EFORWOOD

Sustainability Impact Assessment of the Forestry - Wood Chain

Project no. 518128

EFORWOOD

Tools for Sustainability Impact Assessment

Instrument: IP

Thematic Priority: 6.3 Global Change and Ecosystems

Deliverable D5.2.9

Case study "Iberian Market" - Final Report

Due date of deliverable: Month 51

Actual submission date: Month 58

Start date of project: 011105

Duration: 4 years

Organisation name of lead contractor for this deliverable: FCBA (Forestry, Pulp, Wood Building and Furniture Technology Institute), France

Final version

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	X
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Partners involved:

Coordination	Ludovic Guinard (FCBA)
Researchers involved:	Jean-Baptiste Chesneau (FCBA)
	Matthieu Forcet (FCBA)
	Katri Behm (VTT)
	Carl Olsmats (INNVENTIA)
	Cathrine Löfgren (INNVENTIA)
	Malin Kronqvist (INNVENTIA)
	Chris Dominic (INNVENTIA)
	Hannele Lehtinen (Pöyry)
	Juulia Rouhiainen (Pöyry)
	Jobien Laurijssen (KCPK)
	Beatrix Szirmay (AIDIMA)

Further use of this report:

- *M2-M5 Definition and description of the regional case study "Iberia"*

INDEX OF CONTENTS

1 Summary

1.1 The influence of consumers on sustainability of the FWC

Consumers and end users should be taken into sincere consideration as they are essential drivers in social, economic and environmental sustainability. Through consumption decisions, consumers have significant influence on market evolution. Although there are several fragmented consumer groups, who have different drivers and values, it is clear that at least for some of the groups, one of the key driving forces for choosing a product is sustainability. Even in current economic situation, customers are keen to invest in sustainable products and not to buy products with a bad reputation. As consumers increasingly take sustainability into account in their purchasing decisions, more clear and credible information about sustainability is needed, and consequently market-oriented sustainability assessment tools is required to generate this information. ToSIA is expected to become a useful tool in this context.

This forms the background to the Iberian case study. This case study was designed to test and demonstrate the capability of the ToSIA tool to be operated in a market-oriented mode.

1.2 Iberian Case-study : a market driven case

The main objective of the development of Iberian Case Study was to obtain a model starting from the consumption in the Iberian market via intermediate processes to the European forest origins.

Region of interest of the Iberian Case Study

In geographical terms the Iberian region corresponds to the territory of the Iberian Peninsula, located in the extreme southwest of the European continent. But for practical issues, mainly data availability, the case study only considers Spain and Portugal when referring to the Iberian region (Andorra and Gibraltar are excluded).

Products selected and approach applied in the Iberian Case Study

The Iberian Case Study is a market driven regional case study, underlining the importance of consumption as driver. In accordance with this criterion, the selected FWC products in the case study belong to product groups that are considered as end users know them; for being wood based, fibre-based, and bio energy products. The case study is focusing on those ones that cover a significant part of the Iberian market; that have a share of consumption 60-80% in the relevant product group.

The Iberian case study is a market driven case study, for the purpose of understanding the implications of the selected final products on the intermediate products and processes for the industries and forest resources. There is an analysis carried out in the processes in the FWC for each of the selected

products. This analysis has a starting point at the final link of the chain, and is worked out backwards through the previous stages in the chain towards the forest origin.

1.3 The Lack of data: a structural problem

Distribution, and consumption of products of wood suffers from a serious lack of economic data. This lack of data is structural, and corresponds to the professional structure of fragmented and heterogeneous Forest Wood Sector. Companies are often small in terms of production and distribution, and do not collect or distribute their economic data. The players in distribution and marketing are extremely numerous, and represent many sectors beyond the mere use of timber. Accordingly, it is not possible to distinguish the relative share of wood products.

Data of the different origin were used in the study:

- Specific and empirical data from national Inventory data on the forests, data from experiments or scientific measurements.
- Official and Branch Statistics data. These were modified to be used correctly in to the case study.
- Model-based and estimated data: Transport tools, a logistic approach were applied using models and expert judgement.

A major learning from the Iberian case is that sectors: forestry, wood products, paper does not control economic data on the distribution and consumption. Beyond this statement, calling for an effort to better understand the flow downstream of the sector, this lack of data led the Iberian case study to focus only on paper products.

To be more precise in explaining the lack of economic data related to wood products:

Transport and Logistic: the logistic data concern final products and does not describing the share of wood inside products. So it didn’t exist any specific data concerning the wood in transport.

International exchange: The products are defined as functional units (windows, doors, furniture,...). Customs data count units or tons of products, and do not distinguish the amount of wood involved. The amount of wood per unit varies greatly, it is not possible to extrapolate from these data.

Wood Energy: Wood energy was just starting in Spain, and this activity didn't appear in statistic data. An example: a sawmill creating wood pellet presents results concerning sawing and not energy products.

2 General structure of the Iberian case study

The Iberian case study is one of the case studies undertaken within the EFORWOOD framework. This case study is consumption-defined and aims to describe the network of forestry-wood chains producing products consumed in Iberia, including imports into the region. Other case studies undertaken within the Eforwood project are the Forest-defined "Västerbotten" and Region-defined "Baden-Württemberg" case studies (see Figure 1).

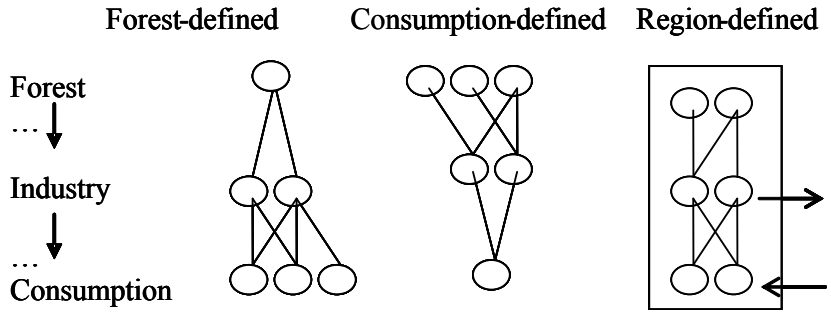


Figure 1: Case studies undertaken in the framework of the EFORWOOD project

Concerning wood based products, the Iberian case is considered representative of a globalization of trade led by consumption. Iberian Case is a market driven case that is based on consumption of FWC products in Iberia so the work is based on consumption estimation of the products of each FWC in Spain and Portugal.

The challenge of this case lies in the ability to trace the chain of manufacture of products from the consumer to forestry, taking into account also the recycling loop. The structural problems have failed to trace the flow of wood consumer products, wood for construction and wood for energy. Indeed, public data is lacking or is insufficient to permit this exercise. However, the Fibre Channel could be studied.

The Iberian peninsula is an area characterized by European import. The wood resource for forest based products consumed, is mainly located outside Spain and Portugal. Imports are in the form of logs (maritime pine), finished and semi-finished products such as pulp and paper, panels, etc. By studying the woodfree fine/office paper, the corrugated boxes, and newspaper, the case was able to cover more than 65% of consumption of paper products in the region.

The wood products´ chain was dropped from the case study because of the following reasons: the different measurement units of consumption data (due to the impossibility to quantify the furniture consumption in tons or m^3 and due to the problems to harmonize these data); the problems of defining the exact components of furniture consumed in Iberia and to provide exact, harmonized consumption data (in a unit of weight, that contains the components´ ratio) to M4.

the bioenergy chain was dropped from the case study because of the following reasons: the close relationship to the wood chain, and the low consumption in the Iberian region (IPB decision - 23rd January 2008)

3 Definition of the Iberian case study

3.1 Boundaries of the case study , description of the region

The Iberian region corresponds to the territory of the Iberian Peninsula, located in the extreme Southwest of the European continent. It is the third biggest peninsula of Europe with an area of 582 860 km². Geographical limits of the Iberian region are: Mediterranean Sea (South and East); Atlantic Ocean (North and West); The Pyrenees mountains (Northeast), are the connecting field to the rest of Europe. At the nearest point, Iberian Peninsula is only 5 miles (8 km) from the Northern coast of the African continent.

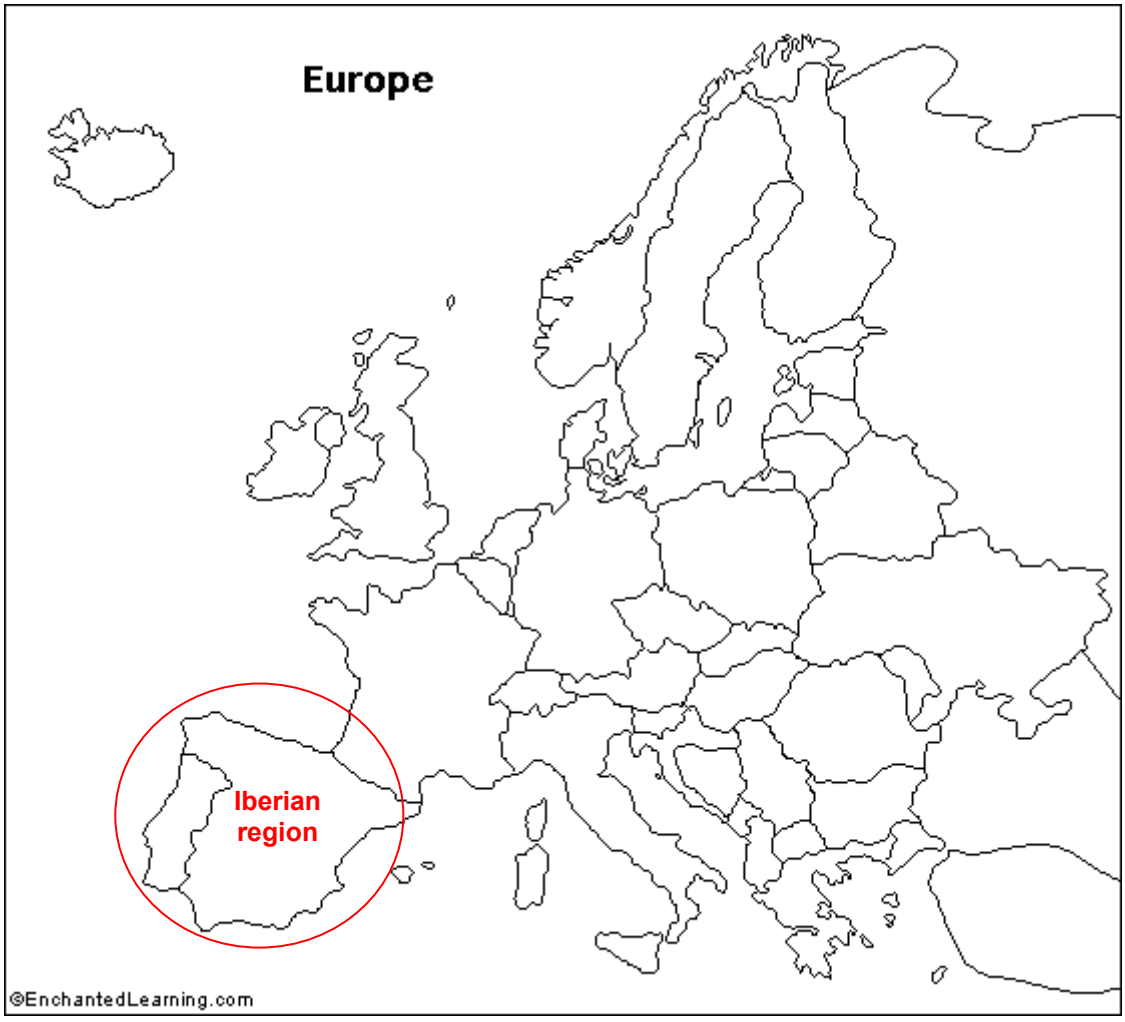


Figure 2: The Iberian Region in Europe, Source: Enchanted Learning.com

3.1.1 Forest Management.

As a result of massive imports (43%) of semi finished product (pulp), the chain takes into account the forestry and logging of the country and the following species:

- Eucalyptus (Spain, Portugal)
- Maritime Pine (France)
- Pine & Spruce (Sweden)

3.1.2 Processing and Manufacturing

The value chain was simplified to allow the establishment of the calculations. It remains broadly representative of the Iberian situation.
We consider three major products in the field of consumption:

- The Fine/Office paper production use all integrated hardwood pulp and wood-free paper production from Iberia. (Wood-free paper: A printing and writing paper which contains little or no mechanical woodpulp.)
- The Corrugated Boxes (packages) production use materials from
  - Pulping and Kraft liner production from France (The Kraft process is the world's predominant chemical pulping process)
  - Pulp and fluting production using recovered fibers from France and Spain.
- The Newspaper production encompasses:
  - Pulping (de-inking) and newsprint production using recovered fibers from France, Iberia and Sweden
  - Sweden production are using also mechanical pulp

3.1.3 Industry to consumer interaction

The manufactured consumer products undergo various steps such as transport and distribution to consumers based on specific modes of distribution, use and reuse, collecting, sorting, recycling and end of life.

Recycling for paper manufacturing is a major issue. The different processes were detailed in the chain to represent this issue, and take into account the different levels of collection and sorting, and recycling.

The end of life of non-material recycled products will be regarded as fully utilised as a source of energy by incineration.

3.2 Pulp and paper sector in Iberia

The paper sector is significant in the Spanish economy. The paper industry in Spain is a clearly growing sector, which is investing heavily in increasing capacity to meet the high growth potential of the internal market and increase its growing presence in foreign markets. The investments made in recent years

have led to the modernization and downsizing of production facilities, thereby improving productivity and competitiveness.

Paper production has grown well above GDP and Industrial Production Index. In the period 1995-2002, the paper production in Spain has seen a cumulative growth of 46%, which is more than double the increase of the Index of Industrial Production and nearly doubles the gross domestic product growth. (Chart 4)

Currently, the market share for the domestic paper production is 51%. The gap which still exists between consumption and production is an important sector for potential growth. In addition, the per capita consumption is still considerable lower than in neighboring countries such as Italy or France. The difference has decreased gradually and steadily in recent years.

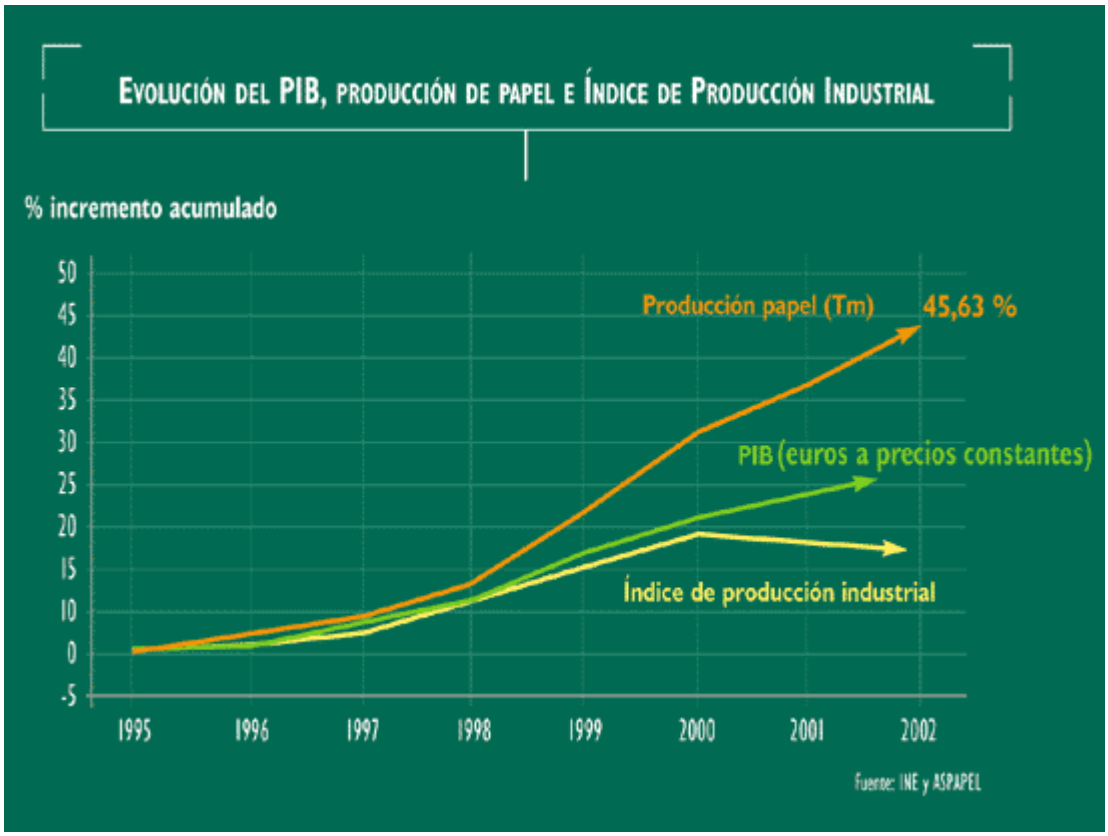


Figure 3 : Paper and general industrial production in Spain

Due to the growing technological capabilities, the paper industry requires large and continuous investments to incorporate more advanced technology. It is therefore a domestic industry of developed countries: in North America and Europe is concentrated over 70% of the world production.

Spain is the sixth largest producer of pulp and seventh largest producer of paper in the EU, where Germany, Finland, Sweden and France are in positions of leadership. Spain is now one of the major European producers, with 15 pulp mills and 132 paper mills, among which are some of the most modern industrial plants in Europe.

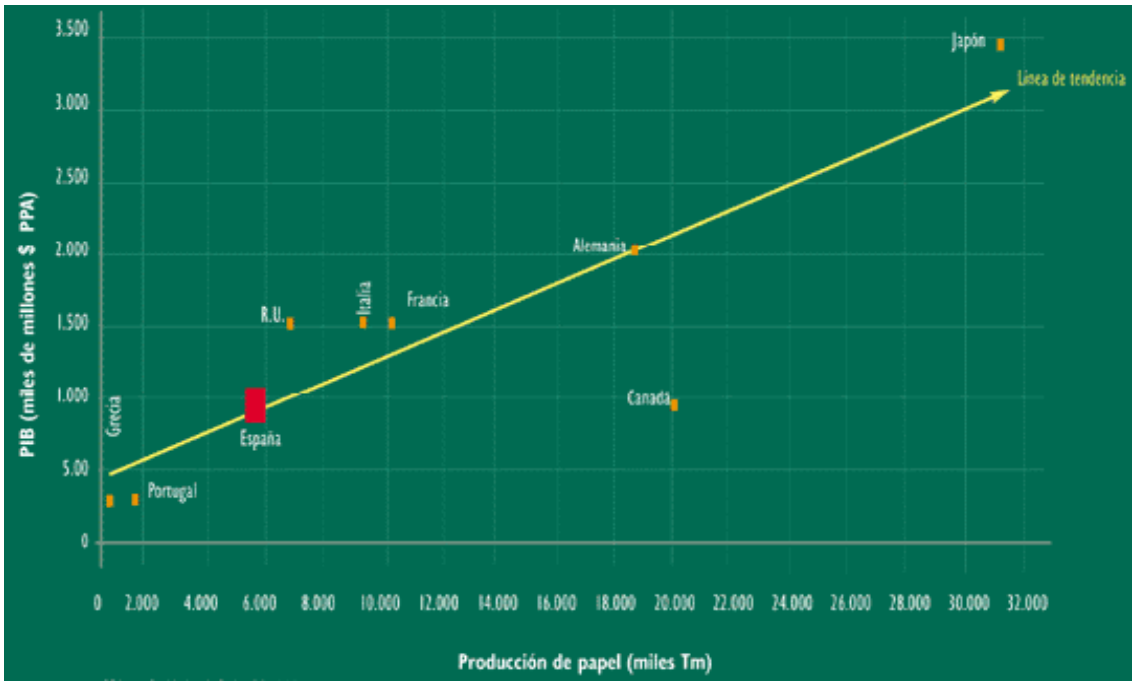


Figure 4: GDP and paper production in Europe (2001)

3.2.1 Quality and increasing penetration in the most demanding markets

In the early nine-tees, Spanish exports represented 18% of the production, today it accounts for 34% and is still growing. Similarly, exports of pulp have increased in the last ten years from 37% of production to exceed 47%.

Spain is the 4th largest pulp exporter of the European Union, and the 7th in the world, and one of the largest producers of eucalyptus pulp. Three quarters of those exports are destined for the European Union. Spanish paper products are present in demanding markets such as Germany, France and the UK.

3.3 Industry to consumer interactions (M5)

3.3.1 Market characterization

The Iberian region is a market with approximately 55.5 million of persons:

Population	
Spain	44 708 964 inhabitants (January 2006)
Portugal	10 642 836 inhabitants (July 2007)

Table 1: Population of Spain and Portugal, source: INE, INE

The population in both countries is aging, the share of the population in the age group of 30-35 years is the highest, and the number of births is decreasing. The situation is not as dramatic as in many other European countries, with the fact, the immigration is giving a boost to the size of the population (in case of Spain, the immigrants are almost 10% of the entire population.). The average life time in Spain (79,78 years) is the highest in Europe.

Alltogether there are 17 661 656 households which are considered to be consumers in the geographic area of Iberia. Calculating upon the number of households and the habitants of Spain and Portugal, an average household in the Iberian region consists of 3,13 persons.

Income of the households in Spain 2005	
SPAIN	22418 Euros / year / household

Table 2: Income of households in Spain and Portugal (2005), Source: INE Spain,

Income per person in Portugal 2005	
PORTUGAL	7 390 Euros / year / PERSON

Table 3: Income per person in Portugal (2005), Source: INE Portugal

To obtain more information on the behaviour of the consumers and to understand their actions there are more index numbers used, such as the consumers´ confidence index. It is based on surveying a representative number of Spanish households.

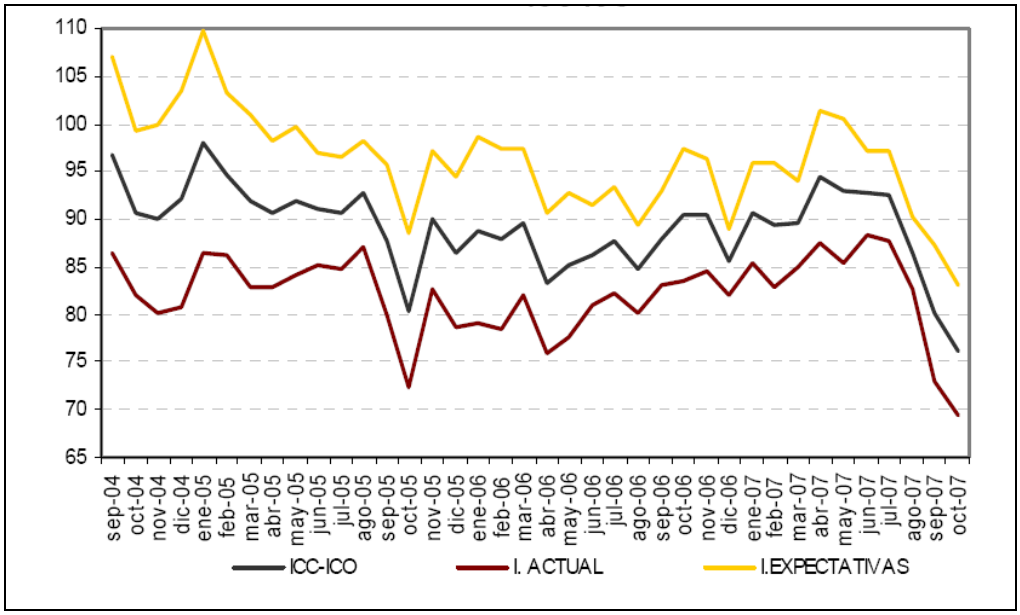


Figure 5: The evolution of the Consumer Confidence index in Spain (September 2004 – October 2007) Source: www.ico.es

The evolution of the consumer confidence index shows that the consumer confidence index (ICC-ICO) in 2005 had a positive evolution from March to August, and from September there can be a big fall observed that has reached the the lowest value in October. There was a positive evolution for a month and then the last month of 2005 was also considered by consumers in a negative way but the index did not reach the nadir of October again till September 2007. It is also seen that the expectations were more positive in 2005, and the market was optimistic.

3.3.2 Estimation of the 60-80% of consumption: selection of products

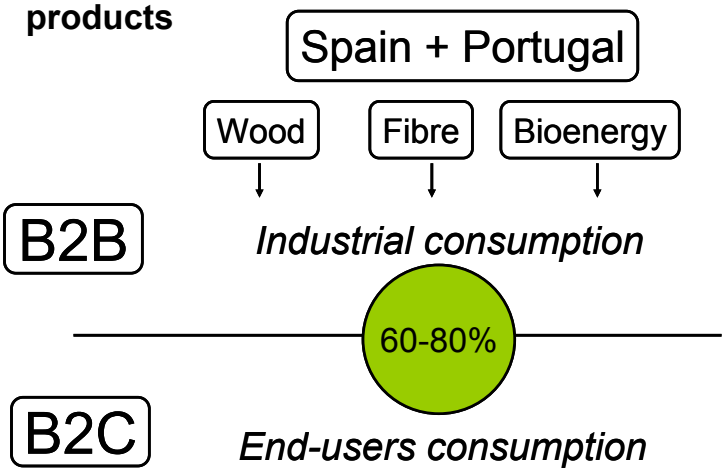


Figure 6: Consumption structure Iberia

The consumption of the products of the forest based industries at the Iberian peninsula are ambiguous, with the fact that some products and product groups are not consumed only by the end users, but are also serving as raw materials for further production activities, e.g. making of corrugated boxes.

Table 4: Consumption, production and trade of paper products

Grade	Consumption	Iberia, tonnes/year Prod.	Import	Export	Use	Minerals %	Without minerals tonnes/ year	Pulp "loss" * %	Total pulp demand tonnes/year	Pulp furnish	Pulp 1 tonnes/year	Pulp 2 tonnes/year	Rec. Paper demand adt/y	Softwood demand m3/y	Hardwood demand m3/y	
NEWSPRINT																**NEWSPRINT**
Total consumption Iberia	844.000	426.000	553.200	129.800												
Newsprint; Use of paper from Iberia					296.200	0	296200	10	325820	100% DIP	325.820		417.050			Iberia DIP
			Import:	547.800												
Newsprint; From France					215.648	0	215648	10	237213	100% DIP	237.213		303.632			France DIP
Newsprint; From the Nordic countries**					332.152	0	332152	10	365367	DIP:TMP = 1:1	182.684	182.684	233.835	456.709		Nordic (VB) Dip, Spruce
					844.000		844000		928400		745.716	182.684				
										Check sum	928.400					
Total import to Iberia covered by France and Nordic countries		Proportion of import **														
Import from France	131.602	0,394														
Import from Nordic countries ****	202.700	0,606														
WOODFREE a)																**WOODFREE**
Woodfree; Iberia	1.745.800	2.330.000	846.800	1.482.500	1.745.800	20	1396640	10	1536304	100% BHKP	1.536.304				5.991.586	Iberia b) Eucalypt
		Large net export														
		Simplification: Full self supply														
CORRUGATED MATERIALS																**CORRUGATED MATERIALS**
Total consumption Iberia	3.131.900	2.719.000	1.051.200	689.600												
Corrugating material; Use of material from Iberia					2.029.400	0	2029400	10	2232340	100% RP	2.232.340		2.321.634			Iberia RP
			Import:	1.102.500												
Corr mat: From France					304.947											
From recycled paper.	*Share*** 0,75*				*228.710*	0	228710	10	251581	100% RP	251.581		261.644			France RP
From kraft pulp.	*Share* 0,25*				*76.237*	0	76237	10	83860	100% SKP***		83.860		410.916		France Maritime pine
Corrugating material, kraftliner; Nordic countries**					797.553	0	797553	10	877309	100% SKP		877.309		4.298.812		Nordic (VB) Pine, spruce
									3445090		2.483.921	961.169				
										Check sum	3.445.090					
Total import to Iberia covered by France and Nordic countries		Proportion of import**														
Import from France	52.000	0,277														
Import from Nordic countries ****	136.000	0,723														
												Total use:	**3.537.795**	**5.166.436**	**5.991.586**	

* Difference pulp/paper in dry content and process losses
**Shares calculated according to imports assuming no imports from other countries
***Maritime pine from Aquitaine
**** Calculated as Sweden + Finland, represented by Västerbotten
***** Share of corrugated materials from recycled paper and new kraft pulp from statistics

Data delivered by Pöyry

Transformation factors

m3 wood used / air dry tonne of pulp	Bleached hardwood kraft pulp	3,9
	Bleached softwood kraft pulp	4,9
	TMP	2,5
air dry recycled packaging paper /air dried tonne of pulp (RP)		1,04
air dry recycled paper (RC) /air drid tonne of de-inked pulp (DIP)		1,28

a) Including uncoated and coated woodfree paper
In the case, the total consumption is, however, covered by uncoated Iberian paper.

b) Some eucalypt wood is imported from countries outside Europe
The import is relatively small
Simplification:
No such import in case study

3.3.3 Consumption of fibre-based products in Iberia

The three product chains – wood products, fibre based products, and bioenergy – have been examined focusing on the consumption. With the fact that the Iberian case is a consumer driven case study, the consumption data on the three product chains is determining the product selection. The structural problems have led to failure to trace the flow of wood consumer products, wood for construction and wood for energy. Indeed, public data is lacking or is insufficient to permit this exercise. However, Fibre Channel could be studied.

Total paper and paperboard consumption in Iberia 2005

	Production (thousand tons)	Imports (thousand tons)	Exports (thousand tons)	Apparent consumption (thousand tons)	Apparent consumption in %
Portugal	1602,0	830,0	1150,0	1282,0	100
Spain	5696,9	3779,1	2087,1	7388,9	100

Table 5: Total paper and paperboard consumption in Iberia 2005, Source: Pöyry

Newsprint consumption in Iberia 2005

	Production (thousand tons)	Imports (thousand tons)	Exports (thousand tons)	Apparent consumption (thousand tons)	Apparent consumption in %
Portugal	0,0	91,2	0,2	91,0	7,1
Spain	426,0	491,0	164,0	753,0	10,2

Table 6: Newsprint consumption in Iberia 2005, Source: Pöyry

Corrugated material consumption in Iberia 2005

	Production (thousand tons)	Imports (thousand tons)	Exports (thousand tons)	Apparent Consumption (thousand tons)	Apparent consumption in %
Portugal	362,0	212,0	245,1	328,9	25,7
Spain	2356,6	956,6	510,4	2803,0	37,9

Table 7: Corrugated material consumption in Iberia 2005, Source: Pöyry

Woodfree paper consumption in Iberia 2005

	Production (thousand tons)	Imports (thousand tons)	Exports (thousand tons)	Apparent consumption (thousand tons)	Apparent consumption in %
Portugal	1037,0	157,6	748,2	446,4	34,0
Spain	1293,0	806,6	800,2	1299,4	17,6

Table 8: Woodfree consumption in Iberia 2005, Source: Pöyry

Consumption of the woodfree paper corrugated material and newsprint altogether covers:

Portugal	66 %
Spain	68 %
Iberia	66%

Table 9: Coverage the three selected fibre based product consumption in % of the total paper consumption figures in Iberia, Source: Pöyry

3.3.4 Processes defined in M5

1000281 Transport of fine/office paper
1000284 Transport of fine office paper small truck
1000286 Transport of newsprint from sweden
1000287 Transport of newsprint from france
1000288 Transport of newsprint in Iberia
1000289 Printing of newspapers in Iberia
1000291 Transportation of newspapers to store
1000292 Transportation of newspapersa to home/office
1000293 Reading information/use
1000294 Separate collection and sorting
1000295 Transportation of recovered paper
1000313 Printing of fine/office paper
1000315 Reading information/use
1000317 Separate collection and sorting
1000320 Transport of recovered fine/office paper
1000369 Transport of Corrugated board materials (liner + fluting) in Iberia
1000370 Transport of Corrugated board materials (liner + fluting) from France
1000372 Transport of Corrugated board materials (liner + fluting) from Sweden
1000375 Production of corrugated boxes
1000376 Transportation of corrugated boxes to industryuser
1000378 Filling of corrugated boxes
1000381 Transportation of filled corrugated boxes (packages)
1000382 Corrugated boxes as packaging material
1000384 Municipal solid waste incineration
1000385 Separate collection and sorting
1000387 Transportation of collected corrugated board

3.3.4.1 Separate collection and sorting

The recycling of paper products is an important source of raw material for pulp. Recycling amounted to 3.6 million tonnes in 2005 corresponding to 11 million m^3 of virgin pulp. The processes of collecting, sorting and separation, are highly important in the industry of wood fiber.

3.3.4.2 Municpal solid waste incineration

Recycling uses 40% of products made from wood fiber at the end of life. The remaining 60% are directed towards a stage of elimination. This portion is treated as municipal waste and disposed of as such. These wastes are incinerated with energy recovery. A very small proportion will be buried in landfills.

3.3.4.3 Use

Both newsprint and fine/office paper, are printed before being used by end consumers. Corrugated boxes, used for logistics and freight, are subject to economic activity, including e.g. a filling operation of the box.

3.3.4.4 Transport in M5

The transportation of the products based on wood fiber can be divided into:

- transport of semi finished products (fine / office paper, Newsprint, corrugated board materials) to its final finishing stage including printing and conversion.
- Finished products are then routed to the final customer (newspaper, books, etc. ...) that are readers or trade/ logistic operators (corrugated boxes).
- The products collected, sorted and separated destined for recycling
- The products considered municipal waste destined for disposal.

The transport tool developed by FCBA has estimated for each of these categories, the types of vehicles transporting goods, and the average distances travelled. It must be noted the important effect of transportation related to product distribution of magazines to readers, as well as goods distribution using corrugated boxes.

3.3.5 Data acquisition and quality

It was very difficult to obtain data for the “consumption processes” of fibre products , partly because of the high level of aggregation. For example, a process such as “printing” had to represent several different techniques. Also the type of processes such as “filling boxes” are unspecific in describing what it is that is filled, it could be anything from building material to food etc.

The data inserted in the model must therefore be used with care since many compromises and assumptions lie behind the numbers.

3.4 Pulp and paper industry (M4)

3.4.1 Production : Mills that produce fibre based products

TOTAL PAPER AND PAPERBOARD		
		PRODUCTION
PORTUGAL	2005	1602,0
SPAIN	2005	5696,9

Table 10: Total paper and paperboard production (thousand tons) in Iberia 2005, Source: Pöyry

The “mill types” are based on statistical analysis of the European pulp and paper industry (size and furnish). This division was accepted in Brussels 2007 Eforwood week.

Selected mills – including median capacity and example furnish (per ton of product):

1. Newsprint :
   -in Iberia (100% DIP, approximately 165 000 t/a)
   -in France (100% DIP, approximately 280 000 t/a)
   -in Sweden (50% TMP: 50%DIP, approximately 270 000 t/a)

2. Woodfree paper :
   - in Iberia (100% BHKP, 25 000 t/a or bigger)

3. Containerboard :
   -in Iberia (100% RP, approximately 20 000t/a)
   -in France (100% RP, approximately 75 000 t/a)
   -in France 2 (100% SKP, approximately 75 000 t/a)
   -in Sweden (100% SKP, approximately 290 000 t/a)

4. Bleached Chemical Pulp mills:
   a. in Iberia (100% BHKP, approximately 205 000 t/a)

Abbreviations:
RP = recovered paper

BSKP = bleached softwood kraft pulp

BHKP = bleached hardwood kraft pulp

DIP = deinked pulp

SKP = soft wood kraft pulp

To cover 60-80/% of the consumption of pulp and paper products in iberia, the case study will consider production of the following products:

- Newsprint paper
- Fine/office paper
- Corrugated boxes

Production volumes for paper & board grades produced in Iberia in 2005

- Newsprint paper 426 000 t
- Fine paper 2 330 000 t
- Corrugated board 2 719 000 t

Input of raw material for the fibre products chains in 2005 sums up to:

Softwood (SW): 5,2 million m^3 of softwood

Hardwood (HW): 6.0 million m^3 of hardwood

Deinked Paper (DIP): 0,9 million tones of DIP

Recycled Paper (RP): 2.6 million tones of RP

Production of pulp in 2005:

- 5,5 mio t pulp

Consumption of paper & board grades in Iberia 2005:

- Newsprint paper 844 000 t;
- Fine paper 1 745 000 t;
- Corrugated board 3 131 900 t;

3.4.2 Recycling

In 2005, 2,74 mio t of recycled paper was available in iberia. The recycling rate for paper in Iberia is increasing over the last decades and is reported as 60% for 2005. However, as the approach for calculations in ToSIAa required fixed material volumes at defined stages the recycling rate was agreed to be flexible in order to feed the required amount of fibres into the fibre production processes.

3.4.3 Processes defined in M4

1000297 Pulping (de-inking) and newsprint production from recovered fibers in Iberia
1000301 Pulping (de-inking) and newsprint production from recovered fibers in France
1000304 Pulping (de-inking) and newsprint production from recovered fibers and integrated mechanical pulp in Sweden
1000321 Integrated hardwood pulp and woodfree paper production in Iberia
1000359 Pulping of Maritime pine in Aquitaine/France and kraftliner production in France
1000360 Transportation of sawmill chips in Sweden
1000363 Transportation of sawmill chips in France
1000365 Pulping and testliner and fluting production from recovered fibres in Iberia
1000367 Pulping and testliner and fluting production from recovered fibres in France
1000686 Integrated pulp and kraftliner production in Sweden

3.4.3.1 Pulping (de-inking) and newsprint production from recovered fibers

The integrated newsprint model mill uses recovered paper as input and in some cases (Nordic countries) also TMP (Thermo Mechanical Pulp).

The raw material input consists mainly of a mix of recovered newsprint and magazines. The recovered paper is fed into drum pulpers, where water and some (deinking) chemicals are added to the fibres to separate them and make them swell. After that, a series of cleaning steps follows to get rid of the contamination and to de-ink the fibres.

Thickening of the pulp is followed by a dispersion step, where the pulp is thoroughly mixed to disperse any remaining contaminants. After dispersion, a second dilution, flotation and thickening step can follow, before the pulp (DIP) is ready for paper making.

The pulp (either TMP or DIP or a mixture of these) is pumped from the storage towers and diluted to the appropriate consistency. And then dried and pressed in several step to approach a water content in the paper at only about 9%.

The final treatment of the paper is surface treatment by soft calendars that function in a way similar to ironing.

3.4.3.2 Integrated mechanical pulp

The TMP plant is designed to produce a low freeness pulp for SC-paper. The bleach plant is a two stage process with peroxide and alkaline as the main bleaching chemicals. The target brightness of the TMP is 75 % ISO. The paper mill has one paper machine for SC-paper production.The mill is self-sufficient in steam from the TMP process when running. Generated steam is mainly used for drying but also for heating purposes of different positions in the mill.

3.4.3.3 Wood free paper production

fine paper model mill including the fibre line, recovery area, steam generation, bleach plant and the fine paper machines.

Pulp mill
The pulp mill in the integrated fine paper mill is the same as in the market pulp mill. The steam production in the recovery boiler is however not enough to meet the steam demand in the integrated fine paper mill. A power boiler burning bark is therefore used to produce the required additional steam.

Paper mill
There are two paper machines, that both produce uncoated fine paper from softwood and hardwood. The fine paper model mill is approximately self-sufficient in steam consumption whereas a third of the power consumption must be bought.

3.4.3.4 Kraftliner production

The kraftliner model mill has two paper machines with the same design. One machine normally produces unbleached liner and the other white top liner. Unbleached kraft pulp is produced in the integrated kraft mill, whereas the bleached pulp is purchased.
Apart from the kraft pulp also a considerable amount of recycled fibres is used, especially in the unbleached liner.

The kraftliner model mill including the fibre line, chemical recovery, steam and power generation, liner machines, and effluent treatment.

3.4.3.5 Transport of sawmill chips

The transport related to sawmill chips is included in module 4, as it corresponds to a product derived from wood processing industry by manufacturing of wood products.
This resource represents 30% of the supply of pulp produced in France, and Sweden.

3.4.4 Data acquisition and quality

The manufacturing of pulp and paper and paperboard products is well organized, and is represented by some companies that accounts for the major part of production. The data are therefore more accessible and more robust. Moreover, most of these companies produce a progress report, and data are disseminated by their representative body at European level.

In the Iberian case the data sources differ from follow up routines from enterprises and data from experiments to scientific measurement and branch statistics. In addition expert opinions and in the reference future calculations. In scenario calculations we used EFI-GTM results as a base to our future projections. Expert opinions were used in processes/indicators were no other data was available on the level it was needed for the Forestry Wood Chain. In transport processes the transport tool was used. The data quality is mostly good or moderate, but in some cases poor. In scenario calculations the data quality is generally poor mostly because of the general assumptions behind the calculations.

3.5 Forest to industry interactions (M3) & Forest resource management (M2)

The wood volume covered by M3 for the Iberian case study is 100% of wood harvested to assume the paper consumption in Iberia. Reference year is 2005.

According to 2005 harvesting statistics, total harvested volume was 11.2 mio m³ roundwood under bark (softwood 5.2 mio m³, hardwood 6.0 mio m³). The other raw materiel came from recovered paper (3.5 mio t). Harvested wood is provided as long logs (poles) and short logs for sawmilling, short logs for board production, mechanical pulping, chemical pulping, and wood for bio-energy production (pellet production, energy chips), but we take into account only the harvested wood for pulping.

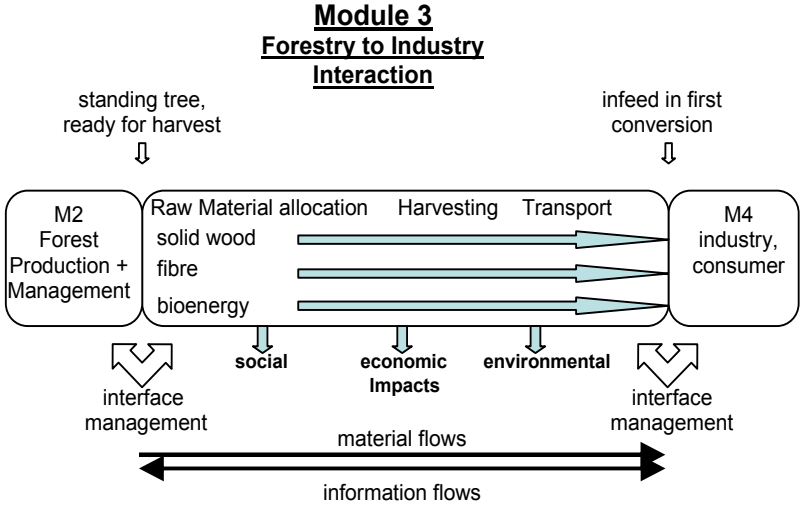


Figure 7:Sceme of M4-M3-M2 relations from an M3 perspective

The forest resources used for wood supply in the case study come from three main regions. The southern Europe area represented by the Portugal/ Spain, Middle Europe represented by France and Northern Europe by the county Västerbotten in Sweden.

	Iberia	France	Vasterbotten
softwood		4%	43%
hardwood	54%		

The Atlantic Arc (Iberia and Aquitaine (in France)) operates principally maritime pine and eucalyptus destined for pulp manufacturer.

REGION	Pinus Sylvestris	%	Pinus pinaster	%	Pinus radiata	%	Other conifers	%	Fagus sylvatica	%	Quercus robur	%	Eucalyptus	%	Other broadleaves	%
Navarra	29				32		22		48		3				44	
Euskadi	15				1542		230				7		48		39	
Cantabria	2				41				477		1		246		4	
Asturias	2		71		71		35		2489		11		314		104	
Galicia	27		2308		654		87				70		2801		54	
North Portugal			1149										1814			
Centre Portugal			3333										1996			
Aquitaine	16		8000						49						296	
Atlantic Arc	102	0.4	**15062**	**56.9**	2340	8.8	488	1.8	107	0.4	321	1.2	**7219**	**27.3**	836	3.2

Table 10: Annual harvest in the Atlantic Arc, Source IEFC, 2002

3.5.1 Wood characteristics

3.5.1.1 MARITIME PINE

To better adapt the pulpwood supply to the industrial needs and to enhance the papermaking potential of the maritime pine Kraft fibers, AFOCEL has created models, simplified into simple charts to help foresters to meet mill requirements[1] [[1]]. A broad sampling of pulpwood logs and sawmill chips was used in 2003 to validate the previous theoretical models. *(Vegetal material consisted in 52 trees from five selected stands aging from 17 to 55 years and different sawmill chips. Kraft cooking was performed in a MK Systems pilot digester, in order to reach Kappa 35-40 and 70-80, then refined using a 12" disks Andritz refiner pilot)*.

It is proved that (i) the models can be used to elaborate industrial strategies of qualitative wood supply, and (ii) for long term issues, connecting the growth models and "fibre and paper quality" models allows to predict the influence of various maritime pine Forest Management Alternatives.

[1] Chantre, G., Bouvet, A., Sens, D., Robin, E., Bongrand, O., "Modeling kraft fiber morphology and paper properties from forest data : the example of maritime pine thinning logs", proceedings from the 2000 TAPPI Pulping / Process & Product Quality Conference, Boston., novembre 2000

Low site index (10.4 m3/ha/year of commercial production)
Initial density of plantation = 1250 st/ha

FOREST DATA					Commercial production			PULP QUALITY (Kappa 35)			
Operation	Age from plantation	Nb of stems/ha before thinning	Average circ (cm)	Average Height (m)	Thinning rate	Comm[al] Unit Volume (m^3)	Comm[al] production (m^3/ha)	Burst index of K pulp (kPam²/g)	Tear index of Kraft pulp (mNm²/g)	Bulk density of kraft pulp (cm^3/g)	Average fibre length (mm)
1 st thinning	14	1168	50.9	10.5	33%	0.07	25.5	6.40	11.98	1.35	2.22
2nd thinning	20	774	67.9	13.7	33%	0.15	39.3	6.17	12.77	1.38	2.35
3 rd thinning	26	514	83.8	17.3	33%	0.30	50.2	6.01	13.31	1.40	2.43
Final CUT	43	325	117.5	24.1	100%	1.03	335.0	5.79	13.96	1.42	2.54
TOTAL							450.0	6.01	13.26	1.40	2.43

Table 11: Example of “Qualitative” Production Table for maritime pine: simulation of growth, fibre and pulp strength properties for every thinning and final cut.

The main resources of maritime pine used in Iberia comes from Aquitaine in France.

Round wood Flow data between France and Spain

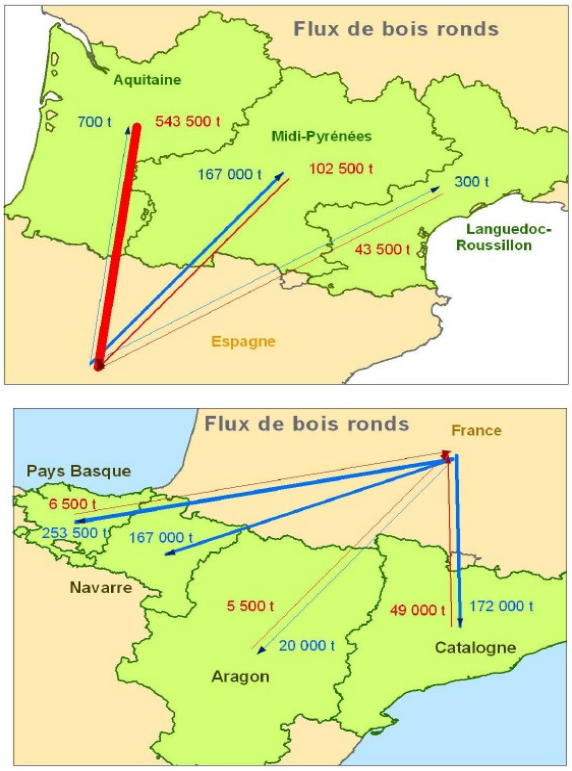


Figure 8: Round wood Flow data between France and Spain Source: AFOCEL

3.5.1.2 EUCALYPTUS

Eucalyptus plantations have been experiencing several decades of considerable development reflecting the plasticity of this kind and its high growth. The physical, chemical and technlogiques its unique timber are a major asset. With an average yield stationer (bleached kraft pulp) between 48 and 52%, this species is superior to most traditional feuilues species.

The harvest is planned when the stems reach a unit volume of about 200 dm3, allowing a levy of 200 tonnes per hectare on average. Under the right conditions and with some clones, this production can be obtained at 9 years. The cultivation of eucalyptus is particularly developed in Portugal and Spain. The total consumption comes from the stands of the peninsula.

3.5.1.3 NORWAY PINE & SPRUCE

Norway Spruce dominated forests, i.e. where more than 70% of growing stock constitutes of Norway spruce, are widely distributed in the Västerbotten county on about 22% of the total forest.

See the Scandinavian case study report PD2.0.5.

3.5.2 Harvesting/forwarding systems

3.5.2.1 Description of maritime pine in Aquitaine (France):

Site and stand characteristics: The maritime pine forest area in Aquitaine is about one million hectares. 891 000 ha are concentrated in the Landes of Gascony, a region with a poor and sandy soil. All of maritime pine stands are even-aged managed. The mean annual increment is actually 10.5 m³/ha/year.

Growth: The following Table roughly sums up the range of productivity depending (1) on the site (2) on the technical schedule

Type of site

	Dunes	Dry lands (Low site index)	Medium and wet Lands (high site index)
Naturally regenerated	4 to 8 m3 /ha/year		
Seedlings on line		5 to 8 m3 /ha/year	8 to 12 m3 /ha/year
Plantations		6 to 10 m3 /ha/year	11 to 15 m3 /ha/year

Regeneration:

The maritime pine forest has been created during the nineteenth century by natural regeneration. Actually, only the local provenance is used with three reforestation methods: the natural regeneration in the coastal dunes represents less then 5% of annual reforestation; the two other methods are direct seedling and plantation. Plantation with improved varieties is a recent practice: less than 10 % in 1980, more than 70 % in 2005. The line spacing vary from 3 to 4.5 m, usually 4 m. Stand density before the first thinning varies from 1100 to 1666 stems/ha.

Management goal:

Depending on stand density, three to five thinnings are necessary to select 250 to 300 tress for the final crop. The target diameter is generally about 40 cm. 8 to 9 millions m³ are annually harvested : 60 % sawing logs and 40 % pulp logs. The highest qualities of sawing logs are used for peeling, panelling or flooring. The remainder is used to produce box and pallets.

The thinning are the principal sources of wood for pulp and paper. :

Regeneration 0-3 years	Precommercial thinning	Generally two pre-commercial thinnings to decrease the stand density down to 1200 to1400 st/ha
Medium 6 – 30 years	Thinning	Average schedule = 1) 30 to 40% of the trees when average girth C =55 cm 2) 25 to 30% of the trees when C=80 cm 3) 25 to 30 % of the trees when C=100 cm
Adult (Mature) 35-60 years	Thinning	Sometimes 15 to 20 % of the trees are removed for commercial reasons 3 to 5 five years before the final cut
	Final harvest	When C=120 to 140 cm

3.5.2.2 Description of eucalyptus in Portugal (economic/production stands)

It is important to stress though, that only 1/4 of the eucalyptus forest area is managed by the pulp and paper companies, the remaining area belongs to private owners with no management preoccupations.

Site and stand characteristics:
The Eucalyptus globulus Labill. area selected for this study is located in the North and Central coastal Portugal and concerns 11 Forest Planning Regions. Eucalyptus is a fast growing species that grows exceptionally well in Mediterranean countries. It is preferably located in coastal areas and below 700 m height. It shows higher productivities for high precipitation values and small number of days of frost. Most of eucalyptus stands are planted. These plantations are mainly used by the pulp industry, being managed as short rotation coppice systems, with a first cycle of planted seedlings followed by 1 or 2 coppiced stands, with an average cutting cycle of 10-12 years.

Regeneration:
All eucalyptus stands originate from plantations which are usually managed for three rotations. Starting with the second rotation the stands are regenerated as coppice. The initial planting grid is approximately 4 x 2 m (~1200 seedlings per ha) with replanting of dead trees 6 months after planting. Due to this species coppicing ability stands can be “self-regenerated“ after the final harvest cut.

Management goal:
Volume production for the pulp and paper industries. Recently, woody debris is being used for biomass for energy.

Young (3-4 years)	Precommercial thinning	Thinning of the shoots leaving 1.5 shoots per stool off. Before this operation we have 6-7 shoots per stool, so this thinning is carried out in order to maintain the stand’s initial density
Medium (5-12 years)	Pre-commercial thinning	Thinning of the shoots if there are new sprouts after the first thinning in order to maintain the stand’s initial density.
	Thinning	Thinning after insects or fungi attacks, if necessary
	Final harvest	Tree harvest and wood processing

3.5.2.3 Description of current management in Västerbotten/ Sweden for Scots pine

Young	Precommercial thinning	Tree height = 1 m; schematic reduction to 1000 – 1500 seedlings if risk of moose damage is low.
Medium	Precommercial thinning	Tree height = 5-8 m; schematic reduction to 1000 – 1500 seedlings if risk of moose damage is high.
Adult (Mature)	Thinning	Tree height 14-16 m removal of 40% of basal area. Tree height 16-18 m removal of 35% of basal area.
	Final harvest	Clear cut when trees are higher than 20 m

3.5.3 Processes defined in M3 – harvesting/forwarding/wood

SPAIN AND PORTUGAL : EUCALYPTUS

1000030 Spain and Portugal : Harvesting of planted eucalyptus with medium single-grip harvester
1000070 Spain and Portugal : Harvesting of coppice eucalyptus with small single-grip harvester
1000073 Spain and Portugal : Final measuring, grading and sorting
1000074 Spain and Portugal : Transport by truck with crane
1000080 Spain and Portugal : Forwarding by medium forwarder (12 tons)
1000136 Spain and Portugal : Pre-commercial thinning of 6-7 shoots per stool on second and third rotation
2030566 Spain and Portugal : Harvesting of coppice eucalyptus with small single-grip harvester
2030567 Spain and Portugal ; Pre-commercial thinning of 6-7 shoots per stool on second and third rotation

FRANCE : MARITIME PINE

1000319 France_Felling with medium harvester of Maritime pine
1000324 France_Clear-cut with large harvester of Maritime pine
1000345 France_Forwarding with large forwarder of Maritime pine
1000347 France_Forwarding with medium forwarder of Maritime pine
1000802 France_felling with small harvester or maritime pine
1000803 France : Transport by 44 t truck with crane acc to assortment

VASTERBOTTEN : PINE & SPRUCE

2030582 Pre-commercial thinning of pine stand in young phase
2030583 1st thinning by medium harvester
2030584 Forwarding by medium forwarder
2030585 2nd thinning by medium harvester
2030586 Forwarding by medium forwarder
2030587 Final felling by large harvester
2030588 Forwarding by large forwarder
2030589 3rd thinning by medium harvester
2030590 Forwarding by large forwarder
2030591 Single tree selection harvesting with large harvester
2030592 Forwarding by large forwarder
2030593 Transport by 60t truck with crane to pulpmill
2030594 Final measurement and sorting at pulpmill

3.5.4 Processes defined in M2

1000002 Development of coppiced eucalyptus stand in medium phase with harrowing
1000014 Spain and Portugal : Application of fertilizers and thinning of eucalyptus saplings on second and third coppice rotation
1000031 Development of coppiced eucalyptus stand in young phase with harrowing and fertilization
1000036 Spain and Portugal : Site preparation, weed control and planting of eucalyptus
1000062 Development of planted eucalyptus stand in medium phase
1000091 Development of planted eucalyptus in young phase with 3 weed controls and 2 fertilizations
1001401 Forest growth (planting, seedling, young stand development, medium age and mature)
2030563 Development of coppiced eucalyptus stand in young phase with harrowing and fertilization
2030564 Spain and Portugal : Application of fertilizers and thinning of eucalyptus saplings on second and third coppice rotation
2030565 Development of coppiced eucalyptus stand in medium phase with harrowing

2030571	Medium age stand development with first thinning (Tree height 14-16 m, 40% of BA) (Pine in Vasterbotten)
2030573	Young stand development with 1 pre-commercial thinning (Tree height 1-2 m reduction to 1000 â€“ 1500 ha-1) (Pine in Vasterbotten)
2030576	Medium age stand development with fertilization (120 kg N ha-1) (Pine in Vasterbotten)
2030577	Medium age stand development with second thinning (Tree height 16-18 m, 35% of BA) (Pine in Vasterbotten)
2030578	Adult stand development with fertilization (120 kg N ha-1 5-10 years prior to final felling) (Pine in Vasterbotten)
2030579	Adult stand development with third â€œthinningâ€? (Tree height 18-20 m, removal of trees down to 50-150 seed trees ha-1) (Pine in Vasterbotten)
2030580	Adult stand development (seed trees) (Pine in Vasterbotten)
2030581	**Adult stand development (spruce in Vasterbotten)**
2030595	**Site preparation. Three years after final harvest disk scarification (Pine in Vasterbotten)**

3.5.5 Data acquisition and quality

Several data sources were used like official statistics, machine calculations schemes, partners' own calculation models and data from own investigations. Where no information was available, expert opinion was used.

The silvicultural models are tools developed largely for the major species. ISA - Portugal developed a model of eucalyptus, FCBA provided a model for maritime pine, and Skogforsk' model on pine and spruce has been used. These models are considered to be robust, not only from many experiments, and data collection, but also from an operational, where calculations has been performed by experienced users. Thus, the data used is of high quality and representative of the resources used. Only a minority of the indicator values can be considered to be of low quality (social data in particular).

However, data present in the Eforwood Database Client must be used with care since many compromises and assumptions lie behind the numbers.

4 Scenarios applied

The specific objective of this case is to model the forestry wood chain from the consumption perspective. Hence, scenarios to be considered are those related to consumption and more specifically its evolution in the years to come. Indeed, changes in consumer behavior, even within the forestry wood, or by substitution or products will have consequences in terms of impacts in the environmental, economic and social dimension of sustainability.

The ambition was to test the tool ToSIA to calculate the consequences of a changes in consumption of paper products. One such area is the rise of new communication technologies that can alter the manner of use and volume of printed media products (magazines, newspapers, etc).

Finally, as a test of the tool (but not necessarily a probable scenario) a scenario

was developed which meant a +/-25% change in overall consumption of newsprint.

5 Results

5.1.1 Theoretical results

The modelling of the flow from consumption to production of biomass in the forest was the major objective of this case. The applied tool proved capable of supporting evaluation of changes of the value chain and associated impacts as consequences of changes in consumption.

The results indicate the success of the ToSIA model. Even though the scope of the case study was reduced, to encompass only paper products, the model was capable to assess the effect of a shift in consumption of Newsprint.

Areas for further development is the use of computational loops (convergent series) to take into account the recycling and reuse feedback loops of materials.

5.1.2 ToSIA results

The preliminary results of the Iberian case shows that an increased rate of collection and sorting of waste paper could reduce environmental impacts. 5% growth rate of collection and sorting results in a reduction of 5% of atmospheric emissions.

However, the model also shows that air emissions are mainly related to manufacturing (45%) and distribution (54%).

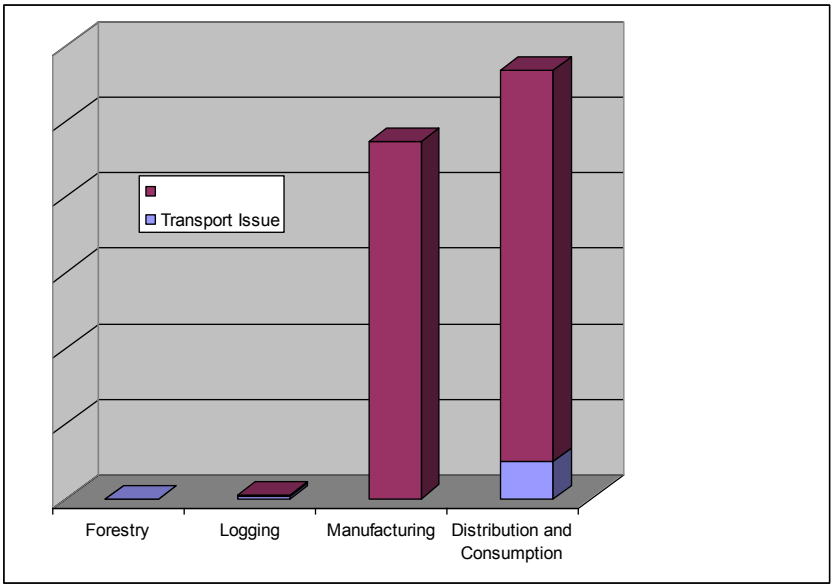


Figure 9: Preliminary results; GES Emissions (kg eq CO2)

Although the exact figures can not be presented, the rate of employment in the stages of distribution, consumption, collection and sorting represents over 75% of total employment in this case study.

5.1.3 Discussion

A number of simplifying assumptions leads to an inaccuracy of the results. However, the guidance given by the comparison of different ToSIA runs is useful to support decision making.

Subsequently, the user should be able to supplement or add processes to improve the accuracy of results.

The recycling loop has to be developed further. For now, the calculation (back) including recycling increases the amount of material in each iteration, giving a total amount of material overestimated.

6 Case study method

6.1 Methodologies

The Iberian Case Study use quantitative methods and tools, namely:

- Official statistics and quantitative data.
- Statistic estimators for not available data.
- Multivariable models (ToSIA).

Data approach:

- Decision on disaggregation: keep data at disaggregated level, but aggregate when disaggregation is not possible (being pragmatic, simplicity is needed).
- Time frame of the case study: focusing on the year 2005, as time and resource constraints and priorities did not make it possible to do the evaluation for reference futures and scenarios for 2015 and 2025..

6.2 Stages of the development of Iberian Case Study

6.2.1 Product selection and mapping

M5 – Industry to consumer interactions
Market characterisation in details
Estimation of 60-80% consumption of each product group: selection of product chains
Processes for selected products (including transport); mapping of chains

M4 – Processing and manufacturing
Industry definition: model mills
Production processes of the products of each chain

Imports of M4 products
Processes for selected products; mapping of chains
Material flows

M3 – Forest to industry interactions
Forest operations chains (incl. harvesting systems)
Wood characteristics
Outcomes and cuttings
Transport
Processes for selected products; mapping of chains
Material flows
Harvesting modelling and expected results

M2 – Forest resource management
Information on forest resources: land, type of forest, forest uses (production, recreational...), risk analysis, etc.
Management alternatives / Processes; mapping of chains
Data sources

6.2.2 ToSIA Inputs: Data collection for sustainability indicators

Based on deliverable PD0.0.15 ; Manual for case study data collection.

6.3 Management of the case study

The case study coordination was initially done by AIDIMA. New roles for partners in the project lead to a transfer of the coordination responsibilities to FCBA in the middle of the project.

Already at an early stage difficulties were encountered in establishing the flow of wood products (especially from the wood construction, furniture, and wood for energy applications). It was found that the market information on the one hand, and related data on processing and international trade of these products on the other hand were not collectable and identifiable satisfactorily. Therefore, it was decided to reorient the Iberian case on paper products, whose main sources of raw materials were in Spain, Portugal, France and Sweden.

Based on consumption figures, it was further decided to focus on three products: fine office paper, newspaper, and corrugated boxes. FCBA and the project team noted difficulties to find upstream data for these applications which lead to the following decisions:

1 - maritime pine from France had robust and reliable data, which was adequate for the case study and hence could be used

2 - the only data on eucalyptus in the project, came from the work of the ISA, representing Portuguese forestry. This data was applied to Eucalyptus for the whole Iberian region: Portugal and Spain. It was considered acceptable to use

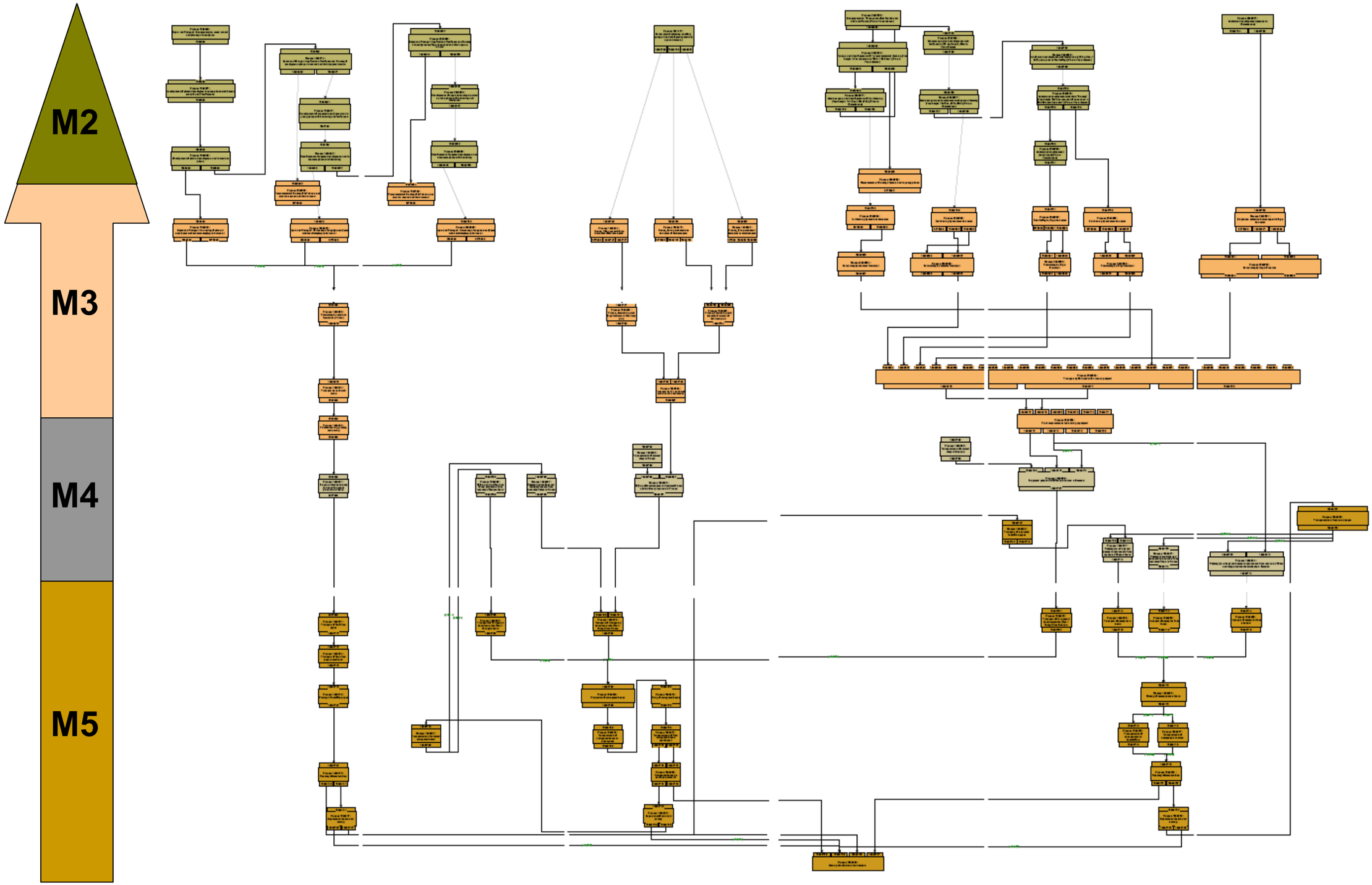
the Portuguese indicators in the absence of data on Eucalyptus forestry in Spain.

3 - data on forestry in the Nordic countries had already been collected in the Västerbotten case. It was decided to use the same date to represent wood imports from the Nordic countries into the Iberian region.

The changes in case study coordination and the difficulties to find upstream data caused some delays in the case study.

In addition, the calculation of recycling loops was difficult to implement in ToSIA. A lot of time and attention was given to this matter which made it impossible to run and evaluate scenario runs as planned initially.

Although the Iberian case did not reach all its initial objectives, it still demonstrated the ability of ToSIA to operate in a market driven mode and analyse changes in consumption and their impact on timber supply from European forests.


M2
M3
M4
M5