Product Carbon Footprint report: Pre-cut timber elements

Study commissioner: Are Treindustrier AS

LCA practitioner: Accend AS

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Contents

1. Goal of the study

The goal of the study has been to provide necessary data and documentation for a product carbon footprint calculation for the purpose of determining CO2 storage for the issuance of CO2 Removal Certificates (COCRs), in accordance with the Puro wooden building element methodology.

Target audiences of the study are buyers of CO2 Removal Certificates and other parties with an interest in the environmental impacts of timber products. The internal audience is comprised of management and business development functions.

This study has been conducted according to the requirements of ISO 14044:2006, and NS-EN 16485:2014 and NPCR015 (08/2013), where applicable. Only the global warning components of the EPD are considered.

2. Introduction

Are Treindustrier AS is a group that owns several production facilities in Norway, including Are Brug AS in Askim in south eastern Norway and Jatak Kaupanger AS in western Norway. They market the products under the brand name Jatak.

Are Brug AS and Jatak Kaupanger AS produce Roof trusses and other structural timber elements at their production facilities. The facilities computer-controlled saw machines to cut-to-order timber elements. The products are roof trusses, pre-cut timber elements, and floor joists, comprising approximately 60%/20%/20% shares by volume. All products are cut to order.

Pre-cut timber elements are made-to-measure wall units that are flat packed for transport and assembled on site. Due to this process, there is no loss of materials at the building site. Customers are typically construction companies who are building houses, cottages, garages, office buildings, agricultural and industrial buildings.

The production processes for Pre-Cut at both sites are similar. They deploy the same Hundegger saw machines. There are differences in the supplier mix for the raw materials, the exact product specifications, the manufacturing emissions, and the transport distances, all of which are considered in the environmental impact calculations.

3. Functional unit and declared unit

The declared unit for this product carbon analysis is **1m^3** of pre-cut timber for construction.

4. Compliance with CORC methodology

The production of pre-cut timber at both facilities is performed in accordance with the eligibility requirements for the Puro wooden building element methodology. Paragraph references to the requirements detailed in Puro CO_2 removal marketplace general rules, version 2.0, annex C are included in parentheses.

- Timber is procured from a range of suppliers in Norway and Sweden. All timber comes from FSC/PEFC Chain-of-Custody certified forestry operations in Norway and Sweden. (§1.2.1)

- Per definition all products are made-to-measure, pre-cut and ready for construction when shipped from the production facility. There is no material loss at the construction site which would decrease the CO2 Removal captured by and embedded in the product. Proof of purpose is available. (§1.1.2)
- The volume of products is quantified and documented in a reliable manner from production data from the saw machines, procurement records and sales documentation (§1.2.2)
- Electricity use is metered and allocation by volume. Waste wood and sawdust is used as feedstock for heating the production facility, the heat energy is calculated based on volume of feedstock and allocated by to the products. The energy use of the production facility can thus be quantified and the emissions from the process calculated. (§1.2.2)
- The emissions from the harvesting and transporting of the raw material are estimated and calculated in a reliable manner, in accordance with NS-EN 16485:2014. (§1.2.2). The GWP of the raw materials is calculated from manufacturer specific EPDs or from generic datasets that give good level of representativeness. All materials including packaging are accounted for in the inventory.
- A 10% buffer for uncertainty is included in accordance with the Puro Methodology (§1.2.2 and §4.3.4)

5. System boundaries

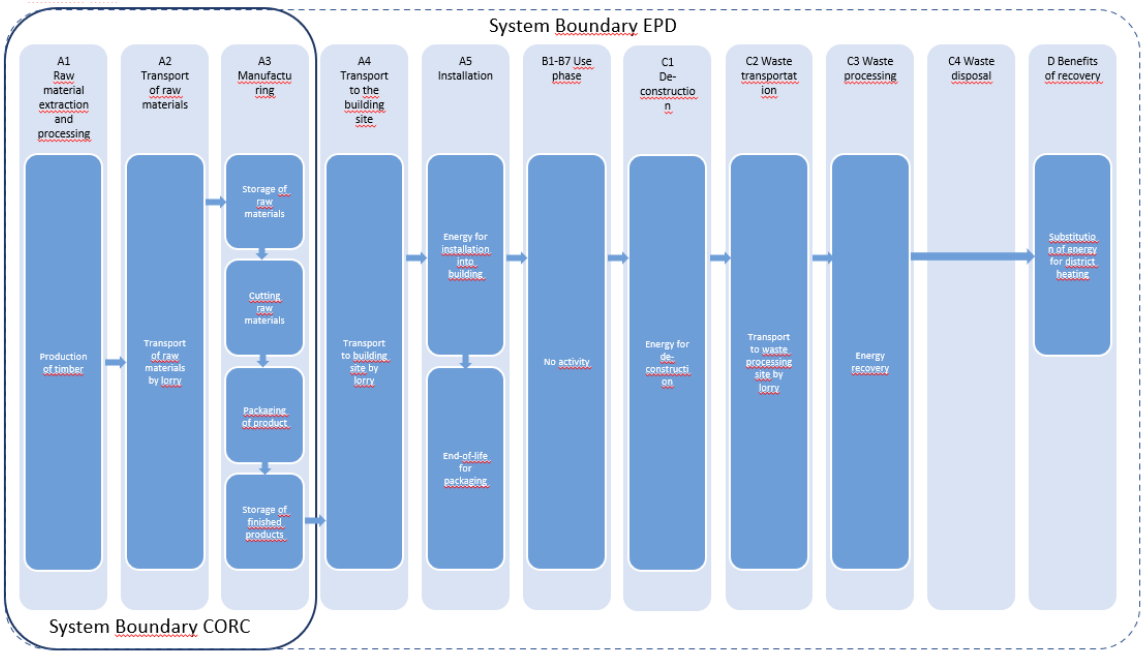


Figure 1: Flowchart for pre-cut timber production

The system boundary is defined using the “cradle to gate” approach A1-A3, figure 1. This includes the production of the raw materials, transport to the production site, the manufacturing process up until the storage of the products at the warehouse.

6. Life cycle inventory of Product phase (A1-3) for ASKIM

Table 1.1 lists the lifecycle inventory of the raw material extraction (A1)

Construction	Resource	User input	Global warming kg CO_2e	Comments
	Planed and strength-graded timber, pine or spruce, 460 kg/m3...?	0,07 m3	2,03E0	Swedish share of timber
	Planed timber, conifer (Treindustrien)?	0,93 m3	4,929E1	Norwegian share of timber
		Total	5,132E1	

A1 emissions are **51,32 kg CO_2e/m^3**

Table 1.2 lists the lifecycle inventory of the transport to manufacturer phase (A2)

Construction	Resource	User input	Global warming kg CO_2e	Comments
	Planed and strength-graded timber, pine or spruce, 460 kg/m3...?	0,07 m3	2,869E−1	Swedish share of timber
	Planed timber, conifer (Treindustrien)?	0,93 m3	4,829E0	Norwegian share of timber
		Total	5,116E0	

A2 emissions are **5,116 kg CO_2e/m^3**

Table 1.3 lists the lifecycle inventory of the manufacturing phase (A3)

Construction	Resource	User input	Global warming kg CO_2e	Comments
	Market for electricity, low voltage (Reference product: ele...?	39 kWh	9,148E−1	Power, plant allocated by volume
	Diesel, burned in building machine (Reference product: dies...?	24 kWh	7,833E0	Forklift usage, allocated by volume
	Heat production, wood chips from industry, at furnace 300kw ...?	45 kWh	3,116E0	Heat from waste wood, plant allocated by volume
	Market for waste polyethylene terephthalate (Reference produ...?	0,11 kg	2,119E−1	Waste processing PET
	Market for waste polyethylene (Reference product: waste pol...?	0,37 kg	1,04E0	Waste processing LDPE
	Market for steel, low-alloyed (Reference product: steel, lo...?	0,16 kg	2,639E−1	Steel band packaging
	Market for packaging film, low density polyethylene (Referen...?	0,61 kg	1,973E0	LDPE packaging
		Total	1,535E1	

A3 emissions are **15,35 kg CO_2e/m^3**

Total A1-A3 emissions for the production on 1m3 Pre-cut at the Askim facility are **71,79 kg CO_2e/m^3**

7. Life cycle inventory of Product phase (A1-3) for KAUPANGER

Table 2.1 lists the lifecycle inventory of the raw material extraction (A1)

Construction	Resource	User input	Global warming kg CO_2e	Comments
	Planed and strength-graded timber, pine or spruce, 460 kg/m3...?	0,1 m3	2,9E0	From AB Hilmer Andersson SWE
	Planed and strength-graded timber, pine or spruce, 460 kg/m3...?	0,14 m3	4,06E0	SCA Timber Supply SWE
	Planed and strength-graded timber, pine or spruce, 460 kg/m3...?	0,2 m3	5,8E0	From wallnas SWE
	Planed timber, conifer (Treindustrien)?	0,21 m3	1,113E1	Begna
	Planed timber, conifer (Treindustrien)?	0,33 m3	1,749E1	Moelven
		Total	4,138E1	

A1 emissions are **41,38 kg CO_2e/m^3**

Table 2.2 lists the lifecycle inventory of the transport to manufacturer phase (A2)

Construction	Resource	User input	Global warming kg CO_2e	Comments
	Planed and strength-graded timber, pine or spruce, 460 kg/m3...?	0,1 m3	1,689E0	From AB Hilmer Andersson SWE
	Planed and strength-graded timber, pine or spruce, 460 kg/m3...?	0,14 m3	4,678E0	SCA Timber Supply SWE
	Planed and strength-graded timber, pine or spruce, 460 kg/m3...?	0,2 m3	6,624E0	From wallnas SWE
	Planed timber, conifer (Treindustrien)?	0,21 m3	1,732E0	Begna
	Planed timber, conifer (Treindustrien)?	0,33 m3	4,007E0	Moelven
		Total	1,873E1	

A2 emissions are **18,73 kg CO_2e/m^3**

Table 2.3 lists the lifecycle inventory of the manufacturing phase (A3)

Construction	Resource	User input	Global warming kg CO_2e	Comments
	Market for electricity, low voltage (Reference product: ele...?	47 kWh	1,101E0	Power, plant allocated by volume
	Diesel, burned in building machine (Reference product: dies...?	20 kWh	6,538E0	Forklift usage, allocated by volume
	Heat production, wood chips from industry, at furnace 300kw ...?	43 kWh	2,987E0	Heat from waste wood, plant allocated by volume
	Market for waste polyethylene terephthalate (Reference produ...?	0,11 kg	2,119E−1	Waste processing PET
	Market for waste polyethylene (Reference product: waste pol...?	0,37 kg	1,04E0	Waste processing LDPE
	Market for steel, low-alloyed (Reference product: steel, lo...?	0,16 kg	2,639E−1	Steel band packaging
	Market for packaging film, low density polyethylene (Referen...?	0,61 kg	1,973E0	LDPE packaging
		Total	1,411E1	

A3 emissions are **14,11 kg CO_2e/m^3**

Total A1-A3 emissions attributable to the production of 1m3 of pre-cut at the **KAUPANGER** facility are **74,22 kg CO_2e/m^3**

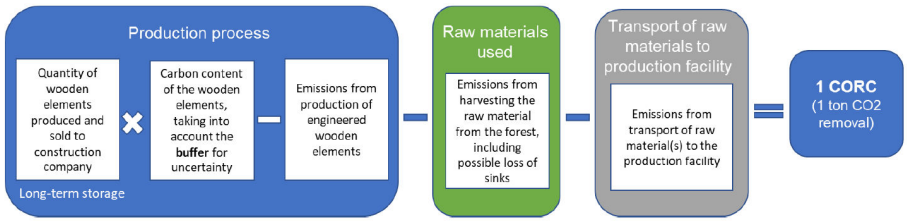
8. Consolidated emissions

Table 3 details the lifecycle emissions from the production of pre-cut at both facilities

Global warming potential **kg CO_2e/m^3**	Askim	Kaupanger
A1 - raw material extraction	51,32	41,38
A2 - transport to manufacturer	5,12	18,73
A3 - manufacturing phase	15,35	14,11
Total for phases A1-A3	**71,79**	**74,22**

9. Carbon storage calculation

According to the Puro methodology for timber building elements, the net carbon capture should be calculated with this formula



4.7.1. Mathematical formula

$$Q_{element} \times (C_{element}\,(100\% - B_{element})) - (E_{element} + E_{rawmaterial} + ET_{rawmaterial}) = CO_2 \text{ Removal (in kg)}$$

Figure 2, Puro 2019

The biogenic carbon content of the products has been calculated in accordance with EN 16449:2014. The variables are the density of the timber and the moisture content. The density is calculated from the volume-weighted average densities of the 2 timber specifications that are used, C30 and C24. The moisture content of finished products is measured during quality control checks. The moisture content varies from a minimum of 9,4% to maximum of 16% and appears to show a natural seasonal variation with higher percentages in Autumn and Winter and lower in the spring and summer. The average moisture content at Kaupanger was 13,6% vs 12,1% at Askim, which can be understood in terms of the generally drier climate in the SE region of Norway. The biogenic carbon content of the product is **697 kg/m^3** at ASKIM and **688 kg/m^3** at Kaupanger. The difference is due to small differences in the average moisture content of the timber. Once the emissions from the manufacturing, transport and raw material production are subtracted the net carbon capture per m^3 of pre-cut timber is **625 kg** at **Askim** and **613 kg** at **Kaupanger.** Once the 10% buffer for uncertainty *and* the emissions from the manufacturing, transport and raw material production are subtracted, the net carbon capture per m^3 of pre-cut timber, for which CORCs can be issued, is **555 kg** at **Askim and 545** at **Kaupanger** as detailed in table 4.

Table 4 Net carbon content of pre-cut elements

CO2e kg/m^3	**Askim**	**Kaupanger**
Biogenic carbon content of timber EN 16449:2014	696,69	687,50
Impacts from process Emissions A1-A3	-71,80	-74,20
Net carbon content	624,90	613,30
Net carbon content inc. buffer	**555,23**	**-544,55**

10. CORC factor

The CORC factor, or number of CORCs available per m3 of product is therefore **0.555** for production at Askim, and **0.545** for production at Kaupanger.

11. Notes on data quality

a. Cut offs

The inputs and outputs that have been initially excluded from the study are the construction of factory infrastructure of the manufacturing site and small quantities of packaging tape. The buildings at the production site are in general quite old and therefore not regarded as a substantial contribution. The excluded processes are listed in table 5.

Process excluded from study	**Cut-off criteria**	**Quantified contribution from process**
Infrastructure of the manufacturing site, including buildings machinery and vehicles.	<5% of module A1-A3	<1%
Packaging tape	<1% of total mass input	0,01%

b. Data collection

All data pertains to calendar year 2019. Data was collected from the manufacturer during and after a site visit that was performed by the LCA practitioners for quality control. The data collection sheets are available in appendix 1.

c. LCI data source representativeness

The sawn, planed wood comes from a range of Norwegian and Swedish sawmills. The LCI-data for Norwegian production is from an EPD published 2015 by the Federation of Norwegian Timber (Treindustrien) from a selection of sawmills, which has been third party verified. The EPD offers good representativeness for the sawmills used by Are Treindustrier. The data was adjusted for the density of the specific strength grades of the timber used (15% C30, and 85% C24).

For the Swedish share of timber, a manufacturer specific EPD from 2018 is used.

For the packaging, a market data set with global representativeness from Ecoinvent 3.6 is used.

The waste processes are also based on Ecoinvent v3.6. This market dataset models the disposal mix for 1 kg of waste polyethylene terephtalate and polyethylene in Norway using country-specific data.

The transport distance of raw materials has been calculated based on actual distances with typical route choices using an online map tool. Market for transport data from Ecoinvent 3.6, which accounts for capacity utilisation, is used to calculate emissions. The market for Euro 5 class of freight vehicle was selected to give good representativeness of the vehicles used. In 2019, 92% of transport in Norway is Euro 5 or Euro 6. Euro Class 5 is selected as a conservative parameter.

The electricity background data is selected according to NPCR015. The electricity mix used is the physical location mix from Ecoinvent v3.6. The emission factors for Norwegian electricity low voltage grid are 0,0237 kg CO2e / kWh.

The emissions from the forklift trucks has been calculated based on fuel consumption and a market profile for building machines from Ecoinvent 3.6.

d. Allocation principles

Allocation of process are carried out in accordance with the NS-EN 15804:2012+A2:2019:

Process with allocation	**Allocation criteria**	**Allocation used**
Electricity use, thermal energy, packaging, fuel for internal transport	Physical	Allocated by volume.

12. References

Ecoinvent v3.6. 2020. Ecoinvent version 3.6. Swiss, Centre for Life Cycle Inventories, Dübendorf, Switzerland.

NS-EN 15804:2012+A2:2019. Sustainability of construction works – Environmental product declarations – Core rules of the product category of construction products.

NS-EN 16449:2014 Wood and wood-based products - Calculation of the biogenic carbon content of wood and conversion to carbon dioxide.

NS- EN 16485:2014. Round and sawn timber – Environmental Product Declarations – Product category rules for wood and wood-based products for use in construction.

NPCR015 rev1 (08/2013). Product category rules for wood and wood-based products for use in construction. EPD-Norge.

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Kjeldstad, NEPD-1384-455-NO

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Europrofil AB, EPD Ref.No 00000043

Stora Enso, EPD, «Planed Timber by Stora Enso»

Jatak product description available at https://www.jatak.no/produkter/precut