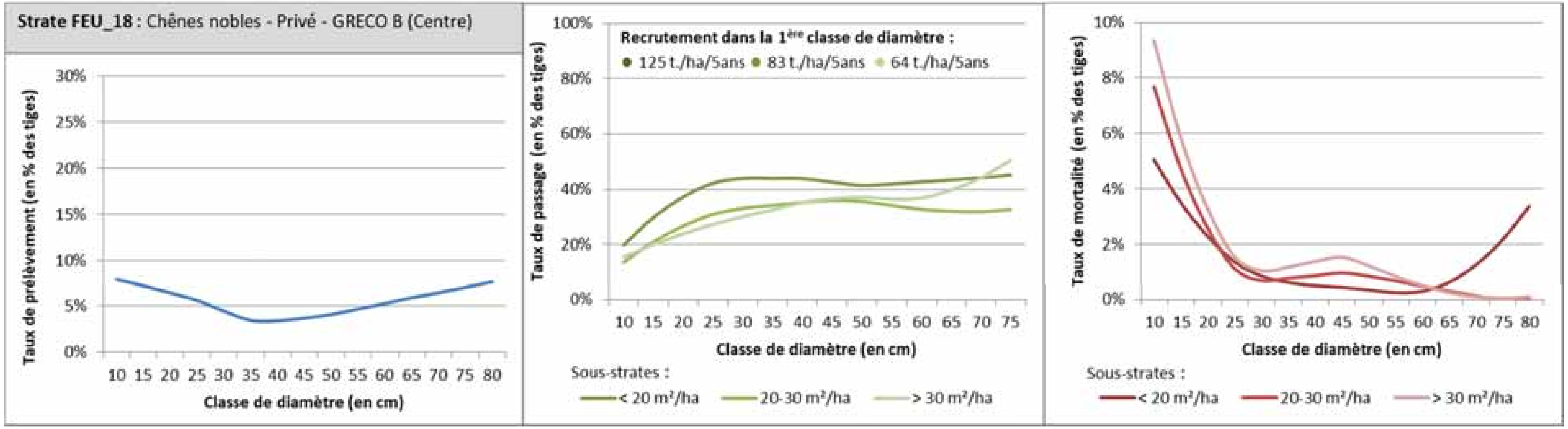
Details on the tables by strata:

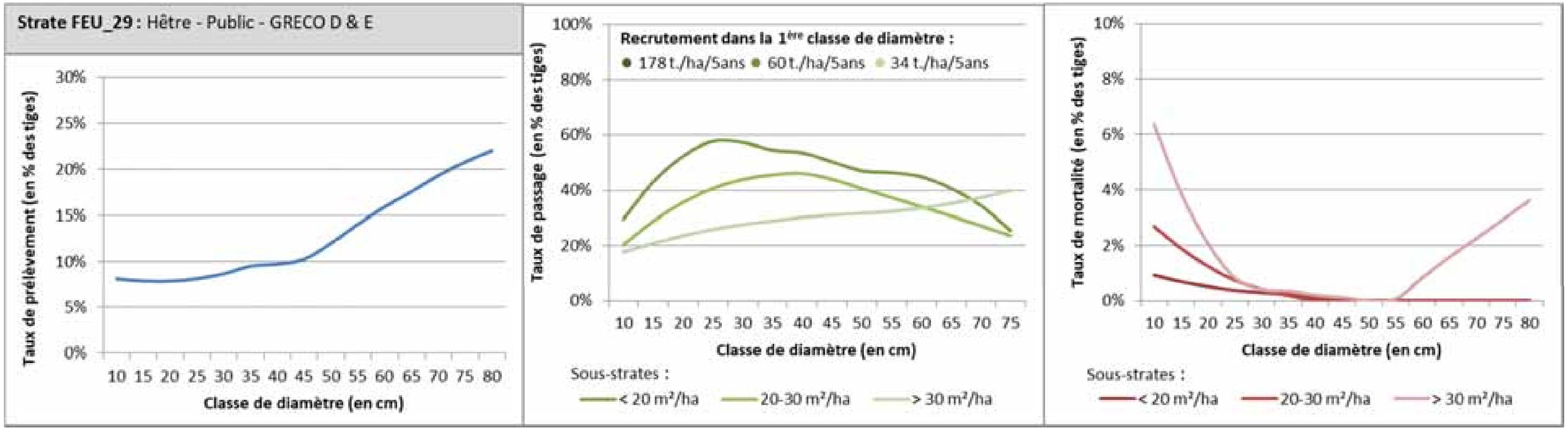
* The values shown correspond to average forest dynamics parameters for all diameter, age and basal area classes. The units of these parameters depend on the type of model used :
- *For the diameter class model,* the production parameter corresponds to the rate at which stems grow into the higher diameter class over a period of 5 years (in %); the recruitment parameter represents the numbers of stems going into the first diameter class per hectare over 5 years; the mortality parameter represents the proportion of stems dying over a period of 5 years (in %); and the extractions parameter represents the proportion of stems felled over a period of 5 years (in %).
- *For the age class model,* the production parameter is expressed in m3/ha/year of stem wood, similarly for the mortality parameter; the extraction parameter is made up of 2 values: firstly, the thinning extraction rate (in % of volume over 5 years) and secondly, the clear felling extraction rate (in % of surface area over 5 years).

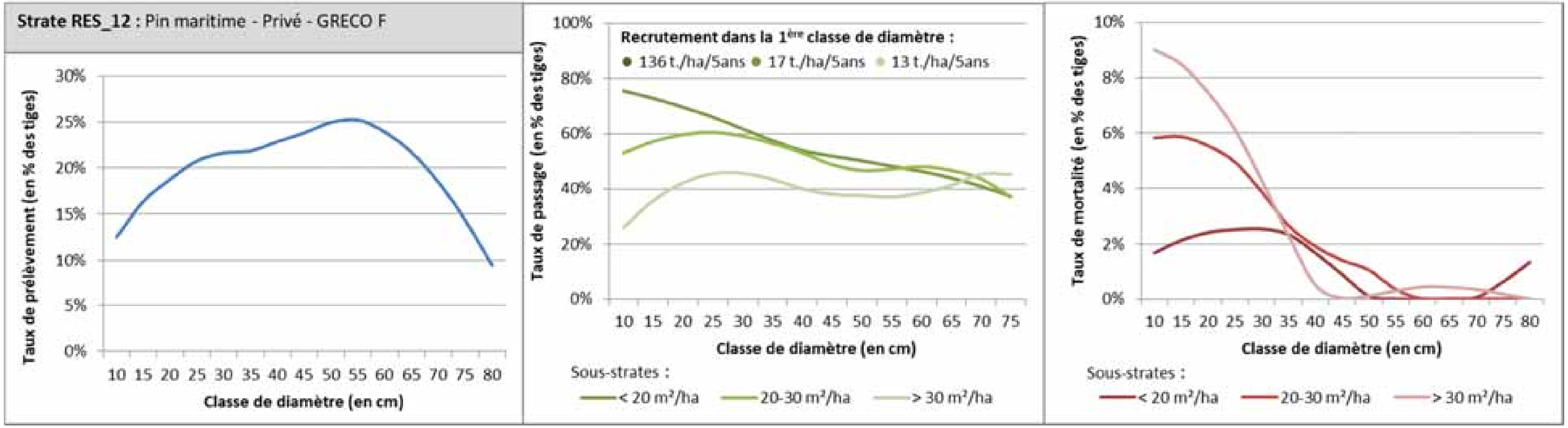
** Sub-stratification into 3 classes of basal area (less than 20 m²/ha, from 20 to 30 m²/ha and more than 30 m²/ha) takes into account the effect of density on production parameters, recruitment and mortality. The distribution of points in the different sub-strata changes during the projection (only the initial distribution is indicated here).

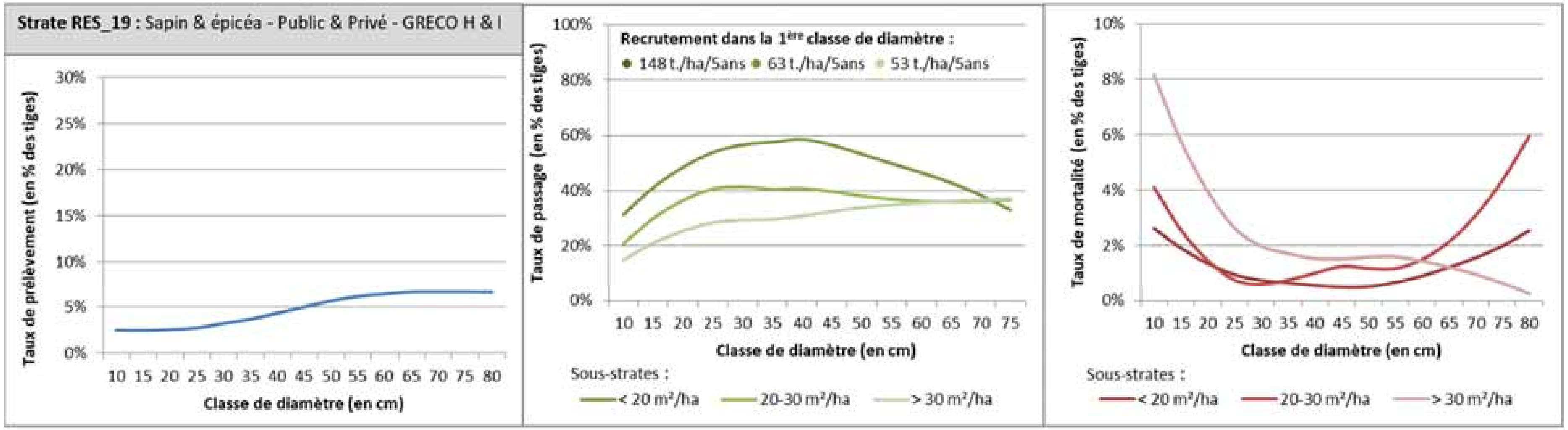
*** The even/uneven age character was dealt with using a forest structure indicator for the stand. Coppice stands and regular forests were considered to be even-aged in the sense of low tree height heterogeneity (different ages may co-exist here).

EXAMPLES OF FOREST DYNAMICS PARAMETERS FOR A NUMBER OF STRATA

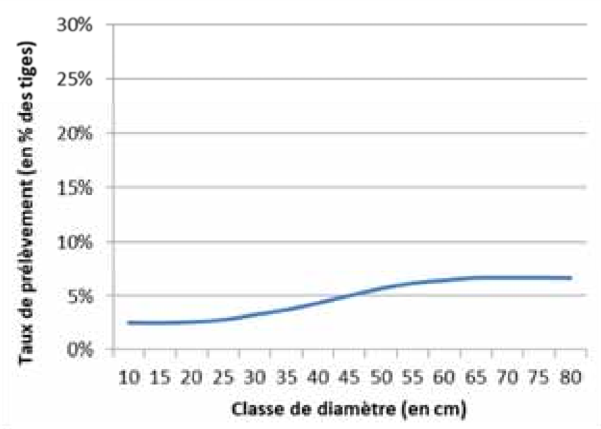


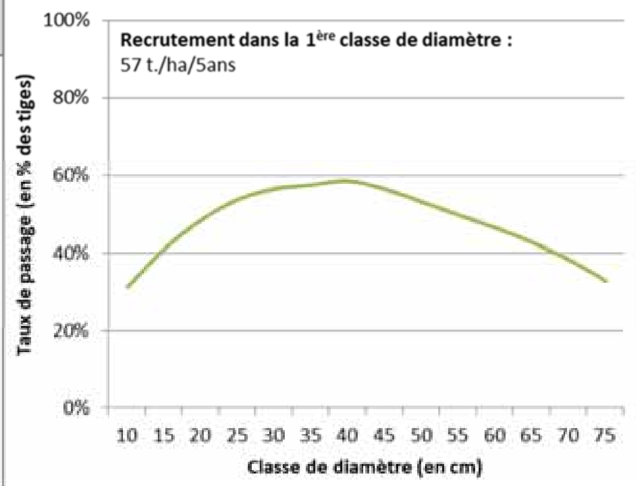


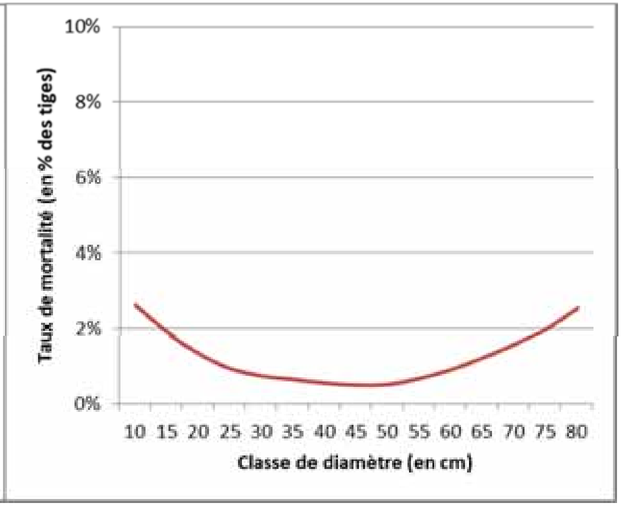

Strate RES_12 : Pin maritime - Privé - GRECO F
Taux de prélèvement (en % des tiges)
Classe de diamètre (en cm)
Recrutement dans la 1ère classe de diamètre :
136 t./ha/5ans
17 t./ha/5ans
13 t./ha/5ans
Taux de passage (en % des tiges)
Taux de mortalité (en % des tiges)
Sous-strates :
< 20 m²/ha
20-30 m²/ha
> 30 m²/ha


Strate RES_19 : Sapin & épicéa - Public & Privé - GRECO H & I
Taux de prélèvement (en % des tiges)
Classe de diamètre (en cm)
Recrutement dans la 1ère classe de diamètre :
148 t./ha/5ans
63 t./ha/5ans
53 t./ha/5ans
Taux de passage (en % des tiges)
Taux de mortalité (en % des tiges)
Sous-strates :
< 20 m²/ha
20-30 m²/ha
> 30 m²/ha

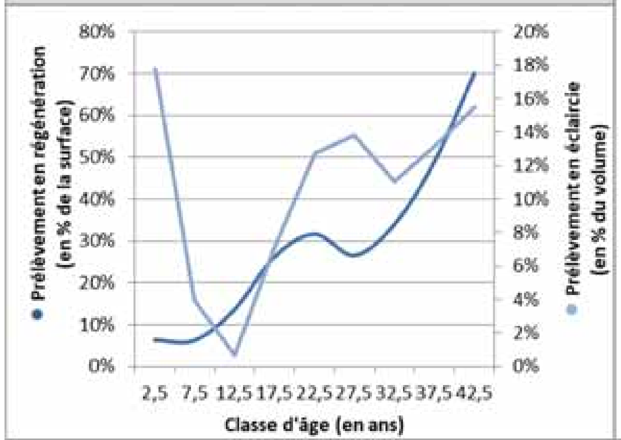
Strate OUV_01 : Ouvert - Feuillus - GRECO A & B & C & F

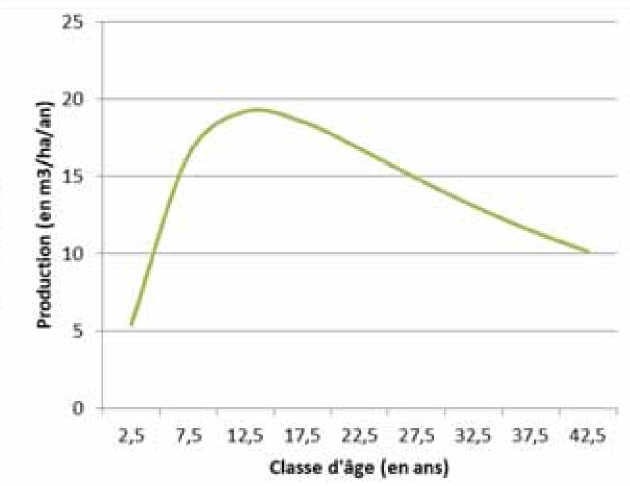


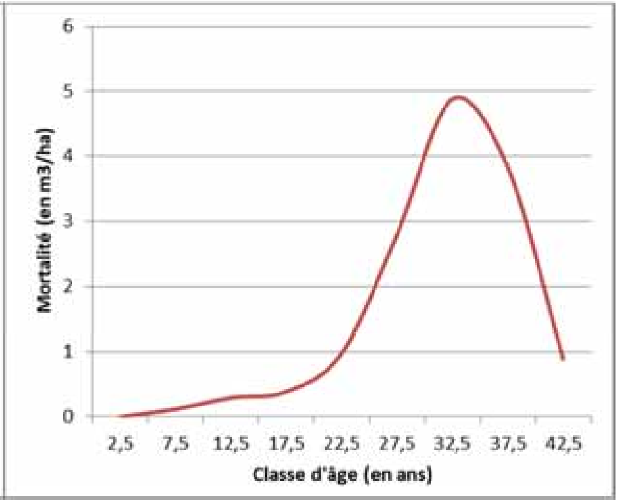




Strate PEU_02 : Peupleraies - GRECO B & C & D & E







DETAILED RESULTS

		croissance			
		inventaire GES éd. déc. 2018		*projection IGN nov 2019. point de départ 2010* ***avant recalage***	
		aérien	**racinaire**	**aérien**	**racinaire**
	année	tCO2e	tCO2e	tCO2e	tCO2e
	1990	-100 144 395	-28 631 629		
	1991	-100 767 933	-28 812 751		
	1992	-101 423 098	-29 002 516		
	1993	-102 109 628	-29 200 862		
	1994	-102 772 945	-29 391 736		
	1995	-103 462 937	-29 592 496		
	1996	-104 181 409	-29 800 581		
	1997	-104 922 933	-30 014 894		
	1998	-105 669 467	-30 230 058		
	1999	-106 345 066	-30 425 615		
Période de référence	2000	-107 155 844	-30 658 792		
	2001	-107 924 117	-30 880 609		
	2002	-108 661 804	-31 092 793		
	2003	-109 493 835	-31 332 068		
	2004	-110 497 017	-31 619 507		
	2005	-111 262 097	-31 837 339		
	2006	-111 999 658	-32 046 316		
	2007	-112 676 538	-32 235 136		
	2008	-113 812 426	-32 564 416		
	2009	-116 414 251	-33 274 161		
	2010	-113 131 331	-32 382 510	-107 286 062	-30 635 967
	2011	-109 655 121	-31 381 325	-108 673 831	-31 036 154
	2012	-109 076 361	-31 194 331	-110 061 601	-31 436 341
	2013	-110 222 569	-31 538 106	-111 449 371	-31 836 527
	2014	-108 751 100	-31 143 879	-112 837 141	-32 236 714
	2015	-110 617 942	-31 659 743	-114 224 911	-32 636 901
	2016	-110 742 896	-31 696 490	-114 925 716	-32 834 415
	2017	-110 808 768	-31 715 986	-115 626 521	-33 031 929
	2018			-116 327 326	-33 229 443
	2019			-117 028 132	-33 426 958
	2020			-117 728 937	-33 624 472
FRL (1)	2021			-118 853 450	-33 947 083
	2022			-119 977 963	-34 269 695
	2023			-121 102 476	-34 592 306
	2024			-122 226 989	-34 914 918
	2025			-123 351 502	-35 237 529
FRL (2)	2026			-124 276 534	-35 500 285
	2027			-125 201 566	-35 763 042
	2028			-126 126 597	-36 025 798
	2029			-127 051 629	-36 288 554
	2030			-127 976 661	-36 551 310

2000-2009	-110 989 759	-31 754 114		
2021-2025			-121 102 476	-34 592 306
2026-2030			-126 126 597	-36 025 798

		mortalité de fond			
		inventaire GES éd. déc. 2018 (1)		*projection IGN nov 2019. point de départ 2010* ***avant recalage***	
		aérien	**racinaire**	**aérien**	**racinaire**
	année	tCO2e	tCO2e	tCO2e	tCO2e
	1990	9 107 572	2 593 723		
	1991	9 149 795	2 605 748		
	1992	9 194 294	2 618 421		
	1993	9 240 938	2 631 705		
	1994	9 294 355	2 646 917		
	1995	9 357 588	2 664 925		
	1996	9 413 868	2 680 953		
	1997	9 471 923	2 697 486		
	1998	9 526 836	2 713 125		
	1999	9 578 035	2 727 705		
Période de référence	2000	9 648 005	2 747 632		
	2001	9 711 437	2 765 697		
	2002	9 772 892	2 783 198		
	2003	9 840 024	2 802 317		
	2004	9 926 849	2 827 044		
	2005	9 989 125	2 844 779		
	2006	10 049 662	2 862 019		
	2007	10 096 486	2 875 354		
	2008	11 420 195	3 252 330		
	2009	11 287 257	3 214 471		
	2010	10 746 797	3 060 554	12 798 506	3 646 078
	2011	12 744 261	3 629 407	12 945 109	3 687 616
	2012	12 610 499	3 591 314	13 091 712	3 729 154
	2013	12 563 029	3 577 795	13 238 314	3 770 693
	2014	13 176 349	3 752 461	13 384 917	3 812 231
	2015	12 418 950	3 536 763	13 531 520	3 853 770
	2016	12 430 639	3 540 092	13 750 327	3 916 129
	2017	12 436 021	3 541 625	13 969 134	3 978 488
	2018			14 187 941	4 040 847
	2019			14 406 748	4 103 206
	2020			14 625 555	4 165 566
FRL (1)	2021			14 762 952	4 204 478
	2022			14 900 349	4 243 390
	2023			15 037 746	4 282 302
	2024			15 175 143	4 321 214
	2025			15 312 540	4 360 126
FRL (2)	2026			15 494 973	4 411 955
	2027			15 677 405	4 463 784
	2028			15 859 838	4 515 614
	2029			16 042 270	4 567 443
	2030			16 224 703	4 619 272

2000-2009	10 174 193	2 897 484		
2021-2025			15 037 746	4 282 302
2026-2030			15 859 838	4 515 614

mortalité exceptionnelle

		tempête		feux de forêt	
		inventaire GES éd. déc. 2018 (1)		*inventaire GES éd. déc. 2018*	*projection Citepa*
		aérien	racinaire	émissions (aérien)	émissions (aérien)
	année	tCO2e	tCO2e	tCO2e	tCO2e
	1990			1782 375	
	1991			288 827	
	1992			388 511	
	1993			430 189	
	1994			445 078	
	1995			589 250	
	1996			501507	
	1997			685 973	
	1998			600 527	
	1999	51437 381	14 648 728	349 781	
Période de référence	2000			549 786	
	2001			396 758	
	2002			1408 393	
	2003			1490 670	
	2004			318 425	
	2005			519 343	
	2006			181975	
	2007			201264	
	2008			176 924	
	2009	16 519 501	4 704 549	479 616	
	2010			343 734	
	2011			333 812	
	2012			293 684	
	2013			98 992	
	2014			241060	
	2015			488 555	
	2016			387 667	
	2017			491572	
	2018				454 388
	2019				454 388
	2020				454 388
FRL (1)	2021				454 388
	2022				454 388
	2023				454 388
	2024				454 388
	2025				454 388
FRL (2)	2026				454 388
	2027				454 388
	2028				454 388
	2029				454 388
	2030				454 388

2000-2009	1 651 950	470 455	572 316	
2021-2025				454 388
2026-2030				454 388

	année	prélèvement (récoltes+pertes) (en forêt)				
		inventaire GES éd. déc. 2018				
		Récoltes, aérien	Récoltes, racinaire	pertes : décomposition	pertes : brûlage in situ (aérien)	total prélèvements dont pertes
	année	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e
	1990	48 370 755	19 149 214	6 576 305	8 154 992	82 251 267
	1991	49 968 164	19 749 045	6 782 328	8 705 001	85 204 538
	1992	50 953 486	20 096 992	6 899 601	8 906 052	86 856 131
	1993	49 447 547	19 460 137	6 675 598	8 618 354	84 201 636
	1994	49 617 587	19 603 432	6 723 641	8 506 859	84 451 518
	1995	50 014 374	19 801 776	6 790 416	8 561 551	85 168 117
	1996	46 788 922	18 501 635	6 344 354	8 024 952	79 659 863
	1997	47 742 004	18 898 432	6 481 296	8 172 536	81 294 268
	1998	48 208 894	19 104 225	6 549 236	8 215 819	82 078 175
	1999	45 815 337	18 206 756	6 243 701	7 767 048	78 032 842
Période de référence	2000	56 329 274	22 480 228	7 689 616	8 999 005	95 498 123
Période de référence	2001	49 441 142	19 763 036	6 753 947	7 903 187	83 861 311
Période de référence	2002	44 409 449	17 733 221	6 060 940	7 200 416	75 404 026
Période de référence	2003	43 022 231	17 118 902	5 858 113	7 132 188	73 131 434
Période de référence	2004	42 608 647	16 977 607	5 809 342	7 006 268	72 401 864
Période de référence	2005	41 971 479	16 721 114	5 725 984	6 959 133	71 377 709
Période de référence	2006	40 500 125	16 192 674	5 539 966	6 573 436	68 806 202
Période de référence	2007	39 928 146	16 008 251	5 478 410	6 433 167	67 847 973
Période de référence	2008	37 747 221	15 126 511	5 178 821	6 165 358	64 217 912
Période de référence	2009	40 884 117	16 490 879	5 621 202	6 401 986	69 398 185
	2010	44 310 492	17 782 385	6 063 681	7 021 933	75 178 491
	2011	44 018 329	17 569 275	6 000 857	7 158 150	74 746 611
	2012	41 883 184	16 621 552	5 686 155	7 029 419	71 220 311
	2013	40 712 721	16 172 230	5 529 317	6 790 497	69 204 765
	2014	43 287 025	17 197 064	5 882 372	7 214 334	73 580 796
	2015	42 910 525	17 029 250	5 826 270	7 195 819	72 961 864
	2016	44 109 120	17 494 259	5 986 690	7 472 625	75 062 694
	2017	45 287 520	17 959 804	6 143 430	7 652 825	77 043 578
	2018					
	2019					
	2020					
FRL (1)	2021					
FRL (1)	2022					
FRL (1)	2023					
FRL (1)	2024					
FRL (1)	2025					
FRL (2)	2026					
FRL (2)	2027					
FRL (2)	2028					
FRL (2)	2029					
FRL (2)	2030					

2000-2009	43 684 183	17 461 242	5 971 634	7 077 414	74 194 474
2021-2025					
2026-2030					

		prélèvement (récoltes+pertes) (en forêt) *projection IGN nov 2019.* *point de départ 2010* ***avant recalage***					
		Prélèvement aérien (dont pertes)	Prélèvement racinaire (dont pertes)	total (dont pertes)	dont pertes : brûlage in situ (aérien) (2)	dont pertes : décompo	pertes totales IGN
	année	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e
	1990						
	1991						
	1992						
	1993						
	1994						
	1995						
	1996						
	1997						
	1998						
	1999						
Période de référence	2000						
	2001						
	2002						
	2003						
	2004						
	2005						
	2006						
	2007						
	2008						
	2009						
	2010	50 278 453	14 400 945	64 679 398	801 463	8 493 945	13 887 618
	2011	50 936 463	14 588 692	65 525 155	811 943	8 423 417	13 887 618
	2012	51 594 473	14 776 440	66 370 913	822 423	8 352 889	13 887 618
	2013	52 252 483	14 964 187	67 216 670	832 903	8 282 360	13 887 618
	2014	52 910 493	15 151 934	68 062 427	843 383	8 211 832	13 887 618
	2015	53 568 503	15 339 682	68 908 185	853 863	8 141 303	13 887 618
	2016	54 206 634	15 522 420	69 729 054	864 035	8 072 850	13 887 618
	2017	54 844 766	15 705 158	70 549 924	874 207	8 004 397	13 887 618
	2018	55 482 897	15 887 897	71 370 794	884 378	7 935 944	13 887 618
	2019	56 121 028	16 070 635	72 191 664	894 550	7 867 491	13 887 618
	2020	56 759 160	16 253 373	73 012 533	904 722	7 799 038	13 887 618
FRL (1)	2021	57 345 439	16 421 235	73 766 674	914 067	7 736 149	13 887 618
	2022	57 931 718	16 589 097	74 520 815	923 411	7 673 261	13 887 618
	2023	58 517 996	16 756 959	75 274 955	932 756	7 610 373	13 887 618
	2024	59 104 275	16 924 820	76 029 096	942 101	7 547 484	13 887 618
	2025	59 690 554	17 092 682	76 783 236	951 446	7 484 596	13 887 618
FRL (2)	2026	60 320 521	17 273 085	77 593 606	961 487	7 417 018	13 887 618
	2027	60 950 488	17 453 488	78 403 976	971 529	7 349 441	13 887 618
	2028	61 580 455	17 633 890	79 214 345	981 570	7 281 863	13 887 618
	2029	62 210 422	17 814 293	80 024 715	991 612	7 214 286	13 887 618
	2030	62 840 389	17 994 696	80 835 085	1 001 653	7 146 708	13 887 618

2000-2009						
2021-2025	58 517 996	16 756 959	75 274 955	932 756	7 610 373	13 887 618
2026-2030	61 580 455	17 633 890	79 214 345	981 570	7 281 863	13 887 618

		bilan biomasse vivante **après recalage**					
		inventaire GES éd. déc. 2018			*projection*		
		aérien	racinaire	total aérien + racinaire	aérien	racinaire	aérien + racinaire
	année	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e
	1990	-26 152 396	-6 888 691	-33 041 087			
	1991	-25 873 818	-6 457 958	-32 331 776			
	1992	-25 081 154	-6 287 103	-31 368 257			
	1993	-27 697 001	-7 109 021	-34 806 022			
	1994	-28 185 425	-7 141 387	-35 326 813			
	1995	-28 149 758	-7 125 795	-35 275 553			
	1996	-33 107 805	-8 617 994	-41 725 799			
	1997	-32 369 201	-8 418 976	-40 788 177			
	1998	-32 568 153	-8 412 709	-40 980 862			
	1999	14 846 217	5 157 574	20 003 791			
Période de référence	2000	-23 940 158	-5 430 931	-29 371 089			
	2001	-33 717 645	-8 351 876	-42 069 522			
	2002	-39 809 714	-10 576 374	-50 386 088			
	2003	-42 150 609	-11 410 850	-53 561 459			
	2004	-44 827 486	-11 814 857	-56 642 343			
	2005	-46 097 033	-12 271 446	-58 368 479			
	2006	-49 154 494	-12 991 623	-62 146 117			
	2007	-50 539 065	-13 351 532	-63 890 597			
	2008	-53 123 906	-14 185 575	-67 309 480			
	2009	-35 220 571	-8 864 263	-44 084 833			
	2010	-44 644 694	-11 539 571	-56 184 265	-38 292 059	-11 230 118	-49 522 178
	2011	-39 399 712	-10 182 643	-49 582 355	-38 875 059	-11 400 618	-50 275 677
	2012	-41 573 421	-10 981 465	-52 554 885	-39 488 256	-11 571 128	-51 059 384
	2013	-44 528 013	-11 788 082	-56 316 095	-40 256 006	-11 741 648	-51 997 653
	2014	-38 949 959	-10 194 354	-49 144 313	-40 686 986	-11 912 177	-52 599 163
	2015	-41 777 823	-11 093 731	-52 871 554	-41 012 531	-12 082 716	-53 095 247
	2016	-40 356 156	-10 662 139	-51 018 295	-40 946 874	-12 035 373	-52 982 247
	2017	-38 797 401	-10 214 557	-49 011 957	-40 676 422	-11 988 032	-52 664 454
	2018				-40 547 057	-11 940 692	-52 487 749
	2019				-40 380 507	-11 893 354	-52 273 861
	2020				-40 213 955	-11 846 018	-52 059 973
FRL (1)	2021				-40 605 576	-11 961 726	-52 567 303
	2022				-40 997 195	-12 077 438	-53 074 633
	2023				-41 388 812	-12 193 151	-53 581 963
	2024				-41 780 427	-12 308 866	-54 089 293
	2025				-42 172 039	-12 424 584	-54 596 623
FRL (2)	2026				-42 274 508	-12 455 229	-54 729 738
	2027				-42 376 978	-12 485 875	-54 862 852
	2028				-42 479 448	-12 516 520	-54 995 967
	2029				-42 581 918	-12 547 164	-55 129 082
	2030				-42 684 389	-12 577 807	-55 262 197

2000-2009	-41 858 068	-10 924 933	-52 783 001			
2021-2025				-41 388 810	-12 193 153	-53 581 963
2026-2030				-42 479 448	-12 516 519	-54 995 967

		croissance		mortalité de fond		tempête	feux de forêt		prélèvements		bilan net	
		inventaire GES éd. déc. 2018	*projection IGN*	*inventaire GES éd. déc. 2018*	*projection IGN*	*inventaire GES éd. déc. 2018*	*inventaire GES éd. déc. 2018*	*projection Citepa*	*inventaire GES éd. déc. 2018*	*projection IGN*	*inventaire GES éd. déc. 2018*	*projection*
		total aérien + racinaire	**total aérien + racinaire**	**aérien + racinaire**	**aérien + racinaire**	**aérien + racinaire**	**émissions (aérien)**	**émissions (aérien)**	**total prélèvements dont**	**total (dont pertes)**	**total aérien + racinaire**	**aérien + racinaire**
	année	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e
	1990	-128 776 024		11 701 295			1 782 375		82 251 267		-33 041 087	
	1991	-129 580 684		11 755 543			288 827		85 204 538		-32 331 776	
	1992	-130 425 613		11 812 715			388 511		86 856 131		-31 368 257	
	1993	-131 310 490		11 872 643			430 189		84 201 636		-34 806 022	
	1994	-132 164 682		11 941 272			445 078		84 451 518		-35 326 813	
	1995	-133 055 433		12 022 513			589 250		85 168 117		-35 275 553	
	1996	-133 981 990		12 094 821			501 507		79 659 863		-41 725 799	
	1997	-134 937 826		12 169 409			685 973		81 294 268		-40 788 177	
	1998	-135 899 525		12 239 961			600 527		82 078 175		-40 980 862	
	1999	-136 770 681		12 305 740		66 086 109	349 781		78 032 842		20 003 791	
Période de référence	2000	-137 814 635		12 395 637			549 786		95 498 123		-29 371 089	
	2001	-138 804 725		12 477 134			396 758		83 861 311		-42 069 522	
	2002	-139 754 598		12 556 090			1 408 393		75 404 026		-50 386 088	
	2003	-140 825 903		12 642 340			1 490 670		73 131 434		-53 561 459	
	2004	-142 116 524		12 753 893			318 425		72 401 864		-56 642 343	
	2005	########		12 833 904			519 343		71 377 709		-58 368 479	
	2006	-144 045 974		12 911 681			181 975		68 806 202		-62 146 117	
	2007	-144 911 674		12 971 840			201 264		67 847 973		-63 890 597	
	2008	-146 376 841		14 672 525			176 924		64 217 912		-67 309 480	
	2009	-149 688 412		14 501 728		21 224 049	479 616		69 398 185		-44 084 833	
	2010	-145 513 841	-137 922 029	13 807 351	16 444 584		343 734		75 178 491	64 679 398	-56 184 265	-49 522 178
	2011	-141 036 446	-139 709 985	16 373 668	16 632 725		333 812		74 746 611	65 525 155	-49 582 355	-50 275 677
	2012	-140 270 692	-141 497 942	16 201 812	16 820 866		293 684		71 220 311	66 370 913	-52 554 885	-51 059 384
	2013	-141 760 675	-143 285 899	16 140 823	17 009 007		98 992		69 204 765	67 216 670	-56 316 095	-51 997 653
	2014	-139 894 978	-145 073 855	16 928 809	17 197 148		241 060		73 580 796	68 062 427	-49 144 313	-52 599 163
	2015	-142 277 685	-146 861 812	15 955 712	17 385 289		488 555		72 961 864	68 908 185	-52 871 554	-53 095 247
	2016	########	-147 760 131	15 970 730	17 666 455		387 667		75 062 694	69 729 054	-51 018 295	-52 982 247
	2017	-142 524 754	-148 658 450	15 977 646	17 947 622		491 572		77 043 578	70 549 924	-49 011 957	-52 664 454
	2018		-149 556 770		18 228 788			454 388		71 370 794		-52 487 749
	2019		-150 455 089		18 509 954			454 388		72 191 664		-52 273 861
	2020		-151 353 409		18 791 121			454 388		73 012 533		-52 059 973
FRL (1)	2021		-152 800 533		18 967 430			454 388		73 766 674		-52 567 303
	2022		-154 247 658		19 143 739			454 388		74 520 815		-53 074 633
	2023		-155 694 782		19 320 048			454 388		75 274 955		-53 581 963
	2024		-157 141 907		19 496 357			454 388		76 029 096		-54 089 293
	2025		-158 589 032		19 672 666			454 388		76 783 236		-54 596 623
FRL (2)	2026		-159 776 819		19 906 928			454 388		77 593 606		-54 729 738
	2027		-160 964 607		20 141 190			454 388		78 403 976		-54 862 852
	2028		-162 152 395		20 375 451			454 388		79 214 345		-54 995 967
	2029		-163 340 183		20 609 713			454 388		80 024 715		-55 129 082
	2030		-164 527 971		20 843 975			454 388		80 835 085		-55 262 197

2000-2009	-142 743 872		13 071 677		2 122 405	572 316		74 194 474		-52 783 001	
2021-2025		-155 694 782		19 320 048			454 388		75 274 955		-53 581 963
2026-2030		-162 152 395		20 375 451			454 388		79 214 345		-54 995 967

CALCULATION OF THE RATIO BETWEEN SOLID USE AND ENERGY USE OF WOOD

		Récoltes de bois en volume (m3/an)		ratio historique, en %		ratio utilisé pour le FRL, en %	
		Usage	Usage	Usage	Usage	Usage	Usage
	1990	36 418	24 987	57%	43%		
	1991	35 518	27 304	54%	46%		
	1992	34 355	29 004	52%	48%		
	1993	31 176	29 912	48%	52%		
	1994	34 252	27 935	52%	48%		
	1995	35 458	26 453	55%	45%		
	1996	32 370	26 105	53%	47%		
	1997	33 928	25 902	54%	46%		
	1998	34 540	25 604	55%	45%		
	1999	35 061	24 079	56%	44%		
Période de référence	2000	46 121	23 258	65%	35%		
	2001	39 859	22 568	62%	38%		
	2002	34 693	21 760	59%	41%		
	2003	32 264	21 897	57%	43%		
	2004	33 093	21 914	57%	43%		
	2005	33 097	22 294	55%	45%		
	2006	33 471	21 537	56%	44%		
	2007	34 955	20 496	58%	42%		
	2008	32 502	20 134	56%	44%		
	2009	34 792	20 680	58%	42%		
	2010	35 315	22 772	57%	43%	58%	42%
	2011	33 181	23 366	56%	44%	58%	42%
	2012	29 189	24 388	51%	49%	58%	42%
	2013	28 238	23 970	51%	49%	58%	42%
	2014	30 465	24 565	52%	48%	58%	42%
	2015	29 614	24 890	51%	49%	58%	42%
	2016	29 919	26 171	50%	50%	58%	42%
	2017	30 221	27 255	49%	51%	58%	42%
	2018					58%	42%
	2019					58%	42%
	2020					58%	42%
FRL (1)	2021					58%	42%
	2022					58%	42%
	2023					58%	42%
	2024					58%	42%
	2025					58%	42%
FRL (2)	2026					58%	42%
	2027					58%	42%
	2028					58%	42%
	2029					58%	42%
	2030					58%	42%

2000-2009	35 485	21 654	**58%**	**42%**		
2021-2025					**58%**	**42%**
2026-2030					**58%**	**42%**

DETAILS OF WOOD HARVESTS BY TYPE OF USE

		Projection on wood removals								
		wood removals m3			*wood removals tC*			*wood removals tCO2*		
		solid use	**energy use**	**total**	**solid use**	**energy use**	**total**	**solid use**	**energy use**	**total**
	year	m3	m3	m3	tC	tC	tC	tCO2	tCO2	tCO2
	1990									
	1991									
	1992									
	1993									
	1994									
	1995									
	1996									
	1997									
	1998									
	1999									
Period of reference	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010	33 857 968	24 229 756	58 087 725	-8 074 182	-5 778 122	-13 852 304	29 605 334	21 186 446	50 791 780
	2011	34 168 311	24 451 847	58 620 158	-8 208 629	-5 874 336	-14 082 965	30 098 306	21 539 231	51 637 537
	2012	34 478 654	24 673 937	59 152 591	-8 343 076	-5 970 550	-14 313 626	30 591 278	21 892 017	52 483 295
	2013	34 788 997	24 896 027	59 685 024	-8 477 523	-6 066 764	-14 544 287	31 084 250	22 244 802	53 329 052
	2014	35 099 340	25 118 118	60 217 458	-8 611 970	-6 162 978	-14 774 948	31 577 222	22 597 587	54 174 809
	2015	35 409 683	25 340 208	60 749 891	-8 746 417	-6 259 192	-15 005 609	32 070 194	22 950 372	55 020 566
	2016	35 870 648	25 670 088	61 540 736	-8 876 907	-6 352 575	-15 229 483	32 548 660	23 292 776	55 841 436
	2017	36 331 613	25 999 969	62 331 581	-9 007 398	-6 445 958	-15 453 356	33 027 125	23 635 180	56 662 306
	2018	36 792 578	26 329 849	63 122 426	-9 137 888	-6 539 341	-15 677 230	33 505 591	23 977 585	57 483 176
	2019	37 253 543	26 659 729	63 913 271	-9 268 379	-6 632 724	-15 901 103	33 984 057	24 319 989	58 304 045
	2020	37 714 508	26 989 609	64 704 117	-9 398 870	-6 726 107	-16 124 977	34 462 522	24 662 393	59 124 915
FRL (1)	2021	38 008 987	27 200 347	65 209 333	-9 518 753	-6 811 899	-16 330 652	34 902 093	24 976 962	59 879 056
	2022	38 303 466	27 411 084	65 714 550	-9 638 636	-6 897 691	-16 536 326	35 341 664	25 291 532	60 633 196
	2023	38 597 945	27 621 822	66 219 767	-9 758 519	-6 983 482	-16 742 001	35 781 235	25 606 102	61 387 337
	2024	38 892 424	27 832 560	66 724 984	-9 878 402	-7 069 274	-16 947 676	36 220 806	25 920 672	62 141 478
	2025	39 186 902	28 043 298	67 230 200	-9 998 285	-7 155 066	-17 153 350	36 660 377	26 235 242	62 895 618
FRL (2)	2026	39 599 685	28 338 697	67 938 382	-10 127 106	-7 247 254	-17 374 360	37 132 722	26 573 266	63 705 988
	2027	40 012 467	28 634 096	68 646 563	-10 255 927	-7 339 443	-17 595 370	37 605 067	26 911 290	64 516 357
	2028	40 425 250	28 929 495	69 354 745	-10 384 749	-7 431 631	-17 816 380	38 077 413	27 249 314	65 326 727
	2029	40 838 032	29 224 894	70 062 926	-10 513 570	-7 523 820	-18 037 390	38 549 758	27 587 339	66 137 097
	2030	41 250 814	29 520 294	70 771 108	-10 642 392	-7 616 008	-18 258 400	39 022 104	27 925 363	66 947 466

2000-2009									
2021-2025	38 597 945	27 621 822	66 219 767	-9 758 519	-6 983 482	-16 742 001	35 781 235	25 606 102	61 387 337
2026-2030	40 425 250	28 929 495	69 354 745	-10 384 749	-7 431 631	-17 816 380	38 077 413	27 249 314	65 326 727

Details of readjustment

		bilan biomasse vivante sans les feux						écart à appliquer en valeur absolue			bilan biomasse sans feux			feux de forêt		bilan biomasse avec feux		
		inventaire GES éd. déc. 2018			*projection IGN nov 2019. point de départ 2010*						*projection IGN nov 2019. recalée point de départ 2010*			*inventaire GES éd. déc. 2018*	*projection Citepa*	*projection IGN nov 2019. recalée point de départ 2010 + projection feux foret*		
		aérien	racinaire	total aérien + racinaire	aérien	racinaire	aérien + racinaire				aérien	racinaire	aérien + racinaire	émissions (aérien)	émissions (aérien)	aérien	racinaire	aérien + racinaire
	année	tC	tC	tC	tC	tC	tC	annuel	moyen	correction	tC	tC	tC	tC	tC	tC	tC	tC
	1990	7 406 988	1 878 734	9 285 722										-434 730				
	1991	7 336 816	1 761 261	9 098 077										-70 446				
	1992	7 128 954	1 714 664	8 843 618										-94 760				
	1993	7 834 365	1 938 824	9 773 188										-104 925				
	1994	7 965 189	1 947 651	9 912 840										-108 557				
	1995	7 961 713	1 943 399	9 905 112										-143 721				
	1996	9 294 016	2 350 362	11 644 378										-122 320				
	1997	9 102 529	2 296 084	11 398 613										-167 312				
	1998	9 156 153	2 294 375	11 450 528										-146 472				
	1999	-3 796 229	-1 406 611	-5 202 840										-85 313				
Période de référence	2000	6 827 422	1 481 163	8 308 585										-134 096				
	2001	9 456 570	2 277 784	11 734 354										-96 771				
	2002	11 125 292	2 884 466	14 009 758										-343 514				
	2003	11 762 648	3 112 050	14 874 698										-363 582				
	2004	12 455 146	3 222 234	15 677 380										-77 666				
	2005	12 805 348	3 346 758	16 152 106										-126 671				
	2006	13 618 065	3 543 170	17 161 234										-44 385				
	2007	13 992 059	3 641 327	17 633 386										-49 089				
	2008	14 687 243	3 868 793	18 556 036										-43 153				
	2009	9 823 962	2 417 526	12 241 489										-116 981				
	2010	12 409 700	3 147 156	15 556 856	12 057 028	3 433 349	15 490 376	-66 480		1 672 002	10 755 615	3 062 760	13 818 375	-83 838		10 671 777	3 062 760	13 734 536
	2011	10 980 925	2 777 084	13 758 009	12 216 071	3 479 958	15 696 029	1 938 019		1 672 002	10 914 768	3 109 259	14 024 027	-81 419		10 833 349	3 109 259	13 942 609
	2012	11 566 652	2 994 945	14 561 597	12 375 114	3 526 567	15 901 681	1 340 084		1 672 002	11 073 917	3 155 762	14 229 679	-71 631		11 002 286	3 155 762	14 158 048
	2013	12 359 403	3 214 931	15 574 334	12 534 156	3 573 177	16 107 333	532 999	1 672 002	1 672 002	11 233 064	3 202 268	14 435 332	-24 145		11 208 919	3 202 268	14 411 187
	2014	10 855 048	2 780 278	13 635 326	12 693 199	3 619 786	16 312 985	2 677 659		1 672 002	11 392 208	3 248 776	14 640 984	-58 796		11 333 412	3 248 776	14 582 188
	2015	11 632 476	3 025 563	14 658 039	12 852 242	3 666 395	16 518 638	1 860 599		1 672 002	11 551 350	3 295 286	14 846 636	-119 161		11 432 189	3 295 286	14 727 475
	2016	11 250 123	2 907 856	14 157 979	12 809 660	3 653 418	16 463 079	2 305 099		1 672 002	11 508 703	3 282 374	14 791 077	-94 554		11 414 149	3 282 374	14 696 523
	2017	10 833 698	2 785 788	13 619 486	12 767 079	3 640 441	16 407 519	2 788 034		1 672 002	11 466 055	3 269 463	14 735 518	-119 897		11 346 158	3 269 463	14 615 621
	2018				12 724 497	3 627 463	16 351 960			1 672 002	11 423 406	3 256 552	14 679 959		-113 853	11 309 554	3 256 552	14 566 106
	2019				12 681 915	3 614 486	16 296 401			1 672 002	11 380 758	3 243 642	14 624 400		-113 853	11 266 905	3 243 642	14 510 547
	2020				12 639 333	3 601 509	16 240 842			1 672 002	11 338 109	3 230 732	14 568 841		-113 853	11 224 256	3 230 732	14 454 988
FRL (1)	2021				12 748 653	3 633 101	16 381 754			1 672 002	11 447 463	3 262 289	14 709 752		-113 853	11 333 610	3 262 289	14 595 899
	2022				12 857 972	3 664 693	16 522 665			1 672 002	11 556 817	3 293 847	14 850 663		-113 853	11 442 964	3 293 847	14 736 811
	2023				12 967 291	3 696 285	16 663 576			1 672 002	11 666 170	3 325 405	14 991 575		-113 853	11 552 317	3 325 405	14 877 722
	2024				13 076 610	3 727 877	16 804 488			1 672 002	11 775 522	3 356 964	15 132 486		-113 853	11 661 670	3 356 964	15 018 633
	2025				13 185 929	3 759 469	16 945 399			1 672 002	11 884 875	3 388 523	15 273 397		-113 853	11 771 022	3 388 523	15 159 545
FRL (2)	2026				13 216 647	3 767 794	16 984 442			1 672 002	11 915 559	3 396 881	15 312 440		-113 853	11 801 707	3 396 881	15 198 587
	2027				13 247 365	3 776 119	17 023 484			1 672 002	11 946 244	3 405 239	15 351 483		-113 853	11 832 391	3 405 239	15 237 630
	2028				13 278 083	3 784 444	17 062 527			1 672 002	11 976 929	3 413 596	15 390 525		-113 853	11 863 076	3 413 596	15 276 673
	2029				13 308 801	3 792 769	17 101 569			1 672 002	12 007 614	3 421 954	15 429 568		-113 853	11 893 761	3 421 954	15 315 715
	2030				13 339 519	3 801 093	17 140 612			1 672 002	12 038 299	3 430 311	15 468 610		-113 853	11 924 447	3 430 311	15 354 758
	moy 2000-2009	11 655 376	2 979 527	14 634 903										-139 591				
	moy 2021-2025				12 853 438	3 696 285	16 549 724				11 666 169	3 325 405	14 991 575		-113 853	11 552 317	3 325 405	14 877 722
	moy 2026-2030				13 164 230	3 784 444	16 948 674				11 976 929	3 413 596	15 390 525		-113 853	11 863 077	3 413 596	15 276 673

EXPLANATORY NOTE ON CONSIDERATION OF THE RECOMMENDATIONS

Summary

Principle of this explanatory note

Under article 8 of Regulation 2018/841, France has submitted a first version of its National Forestry Accounting Plan produced in 2018. This document and the calculation of the Forest Reference Level (FRL) were reviewed by experts and by the European Commission in 2019. Recommendations were made in 2019 Staff Working Document (SWD) 213 final: Assessment of the national forestry accounting plans, 18/06/2018. France: pages 19-20.[8] This Commission document reiterates, summarizes and supplements the assessments of the expert group (Synopsis of April 5 2019. France: pages 48-58[9]).

The National Forestry Accounting Plan and the FRLs included in it have been updated to take these recommendations into account. This note clarifies the paragraphs where changes have been made and in response to which recommendations these changes were made. These points relate to both transparency and technical aspects and update both the text of the accounting plan and the figures set out in it.

Only this new modified Accounting Plan is valid.

8 https://ec.europa.eu/energy/sites/ener/files/documents/staff_working_documet_en_212.pdf

9 http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupMeetingDoc&docid=30965

Consideration of the recommendations

1. Demonstrate that the FRL is based on a continuation of the forestry practices documented for 2000-2009.

Recommendation	*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.*
Item	Article 8(5) Principles. 1)
Change in the FRL calculation	no
Changes in the Accounting plan	Section 3.2.3.1 of the Accounting Plan has been completed.
Detailed explanations	*Section 3.2.3.1 of the NFAP :*

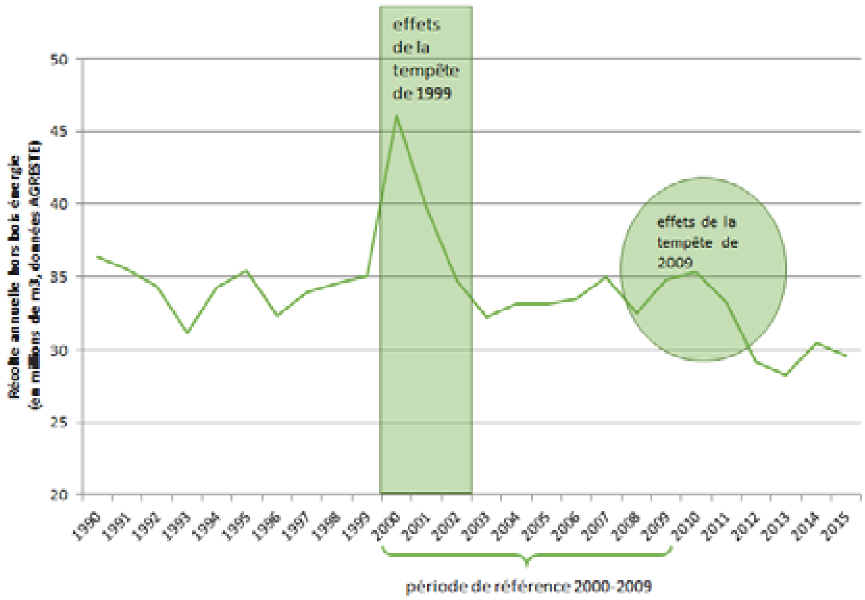
“The LULUCF regulation specifies that the FRL must be based on the continuation of sustainable forest management practices as documented over the 2000 -2009 period. Given the characteristics of the MARGOT model used for the projections, the forest management scenario for the reference period is defined as a rate of harvested number of trees per diameter class.

Since 2010, the IGN (national geographic institute) has been measuring extraction from forest land available for timber production by re-listing the inventory of all NFI (National Forest Inventory) points visited 5 years previously [Hervé et al., 2014]. Harvest rates are known per stratum and per diameter class, and they are consistent with all the other tree measurement estimators of the NFI.

However, these data are not directly usable to define the reference scenario because the first period of direct measurement of wood harvests from French forest land refers to the 2005-2010 period. Moreover, these results are statistically poor because they rely on a single measuring campaign. By contrast, the harvest rates usable by the MARGOT model can be calculated robustly thanks to the NFI observations per stratum and per diameter class over the 2005-2014 period.

A specific method has been developed to define a forest management scenario over the reference period using these NFI data, compatible with the MARGOT model. It consists of using the spatial and temporal changes observed in the AGRESTE data as a proxy to readjust the NFI harvest rates of the 2005-2014 period to the reference period.

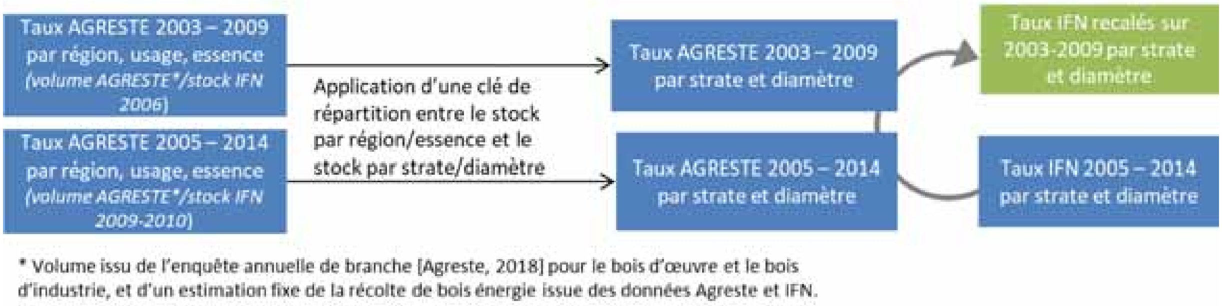
Every year since 1948, the Ministry of Agriculture has carried out a survey on forest extraction [Agreste, 2018]. All the logging companies, every year declare the volumes of timber harvested and traded, distinguishing the species, categories of products and regions of origin. These data have been supplemented by a non-traded wood energy value per region and per species derived from comparing AGRESTE data with the total harvest from forest land observed by the IGN. Since 2000, fuelwood harvests (traded and non-traded) are estimated to be stable.



During the reference period the harvesting of wood in French forest land was severely affected by the Lothar and Martin storms of December 1999. These storms affected nearly all the country and the volume of wood from windblow has been estimated at more than 140 million m3 [NFI, 2003]. Since this weather event of an unprecedented scale had a significant impact on the harvest of 2000, 2001 and 2002, it was decided to exclude these 3 exceptional years from the calculation of total harvests over the reference period. Similarly, in January 2009 the Aquitaine Forest area was again hit by storm Klaus. For this more recent and more localized storm, AGRESTE data make a distinction between volumes obtained from “normal” harvests and those obtained from accidental products. The accidental products were excluded from the extraction rate calculation. This choice was used to define a scenario that reflects normal management practices over the reference period and not practices related to managing an exceptional crisis.

The harvested volumes observed by AGRESTE over the 2003-2009 and 2005-2014 periods were compared to the stocks measured by the NFI over the same periods (i.e. respectively, the central years 2006 and 2010). In order to make these felling rates, defined using the AGRESTE data, comparable to those used as input for the MARGOT model, these rates per region/species/product have been converted into a rate per stratum and diameter class using an allocation key for these various criteria.

Changes in the harvest rates observed with AGRESTE between the 2003-2009 and 2005-2014 periods were finally applied to the harvest rate as measured by the NFI over the 2005-2014 period to estimate the harvest rate over the 2003-2009 reference period. Accordingly, the FRL is based on continuation of the "normal" forestry practices documented for the reference period. These extraction rates are expressed in the number of stems per diameter class and per stratum in relation to the standing stock. They are therefore compatible with the dynamic forestry model and applied as such to the different projection periods.



The sustainability of forest management practices over the reference period has been analyzed on the basis of the "extraction rate" sustainable management indicator [Forest Europe, 2015] which is obtained by dividing the extracted volume by the volume of biological growth excluding dead wood. For all French forest land, this rate is around 50%, and on a stratum scale it is always less than 100%, indicating that harvests do not exceed forest production. The only exception is the North of France poplar stand stratum where it reaches 102%. These stands which represent less than 1% of the national forest area suffer from an imbalance of age classes in favour of the older classes which are currently being felled. The felling scenario for this stratum has been maintained unchanged.

2. Specify how age dynamics have been taken into account

Recommendation — *Demonstrate how dynamic age-related forest characteristics have been taken into account and revise the FRL, if applicable.*

Item — Article 8(5) Principles. 1)

Change in the FRL calculation — no

Changes in the Accounting plan — Section 3.3.1.1 has been filled in. Appendices on forest dynamics by strata have been added.

Detailed explanations — Changes in forest biomass were projected via large-scale demographic models by diameter class for the 56 forest strata and by age class for the 2 poplar strata [Wernsdörfer et al., 2012; Colin et al., 2017]. Forest dynamics parameters (growth, mortality, extracted volumes) are expressed and applied by diameter class or by age class, thus reflecting changes in dynamics linked to the level of maturity of the stands (see graphs appended).

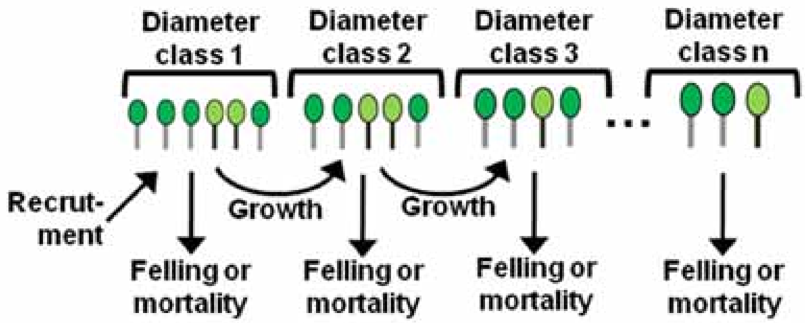
Section 3.3.1.1 of the NFAP (National Forestry Accounting Plan):

The MARGOT resource model (MAtrix model of forest Resource Growth and dynamics On the Territory scale) used by the IGN for projecting French forest-wood resources [Wernsdörfer et al., 2012; Colin et al., 2017] is the main modelling tool used to simulate the development of the 56 forest strata excluding poplar stands.

It is a dynamic model of the forest resource per diameter class, which iteratively simulates growth, mortality and forest-management (extraction) at the scale of strata and for successive 5-year periods. It is used to estimate the future state of the resource (and of the carbon stock), and to simulate future wood extraction and mortality.

The model is generic, i.e. it is configurable and applicable regardless of the type of stand. By modelling the diameter (a key variable of tree growth and forestry), it can be used both for even-aged stands (regular forest) and for heterogeneous stands (uneven-aged forest), the latter being the most prevalent in France [Morneau et al., 2008].

The model is of a matrix type, in which the resource and the parameters are described by stratum, by class of basal area per hectare and by diameter class. Adjustment of the production, recruitment and mortality by class of basal area means that the effect of the density of the stands on the variation of these parameters is taken into account.



Operating principle of an iteration of the MARGOT model (in numbers of trees per diameter class)

The development of the two strata of poplar stands was projected using the forest dynamics model by age class developed by the IGN (Colin et al., 2017), also using 5-year iterations. This model is particularly well adapted to plantations in which the trees have the same age and show the characteristics of uniform growth. The resource is described per stratum thanks to an average area and volume per hectare by age-class. Forest dynamics are modelled for each age class by a biological production per hectare, a natural mortality per hectare, a volume harvest rate for thinnings and a clear felling rate over the 5-year period.

3. Explain the reason for the difference between the biomass gains in the model and the national greenhouse gas emissions inventory

Recommendation	*Specifically, clarify why there is a discrepancy in biomass gain between model output and greenhouse gas inventory for the 2010-2016 period. Describe how the model used input data and model calibration, thereby minimizing this discrepancy.*
Item	Article 8(5) Principles. 1)
Change in the FRL calculation	The model has been corrected to be more realistic.
Changes in the Accounting plan	Paragraph 4.2. of the Accounting Plan has been revised and paragraph 3.3.1.1. has been completed.
Detailed explanations	***Resetting the model to reduce the divergence from the inventory results***

In a previous version of the FRL (Forest Reference Level) calculation submitted in 2018, over the 2010-2015 period there was a difference of approximately 8 $MtCO_2$/year between the historic GHG (greenhouse gas) inventory and the projection. This difference was mainly due to production (gains in living biomass) for which the historic data and the projection neither had the same initial absolute value nor showed the same trend over recent years. Certain causes were identified and could be taken into account to revise the FRL:

- the method used for converting the number of stems per diameter class (calculation unit in the model) into volume and into carbon (unit for the FRL) has been revised to better match the data from the national forest inventory. Specifically, an average volume unit is calculated by diameter class. The corrections for these average volume units relate to taking into account a slight bias linked to the uneven distribution of the stems within a diameter class, and to consideration of the "technical effect" which generates specific average volume unit that is different for felled trees. These corrections reduce the modelled production by around 1.5 $MtCO_2$/year;

- the method for calculating the modelled production has been modified to be more consistent with the GHG inventory. Two method of calculating production (biomass gains) are possible with the modelling results: 1/ by taking account of the difference between two simulated stock states and adding losses to them; 2/ by directly determining tree growth during a projection period. The first method was used in the previous version of the FRL calculation, but the second method is more consistent with the method used in the GHG inventory, which is based on measured tree growth data. This point is the main reason for the absolute difference in biomass gains, with a difference of about 5-6 $MtCO_2$/year.

These developments harmonize the FRL projection with the GHG inventory a little more and are an improvement in the representation of forest dynamics by the model.

New results but a persistent discrepancy

The configuration of the model has been changed to make the results as realistic as possible. Nevertheless, there is still a discrepancy in terms of the trend and the level for biomass gains between the historical and projected data for the period 2010-2017. A projection starting in 2000 was also carried out in order to extend the analysis over the 2000-2009 period. Over this period (reference period), the projected biomass gains are more than 10 $MtCO_2$/year lower than historical GHG data. There are numerous assumptions to explain this difference:

- comparison of the results (historic vs. projected) obtained from different national forest inventory samples. These differences necessarily entail a purely statistical discrepancy which has proved to be substantial. In particular, the uncertainty related to sampling, assessed on the basis of historical production data and the projection results (using a "bootstrap" approach) is of the order of ± 4$MtCO_2$/year (see the confidence intervals on the graph below). In projection, an error linked to the effects of modelling forest dynamics parameters would in theory further increase the amplitude of uncertainty around the results.

- the absence of IFN data on the state of forest land in 2000 makes the projections made from this starting point particularly unreliable. In order to make this projection, the initial state in the year 2000 was reconstituted from (1) 2005 national forest inventory data, i.e. only one inventory survey (i.e. not very up-to-date, which makes it less reliable). (2) growth measurements for backward extrapolation of diameters and stump observations to determine the number of harvested trees (these observations are highly imprecise and stamps tend to be overlooked) and (3) by making an approximate assessment of forest expansion on the basis of historical information on the population on inventory plots (this information is difficult to assess and tends to underestimate expansion). This reconstitution, carried out in the absence of more suitable and accurate data, makes the starting point of projections and the results for the 2000-2009 period uncertain.

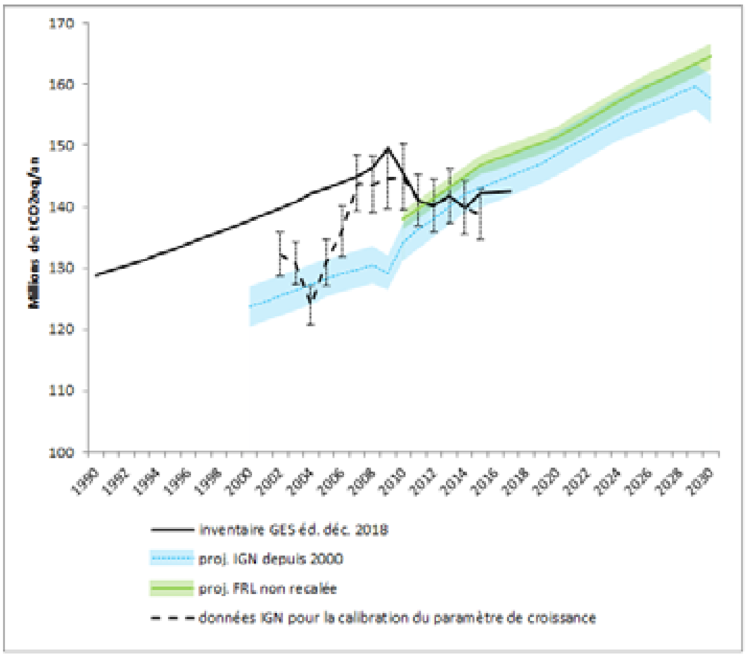
- the historic GHG inventory biomass gains are obtained from national forest inventory production data from 2007 and from interpolations for the period between 1990 and 2007. For its part, the growth parameter of the model is calibrated on the basis of national forest inventory data corresponding to the reference period. These IFN data are slightly different from the greenhouse gas inventory before 2007 (see the diagram below), hence also part of the discrepancy between projected production and historical production as described in the greenhouse gas inventory.

- the forest dynamics parameters of the model (and in particular the growth parameter) represent an average of the production data over the entire reference period. In addition, the projection provides results by 5-year periods which are subsequently annualized. This projection method tends to smooth out the results mechanically and cannot reproduce variations between years.

- in the absence of knowledge of the real changes in forest area by the year 2030, forest expansion was taken into account via a constant area projection as from 2010. By subsequently removing the contribution of recent afforestation, this method can approximate the areas of managed forest land taken into account in the greenhouse gas inventory. However, clear felling which will take place between now and 2030 is not reported (it will be reported in subsequent technical corrections) and the method differs slightly from what is traditionally carried out in the greenhouse gas inventory, where the actual changes in forested areas are known. This might have a slight impact, particularly on the trend towards increasing living biomass on the curve.

- the fact of fixing the strata and the growth parameter over time constrains the assumptions of the model, generating a discrepancy, particularly in the trend of the production curve. Assuming that growth is stable over time for a stratum, a diameter class and a basal area class is an over-simplification of reality and leads to a discrepancy in the projection. Changes in the climate, fertility conditions, changes in species, etc., also play major roles which cannot be taken into account in the current version of the model in the absence of consolidated knowledge, but which certainly tend to reduce actual production. Research work is currently being undertaken to make these assumptions more flexible and the model is not operational for the time being. This would no doubt require some scenario creation.

Differences in terms of gains in living biomass (above-ground + root growth) between projections and historical data from the GHG inventory (in tCO_2eq/year)



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4. Demonstrate how the 2050 carbon neutrality objective will be achieved

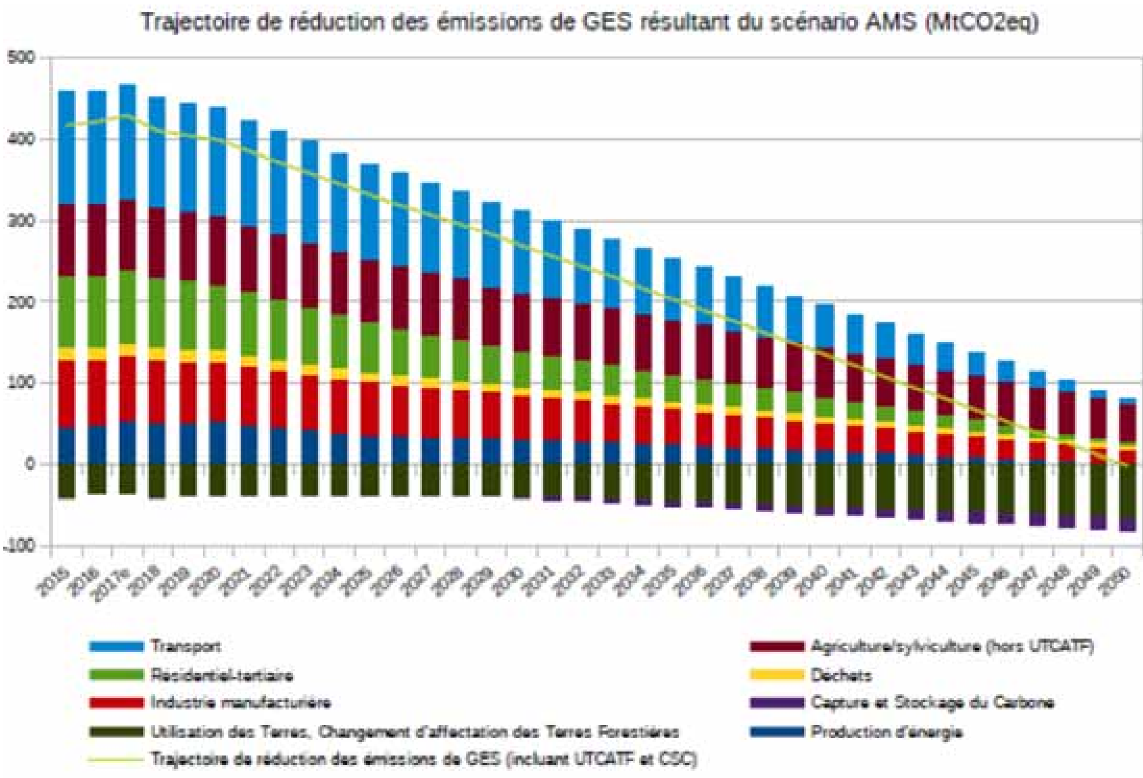
Recommendation	*Demonstrate how the goal of achieving a balance between anthropogenic emissions and removals will be achieved in the second half of the century. Provide qualitative and quantitative information until at least 2050 consistent with the long-term strategy required under Regulation (EU) 2018/1999.*
Item	Ann. IV, A. a)
Change in the FRL calculation	no
Changes in the Accounting plan	Section 2.3.1 of the Accounting Plan has been revised.
Detailed explanations	With regard to achieving carbon neutrality by 2050, as France is planning to do in its national strategy, re-positioning is required from a more overall point of view, broadened to cover all the activity sectors and in compliance with the most recent forecasting exercises.

The target of carbon neutrality by 2050, an ambitious reflection of the carbon neutrality target of the Paris Agreement, has been introduced more recently into French climate policy, in particular with the Climate Plan of 6 July 2017. The 2nd national low-carbon strategy (SNBC 2), a draft of which was made public on 6 December 2018, aims to achieve a target of carbon neutrality by 2050 in France and provides details of the measures and steps planned by the Government for the environmental and inclusive transition required to achieve this target. This draft was submitted in 2019 for the opinion of the Environmental Authority, the High Council for Climate and the Economic, Social and Environmental Council and will be subject to public consultations in early 2020 before it is adopted.

With the Multi-Annual Energy Plan, SNBC 2, the 2nd National Low Carbon Strategy (SNBC 2) constitutes the French integrated national energy and climate plan, a draft of which was presented in February 2019

In the course of work carried out in 2018 on reviewing the National Low Carbon Strategy, France has projected forecast scenarios. The aim of the scenario referred to as “including additional measures” (AMS, Avec mesures supplémentaires) is to comply with France’s self-prescribed energy and climate targets in the short, medium and long term. It outlines a possible trajectory for reducing greenhouse gas emissions until carbon neutrality is achieved by 2050.

This scenario is based on the assumption that greenhouse gas emissions will be reduced dramatically in all sectors (see the diagram and table below). In quantitative terms, the expected emissions reductions from 2015 exceed 90% for the three sectors in transport, construction, the residential/service sector and energy generation. Due to the fact that emissions from the agricultural sector cannot be compressed, the reduction would be the least substantial in this sector (excluding LULUCF).

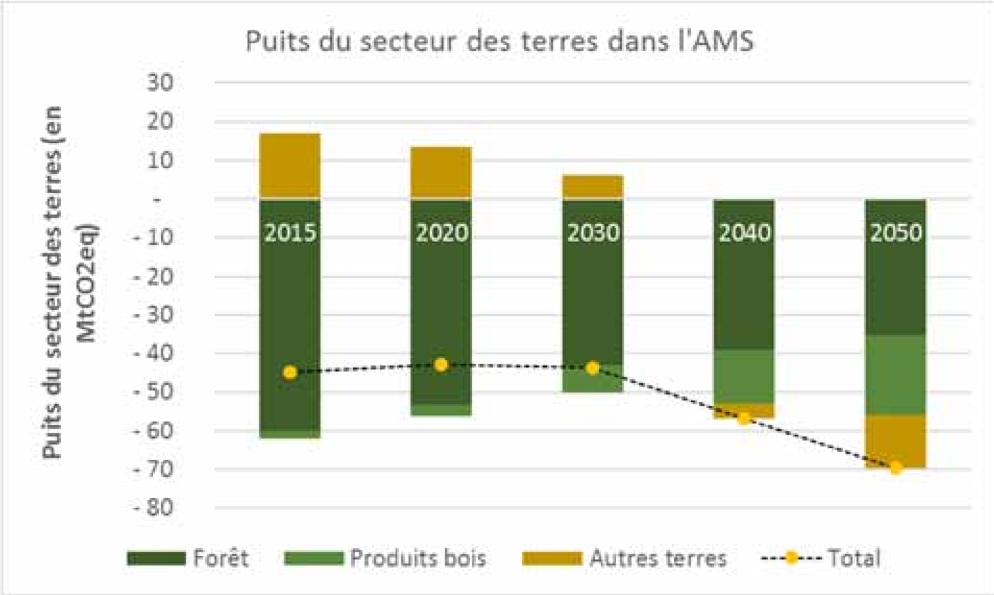


Secteurs	Réduction des émissions par secteur du scénario AMS **par rapport à 2015**
Transports	-97%
Bâtiment	-95%
Agriculture/sylviculture (hors UTCATF)	-46%
Industrie	-81%
Production d'énergie	-95%
Déchets	-66%
Total (hors UTCATF)	-83%
UTCATF	64%

In addition to this emissions reduction, in terms of carbon sinks, the National Low Carbon Strategy 2 seeks to improve the efficiency of the forest-wood sector. Indeed, the latter is strategic because it meets the need to supply the economy with biosourced and renewable energy and products, and at the same time, contributes significantly to the carbon sinks of the land sector through carbon sequestration in forest land and in wood products.

Accordingly, still in the "With Additional Measures" (WAM) scenario, intelligent and sustainable forest management will allow us to progressively increase the carbon pump effect while improving forest resilience to climate risks and better conserving biodiversity. The land area under forests will increase through afforestation. Harvests will rise progressively from 44 Mm^3 in 2015 to 59 Mm^3 in 2030 and 75 Mm^3 in 2050, which will require significant efforts to reverse current trends, notably in private forests. Using wood from forest land as a building material is highly recommended in comparison to using it for energy purposes. The production of wood products with long lifespans (particularly for use in construction) will triple between 2015 and 2050, which will increase the carbon sink of wood products. Downstream, improved collection of wood products at the end of their life will improve recovery of this type of biomass, reducing landfill. Finally, the sink in the forest/wood sector will be maintained despite the current decrease in the forest sink caused by an increase in harvests. This will be achieved through the wood product sink and new forests.

The diagram below shows the changes in the land sector sink as a whole, including forest land as well as other land (crops, grassland, developed land etc.). Forest management should enable us to attain the target of zero net development in 2050 and if we account for the carbon stored in agricultural lands, this sink will rise net between 2030 and 2050, after little change between 2015 and 2030.



The forest management envisaged in the SNBC is more dynamic than the one envisaged in France's FRL, in order, in particular, to renew forest stands by making them more resilient to climate change, by bringing more biosourced materials into the economy taking advantage of the associated effects of temporary storage and replacement of more emitting materials and fossil fuels. It provides better preservation of soils carbon stocks. An increased afforestation and a reduction in deforestation in order to enhance the land sector sink are also considered.

The various guidelines of the new SNBC for forests are not integrated into the management practices used to elaborate the FRL because they are, by definition, subsequent to the 2009 date. All these guidelines however apply to current forestry guidelines.

Finally, the WAM scenario assumes moderate use of carbon capture and storage (CCS) technology to increase the sink. In 2050, the guidelines will avoid around 6 $MtCO_2$/year in industry and to save around ten $MtCO_2$ of emissions annually with energy production installations using biomass.

All of these assumptions will be developed in grant's national integrated energy and climate plan.

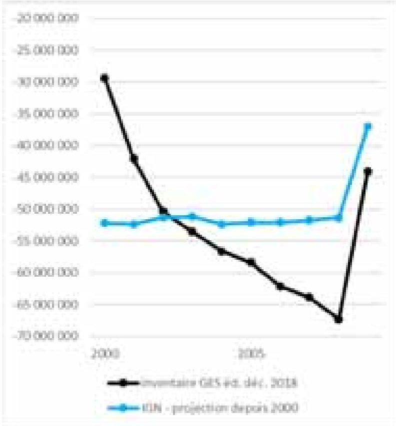
5. Provide the post-2010 data used for the readjustment

Recommendation	*Provide data from the reference period to the dataset used for the ex-post adjustment, since this has an impact on the accuracy of the FRL. As France did not use the entire reference period consistently, additional available data from the reference period to the dataset used for the ex-post adjustment should be used.*
Item	Ann. IV, A. c)
Change in the FRL calculation	yes
Changes in the Accounting plan	The Accounting Plan and the Appendices have been revised.
Detailed explanations	The difference between the model results and the national inventory does not reflect differences in forest management, but reflects the calibration of the model. Accordingly, these two results can be made consistent by readjustment.

Choice of period used for the readjustment

Readjustment is then carried out to bring the results of the projection since 2010 into phase with the greenhouse gas inventory. For this purpose, the readjustment could have been carried out over the periods between 2000 and 2009 or between 2000 and 2017. But over the 2000-2009 period the two curves, having opposite trends, are too inconsistent to be used as a basis for the readjustment (see point 9). At the start of the period, the model results are lower than the inventory results, then higher. Accordingly, the average difference over the period is offset and is now only 1%, while the two curves do not coincide in reality.

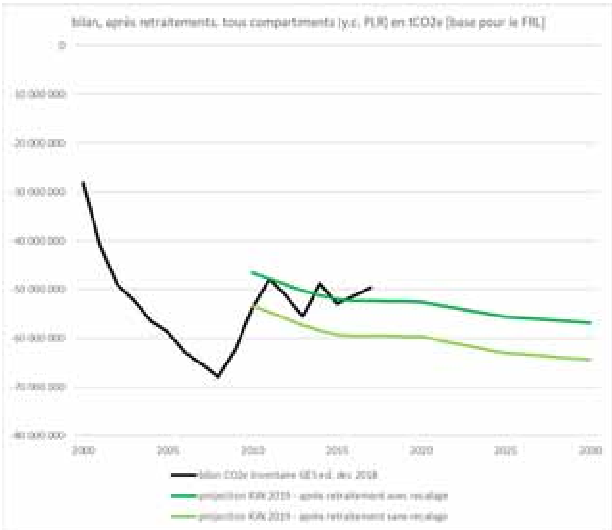
Comparison of the living biomass balance between the projection since 2000 and the inventory (tCO_2/year)



Adjustment on the basis of the average discrepancy over the 2010-2017 period

Accordingly the chosen readjustment was made over the 2010-2017 recovery period.

Comparison of the living biomass balance between the projection since 2010 and the GHG inventory (tCO_2/year)



See the detailed table in the Appendix on the readjustment.

6. Document the ratio between solid biomass use and its use for energy.

Recommendation	*Provide more detailed documentation of data source(s) used for the ratio between solid and energy use of forest biomass.*
Item	Ann. IV, A. e)
Change in the FRL calculation	Yes – the calculation of the ratio has been corrected in the new version of the FRL.
Changes in the Accounting plan	paragraph 1.2.5 of the Accounting Plan has been revised. A table has been appended.
Detailed explanations	The distribution between solid use and use for energy comes from the results of the national GHG inventory. These data are obtained from national statistics. Accordingly, for the reference period, we have data on wood extraction in terms of volume (m3 of wood) and in terms of carbon, distributed according to solid use (lumber and industrial timber) and energy use (firewood). The average ratio between these two uses is calculated for the 2000-2009 reference period. This ratio is then applied to the extraction of wood obtained from the model.

Section 1.2.5 of the NFAP (National Forestry Accounting Plan):

"The distribution between solid use and energy use of wood is based on the average ratio estimated in the GHG national emissions inventory between harvests of Lumber and Industrial Timber (LIT) and Fuelwood (FW) during the reference period (2000-2009). This average ratio observed during the reference period (2000-2009) stands at 58% for solid used and 42% for energy use. This ratio between solid and energy use is then applied directly to the wood harvest projection as from the year 2000. The table in the appendix sets out the historical data and the calculation of this ratio".

NFAP Appendix: Calculation of the ratio between solid use and energy use of wood

		Wood harvest by volume (m3/year)		historical ratio, in %		ratio used for the FRL in %	
		Solid use	Energy use	Solid use	Energy use	Solid use	Energy use
	1990	36,418	24,987	57%	43%		
	1991	35,518	27,304	54%	46%		
	1992	34,355	29,004	52%	48%		
	1993	31,176	29,912	48%	52%		
	1994	34,252	27,935	52%	48%		
	1995	35,458	26,453	55%	45%		
	1996	32,370	26,105	53%	47%		
	1997	33,928	25,902	54%	46%		
	1998	34,540	25,604	55%	45%		
	1999	35,061	24,079	56%	44%		
Reference period	2000	46,121	23,258	65%	35%		
Reference period	2001	39,859	22,568	62%	38%		
Reference period	2002	34,693	21,760	59%	41%		
Reference period	2003	32,264	21,897	57%	43%		
Reference period	2004	33,093	21,914	57%	43%		
Reference period	2005	33,097	22,294	55%	45%		
Reference period	2006	33,471	21,537	56%	44%		
Reference period	2007	34,955	20,496	58%	42%		
Reference period	2008	32,502	20,134	56%	44%		
Reference period	2009	34,792	20,680	58%	42%		
	2010	35,315	22,772	57%	43%	58%	42%
	2011	33,181	23,366	56%	44%	58%	42%
	2012	29,189	24,388	51%	49%	58%	42%
	2013	28,238	23,970	51%	49%	58%	42%
	2014	30,465	24,565	52%	48%	58%	42%
	2015	29,614	24,890	51%	49%	58%	42%
	2016	29,919	26,171	50%	50%	58%	42%
	2017	30,221	27,255	49%	51%	58%	42%
	2018					58%	42%
	2019					58%	42%
	2020					58%	42%
FRL (1)	2021					58%	42%
FRL (1)	2022					58%	42%
FRL (1)	2023					58%	42%
FRL (1)	2024					58%	42%
FRL (1)	2025					58%	42%
FRL (2)	2026					58%	42%
FRL (2)	2027					58%	42%
FRL (2)	2028					58%	42%
FRL (2)	2029					58%	42%
FRL (2)	2030					58%	42%

	Solid use	Energy use	Solid use	Energy use	Solid use	Energy use
2000-2009	35,485	21,654	**58%**	**42%**		
2021-2025					**58%**	**42%**
2026-2030					**58%**	**42%**

National inventory method (NIR ed. 2019):

Calculation of wood extracted from forest land remaining as such (P_FFij) - Mainland France

In the French inventory, it is considered that all wood extraction take place from forest land remaining as such. Wood extraction is therefore not distributed between forest land remaining as such and land turned over to forestry.

"Direct" wood extraction measurement method by IGN

Extraction is first estimated with IGN data: an estimate of wood extracted directly from forest land [202], available in terms of volume (IGN stem wood), total biomass and total carbon (by using volume rates (Vallet, 2006) and specific conversion factors) and over 5-year periods.

IFN methodology: harvest measurement

"To estimate extraction, the IGN re-examines all the "forest" and "poplar plantation" plots listed five years previously and on which living trees had been observed. The choice of the five-year interval corresponds to the period of assessment of

These data have only been available since the methodological update of the 2005 IFN and is therefore available for 5 year periods (2005-2009, 2006-2010, 2007-2011, etc.). They take into account the extracted from forest land between two forest other flows (tree growth and mortality). [...] On points where at least one harvest of less than 5 years is reported, each tree that was alive and listed the previous time is noted as felled or otherwise. A tree is reported as felled regardless of whether the log is removed or not and whether the stump is uprooted or not." [594] inventory surveys and enable assessment with a low level of uncertainty of the volumes of wood harvested in the forest land.

These extraction data relate both to forest land remaining as such and forest land that will ultimately be clear felled. The share of extraction from clear felling (P_Défrichement IGN), accounting for approximately 1.5 Mm3 of stem wood over the years covered, is thus deducted from this overall level of wood extraction from forest land. In this way biomass loss is not double-counted with the loss due to clear felling.

Equation 1 *(Forest land)*

P_Forest_IGN = P_Total_IGN - P_Clear felling_IGN

With:

P_Forest_IGN	= Extraction from forest land, tC/year
P_Total_IGN	= Extraction from forest land and clear-felled land according to IGN, tC/year
P_Clear felling_IGN	= Extraction from clear-felled land according to IGN, t C/year

This overall level of extraction (P_Forest_IGN) is used in addition to statistical data on wood extraction obtained via the "model" method (§ 2.3.3.1.2). These IGN data are only used as calibration data to set the overall level of extraction for all the years available since 2005 for each of the 5 inter-regions (§2.2.2.2). This general level is calculated with a weighted average, taking into account the fact that the years in the middle of the five-year periods are considered in the calculation of several five-year periods and therefore "weigh" more than the years at the ends. These data are therefore not yet used to estimate the trend in wood extraction from forest land or to estimate the type of forest land on which extraction takes place.

"Model" method - general approach

Secondly, the annual extraction level is estimated from various statistics on the basis of the sale of lumber and firewood consumption, using a model that estimates the wood extracted and its destination. This "model" approach is then readjusted to the general extraction level measured in forest land using the "direct" method (§ 2.3.2.3.1.2). The model approach is still required because it estimates extraction that has taken place since 1990 and it can be used to predict what happens to the extracted timber (whether it is harvested, burned on site or left to decompose), the direct method serving as a reference value for the most recent years. Extraction from forest land reported in the LULUCF inventory is therefore consistent with the IGN results obtained by the "direct" method, but the "model" method must be kept in order to have consistent data for the entire inventory period and data appropriate for reporting in the emission inventories. The "model" method corresponds to the IPCC method for estimating extraction.

Equation 2 *(Forest land) (inspired by IPCC equation 2.12 of 2006 [672])*

$L_{wood\text{-}removals} = H \bullet D \bullet BEF_R \bullet (1+R) \bullet CF$

With:

$L_{wood\text{-}removals}$	=	Annual carbon loss due to commercial timber extraction, tC/year
H	=	Volume of commercial wood extracted annually, m^3/year
D	=	Wood density, t MS/m^3
BEF_R	=	Expansion factor applicable to harvested volumes, no units
R	=	root/above-ground biomass ratio, no units
f_{BL}	=	fraction left to decompose
CF	=	Carbon fraction of the dry matter, t C/t DM

Equation 3 *(Forest land) (inspired by IPCC equation 2.13 of 2006 [672])*

$L_{firewood} = FG \bullet D \bullet BEF_R \bullet (1+R) \bullet CF$

With:

Fuelwood	=	Annual carbon loss due to firewood extraction, tC/year
FG	=	Volume of firewood extracted annually, m^3/year
D	=	Wood density, t MS/m^3
BEF_R	=	Expansion factor applicable to harvested volumes, no units
R	=	root/above-ground biomass ratio, no units
CF	=	Carbon fraction of the dry matter, t C/t DM

The "model" method is based on estimation of two values: commercial extraction (mainly lumber and industrial timber) and non-commercial extraction (mainly firewood).

"Model" method - Commercial extraction - Lumber and industrial timber

Commercial extraction is derived from sales statistics for lumber and industrial timber. In mainland France, the annual branch survey (EAB) on "logging and sawmill operations" from the SSP (Office of Statistics and Forecasting) provides the volumes of commercial timber extraction on a regional scale [200].

"Model" method - Non-commercial extraction - Fuelwood

This is essentially **firewood** extraction, (i.e. part of fuelwood extraction), which must be specifically estimated, although it is difficult to assess the volumes passing through this sector due to the diffuse nature of the activity.

Use of the energy balance sheet.

The use of biomass consumption balance sheets for energy purposes (residential, service sector, district heating, industry, etc.) provides a realistic estimate of the volumes extracted. Accordingly, the overall consumption of fuelwood is provided by the SOeS [1] but these data must be adapted to estimate fuelwood extraction from forest land.

Cutting down on fuelwood from recycled wood products

First of all, some of the wood used as firewood comes from the second life of commercial timber (e.g. burning a wooden table). An estimate of the recycling rate of wood products is therefore taken into account so as to avoid double counting. This rate is estimated at 5% of the fuelwood consumed in the residential sector on the basis of a study carried out in 2000 for ADEME [596].

Distinction between firewood from forest land and of other origins

The Andersen study (1999) [596] also estimates that 70% of the firewood consumed by households comes from forest land, the remaining 25% representing extraction from another resource (agriculture, etc.). Combined with results from INESTENE [201], it was possible to break down the quantities according to their origin (forest land, groves or hedges, orchards and vines) by region [493].

Cutting down fuelwood consumed in industry from related sawmill products

In the energy balance sheet, the following distinction is then made for fuelwood consumed in industry:

- a majority proportion, corresponding to related sawmill products (bark, sawdust, shavings, sawmill chips, etc.). It is considered that all fuelwood consumed in industry came from this source until 2007. This wood is therefore not deducted from the forest land extraction figure to avoid double counting.

- a share corresponding to wood extraction from forest land, which corresponds to surplus fuelwood consumption in industry observed since 2007, due to the increasing use of forest chips.

Correction of the time delay effect between firewood extraction and consumption

Finally, there is a discrepancy between the consumption of wood in residential sector and its extraction from forest land. On average, we consider that fuelwood is kept between 2 and 3 years

Method (not applied) to estimate wood extraction taking this discrepancy into account

The firewood extracted in year i could be estimated on the basis of the firewood consumption of the following years, using the following equation:

Equation 4 *(Forest land)*

$$Extraction\_BE_{(i)} = (Frac_1 \bullet Conso\_BE_{(i+2)} + Frac_2 \bullet Conso\_BE_{(i+3)}) \bullet VCF$$

With:

Extraction_BE(i)	=	Fuelwood extracted in year i, m3
Frac1	=	Share of consumption in year i + 2 corresponding to wood extracted in year i
Frac2	=	Share of consumption in year i + 3 corresponding to wood extracted in year i
Conso_BE(i+2)	=	consumption of fuelwood for year i+2, TOE (tonne of oil equivalent)
$Conso\_BE_{(i+3)}$	=	consumption of fuelwood for year i+3, TOE
VCF	=	Volume conversion factor, m^3/toe

Unfortunately, it is impossible for loggers to predict how much fuelwood will be consumed in future i + 2 or i + 3 years, so this method does not provide a reliable estimate of the fuelwood extracted. Another approach was therefore prioritized.

It was assumed that logging operators build up stocks to provide for two successive years with very high wood consumption. These stocks therefore allow them to meet the demand for wood and to replenish it according to consumption during the current year and the previous year. It was thus estimated that annual fuelwood extraction could be approached by averaging the last two years of fuelwood consumption.

Equation 5 *(Forest land)*

$$Extraction\_BE_{(i)} = (Conso\_BE_{(i)} + Conso\_BE_{(i-1)}) / 2 \bullet VCF$$

With:

$Harvest\_BE_{(i)}$	=	Fuelwood extracted in year i
$Conso\_BE_{(i)}$	=	consumption of fuelwood for year i
$Conso\_BE_{(i-1)}$	=	consumption of fuelwood for year i-1
VCF	=	Volume conversion factor, m^3/toe

In the current inventory, the volume conversion factor (VCF) is estimated at 4.5 m^3/toe based on the following fuelwood estimates: 18GJ/t and 0.147 toe/cubic metre and an average density factor of 0.51 t/m3 obtained from CARBOFOR [204]. For industry, wood consumption is assumed to be essentially composed of by-products from the wood industry (already taken into account in wood extraction (logs and industrial timber) except in recent years for which the development of fuelwood generates additional extraction from the resource.

- lumber and fuelwood extraction are not independent (some of the trees felled to produce lumber or industrial timber go into fuelwood)
- wood extraction statistics do not differentiate between wood extracted from forest land or from clear-felled land,
- fuelwood consumption statistics do not distinguish the source of the fuelwood consumed.

Table 2: Extraction of timber and fuelwood in mainland France since 1990.

rapportageUTCATF.xls /OMINEA

YEAR	LUMBER (deciduous) (1000 m³)	LUMBER (softwood) (1000 m³)	INDUSTRIAL TIMBER (deciduous) (1000 m³)	INDUSTRIAL TIMBER (softwood) (1000 m³)	FUELWOOD (ktoe)
1990	10,156	15,260	5194	5808	7965
1991	9724	14,077	5435	6283	8452
1992	9043	13,340	5459	6513	9231
1993	8033	12,509	4732	5901	9356
1994	8131	13,767	5479	6876	8807
1995	8290	14,374	5523	7271	8155
1996	7771	13,649	4820	6130	8100
1997	7845	14,245	5342	6495	8237
1998	7863	15,107	5228	6342	7899
1999	7952	15,240	5366	6503	7544
2000	9598	22,619	5342	8561	7245
2001	7642	18,952	4788	8477	6981
2002	6002	16,631	4913	7146	6826
2003	5719	15,120	5142	6283	6726
2004	5671	15,240	5355	6826	6851
2005	6076	14,803	5413	6805	6948
2006	5854	15,633	5166	6818	6977
2007	6343	16,427	5344	6840	6606
2008	6086	15,048	4983	6384	6677
2009	5228	17,216	4,113	8235	6863
2010	5164	15,922	4411	9819	7514
2011	5479	15,427	4418	7857	7717
2012	4924	13,216	4636	6414	7328
2013	4809	13,624	4089	5716	7791
2014	5209	14,135	4726	6395	8195
2015	5127	13,785	4663	6039	7892
2016	5393	13,696	4615	6215	8200
2017	5304	14,127	4584	6206	8768

Extraction is estimated by the "model" method with the following equation.

Equation 6 *(Forest land)*

P_model_i = $Extraction\_SSP_i$ ● BEF + extraction_ $BE_{(i)}$ ● (1- %excluding_forest – %tree crowns) ● BEF_BE - R_ Clear felling_$Model_i$

Where:

P_model_i = Wood extraction for year i estimated by the " model " method

Extraction_SSPi = Commercial timber extraction estimated by the SSP for year i

BEF = Biomass expansion factor that can be applied to timber extraction

$Harvest\_BE_{(i)}$ = Fuelwood extraction estimated for year i

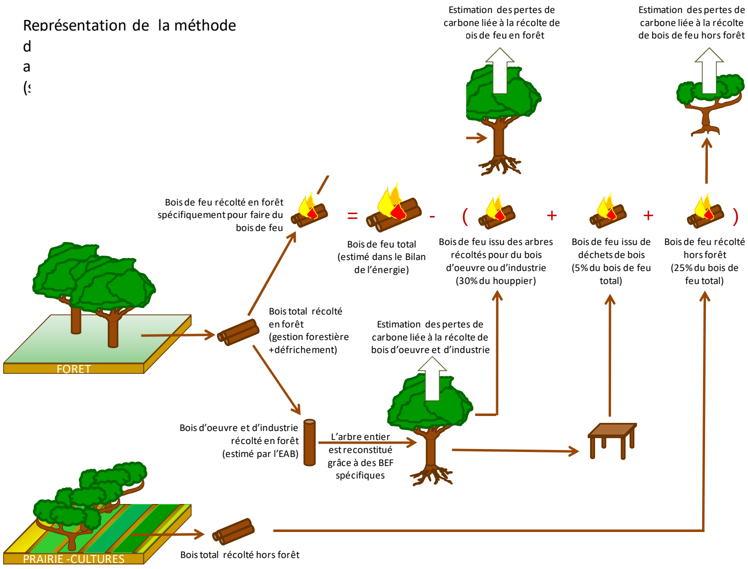
%excluding_forest = Fuelwood extraction from forest land

%tree crowns = Share of tree crowns used for fuelwood

BEF_BE = Biomass expansion factor that can be applied to fuelwood extraction

R_ Clear felling_$Model_i$ = Wood extraction estimated for year i from clear felled land using the method based on land use change matrices

Figure6: Diagrammatic representation of the method (called "model") for estimating emissions related to wood extraction)



"Model" method - wood expansion and conversion factors

For the results produced by the IGN, total biomass volumes are obtained by volume rates [595], i.e. equations which can be applied to the characteristics of each tree (species, circumference, height). In the "model" method, it is impossible to use these volume rates. The IPCC therefore proposes the use of biomass expansion factors (BEF). Unfortunately, these BEFs are very difficult to apply outside their own study area. For this reason, in the "model" method, the BEFs used are those specific to French forest land, calculated on the basis of the standing resource and the volume rates used by the IGN. The factors currently used in the inventory are provided by the IGN and are very close to the results available in the CARBOFOR report [204].

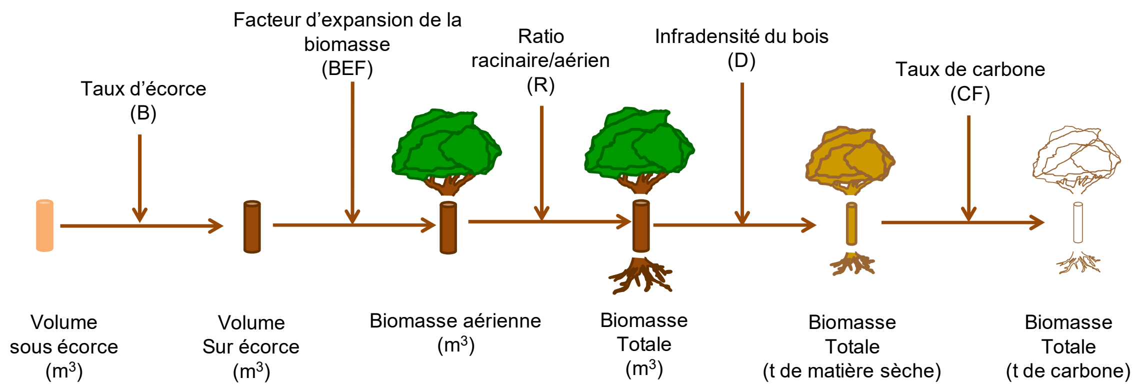
Table 3: Expansion factors used for timber extraction

	PURELY DECIDUOUS	MIXED	PURELY CONIFEROUS	POPLAR
CENTRE-EAST	1.65	1.45	1.27	1.42
NORTH-EAST	1.56	1.47	1.25	1.42
NORTH-WEST	1.59	1.53	1.30	1.42
SOUTH-EAST	1.94	1.62	1.39	1.42
SOUTH-WEST	1.66	1.52	1.31	1.42
FRANCE	**1.63**	**1.50**	**1.30**	1.42

Several classes are also identified for the underground expansion factors. The values of 1.28 and 1.30 were used respectively for old hardwood and conifer stands and the values of 1.48 and 1.37 for young hardwood and conifer stands [204].

In the case of firewood, since the composition of the species harvested is unknown, the expansion factors used are a weighted average value of the expansion factors for hardwoods and conifers. These values vary substantially depending on the year and are approximately equivalent to 1.5 for the branch expansion factor and 1.29 for the root expansion factor. The same applies to the infra-density value.

Figure 7: Conversion of volumes of sold wood into carbon



Biomass infra-density data are specific to each species, both for estimating growth and for extraction.

Table 4: Infra-density used for the main species [598]

Species	Density tMS/m³	Species	Density tMS/m³
oak	0.56	fir, spruce	0.38
beech	0.56	douglas fir	0.41

sweet chestnut	0.50	maritime pine	0.44
poplar	0.36	scots pine	0.43

The work carried out under the CARBOFOR project has also made it possible to adopt a value for the carbon content of wood biomass that is more appropriate to the French case. The value adopted in the inventories is 0.475, very close to the value of 0.47 used by default by IPCC in 2006.

Combination of the "model" approach and the "direct" approach

There are therefore two method for estimating extraction from forest land: the "model" method based on the 2006 IPCC guidelines and the "direct" method of measuring extraction by the IGN. These two method are combined in the current GHG inventory and extraction is estimated using the following equation.

Equation 7 (Forest land)

$Extraction_i = P\_model_i \bullet P\_Forest\_IGN_{2005/20xx} / P\_model_{2005/20xx}$

Where:

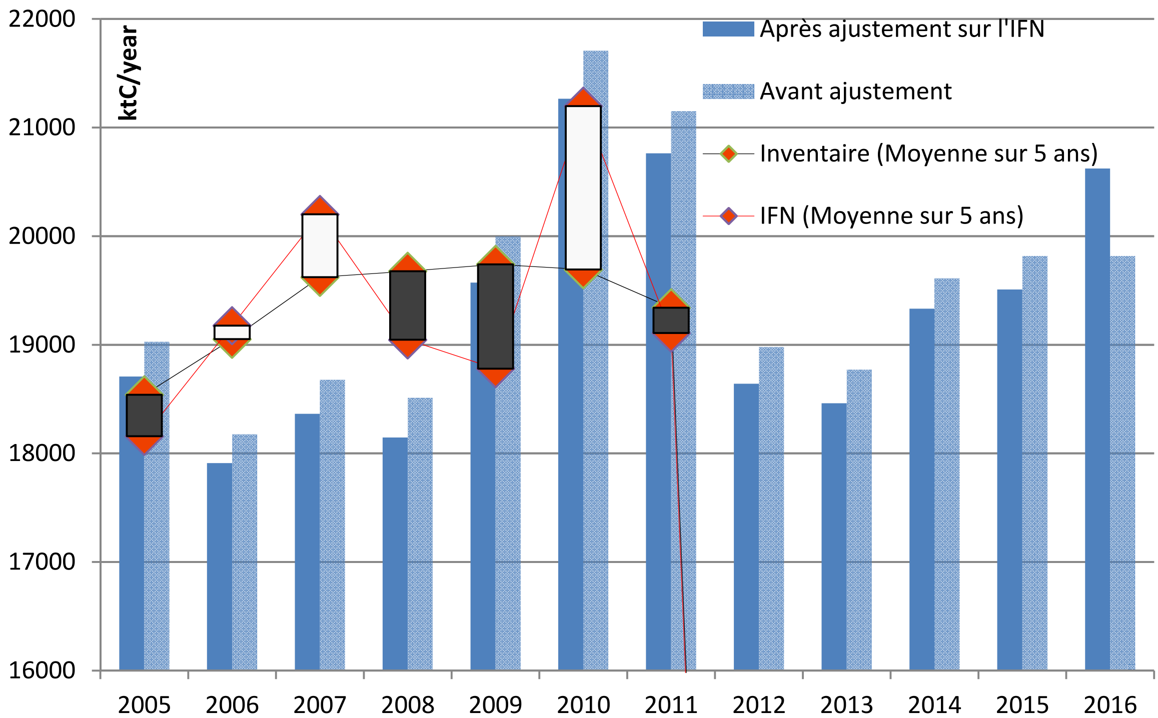
$Extraction_i$ = Wood extraction for year i

P_model_i = Wood extraction estimated for year i from commercial timber data and fuelwood consumption

$P\_Forest\_IGN_{2005/20xx}$ = Wood extraction over the period 2005-20xx by the IGN direct method

$P\_model_{2005/20xx}$ = Wood extraction over the 2005-20xx period from commercial timber data and fuelwood consumption

Figure 8: Representation of the adjustment on the basis of direct extraction data obtained from the IFN



Equation 8 (Forest land)

$P\_FF_{ij} = Extraction_{ij}$

Where:

P_FF_{ij} = Estimated wood extraction from forest land that remains as such, by forest type (i = 1 to n) and by climatic zone (j = 1 to m)

$Extraction_{ij}$ = Estimated wood extraction by forest type (i = 1 to n) and by climatic zone (j = 1 to m)

7. Demonstrate the consistency between the projections and the FRL

Recommendation	*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*

Item	Ann. IV, A. g)
Change in the FRL calculation	no
Changes in the Accounting plan	the Accounting Plan has been revised.
Detailed explanations	

Methodological consistency

From a methodological point of view, the calculation of projections established in the framework of EU Regulation Nº 525/2013 differs substantially from the calculation of a forest reference level established in the framework of EU Regulation Nº 2018/841. The FRL is based on a forestry model. The projections are not based on the results of a forestry model but on the assumptions of experts regarding changes in the forest, forestry practices and the scenarios.

GHG emissions and absorption projections made under EU Regulation Nº 525/2013 are produced according to two scenarios: with existing measurements and with additional measurements. In both cases the proportion of forest land (different scope from that used for the FRL, which only relates forest remaining as such) is projected up to 2035 on the basis of a known starting point in 2015. Accordingly, this starting point is different from that of the FRL (2010).

No forestry model has been used for calculating the projections. By contrast, the baseline data used for the projections and for the FRL are the same: IGN growth, death and sampling data.

Consistency of results

In developing forecasts of the reliable assumptions, it has been assumed in particular that gross production and mortality would be stable until 2035. With this choice, it is possible to focus on the effects of harvesting practices. As part of the work on the FRL, the model used by IGN gives a combined increase in gross production and mortality over the period modelled until 2030. Production and mortality dynamics remain uncertain, as they are highly dependent on meteorological conditions that have not been modelled for the purposes of this work. To a large extent, this choice explains the trend towards a reduction in the sink in the predictions, while the sink continues to grow in the FRL.

Subsequently, policies aimed at increasing forest harvests are included in the projection scenario with existing measures. This is not the case for the FRL, in which forestry practices are those observed over the 2000-2009 period. Consequently, the increased harvests taken into account in the projections is higher than the harvests modelled in the FRA.

8. Use the managed forest land surface area as indicated in Annex IV, Part B (e) i.

Recommendation	*Estimate the FRL based on the area under forest management as indicated in Annex IV, Part B (e) i. [The total area of managed forest land included under the accounting category (as defined in Art 2(1) of the LULUCF Regulation) must be consistent with the latest national GHG inventory. Member States may choose to provide a dynamic development of managed forest land area taking into account afforested and deforested land moving between accounting categories during the compliance period]*
Item	Ann. IV, A. h)
Change in the FRL calculation	no
Changes in the Accounting plan	Section 3.2.2 of the Accounting Plan has been completed.
Detailed explanations	*Section 3.1.1 of the NFAP:*

"The FRL is calculated for managed forest land only. For France, forest land is managed according to the UNFCCC definition when it is subject to forest management operations aimed at providing its environmental, economic and social functions. The term, "forest management operation" covers felling or forestry work but also forestry planning, providing visitor access to forest land and protection of the forest ecosystems. Only forest land that is subject exclusively to natural processes, in particular due to limited accessibility, is considered as unmanaged. Such unmanaged forest land is estimated from the surface areas of "other forest land" defined by the IGN which represents approximately 5% of forest land areas in mainland France.

The FRL of mainland France is estimated on the basis of a changing surface area, taking into account afforestation occurring during the reference period (2000-2009) which results in an increase in the forest area, these afforested areas of over 20 years old being gradually added each year during the periods from 2021 to 2030. This changing surface area does not include any cases of deforestation, which will be included later by correction as soon as they become known."

Section 3.2.2 of the NFAP:

"The national forest inventory provides an estimate of the forest land area available for wood production at the beginning of 2010. This area includes afforestation of less than 20 years old, which does not meet the UNFCCC definition of managed forest land. For calculation of the FRL, since the projections are made including all the stands of 2010, without any increase or decrease in the forest area, it is necessary to exclude from the 2020 area, afforestation which was less than 10 years old in 2010, from that of 2025 afforestation which was less than 5 years old in 2010, and none for the 2030 area. Specific processing aimed at excluding young afforestation of less than 20 years old from the projected carbon sink has been established.

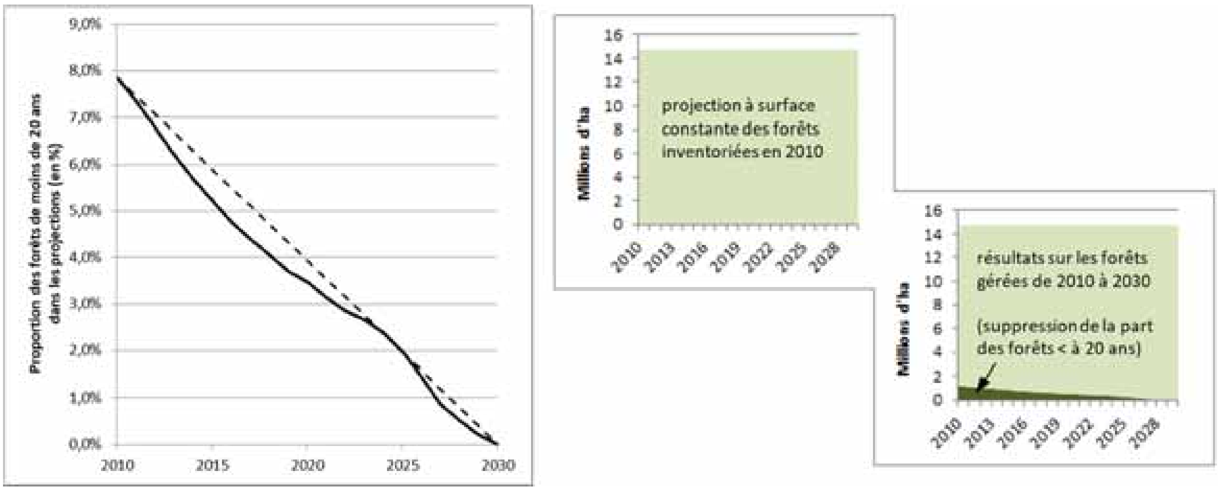


Figure9: Contribution of forests less than 20 years old to the calculation of the projections

The land use annual survey by the Ministry in charge of agriculture (Teruti-Lucas survey) provides information about the situation of forest areas distinguishing afforestation, forest clearance and forest land remaining as such. This matrix can be used to find out the proportion of afforestation of less than 20 years old in 2010, i.e. all the afforestation which has occurred since 1990, in the Teruti-Lucas 2010 forested area. Young afforestation thus represented 7.9% of the area in 2010.

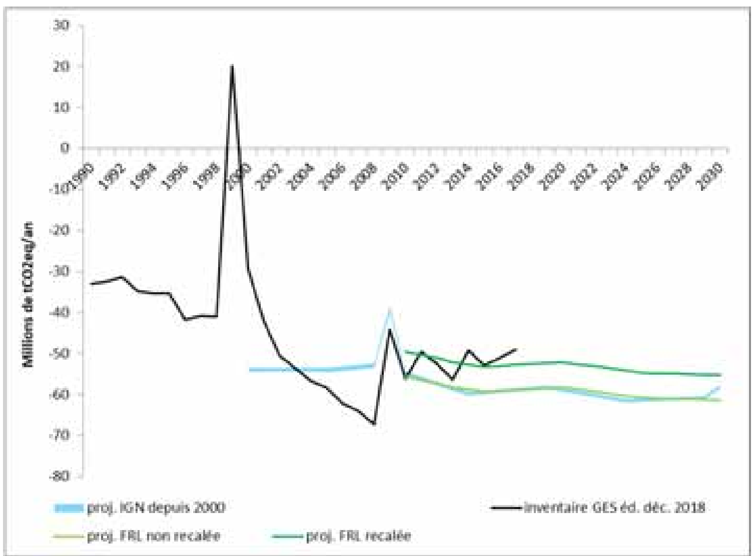
The Teruti-Lucas matrix also shows changes to forested areas for all the years between 1990 and 2010. The annual surface area of incorporation of afforestation in the category of managed forest land can be derived from it. The solid line on the left-hand graph shows the decline in the surface pool of young afforestation over time.

The contribution of this young afforestation to the CO_2 sink in living biomass is estimated according to the method defined by CITEPA for the France's UNFCCC inventory. The difference between the production per hectare of young afforestation and that of managed forest land is considered stable over the entire period. Given this difference and the annual proportion of young afforestation, it is possible to calculate the contribution of this afforestation to total annual production. This contribution of forest land of less than 20 years old at year X is finally subtracted from the total carbon gain projected for this same year X. Concerning carbon losses, the same method is applied for mortality; however, the share of recently afforested areas in harvest figures is considered to be zero in France's GHG inventory (no felling in this type of stand).

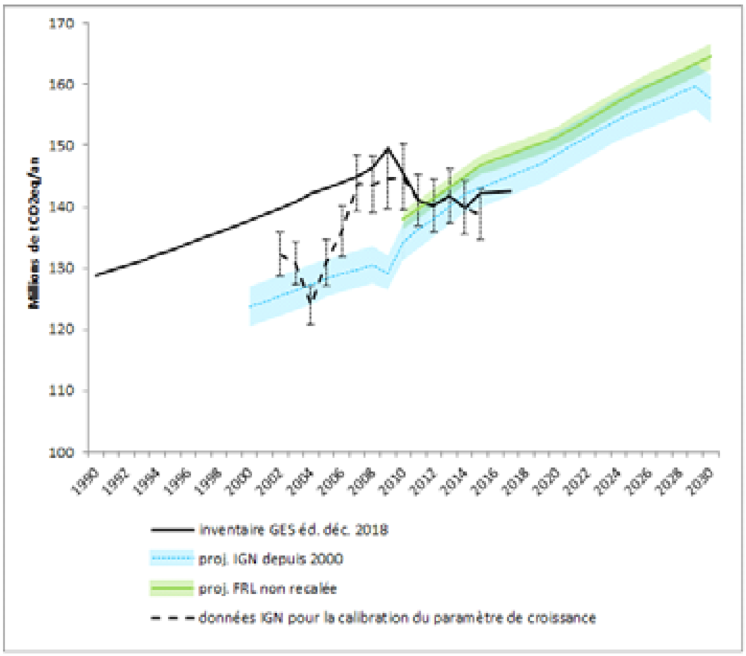
9. Demonstrate the capacity of the model to reproduce the historical GHG inventory

Recommendation	Demonstrate the ability of the model used to construct the FRL to reproduce historical data from the national GHG inventory.
Item	Ann. IV, A. h)
Change in the FRL calculation	no
Changes in the Accounting plan	paragraph 4.2 of the Accounting Plan has been revised.
Detailed explanations	In order to assess the "capacity of the model to reproduce the historical GHG inventory data over the reference period", a reconstruction of the state of affairs in 2000 (unreliable estimate) followed by a projection based on this date were carried out. If the projection gives an average forest sink roughly equivalent to the historic sink over the 2000-2009 period, this average masks any disagreements on the trends in sink development and on the contribution of the various phenomena (growth, mortality, extraction) to this sink in the living biomass.

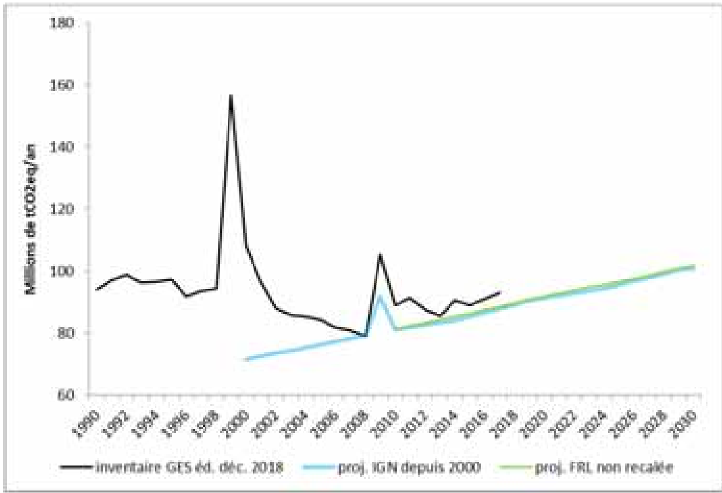
Projected and historic living biomass balance (tCO2eq/year)



Projected and historic gains in living biomass (growth) (tCO2eq/year)



Projected and historic living biomass losses (extraction and mortality) (tCO_2eq/year)



More specifically, the projected gains in living biomass are more than 10MtCO_2/year less than those in the historic GHG inventory between 2000-2009. The causes of this deviation are described in point 3 of this document.

Some of these reasons for the discrepancy are also valid for losses in living biomass (due to mortality and extraction). In particular, the uncertainty related to the use of data obtained from statistical sampling, the unreliability of reconstitution from the starting point in 2000 and the smoothing out of the product by the projection, which works in 5-year periods, are equally important in the discrepancy between projected and historical loss data. Added to these reasons are:

- storms Lothar and Martin in December 1999 were not taken into account. These storms had a major effect on extraction dynamics in the years following the storms (2000 to 2002) with additional harvests arising from this exceptional crisis that increased losses in living biomass. The effect of these storms was not taken into account in the simulation, as the latter is based on a starting point after the storms and the baseline scenario applied to it is calculated without these years. For storm Klaus, exceptional extraction was simulated for year 2009 of the projection, starting from 2000 only.

- operation of the extraction parameter expressed as a rate in the model. The baseline scenario is expressed in the projection in the form of an extraction rate dependent on the stock. Although standing timber stocks increased over the 2000-2009 period, the observed volumes harvested diminished slightly as the felling was not only related to the available timber stock. Applying a scenario in the form of a fixed extraction rate does not therefore enable the trend in the fluctuation of extraction over the 2000-2009 period to be reproduced.

10. Demonstrate the consistency between the historic and the FRL data

Recommendation	*Demonstrate the consistency between historical data from the national GHG inventory and modelled data for estimating the FRL for the reference period.*
Item	Ann. IV, A. h)
Change in the FRL calculation	no
Changes in the Accounting plan	paragraph 4.2 of the Accounting Plan has been revised.
Detailed explanations	An analysis of the consistency between historical and projected data is provided in points 3 and 10 of this document. The proximity of the curves from the projection based on the 2000 starting point and that used for the FRL since the 2010 starting point makes the analysis valid for both projections.

11. Consistency in terms of carbon pool accounting

Recommendation	*Ensure consistent modelling of carbon pools, in particular across the time series and between Mainland France and Outermost regions.*
Item	Ann. IV, B. b)
Change in the FRL calculation	no
Changes in the Accounting plan	The Accounting Plan has been revised.
Detailed explanations	***Overall harmonization with regard to the consistency between carbon pools***

The approach of reporting implementation for the FRL calculation applies the same rules and assumption as the national greenhouse gas inventory. Carbon flows are reported for each carbon pool without double counting:

Living biomass: growth, background mortality, exceptional mortality (due to storms and forest fires), extraction (wood harvests and extraction losses).

Dead wood: exceptional gains due to windblow (on the year of the storm); exceptional losses due to decomposition of windblow (losses spread out over several years).

Litter and soil: neutrality assumption: balance between losses and gains.

Wood products: gains due to wood harvests and losses due to the end of life of the products.

Overall harmonization with regard to the consistency with which carbon pools are treated between Mainland France and the Outermost regions.

For Outermost regions, the assumption in the inventory, supported by experts and the scientific literature, concerns the neutrality of living biomass, dead wood, litter and soils in forest land that remains as such; with the exception of exceptional losses linked to forest fires and to burning extraction site-products; phenomena in which gases other than CO_2 are also emitted.

Extract from NIR 2019:

In the French outermost regions (Kyoto zone), similar results have not been obtained from Forest inventories due to the low level of forest extraction and the type of forest. Accordingly, estimates have been produced on the basis of default IPCC data on forest growth. These results show growth in excess of the losses in all territories. Accordingly, it has been chosen in a conservative manner, retaining a forest biomass stability assumption in these areas and assuming that growth merely offsets harvests and does not generate any additional sink.

This neutrality assumption is based on the expert knowledge of Guitet et al. (2006) [328]. Accordingly, growth is estimated indirectly on the basis of the extraction rate and amounts to 0.02tC/ha (above-ground and root biomass). For land that was afforested less than 20 years ago, a value of 1tC/ha has been used as in mainland France, consistently with Guitet et al. 2006 (post-harvest growth value between 1.5tC and 2tC/ha).

Uncertainties over the role of the sink in forest land in French Guiana

The carbon balance of the Amazon forest ecosystem is uncertain. A number of studies tend to show that the Amazon rain forest in general could play the role of a sink, while others show that it may rather be a source. These results depend on numerous parameters (scope, measurement or estimation, region, sampling, period, etc.).

Taking into account increased mortality phenomena linked to precipitation and climate variations and to forest degradation (beyond deforestation) results in estimates that occasionally cast doubt on the role of the Amazon rainforest as a carbon sink. On a global level, using satellite measurements coupled with field data, Baccini et al. (2017) concluded that tropical forest areas might to a small extent constitute a source, not a sink. Growth is not offsetting deforestation, nor degradation and disturbance (69% of losses).

Analysis of historical forestry data show that although Amazonia has a role as a carbon sink, a trend towards a decline in this accumulation has been observed in the long term (Brienen et al., 2015). The above-ground biomass growth rate has diminished by 2/3 between the 1990s and the 2010s. Recently there has been observable stagnation (levelling-off) in growth, while mortality has continued to increase.

According to Philips and Brienen (2017), the Amazon rainforest still represents a sink, although this role has diminished since the 2000s. In French Guiana, this sink is large enough to offset all generated emissions, including those due to deforestation and changes in land occupation. The forests of French Guiana are not necessarily as sensitive to increase mortality as those in the rest of the Amazon region. This sensitivity is still correlated to the amount of above-ground biomass present (Johnson et al. 2016).

12. Provide results tables

Recommendation	*Provide complete data on historical and projected extraction levels. Provide a more detailed description of sustainable forest management practices used in the determination of the FRL.*
Item	Ann. IV, B. c)
Change in the FRL calculation	no
Changes in the Accounting plan	The tables and graphs in the Appendix have been added to the Accounting Plan.
Detailed explanations	The tables provided in the Appendix set out detailed information for each carbon pool, flow and year and in terms of CO_2e. The same information is provided both for the historical GHG inventory (1990-2017) and for the projection (2010-2030).

13. Provide detailed information on forest land areas

Recommendation	*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. Provide more complete information regarding managed and unmanaged forest area to guarantee that the same information is used for the FRL and the national GHG inventory.*
Item	Ann.
Change in the FRL calculation	no
Changes in the Accounting plan	Section 3.2.2 has been completed and a table shows the surface area data.

		Non-managed forest (unavailable for wood supply)	**Managed forest (in the meaning of the UNFCCC, taken into account in the FRL)**	Afforestation less than 20 years ago	Forest land becoming non-forest land
National GHG inventory ed. dec. 2018 for metropolitan France only *	2000	761 873 ha	**13 413 124 ha**	1 213 478 ha	733 718 ha
	2001	761 873 ha	**13 422 079 ha**	1 225 938 ha	728 614 ha
	2002	761 873 ha	**13 431 471 ha**	1 230 535 ha	723 104 ha
	2003	761 873 ha	**13 447 249 ha**	1 220 304 ha	711 241 ha
	2004	761 873 ha	**13 483 619 ha**	1 197 340 ha	697 201 ha
	2005	761 873 ha	**13 488 185 ha**	1 214 210 ha	704 652 ha
	2006	761 873 ha	**13 487 371 ha**	1 244 308 ha	713 530 ha
	2007	761 873 ha	**13 471 799 ha**	1 298 230 ha	732 586 ha
	2008	761 873 ha	**13 467 855 ha**	1 294 220 ha	751 020 ha
	2009	761 873 ha	**13 480 715 ha**	1 277 447 ha	763 291 ha
	2010	761 873 ha	**13 517 020 ha**	1 237 771 ha	760 942 ha
Projection for metropolitan France only	2011		**13 590 524 ha**		
	2012		**13,675,213 ha**		
	2013		**13,764,056 ha**		
	2014		**13,847,257 ha**		
	2015		**13,918,569 ha**		
	2016		**13,989,221 ha**		
	2017		**14,044,367 ha**		
	2018	Not estimated in the projection	**14,097,799 ha**	Only the proportion of afforestation prior to 2010 was estimated to deduct it from the projection (afforestation appearing between 2010 and 2030 is not estimated)	Not estimated in the projection
	2019		**14,153,973 ha**		
	2020		**14,190,274 ha**		
	2021		**14,241,227 ha**		
	2022		**14,284,451 ha**		
	2023		**14,312,971 ha**		
	2024		**14,359,129 ha**		
	2025		**14,422,053 ha**		
	2026		**14,500,655 ha**		

2027	14,594,346 ha
2028	14,645,784 ha
2029	14,693,461 ha
2030	14,726,526 ha

* In 2010 managed forest (in the meaning of the UNFCC, taken into account in the FRL) represents 8 183 858 ha in outermost regions included in the UE.

The paragraphs below have been added in order to specify the areas considered in outermost Regions.

3.2.2.2 French outermost Regions

In outermost Regions (Guyana, Guadeloupe, Martinique, Reunion, Mayotte), all the area is considered as managed with regards to the UNFCCC definition. In 2010, the total "forest remaining forest" area in outermost regions considered in the NFAP is 8 183 858 ha, amongst which the French Guiana "forest remaining forest" area represents 7 982 688 ha.

3.2.2.3 Surface area covered by managed forests in total

In 2010, the managed "forest remaining forest" area used in the NFAP is 21 700 878 ha. It corresponds to the area reported under the national GHG inventory to the UNFCCC on the Kyoto Protocol perimeter, e.g. mainland France and the outermost regions (which correspond to the part of France included in the EU).

Unmanaged areas are not considered in the NFAP and they are not considered as areas associated with emissions in the GHG inventory reporting.

Forest areas in overseas territories that are not part of the EU (New Caledonia, French Polynesia, French Southern and Antarctic Territories, Wallis and Futuna, Saint-Pierre and Miquelon) are also not considered in the NFAP (these territories represent 982 000 ha of managed forests).

Forest Areas in 2010 according to UNFCCC GHG inventories (submission March 2019)

			Forest								
			Forest remaining forest			Land converted to forest			Total Forest		
			Managed forest	Unmanaged forest	Total	Managed forest	Unmanaged forest	Total	Managed forest	Unmanaged forest	Total
France	EU	Mainland	13 517 020	761 873	14 278 893	1 237 771	0	1 237 771	14 754 791	761 873	15 516 663
		Outermost regions	8 183 858	0	8 183 858	26 545	0	26 545	8 210 403	0	8 210 403
		Mainland + Outermost regions	21 700 878	761 873	22 462 751	1 264 316	0	1 264 316	22 965 194	761 873	23 727 067
	Non EU	overseas territories	982 000	0	982 000	0	0	0	982 000	0	982 000
		Total EU + Non EU	22 682 878	761 873	23 444 751	1 264 316	0	1 264 316	23 947 194	761 873	24 709 067

(blue)	Values reported under Table4.A in FRK reporting
(green)	Values reported under Table4.A in FRA reporting
(yellow)	Value relevant for FRL

14. Provide detailed data on forest dynamics

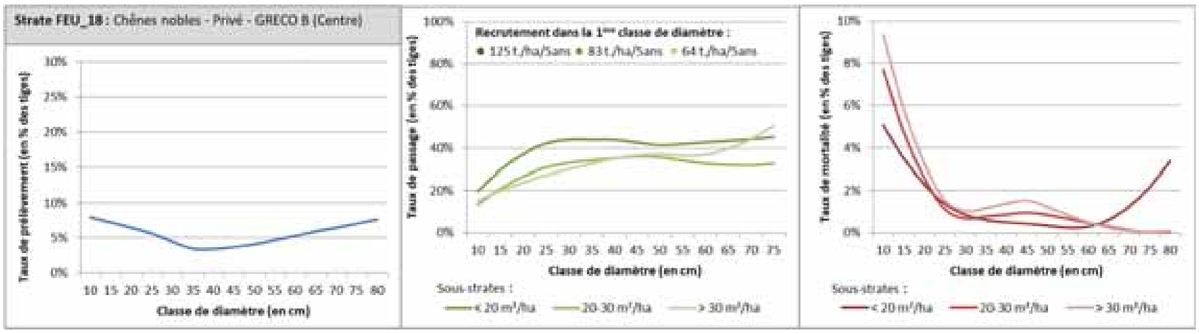
Recommendation	*Provide data on increments, dynamic age-characteristics and rotation length. Provide a more detailed description on the share of even and uneven-aged forests and the related information for the strata.*
Item	Ann.
Change in the FRL calculation	no
Changes in the Accounting plan	The tables and graphs in the Appendices have been added to the Accounting Plan.

Detailed explanations	The forest dynamics parameters are summarized in the tables by forest stratum and are illustrated in the diagrams for some strata. The forest dynamics parameters are as follows:

- transition and recruitment rate (or production per hectare for poplar plantations) representing the growth parameter;
- mortality rate (or mortality per hectare for poplar plantations) representing the mortality parameter;
- extraction rate (overall for most strata or thinning and clear felling for poplar plantations) representing the extraction parameter.

Extract from the NFAP appendices:

Nom	Ressource initiale en 2010				Paramètres du scénario de référence				Taux de prélèvement projeté (en % de la production entre 2010 et 2030)
	Nombre de points	Répartition des points par classe de suface terrière (sous-stratas <20 / 20-30 / >30 m²/ha) **	Volume en 2010 (en milliers de m3 bois fort tige)	Répartition du volume par structure (équien / inéquien) ***	Param. moy. de production (en % des tiges ou en m3/ha) *	Param. moy. de recrutement (en tiges/ ha/5ans) *	Param. moy. de mortalité (en % des tiges ou en m3/ha) *	Param. moy. de prélèvement (en % des tiges, du volume ou de la surface) *	
FEU_01	770	29% / 24% / 48%	68 886	42% / 58%	33%	160	4%	4%	50%
FEU_02	653	38% / 25% / 37%	49 376	43% / 57%	36%	234	3%	7%	56%
FEU_03	428	52% / 26% / 22%	26 473	47% / 53%	37%	162	2%	8%	50%
FEU_04	828	57% / 28% / 15%	46 432	54% / 46%	33%	116	1%	9%	65%
FEU_05	368	48% / 26% / 26%	22 899	44% / 56%	33%	149	2%	8%	31%
...	...	...	...	...	...	...	...	...	...



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15. Disaggregate (historical and projected) extraction data for energy and non-energy uses.

Recommendation	*Provide historical and future extraction rates disaggregated between energy and non-energy uses.*
Item	Ann. IV, B. e) iv
Change in the FRL calculation	no
Changes in the Accounting plan	The table in the Appendix has been added to the Accounting Plan.
Detailed explanations	See Appendices.