Forests, agro-forestry and wood industry in France :
What climate mitigation potential in the medium and long term ?

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Executive Summary

Dynamic management of forests and timber industry, afforestation and demand for wood are considered by the IPCC (2014) as fundamental tools for mitigating climate change. But what is and what could be their contribution regarding GHG (greenhouse gas) mitigation throughout the French territory ?

This note describes how to measure this contribution. It encrypts today (2012) and prospective horizons to 2030 and the long term, according to two scenarios (business as usual, dynamic scenario). The dynamic scenario, which is both ambitious and realistic, would allow a further reduction of GHG emissions (up to 50 MtCO2 per year in the long term compared to current emissions), a 38% increase in the mitigating effect of forests and wood chain, and a tripling of the substitution effect, the only sustainable long-term climatic effect.

1. The carbon impact of the forest from the sink to the pump

The fossil fuels burning and cement production are the main CO2 greenhouse gas emissions (78% of total global emissions measured in "CO2 equivalent ton"). However, through photosynthesis, these emissions are partly offset by CO2 flux from the atmosphere to the earth and the oceans. The forest, but also grasslands, crops, algae and plankton effectively capture the carbone and store it in biomass and soils. This storage represents organic growth or primary production; which is in turn partly used by humans for their own needs. When the organic growth exceeds the removal, the excess is stored every year ; this additional storage is described as a carbon sink, and that we will be called storage in the following text Carbon is stored in every part of the tree (stump, branches, root), as well as in the forest floor and soil, this latter part being the richest in carbon of all other agricultural soils.

However, carbon storage has limitations (you can hardly store over 1000m3 per hectare in France). In a forest left to itself, the biomass created equals the biomass decomposed, releasing its carbon into the atmosphere. We can compare the forest to a tank of carbon: torage can usefully operateduring the time of filling, but when the tank is full, the storage function ceases.

The interest for using biomass before it decomposes, releasing CO_2, is primarily to substitute biomass to a fossil fuel or wood to materials (concrete, aluminium) which process uses a lot of fossil materials . To optimize the lever of striking, man can act triple :

- To balance the quantity of wood extracted and the organic growth.
- To promote the production of lumber and panel production, allowing a cascade of substitutions at the base of the circular economy, and also increase the stock in the uses of wood (storage which, like any storage, has a limited effect in time).
- To improve energy efficiency production of biomass, of heating, cooking and production, while moderating needs (house insulation, passive houses).

An advantage of the substitution lever on the forest storage lever is that the forest carbon stock can burn, be hit by a storm, die from insect attack or after a heat wave. Saving on fossil energy is acquired permanently.

That is why the storage lever can be useful, but it must remain "second" compared to the substitution lever, which is the only sustainable and irreversible effect: in addition, excessive storage in forests can impede the natural regeneration of the forest, a good management and hence the possible subsequent substitutions.

2. The calculation of the forest carbon footprint - storage and substitution

The forest (as well as agro-forestry and hedges) carbon balance must be calculated by measuring both the effects of additional storage in forest and non-forest and replacing in a cross-sectoral vision. To show the potential importance and justify public policies to meet the challenges, we need to measure accurately the effects. It is therefore necessary to agree on the method of calculation and measure the possible evolution of carbon footprint over time, based on differentiated assumptions of forest and agro-forestry policies (“Business as usual” and dynamic scenarios).

The **calculation of the substitution effect** shows significant GHG emissions gains. Indeed :

• 1 m3 of wood energy instead of fossil fuel (gas or oil) reduces CO_2 emissions by 0.94 TCO_2 (for hardwoods) and 0.76 TCO_2 for softwood

• the use of 1 m3 of hardwood lumber immediately prevents the emission of 1.1TCO_2 and in the long-term 2TCO_2.

- the use of 1 m3 of softwood lumber immediately prevents the emission of 1.1TCO2 and in the long-term 1.86 TCO2. (Source ADEME, R.Sathre and Leif Gustavsson.2009 [1], see calculations in the appendix)

These figures also show the importance of proper prioritization of uses. Indeed, if we used 1 m3 of hardwood logs as fuel wood and not as a timber, the reduction of CO2 emissions by would be only 0.94 instead of 1.1, a 0.16TCO2 per m3 loss, and in the long term a loss of 1.06 TCO2 per m3.
The calculation of the storage effects (in fact the annual balance of stocks) : must distinguishbetween the forest storage, the storage resulting from new plantations and agro-forestry, and the storage in wood products downstream of the forest.

- The storage in forests is currently 70 MtCO2 / year[2] in France, resulting from the dynamic afforestation policyconducted from 1953 to 1990 which provided strong incentive for new plantations (Fonds Forestier National), the natural increase of wooded area, the increase of CO2 in the atmosphere, and the under-exploitation of forests. Its evolution over time is calculated by taking into account the observed and expected growth, minus the proposed additional removals

- The storage due to new plantations and agroforestry results of the increase of the new biomass produced

- The storage in wood products downstream of the forest.

In the long term, the benefits of these storages will disappear.

The overall calculation of carbon footprint

We know the annual forest harvest from allFrench forests (wood energy, paper, panels and timber) and its evolution over time. It is therefore possible to quantify for two scenarios its direct carbon footprint (storage or retrieval of biomass in the forest, and the uses of wood) but also indirect (substitution) and in total, the overall net emissions of CO2.

[1]« A state-of-the-art review of energy and climate effects of wood product substitution » School of technology and design reports N°57 Wäxjö University Sweden 2009
[2]IGN A.Colin 2014 « Emissions et absorptions de gaz à effet de serre liées au secteur forestier et au développement de la biomasse énergie en France aux horizons 2020 et 2030 «

3. The carbon footprint of French forests: what evolution from 1908 to 2009 ?

Throughout the 20th century, several factors (wars, industrialization and urbanization, development of transport and globalization, agricultural mechanization, ...) have combined to cause a significant rural exodus and a decline in agriculture in less productive areas. This led to the reforestation of more than 6 million hectares. In addition, during the second half of the 20th century, a dynamic forest policy has established coniferous stands of high economic interest for our country, knowing a softwood deficit. Although these reforested areas have sometimes been scattered over the territory, they have revitalized entire regions and generated a large number of jobs in the uplands, often in less favoured areas.

The consequences throughout the century (2009/1908) consisted of an almost tripling of annual timber removal, which increased from 24 to 62 million m3[3], the additional annual carbon storage by forest from 39MTCO2 by 70MTCO2 per year. Thus, without the contribution of the forest and wood industry, emissions in France today would amount to 584 Mt CO2 instead of 451 MtCO2. They would therefore be 30% higher !

However, the trend over the last twenty years is much less favorable.

• The harvest is stagnating 43 Mm3 per year, less than half of the increase 92Mm3[4]/year; there remains a maximum gross annual increase of41 million m3 per year r (net of mortality) located 57% in small and medium private forest, 25% in large private forest and to 18% in communal forest.

• We import 2.8 million m3 of sawn softwood, which represents + 5 million m3 of round softwood, while our annual allowable harvest additional in forest is 11Mm3[5]. Withdrawals due to climate-induced dieback suggest otherwise of species renewal needs.

• We have little additional storage in the products since the activity of downstream industries is stable (5,4Mm3)[6].

TABLE A : MITIGATION BY THE FOREST AND USE OF WOOD IN 2012

[3]Rapport national d'inventaire pour la France au titre de la Convention cadre des Nations Unies sur les changements climatiques et du protocole de Kyoto CITEPA Mars 2014

[4]IGN « émissions et absorptions de gaz à effet de serre liées au secteur forestier et au développement de la biomasse–énergie en France aux horizons 2020 et 2030 » Janvier 2014 Antoine Colin

[5]IGN ibid. p.29

[6]CITEPA Mars 2014 Elaboration d'émissions et d'absorptions de gaz à effet de serre liées au secteur forestier et au développement de la biomasse –énergie en France aux horizons 2020 et 2030

	Références	Mm3	Mm3 short life	M3 long life	Sink MTCO2	Substitution MTCO2	TOTAL MTCO2
Références	*A1*	*A2*	*A3*	*A4*	*A5*	*A6*	*A7*
Forest wells outside plantations	*B1*				*70*	*0*	*70*
Wood logs forest and farmland	*B2*	32.0	32.0			24.0	*24.0*
Energy wood chips	*B3*	1.2	1.2			1.1	1.1
Wood logs Trituration	*B5*	12.0	8.0	4.0		11.4	11.4
Hardwood timber logs	*B6*	5.2	2.6	2.6		5.3	5.3
Logs Softwood	*B7*	15.9	8.0	8.0		14.8	14.8
Plantations							
Agroforestery	*B8*						
Sup. storage in the uses					5.4		5.4
TOTAL	*TOTAL B2 à B31*	66.3	51.7	14.5	75.4	**57**	**132**

* Including wood energy 31MTCO2. or 55% of the total substitution. It was classified by simplifying sawmill related exits pads for the production of panels into short-lived products. Similarly, the direct substitution of the current use of end of life wood products is not taken into account (reported in Table C).

Agreste sources agri-Graph 2013 (A2). IGN ibid. (B1) CITEPA ibid. ADEME (Etude sur le chauffage domestique au bois : marchés et approvisionnement Pouet June 2013).

4. What scenarios and what carbon balances for France in 2030 and beyond ?

4.1. An undergone future: business as usual

If one remains at the current status quo, which has lasted for 25 years, storage in forests, which should go through a peak at 84 MtCO2 / year[7], could level off to the current level in 2050[8]. Moreover, the forests of southern countries risk being severely degraded by the effects of global warming, which would result in a resumption of fire and increased vulnerability to storms and attacks by insect pests.

In total, the total forest-attenuation increase from 132MTCO2 currently to 148MTCO2 in 2030, falling to long-term 57MTCO2 (all effects storage canceling), which would represent a regression of -75MTCO2, compared to the current situation.

4.2. A selected future : the dynamic scenario. ambitious and realistic

Making the choice for an ambitious and realistic scenario to optimize the use of woody biomass involves working simultaneously on three complementary areas:

i) a deposit mobilization policy.

ii) a policy of agro-forestry and forest plantations and

iii) a downstream dynamic policy (boosting the demand for wood. boosting processing industries and wooden houses building).

Making the choice of such a scenario involves setting goals that are both ambitious and realistic. This leads to propose the following objectives:

• Mobilization of the deposit. All the French deposit cannot be mobilized, some territories are very difficult operation, and consolidation effort of small and medium private forest will take time. An ambitious but realistic policy is the dynamic scenario IGN study in 2030 (60% of the leafy growth and 90% of the softwood growth. [50 million m3 hardwood (branches included) + 11Mm3 from the farmland +37 Mm3 softwood] and 90% of all species growth in 2050. We recall that currently only 46% of the French forest benefits from sustainable management plans, and that less than half of the increase is mobilized.

• Forest plantations. Additional mixed plantings well integrated into the landscape at a rate of 30.000 ha per year in forest and fallow areas (of which there are 2.1 million in France) would complement the productive forest stands of high-value required for the timber industry, while adapting forests impact of climate change.

• Agro-forestry plantations outside forests. Agroforestry including the farmlands, but also trees in field alignments can contribute both in current efforts to agro-ecology while providing wood material and a large biomass. This creation of hedges and alignment at a rate of 50 to 80 trees per hectare would return more rationally the benefits of farmland and past practices of scattered trees (apple cider) : sequestration, biomass production, organic matter, integrated protection,

[7] IGN ibid.
[8] Inra Carbofor Study

shading, fight against erosion, water cycle, pollination. Proposed in 2050 a 4 million ha of assumption (2.5 Mha in 2030) with planting trees in the field including the reconstitution of hedges on 0.7 million km (1.4 million who have been abolished since 1960[9]) 11% of the UAA, which is in the order of magnitude of the proposals of the ADEME (15% of UAA).

5. The expected benefits of the dynamic scenario

The implementation of the dynamic scenario would have a major impact for our greenhouse gas emissions and in terms of employment. The calculation tables below and in the appendix indeed show the following benefits :

By 2030. the annual carbon benefit due to the action of man. would decompose in :

- 60MTCO2 direct substitution by the development of wood energy (and second-generation fuels)
- 32 MtCO2 indirect substitution of the use of timber in place of energy-intensive materials;
- 69 MtCO2 per carbon storage in forests and the use of wood (The annual storage in forests would be reduced to 62MTCO2, including plantations, but would however remain positive)

The net benefit in terms of CO2 emissions by 31 additional annual Mm3 compared to 2012.

Moreover. recent targets set by the Minister for Ecology. Sustainable Development and Energy. set a target of 32% renewable energy in the French energy mix by 2030. ie. tons oil equivalent being transformed into TCO2. an effort 82MTCO2. Direct and indirect potential contribution of biomass and timber by forest and agro-forestry can represent 31 MtCO2. 38% of this effort. and all of the biomass would represent 62 MtCO2 / 424 MtCO2 or 14 % of French energy mix. against 6% today (31/520 MtCO2).

Table B below shows a prospective synthetic reading in 2030 of the dynamic scenario.

[9]Ph.Pointereau « Les haies, évolution du linéaire en France depuis 40 ans » Courrier de l'environnement de l'INRA. France 605 000ha of hedges and 333 000ha isolated trees , representing 3,1% of UAA.

TABLEAU B SIMULATION: OPTION PROPOSED 2030 (Scenario dynamic IGN farmland included)							
	Références	**Mm3 harvested**	**Of which Mm3 short life**	**Of which M3 long life**	**Sink MTCO2**	**Substitution MTCO2**	**Total mitigation MTCO2**
Références	*A1*	*A3*	*A31*	*A4*	*A6*	*A8*	*A9*
Forest wells outside plantations	*B1*				50	0	50
Wood logs forest and farmland		32	32			24	24
Energy wood chips	*B2*	11	11			9.7	10
Wood logs Trituration	*B21*	26	13	13		26.0	26
Hardwood timber logs	*B3*	8	4	4		8.2	8
Logs Softwood	*B31*	23	11.5	11.5		21.4	21
Plantations	*B4*		0	0	3	0.0	3
Agroforestery	*B5*	5	5		9	4.7	14
Storage in the uses					7.1		7
TOTAL	*B1 à B5*	**105**	**77**	**29**	**69**	**94**	**163**

Table C provides a vision in the long-term, permanent position, of mitigation through the forest and wood. when the effects of storage are canceled. and all substitution effects are taken into account.

TABLEAU C SIMULATION TABLE C: PROPOSED OPTION long term (90% mobilization 2030 growth. farmland included). storage effects canceled							
	Références	**Mm3 harvested**	**Of which Mm3 short life**	**Of which M3 long life**	**Sink MTCO2**	**Substitution MTCO2**	**Total mitigation MTCO 2**
Références	*A1*	*A3*	*A31*	*A4*	*A6*	*A8*	*A9*
Forest wells outside plantations	*B1*				0	0	0
Wood logs forest and farmland		32	32			24	24
Energy wood chips	*B2*	18	18			15.8	16
Wood logs Trituration	*B21*	27	13.5	13.5		37,9	42
Hardwood timber logs	*B3*	10	5	5		14.7	15
Logs Softwood	*B31*	26	13	13		34.1	34
Plantations	*B4*	17	10	7	0	20.6	21
Agroforestery	*B5*	24	12	12	0	35.3	35
Storage in the uses					0		0
TOTAL long term. dynamic scenario	*B1 à B5*	**154**	**104**	**51**	**0**	**182**	**182**
Scénario "business as usual » long terme		**66**	**52**	**14**	**0**	**57**	**57**

Discussion :

Technically speaking. we notice that in the medium term, the additional use of the forest by reducing the additional annual storage (but without reducing the total stock of the forest) has no minoring effect on emissions, on the contrary, due in particular to the substitution rate of lumber, higher than the content of the timber in forest.

Overall, a gain from a total 163MTCO2 mitigation in 2030 and long-term 182MTCO2 seems modest compared to 2012 (132MTCO2), due to a decrease in forest sink. We need to consider actually the progress of the substitution lever, the only sustainable one, which would double by 2030 and could triple in the long term.

In this perspective, all things being equal, the forest sink and in the uses would void, and the scenario "business as usual" extended would result in a total attenuation reduced to mere substitution (by using the coefficients of long term substitution) 57 MtCO2 in a degraded attenuation situation -75MTCO2 compared to the current situation, while the dynamic scenario would result in an attenuation reduced to the single substitution of 182 MtCO2, in an improved situation 50 MtCO2 compared to the present situation, but to 125 MtCO2 from the scenario " business as usual "!

6. Public policy measures to switch from business as usual to the dynamic scenario

The transition to the dynamic scenario would justify a forestry component national mitigation plan of global warming, combining public action and private initiative.

The main axes could be the following :

- Organization of the mobilization of additional wood from council forests and large private forests.
- Organization of the deposit mobilization by the establishment of forest territories plans in forest areas that warrant. These forest plans would consist in a powerful incentive for owners of small and medium-sized private forests to gather in GIEF (new groups created by the new law) within a given time, the communal and intercommunal level may be preferred. This obligation of sustainable management of forests entailing double socio-economic and environmental potential would be coupled with tax benefits and ad hoc incentives.
- Implementation with affirmative action areas to support the development of agro-forestry and planting hedges under agricultural development policy.
- Revival of a reforestation policy through the strategic fund of the forest and wood fuel by carbon-funds. This action must be conducted with caution. The most important projects must be preceded by a landscape and soil survey, and species mixtures should be recommended at maximum, taking into account the needs for adaptation of the French forest to the new climate.

- Adoption of measures to give a competitive advantage for the use of wood in construction (of hardwood in particular) including through public procurement, marketing actions and design innovation, and the development of panel industry whose attenuation effect is crucial.
- Development of the carbon market by setting a minimum price per tonne of carbon, sustainable funding for alternative facilities to fossil fuels and promote the most useful sectors for climate mitigation.
- Creation of a national forest / climate observatory to follow the implementation of the national plan and propose the necessary adjustments.

The risk of being satisfied with the current situation, where we can be tempted to consider the carbon sink as data acquired forever, is to be in a seriously degraded one. All too important carbon sink must instead function as a warning signal to boost the use of wood and the substitution it entails, involving more and more the forest and its sector in the green economy of tomorrow.

This is not the subject of this study, but the additional substitution being directly correlated to job creation, there is again a reason to closely involve environmental and social aspects in the design of forest-based strategies.

ANNEX

Reading instruction tables

FOREST BIOMASS AERIAL

Tables B col.A6
Hardwood : Expansion factor leafy branches for 1.61, 1.46 for the roots. or 2.06 as a total. compared to the total volume IGN (Loustau .2004)[10]
Softwood : expansion factor 1.33 branches, roots and 1.40, 1.73 as a total compared to the volume IGN (Ibid.)

CONVERSION TABLE

Carbon Content of wood		Td.m./m3	TC/T.d.m.		TC/m3	TCO2/m3	
Hardwood	m3	0.54	0.475		0.26	0.94	0.94
Softwood	m3	0.438	0.475		0.21	0.76	0.76
Average for the calculation of the sink							0.86

Source: Carbofor INRA 2004

AGROFORESTRY

The storage benefit of agroforestry on a meadow mix 80-20 annual crops per hectare in 40 years would be 41tC. 150TCO2. 3.7 TCO2 / ha / year. Will be adopted in fine figure 3.7TCO2 / ha storage-reduction of emissions given by INRA[11].,which takes into account many effects such as reduced fertilizer substitution by the use of wood products being disregarded.

Cross reference: for agro-forestry, yields would be 2 tons of dry matter per hectare per year for storage / growth in agro-forestry (AFAF) or 0.475 * 3.66 * 2 = 3.47TCO2 / ha / year.

Tables B. crossing A6 *B5

[10]CARBOFOR INRA D. Loustau 2004
[11]Atténuation des gaz à effet de serre Juin 2014 C. Chenu p.32

One hectare of coniferous unthinned 15 years old counts 75m3 so as and 75 * 1.73 = 129 m3 of total biomass or 26 TCarbone, additionally in the case of a settlement on a wasteland so as 1.7TC / year or 6.3 TCO2 / year for 15 years. An average population. mix Pinus Pinaster-Douglas 35 years old counts after thinning, 300m3 on foot or 420 m3 of total biomass or 93TC that represents 2.6TC per year, so as 9.7 TCO2 per year for 35 years.

RETURNS AND FOREST AGRO-FORESTRY

B4 lines

Mix yields Pinus Pinaster (or P.Laricio)-Douglas[12]

14m3 / ha / year, 50% BO and 50% PB plus 20% of usable branches, or 7 m3BO / ha / year and 9.8m3 / ha / year of small wood.

B5 lines

For agro-forestry yields we took a 30% mix poplars, and 70% of local hardwoods. Poplar yield is 12.7 m3 / ha / year average in France[13] (including 7.9 M3 / ha / year in timber and 4.8 M3 / ha / year of small woods).

Average yields hardwood in France: 54.8 million m3 tiges IFN / year + 60% of branches divided by 10.0 million ha. 8.7m3 / ha / year of which stem 5m3, 70% BO (estimate for agro-forestry) or 3.5M3BO / full ha + 1.5 m3PB / ha full and 3.7m3 branches tatalling 5.2M5PB / ha.

Taking a factor of 60% between one hectare agroforestry and forest hectare in full[14]. there is an average for the afore mentioned mix 2.1m3BO / ha agro forestry and 3. 1 m3PB / ha / yr (all branches exploited) or 5.2M3 / ha / air annually. an estimated alone 2 m3PB / ha / year of small wood removals in 2030.

For mixtures 1 / 3peupliers-2/3 hardwood gives permanently 3m3 BO/ ha / year on one hectare of agroforestry for the timber. and 3 m3 / ha / year of firewood in a hectare of agroforestry.

[12] Le Douglas dans le Nord-Est du Massif Central : tablesde production provisoires N. Decourt

[13] (A. Berthelot AFOCEL La culture du peuplier en France : (1, 9 Millions de m3 pour 240 000ha, soit 7,9 m3 grume /ha /an plus 61 % de branches , soit 4,8m3 de petits bois)

[14] C.Dupraz « Agroforesterie, des arbres et des cultures » Editions france Agricole

SUBSTITUTE FOR WOOD ENERGY

Tables B and B2 col.A8 :

The analysis of the life cycles[15] shows emissions :

-24 Kg CO2 / MWh useful for wood chips, 8 for related sawmill, 242 for natural gas,490 for Fuel, 105 for electricity, an average value of 366 for a mix fuel gas,two energies currently being equally used for heating

-16Kg CO2 for an average value forest-related platelet sawmill, representing an average saving of 350Kg CO2 per MJ, either, knowing that a tonne of dry matter contains 5MWh or 1.650 TCO2 per tonne of dry matter or 0.94TCO2 per m3 hardwood and softwood 0.76TCO2 per m3 or 0.88 TCO2 per m3 with two-thirds of hardwoods.

This coefficient of substitution is different from the ADEME coefficient. which calculates an average substitution on the average energy mix of the current heating Park; this reasoning is not acceptable because we will try to replace the most polluting energy. Although coefficients of substitution and TCO2 content in the wood-matter are the same, this is purely coincidental. Substitution coefficient varies from country to country, depending on each energy mix and user behaviour.

SUBSTITUTION FOR LUMBER and PANELS

Tables B croissements A8 * B5 to B21 :

In a meta-analysis of factor substitution in the world. R. Sathre[16]finds an average of 2 tonnes of carbon substituted for every ton of carbon timber implementation. Coralie RAVIER[17]. extracted from the meta-analysis pure proxies or 1.1TCO2 / m3 values we adopt here. For the timber. we will apply this given figure to half the volume of timber (lumber) and for the panels to their full volume.

[15] ADEME : « Bilan environnemental du chauffage collectif » 2005

[16] A state-of-art review of energy and climate effects of wood product substitution , R.Sathre and G Gustavsson 2009 Wäxjö University

[17] Coralie Ravier Rapport de stage ingénieur FCBA 2012 « Etude sur la substitution-matière du bois »

Storage , direct and indirect short-term and long-term Substitution coefficients

	Storage coefficient in the uses	Direct and indirect substitution in the short term	Direct and indirect substitution in the long term
	TCO2/m3	TCO2/m3	TCO2/m3
Wood energy-logs		0.75	0.75
Hardwoods energy (platelets and related)		0.94	0.94
Coniferous wood energy		0.76	0.76
Average fuelwood France		0.88	0.88
Hardwoods work of product used	0.94	1.1	2
Bois d'œuvre résineux(produit mis en œuvre)	0.76	1.1	1.86
Hardwood panel (product used)	0.94	1.1	2
Softwood panel (product used)	0.76	1.1	1.86

• Note : For timber and panels, the end of life substitution is integrated to calculate the long-term substitution coefficient.

CALCULATION OF TOTAL DEPOSITS in 2030 and LONG TERM

They come from the work of the IGN (« émissions et absorptions de gaz à effet de serre liées au secteur forestier et au développement de la biomasse–énergie en France aux horizons 2020 et 2030 » Janvier 2014 Antoine Colin).

For 2030, the tax rate on softwood reaches 93% for softwood. or 31.2 million m3 (p .34 Colin study), and 37.4 million m3 branches included (facteur1.2 leaving a third of the branches to the ground) and 58% for deciduous wood 35.8 Mm3 strong stem and branches included 50Mm3 (factor 1.2. leaving one third of the branches to the ground) + 11Mm3 wood-logs from the grove, totaling 98. 4 million m3 + 2Mm3 poplars that is 100 million m3, to which must be added volumes from the first production agroforestry 5 Mm3 or 105Mm3 in total.

For the calculation of the long-term availability, we considered 90% of the estimated increase for 2030 (p.29 of the above study) of all species is 61.2Mm3 wooden fort -tiges and 85.6 with branches for hardwood and softwood 34.5Mm3 wood -Fort buds and branches 41.4Mm3, either. with 11 million m3 of grove or 113Mm3 totals including poplars, to which must be added volumes from agroforestry surfaces new plantations, totaling 154Mm3.