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 PD5.1.5
Report on revised process mapping and aggregation, serving the case studies in WP 5.2, including identification of tentative sustainability indicators for WP 5.3

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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)	

Contents:

1 Objectives

This deliverable includes the results of the mapping process of Work Package 5.1 (Mapping, aggregation of processes and value chains for final products) in Module 5 (Industry to consumer interactions) of the Eforwood project and a set of indicators serving the data collection in the single chains.

The main objectives of this deliverable are:

a. The fine tuning of the identification of the methods and processes to be fulfilled for working out with WP 5.1. Methods are related to:

   Mapping for processes related to FWC products in the test chains of the interactive chains in the final links of the supply chain, including the interaction between industrial manufacturers and distributors, retailers, professional users and end-users (consumers).

   Aggregation of the before-mentioned processes in the test chains of the interactive chains, establishing the boundaries and limits of FWC final interaction between industry and end-users.

b. Providing a set of sustainability indicators for the collection of data in the single chains, regional chains, case studies and European Forestry Wood Chain.

This deliverable fits in the Module 5 specific objectives in the extent that planning and actions presented here will be the operational basis for further work, including the development and fulfilment of WP 5.1. The focus of WP 5.1 is intrinsically related with the more general objectives of Eforwood. The mapping and aggregation of processes in the test chains will be useful for further identification of reference chains at case study level, regional and EU level, having an operational frame in which new FWC tests may be implemented. Furthermore, to map and aggregate processes and products in interacting value chains will lead to an appropriate implementation of sustainability impact assessment (SIA) tools applied to similar chains. The sustainability issue is a key point of Eforwood, focusing on evaluating the impact in terms of sustainability along different forest and wood-based interacting value chains.

Module 5, and particularly WP 5.1, contributes to the general objectives of Eforwood by including the consumption perspective in the global analysis, being crucial for a comprehensive understanding of the final links of the supply chains. Forestry-Wood-Chain products are organised in a supply chain in which raw materials, intermediate materials and finished goods are procured through a chain of processes that supply one another. This chain of processes is reflected in the modular structure of the project. The contribution to the rest of Eforwood modules will be clear in the extent that this deliverable will identify the final links of the FWC, complementing the analogous work performed by the rest of modules in preceding stages of the FWC (Module 2: Forest Resources Management; Module 3: Forest to Industry Interactions; Module 4: Processing and Manufacturing):

Mapping of this deliverable has been aligned with that one of Module 4, so industrial boundaries are agreed and no overlapping is generated in the global FWC. The inputs of Module 5 are the outputs of the processes in Module 4. Potential contribution of WP 5.1 to other modules includes the implementation of interacting processes between industry and consumption in ToSIA, which can be characterised as a dynamic FWC pathway analysis model. Thus, this deliverable should make clear the processes between industry and consumption when implementing further FWC in ToSIA. Moreover, testing the tool in a stepwise procedure with different cases (test chain, single chain, regional case studies) will allow adjustments to be made according to the experiences gained in the starting stages of Eforwood. Virtually, changes might be proposed to upstream modules to improve FWC product's functional performance with a view to improve the level of sustainability in interacting value chains. By fulfilling these aims, WP 5.1 contributes to the enhancement of ToSIA utility for stakeholders and the European forest industry in general.

2 Process mapping and aggregation

2.1 Interactive chains and test chains

Consumers purchase and use products with full or partial origin in the forest. Commodity type FWC products are distributed to interacting value chains for further processing and adding value. Forest-based products are incorporated into more and less complex products consisting of various materials. Main task of WP 5.1 is to establish the methodology needed for identifying the final processes included in the supply chains of forest-based products. Under this scope, this deliverable covers the part of the FWC where the chain comes virtually to an end, with consumers as the closing link. In the "industry to market" part of the FWC, one can distinguish the following major subjects of influence in this stage:

i. transportation and logistics systems,
ii. production processes in interacting value chains,
iii. systems for recovery of used materials and flow back of material to M4 serving as raw material;
iv. policy issues related to the area, and
v. intermediaries and consumers needs, views and perceptions.

The detailed analysis of supply chains in the FWC in Module 5 through the mapping and aggregation of processes comprises of environmental matters (material use, energy use and emissions from production and logistics processes, wasted products and waste creation), economic matters (much of the added values occur along this part of the FWC) and social values (safe products, availability…).

A **supply chain** or supply network is a coordinated system of entities, activities, information and resources involved in moving a product or service from supplier to customer. The entities of a supply chain typically consist of manufacturers, converters, service providers, distributors, and retail outlets. Supply chain activities transform raw materials and components into a finished product along the primary and secondary industrial transformation before being distributed to the end-user.

Frequently there may be a chain of intermediaries, each passing the product down the chain to the next organisation, before it finally reaches – after a series of processes - the consumer or end-user. These processes can be described by a process mapping. **Process mapping** is a technique using workflow diagrammes to bring forth a clearer understanding of a process or series of parallel processes along the interactive supply chains within the scope of the project and their different modules:

- Module 3 "Forest to Industry Interaction"
- Module 4 "Processing and Manufacturing"
- Module 5 "Industry to Consumer Interactions"

The final products referred to in this project and managed in task 5.1 are from the three different interactive chains:

- Interactive chain 1: WOOD incl. wood-based panels
- Interactive chain 2: PAPER
- Interactive chain 3: BIOENERGY

ToSIA applies to FWCs at various scales of geographic area and time perspective. Therefore, test chains were defined taking into account different approaches (forest-defined, industry-defined, consumption-defined). The rationale for executing the Test Chains exercise is the later integration into three Regional Cases. In this deliverable, the first testing of the mapping and aggregation process in in the single chains order to provide the first data to the preliminary ToSIA is finished.

The following test chains are defined:

- A forest-defined pine chain in Scandinavia for furniture and bio-energy.

The approach of this test chain is to study a raw material driven FWC including interactive chain 1 (wood incl. wood based panels) and 3 (bioenergy) focussed on the use of pine wood. The materials focussed on are pellets for bioenergy use and solid wooden pine chair.

- A product-defined fine paper/newspaper chain.

This chain is a consumption driven approach focused on the Iberic peninsula, mainly based on eucalyptus and including recycling. This case study is including the interactive chain 2 (paper). The material involved is fine paper for printing and newspaper, printing processing and collection and sorting of used paper for recycling.

- A regional-defined spruce chain in Baden-Wurttemberg.

The approach of this case study is to describe a closed region including the raw material driven approach as well as the consumer driven approach in order to create a whole overview of the forestry wood chain in that region. The case study is including the interactive chain (wood incl. wood based panels) focusing on the use of Spruce wood for the use in timberframe house building.

2.2 Process mapping for the single chains

The processes of the case studies have been updated and fine tuned in order to start the first data collection for testing the ToSIA later on.
In the following pages the parts corresponding to Module 5 are visualised in workflow diagrammes. The border between Module 4 and Module 5 has been set between the manufactured product in M4 and the transport of the product to the first user or retailer of the products. Each M5 chain starts thus with a transport process.

The flow diagrammes of the different test chains visualised below are:

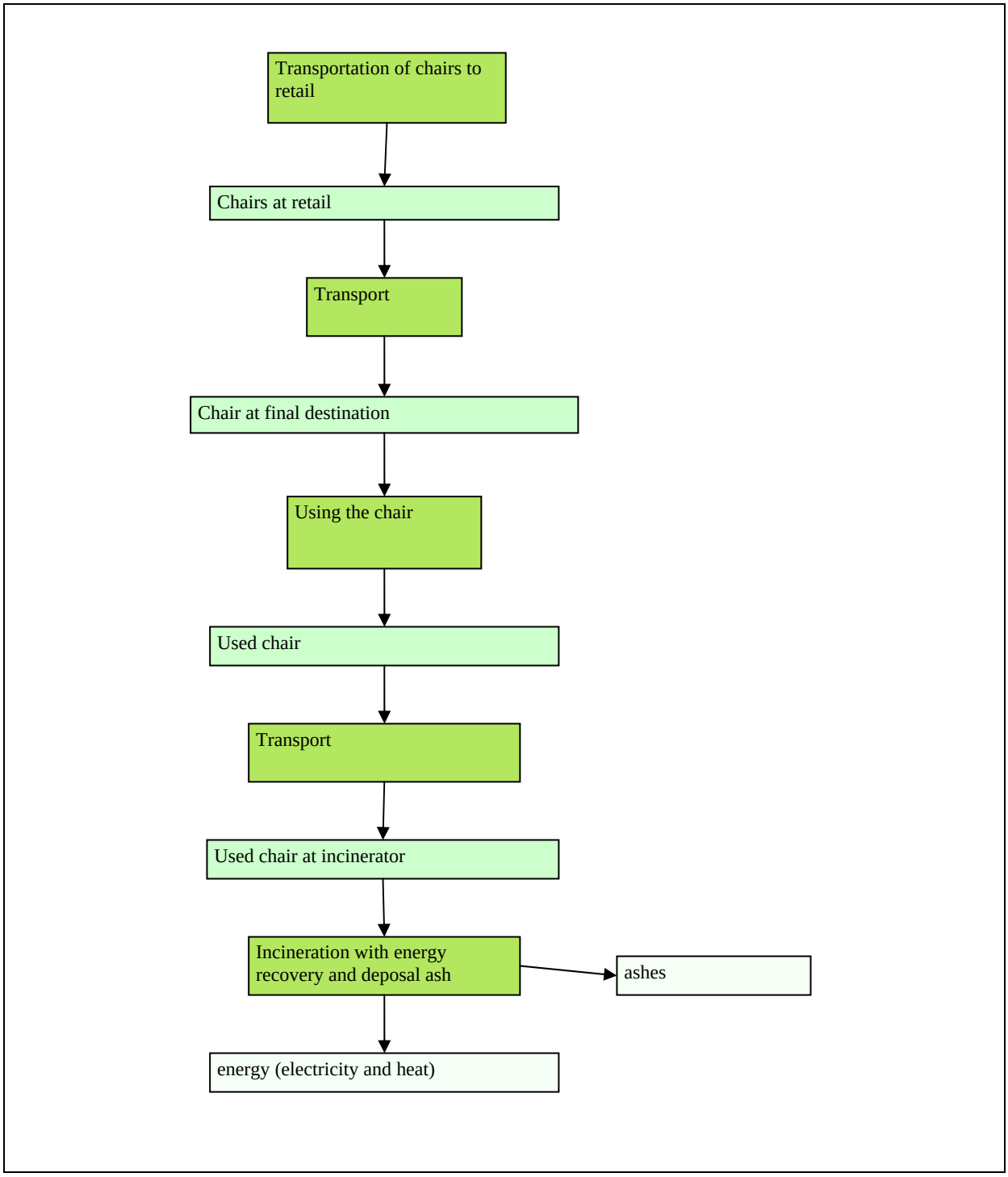
Test chain 1 - furniture:
The input process for this chain in M5 is a pine chair to the retailer site. At the end of life in M5 the chair becomes incinerated with the recovery of the produced energy, both for electricity generation and in the form of heat. The ashes become disposed.

Test chain 1 - bioenergy:
The input process in M5 for this chain is the transport of the pellets to the end user. The final outcome of the chain is energy in the form of heat and little amounts of ashes.

Test chain 2:
Test chain 2 has two different inputs in M5. The first input process is the transport of fine paper to offices. The second input is the transport of newsprint paper to the printer site. At the end of life of both input streams two management option are possible: the used paper gets collected and separated and transported back to M4 for recycling (material back loop), or the paper get collected for waste management. The outcomes of the waste management are energy in the form of electricity and heat and ashes.

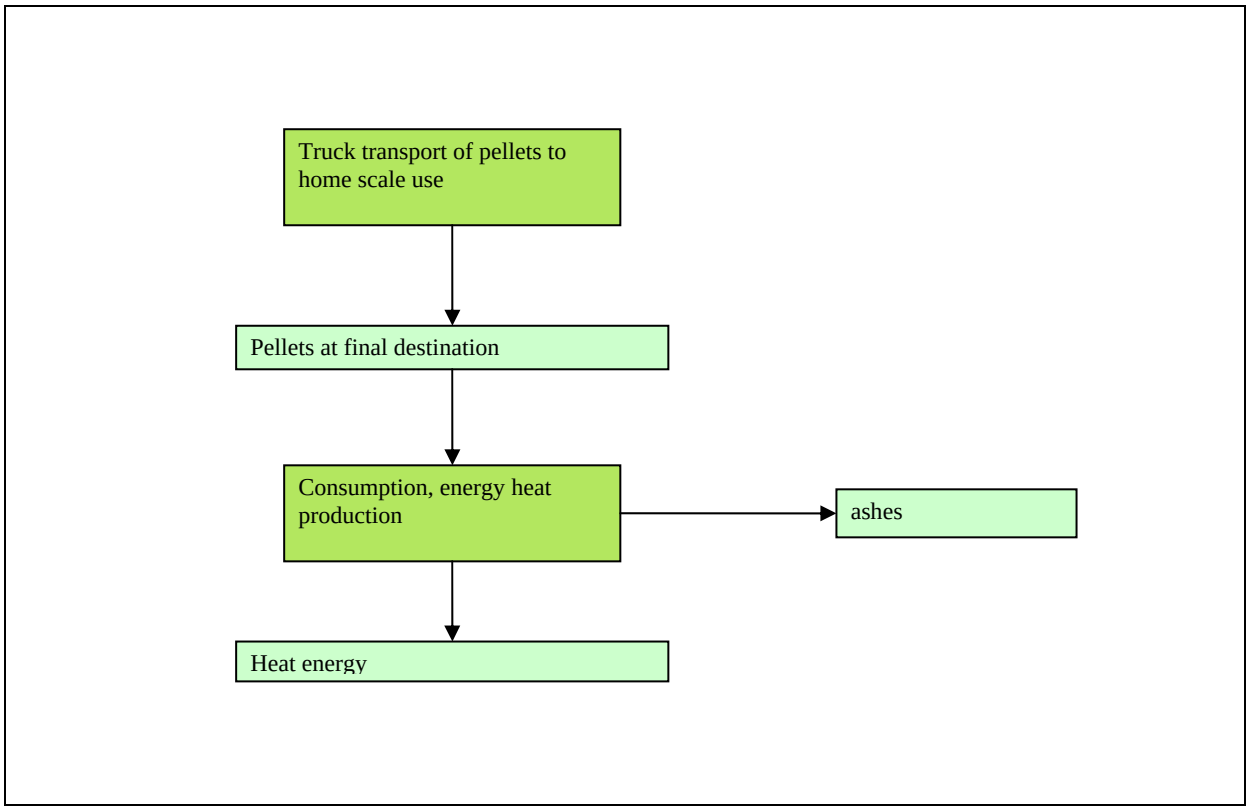
Test chain 3:
The input process in M5 of test chain 3 is the transport of the prefabricated external wall panel from the producer site to the house building site. The final outcome of the chain at the end of life is the transport of the demolished timberframe from the recovery site to the panelboard producer (material recovery).

2.3 Test chain 1: A forest-defined pine chain in Scandinavia for furniture and bio-energy - furniture

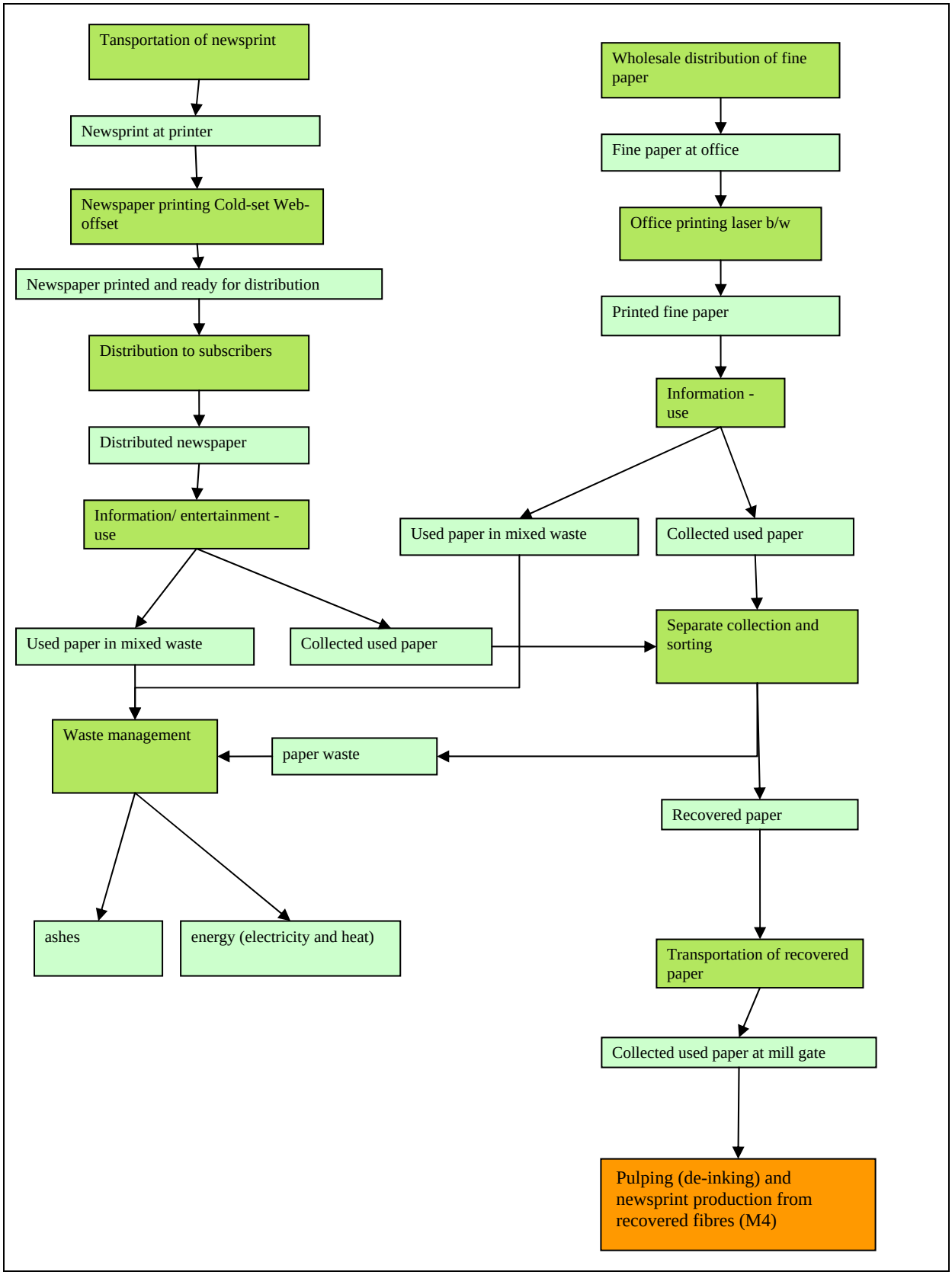


2.4

Test chain 1: A forest-defined pine chain in Scandinavia for furniture and bio-energy - bioenergy

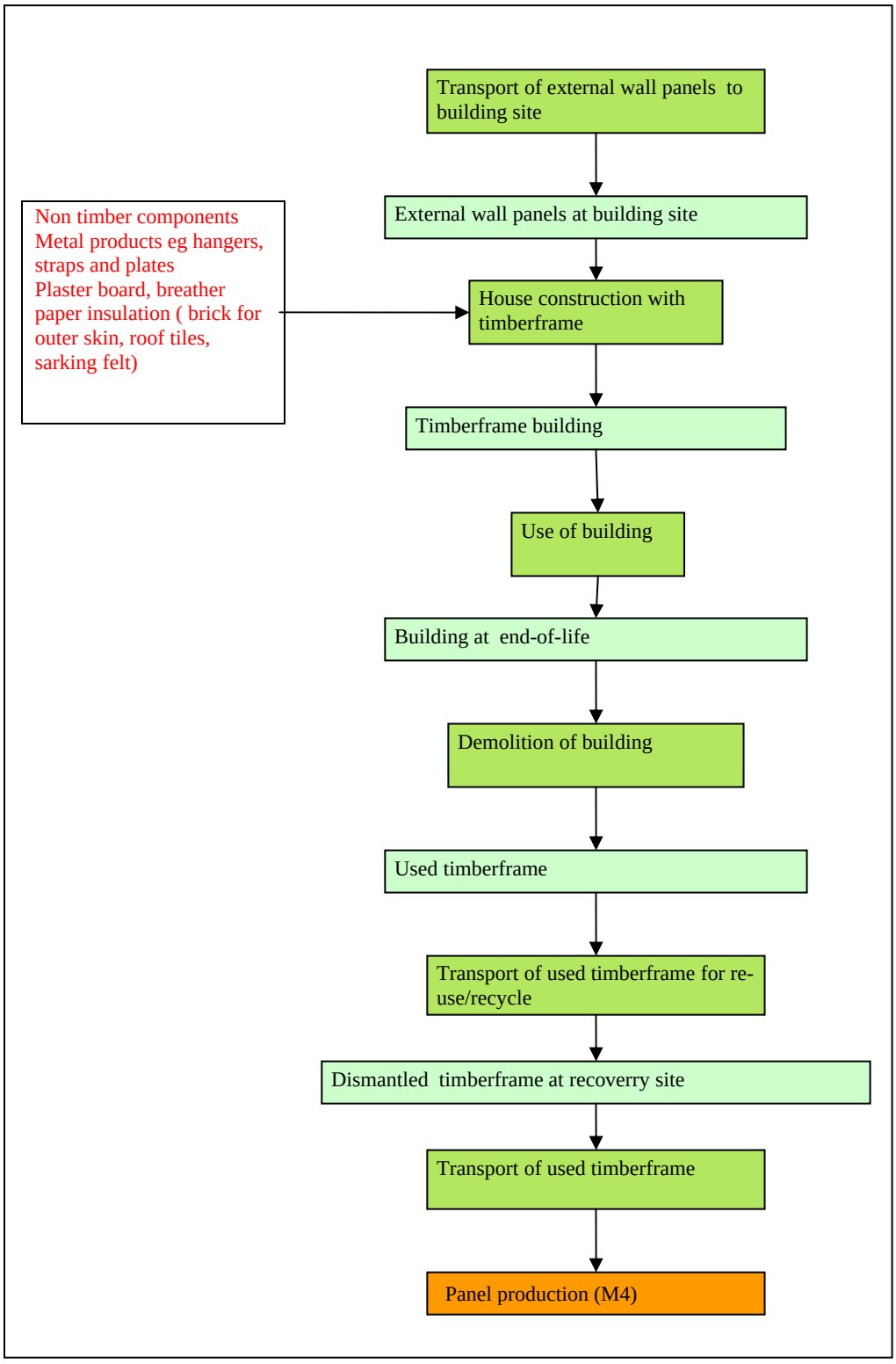


2.5 Test chain 2: A product-defined fine paper/newspaper chain mainly based on eucalyptus and including recycling



2.6

Test chain 3: A regional-defined spruce chain in Baden-Wurttemberg



3 Indicators

The indicators for data collection have been revised in 5 working groups:

- Working group on environmental related indicators
- Working group on energy related indicators
- Working group on transport related indicators
- Working group on waste related indicators
- Working group on socio-economic related indicators

M5 was represented in the working groups for giving the necessary input in the development of the indicators concerning producer –consumer interaction related topics. Serving the data collection of the single chains a set of indicators has been prepared and a protocol for use, including boundaries and reporting units. Within M5 it has been decided that no module specific indicators will be defined for the single chain data collection.

The proposed indicators are divided according to the three sustainability dimensions for the Forestry Wood Chain.

> *Economic*: competitiveness, value-adding, development of existing and new markets, real income, investment capital formation, cost-benefit, energy use and production."
>
> *Social*: employment, consumers' requirements for and expectations of products and services, cultural values, recreational possibilities, rural development, human health and well being.
>
> *"Environmental and energy*: biodiversity, carbon sequestration, soil fertility, pollutants and wastes, water quality, energy efficiency in production, water use efficiency, change of natural resource stock and degree of recycling.

The list of the indicators to be dealt with is provided below. The selection and definition of indicator and recommendations will be consistent with the reports from the Indicator Working groups, on Socio - Economic indicators, Energy, Environmental indicators, Transport and Waste.

3.1

List of indicators

Indicators in black are operative for immediate data collection for the Single FWC. The indicators 4, 7, 16, 19 were still subject for improvements and further definition, they are marked in red in the table. Indicator 18 had been deleted from the previous list. The indicators marked in blue (17, 20, 21, 28, 30, 31) have not been dealt with by the indicator groups and are not used for the data collection within the test chains. The indicators marked in black and red have been used for the data collection in their existing definition, the red ones were still open for revision and fine tuning later on regarding to the experiences gained during the data collection.

Economic indicators

Number	**(1)**
Name	**Gross value added and gross domestic product**
Sub- Indicators	1.1. Gross value added (at factor cost) by processes within each Module (M2-M5)
Measurement units	1.1 in Euro (million) per reference unit .
Number	**(2)**
Name	**Production costs**
Sub- Indicators	2.1. Average cost by processes within each Module (M2-M5) classified by: a) Raw materials from FWC [Production cost of process inputs from the FWC i.e. wood raw material from preceding FWC processes] b) Raw materials from outside FWC [Production cost of process inputs from outside the FWC] c) Labour costs d) Energy costs (e.g. fuel costs in case of transportation) e) Other productive costs (maintenance, general industrial costs, administrative costs, etc) f) Non-productive costs (corporate taxes, capital charges, VAT and any other taxes or charges)
Measurement units	2.1.a – 2.1.f) in Euro (million) per reference unit .
Number	**(3)**
Name	**Trade balance**
Sub- Indicators	3.1. Imports of wood in total FWC and by sub-sector classified by: a) volume b) value c) % of total volume consumed 3.2.Imports of products derived from wood in total FWC and by sub-sector classified by a) volume b) value c) % of total volume consumed 3.3. Exports of wood in total FWC and by sub-sector classified by: a) a) volume b) value c) % of total volume consumed 3.4. Exports of products derived from wood in total FWC and by sub-sector classified by a) volume b) value c) % of total volume consumed
Measurement units	3.1.a and 3.2.a and 3.3a and 3.4a) ktonnes, kg, m^3, etc. (depends on product unit)

	per reference unit. 3.1.b and 3.2.b and 3.3b and 3.4b) Euro (million) (aggregated) per reference unit.. 3.1.c and 3.2.c and 3.3c and 3.4c) % of total volume consumed per reference unit.
Number **Name** **Sub- Indicators**	**(4)** **Resource/ material use** 4.1.) volume of material from inside the FWC of virgin origin 4.2.) volume of material from inside the FWC of recovered origin 4.3.) volume of material from outside the FWC of virgin origin 4.4.) volume of material from outside the FWC of recovered origin
Measurement units	4.1– 4.4) ktonnes, m^3, kg, etc. (depends on the unit) per reference unit.
Number **Name** **Sub- Indicators**	**(5)** **Enterprise structure** 5.1. enterprises and forest holdings in total FWC and by sub-sector classified by: a) size classes i. enterprises: micro and small enterprise (0-49 employees), small and medium sized (50-249 employees), large enterprises (>250 employees) ii. forest holdings (≤500 ha), (≥ 500 ha) b) ownership categories for forest and other wooded land i. in public ownership ii. in private ownership iii. in other ownership
Measurement units	5.1.a) number per class per reference unit. 5.1.b) number per category per ha per reference unit.
Number **Name** **Sub- Indicators**	**(6)** **Investment and Research & Development** 6.1. Investment (gross fixed capital formation) in total FWC and by sub-sector classified by: total value of fixed assets (machinery and equipment, vehicles &, the value of land improvements, and buildings) 6.2. Research & Development expenditure in total FWC and by sub-sector classified by: total value of private and public expenditure:
Measurement units	6.1 – 6.2) in Euro (million) per reference unit.
Number **Name** **Sub- Indicators**	**(7)** **Innovation** 7.1. New products in total FWC and by sub-sector classified by: a) goods (definitions see annex) b) services (definitions see annex) 7.2. New technological processes in total FWC and by sub-sector
Measurement units	7.1.a –7.1.b & 7.2) total number per reference unit. 7.1.a –7.1.b & 7.2) in % of turnover per reference unit.
Number	**(8)**

Name	**Total production**
Sub- Indicators	8.1. Goods (marketed) (classification see annex) in total FWC and by sub-sector classified by: a) volume b) value 8.2. Services (marketed) (classification see annex) in total FWC and by sub-sector classified by a) volume a) b) value
Measurement units	8.1.-8.2.a) tonnes, kg, m³, etc. (depends on the product) per reference unit. 8.1.-8.2.b) Euro (in million) per reference unit.

Social indicators

Number	**(9)**
Name	**Employment**
Sub- Indicators	9. 1. Persons employed by processes within each Module (M2-M5) classified by gender categories i. male ii. female
Measurement units	9.1.) Number of employees per year (in full-time equivalents) per reference unit.

Number	**(10)**
Name	**Wages and salaries**
Sub- Indicators	10.1. Wages and salaries by processes within each Module (M2-M5) classified by gender category i. male ii. female
Measurement units	10.1. €/hour per reference unit.

Number	**(11)**
Name	**Occupational safety and health**
Sub- Indicators	11. 1. Occupational accidents by processes within each Module (M2-M5) classified by: a) non-fatal occupational accidents b) fatal occupational accidents 11.2. Occupational diseases by processes within each Module (M2-M5)
Measurement units	11.1.a) absolute numbers and in % per 1000 employees per reference unit. 11.1.b) absolute numbers by 100 employees per reference unit. 11.2.) frequency of cases per number of persons exposed multiplied by number of years of exposure and in % per 1000 employees per reference unit.

Number	**(12)**
Name	**Education and training**
Sub- Indicators	12. 1. Education time by processes within each Module (M2-M5) 12.2. Training expenditure by processes within each Module (M2-M5)
Measurement units	12.1.) per person-year working time per reference unit. 12.2.) in Euro per person-year working time per reference unit.

Environmental and Energy

Indicators

Number	**(13)**
Name	**Energy generation**
Sub- Indicators	13.1. On-site energy generation from renewables by processes within each Module (M2-M5) classified by origin: The total renewable energy generated in the process; energy generation from renewable sources in excess of what is needed in the process (e.g. sold to the grid) should also be accounted for here. i. from residues from process – inputs (wood processing residues and lignin) ii. from other wood biomass – (wood with the main purpose to be used for energy) (branches, small logs, tops, debris and other forest residues) iii. Non-wood based renewable energy (other biomass, wind, solar, geothermal, hydropower etc.) 13.2. Energy use by processes within each Module (M2-M5) classified by origin: The total amount of energy used within the process, classified by origin: i. renewable energy **(see LI 15c)** (excluding electricity from the grid) ii. non-renewable energy (oil, gas, coal, nuclear and others) (excluding electricity from the grid) iii. Electricity from the grid (external electricity; this may origin from renewable or non-renewable sources)
Measurement units	13.1.a & 13.2) absolute numbers in energy terms (MWh) per reference unit.
Number	**(14)**
Name	**Greenhouse gas balance**
Sub- Indicators	14.1. Greenhouse gas emissions by processes within each Module (M2-M5) 14.2. Carbon sequestration by processes within each Module (M2-M5) on average for the reference year averaged over a period of 5 years for: a) living woody biomass above and below ground, dead wood and in soils of forest **b)** harvested wood products
Measurement units	14.1, 14.2.a – 14.2.b) all converted in kg of CO_2-equivalents per reference unit.
Number	**15**
Name	**Distance and load indictor**
Sub- Indicators	15.1. Transport distance (loaded and backhaulage for road mode) by processes within each Module (M2-M5) classified by mode of transport: 15.2. Volume of freight (loaded and backhaulage for road mode) by processes within each Module (M2-M5) classified by mode of transport
Measurement units	15.1 km, 15.2 ton
Number	**(16)**
Name	**Water use**
Sub- Indicators	16.1. Water use by processes within each Module (M2-M5)
Measurement units	kg per reference unit. 1kg = 1 dm^3 of water
Number	**(17)**
Name	**Forest resources**
Sub- Indicators	
Measurement units	
Number	
Name	
Sub- Indicators	
Measurement units	

Number	**(19)**
Name	**Emisions to soil, water and air**
Sub- Indicators	19.1 Soil pollution by processes within each Module (M2-M5) 19.2 Water pollution by processes within each Module (M2-M5) classified by: a) organic substances (biochemical oxygen demand) b) nutrients (nitrogen, phosphorus) as BOD5 c) hazardous substances
Measurement units	21.2.a – c) gram or kg per reference unit.
Number	**(20)**
Name	**Tree species composition - not treated**
Sub- Indicators	
Measurement units	
Number	**(21)**
Name	**Corporate responsibility**
Sub- Indicators	
Measurement units	
Number	**(22)**
Name	**Generation of waste**
Sub- Indicators	22.1 Generation of waste 22.2 Hazardous waste (part of 22.1) 22.3 Waste to material recycling (part of 22.1) 22.4 Waste to landfill (part of 22.1)
Measurement units	kg per reference unit.
Qualitative Indicators	
Number	**(23)**
Name	**Compliance costs**
Sub- Indicators	
Measurement units	Low – medium – high (see indicator description)
Number	**(24)**
Name	**Quality of work**
Sub- Indicators	24.1. Persons employed in total FWC and by sub-sector classified by: a) skills i. low skilled workers ii. high skilled workers b) type of employment i. direct employment ii. indirect employment c) equality of treatment
Measurement units	24.1.a – 24.1.c) absolute number (in full-time equivalents) per reference unit .
Number	**(25)**
Name	**Other services to the public including the recreational use of forests (social indicator)**
Sub- Indicators	
Measurement units	
Number	**(26)**
Name	**Community participation and communication (social indicator)**
Sub- Indicators	
Measurement units	
Number	**(27)**

Name	**Consumer attitudes on forest management, forestry and forest products (social indicator)**
Sub- Indicators	
Measurement units	% of certified products Or: Qualitative assessment? – Good – bad?
Number	**28**
Name	**- missing-**
Sub- Indicators	
Measurement units	
Missing: 28 - blue	

Indicators under construction/consideration

Number	**(29)**
Name	**Revenue**
Sub- Indicators	29.1. goods and services (see classification in the annex) in total FWC and by sub-sector classified by value
Measurement units	29.1.a) Euro (million)
Number	**(30)**
Name	**Noise and smell - not treated**
Sub- Indicators	
Measurement units	
Number	**(31)**
Name	**Aesthetics- not treated**
Sub- Indicators	
Measurement units	

The list of indicators presented in this deliverable and the processes mapped in the different test chains are the base of the first data collection. This data collection has been used for the first try-out of the ToSIA tool.
The results of this data collection within module 5 will be bundled in the Deliverable D 5.1.6.