CAPEM

Cycle Assessment Procedure for Eco-impacts of Materials

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Environmental Product Declaration

In accordance with EN 15804

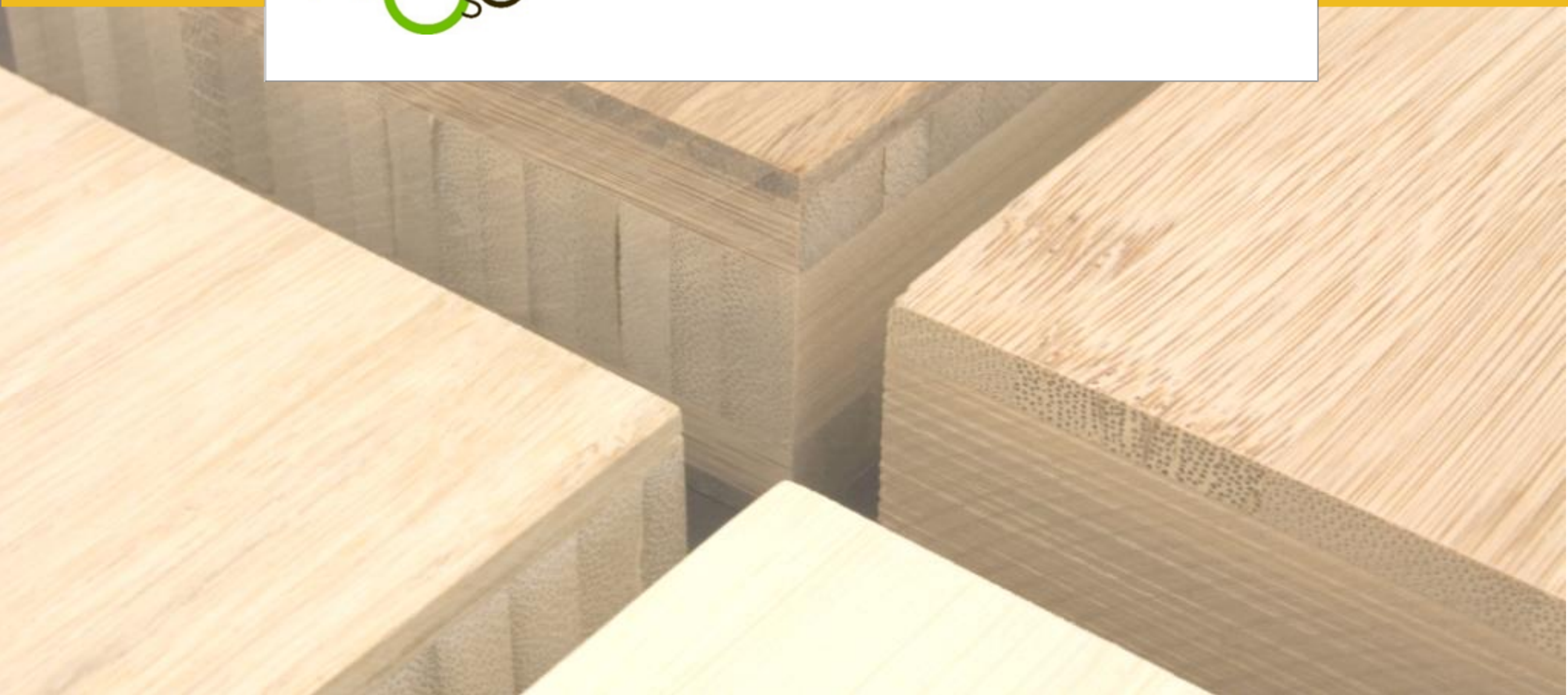
Product name:	MOSO solid panel and beam, caramel
Date of Issue:	5 April 2016
Validity:	5 years
Product unit:	MOSO solid panel and beam made from laminated bamboo (side pressed / plain pressed), caramel, for various interior applications, per kg

Scope of the Declaration

Type of EPD is 'Cradle to gate with options' including transport to building site and End of Life. The LCA is performed by Stichting Agrodome, based on the process and production data of MOSO International BV.

Product Description

MOSO® solid panel and beam is a visually appealing product (semi-finished material) that consists of multiple layers of bamboo, available in multiple variations with respect to size, thickness, configuration, style and colour. The solid panel can be used in various indoor applications such as work tops, walls, ceilings, stairs and furniture. The beam is mainly used in semi structural indoor applications such as window and door frames.



Goal and scope

Goals of the research is to gather data regarding the environmental effects during the lifespan of the MOSO solid panel and beam to get a better understanding of the environmental impact over the lifecycle. The results can be used to improve the production process in terms of environmental impact. Furthermore, the results can be used to inform potential customers about the environmental impact of the MOSO solid panel and beam compared to other materials.

Product

Application

After harvesting the mature bamboo stems are split in longitudinal direction and the outer skin is removed. The resulting strips are either placed horizontally (plain pressed) or vertically (side pressed) to produce the MOSO solid panel and beam. The strips naturally have a light yellow colour (natural), but can be steamed for a light brown colour (caramel) or thermally treated for a dark brown colour (chocolate). For this LCA the carbonized version was assumed.

MOSO solid panel and beam is a semi-finished material which can be used in several indoor applications. It consists for 97 % of rough strips made from the giant bamboo species "Phyllostachus Pubescens" from China (diameter up to 15 cm, length up to 15 meters) and is also available with FSC certificate.

Technical Data

Name	Value
Density	700 kg/m3
Hardness (Brinell)	> 4kg/mm2 (EN 1534)
Fireresistance class	D, EN 13501-1
Heat transfer (λ)	0,17 W/mK

Bill of Materials

Material	Amount
Bamboo strips	97%
Other substances	3%

Temporary carbon storage

Bamboo is a fast growing crop that absorbs CO_2 during the growth of the material. As long as the product is in use this carbon is stored in the product. For Moso solid panel and beam this amount is 1,60 kg CO_2 / kg solid panel and beam materials[1] and is not included in the overall LCA results.

[1] Calculation: 0,97 (bamboo content) x 0,9 (factor 10% > 0% moisture content) x 0,5 (carbon content) x 3,67 (mol ratio CO_2 – C) =1,60 kg CO_2 / kg MOSO Solid Panel and Solid Beam materials

LCA calculation rules

Declared/Functional Unit

MOSO solid panel and beam made from laminated bamboo (side pressed / plain pressed), caramel, for various interior applications, per kg.

Name	Value	Unit
Declared unit	1,00	kg
Density	700	Kg/m3

System boundary

This EPD is made for "Cradle to Gate with options" according to EN 15804

Comparability

A comparison or evaluation of EPD data is only possible if all datasets are made following EN 15804 applying the same relevant product category rules and for the same modules.

LCA-modules

The following data refer to the declared modules and form the basis for further calculations. All provided values refer to the declared product unit.

The European norm EN 15804 is based on four main modules corresponding with the various phases in the lifecycle of a building material: Module A (production and construction stage), Module B (use stage), Module C (End of life stage) and Module D (Environmental effects outside of the system boundary). See figure 1.

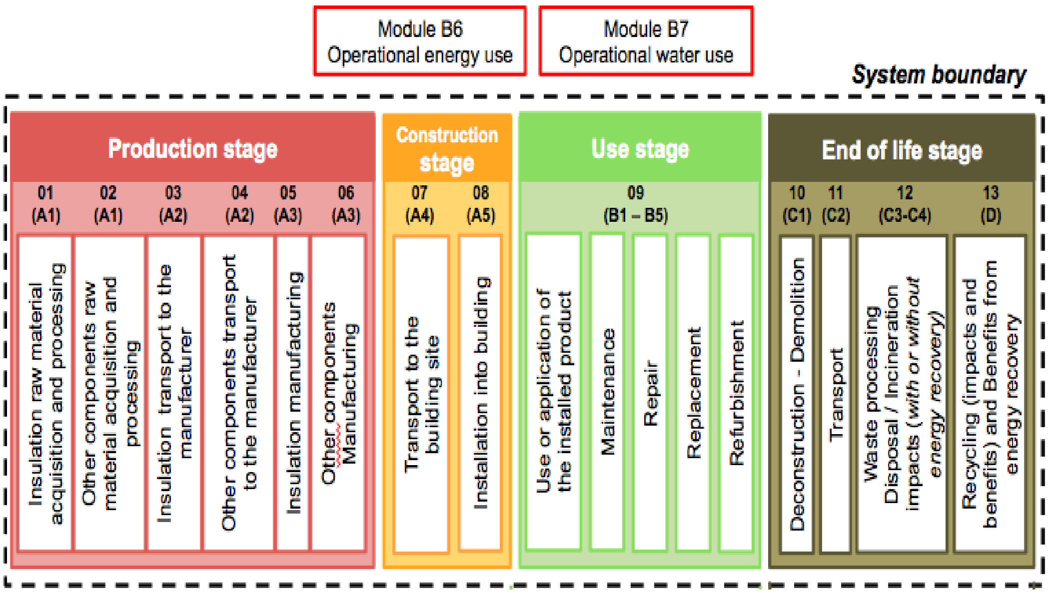


Figure 1: Division of the modules over the lifecycle of a building material as determined in EN 15804.

This EPD gives information about the stages A1-3, A4, C1-4 and D.

LCA results

In the table below the results for the various environmental categories are provided for 1 kg of MOSO solid panel and beam material.

Basic profiles Stage(s) EN 15804	Unit	A1-3 (+ A5)	A4	B1	B2	C2	C3 (+ C1, C4 and/or D)
Abiotic depletion, non fuel	kg antimoon eq.	1,257E-06	8,423E-07	--	--	4,351E-08	-2,894E-09
Abiotic depletion, fuel	kg antimoon eq.	5,581E-03	1,523E-04	--	--	1,062E-04	-5,284E-03
Global warming (GWP100)	kg CO2 eq.	8,277E-01	2,061E-02	--	--	1,469E-02	-5,774E-01
Ozone layer depletion (ODP)	kg CFK-11 eq.	5,538E-08	3,398E-09	--	--	2,357E-09	-4,639E-08
Photochemical oxidation	kg ethyleen eq.	7,613E-04	1,763E-05	--	--	1,082E-05	-4,218E-05
Acidification	kg SO2 eq.	9,728E-03	1,082E-04	--	--	7,944E-05	-5,781E-04
Eutrophication	kg PO4- eq.	9,729E-04	2,987E-05	--	--	2,193E-05	6,847E-05
Human toxicity	kg 1,4- DB eq.	3,395E-01	7,204E-03	--	--	5,073E-03	-5,528E-02
Fresh water aquatic ecotox.	kg 1,4- DB eq.	4,892E-02	2,050E-03	--	--	1,447E-03	2,539E-03
Marine aquatic ecotoxicity	kg 1,4- DB eq.	1,216E+02	4,098E+00	--	--	2,941E+00	-3,238E+01
Terrestrial ecotoxicity	kg 1,4- DB eq.	4,791E-03	4,853E-05	--	--	3,368E-05	-3,262E-04
Total renewable energy	MJ	3,823E-01	4,138E-03	--	--	3,071E-03	-3,271E-01
Total non renewable energy	MJ	1,088E+01	3,524E-01	--	--	2,467E-01	-1,115E+01
Total Energy	MJ	1,126E+01	3,565E-01	--	--	2,497E-01	-1,148E+01
Water, fresh water use	m3	1,057E+00	2,411E-02	--	--	1,786E-02	-2,671E-01
Waste, non hazardous	kg	3,052E-02	5,159E-03	--	--	3,100E-03	1,128E+02
Waste, hazardous	kg	2,118E-01	8,138E-03	--	--	5,804E-03	-5,583E-01

Representativeness production process

This product is made following the production protocols of MOSO in the factories in China, which is representative for all MOSO solid panel and beam material sold worldwide.

Representativeness Geographically

MOSO solid panel and beam as described in this EPD is made from giant bamboo sourced from sustainable managed production forests. Harvesting and first processing takes place in the region Anji in Zhejiang province, China. The final manufacturing processes are executed in Hangzhou and Jianyang, China after which the products are shipped via Shanghai and Rotterdam to the warehouse of MOSO International in Zwaag, the Netherlands.

For the transport to the building site an average distance was assumed in the LCA calculations of 150 kilometres which is representative for the Dutch situation.

Qualitative informative

MOSO solid panel and beam material is produced in ISO 9001 and 14001 certified factories. Various MOSO products are available with CE mark and FSC certification. All indoor products meet the European E1 norm (EN 717) with respect to indoor emissions while several products even comply with E0, the strictest emission class available.

Sourcing raw materials

MOSO works with a limited amount of suppliers for the main input material, the giant bamboo. The various other ingredients are sourced from several suppliers which are therefore based on generic LCA data from the Dutch SBK and the Ecoinvent database.

Data quality

The data about the process and products are mainly based upon the LCA study documented in the INBAR Technical-Report-No.35: The Environmental Impact of Industrial Bamboo Products: Life-cycle Assessment and Carbon Sequestration by: P. van der Lugt and J. Vogtländer of Delft University of Technology.

As some production data from this report might be slightly outdated there has been frequent contact with MOSO International to guarantee that this EPD is based on the most up-to-date production data. Missing data was collected from Eco-invent version 2.2.

For the production phase (A1-3) the information of the INBAR study from 2014 is used. For the other phases the fixed values have been assumed following the Dutch SBK-bepalingsmethode 2.0. This applies for transport distances to the building site and waste scenarios in the End-of-Life phase.

Life Cycle Stages (A1-3)

Flowchart for the production of MOSO solid panel and beam.

INPUT: MATERIAL	INPUT: ENERGY	PROCESS	OUTPUT: MATERIAL	OUTPUT: EMISSIONS
	chainsaw gasoline	Harvesting of bamboo on sustainably managed plantations		exhaustgases
wet culms	truck, 5 tons *diesel*	Transport from plantation to strip manufacturing facility		exhaustgases
	electricity for equipment	Strip making		Sawdust
	truck, 28 tons *diesel*	Transport from strip manufacturing facility to factory		exhaustgases
	electricity for equipment	Rough planing		
		Strip selection		
	electricity for equipment	Preservation & coloring: carbonization		
	electricity for equipment	Drying		heat? vapor bamboo
	electricity for equipment	Fine planing		
Melamine formaldehyde (dry condition)		Glue application		
	electricity for equipment	Pressing strips to 1-layer board		
	electricity for equipment	Sanding 1-layer board		Sawdust
Emulsion Poly Isocyanate (glue) (dry condition)		Glue application		
	electricity for equipment	Pressing three layers to one board		
	electricity for equipment	Sawing		Sawdust
	electricity for equipment	Sanding 3-layer board		Sawdust
	electricity for equipment	Dust absorption (during all steps)		
	truck, 28 tons *diesel*	Transport from factory to harbor		exhaustgases Final product

Product stage (A1-3)

The cultivation and harvesting of the bamboo stems is included in the calculations. No fertilizers nor pesticides have been assumed. Harvesting of mature stems takes place with machetes and sometimes chainsaws. Bamboo is harvested like an agricultural crop and will grow back automatically after the annual harvest of 20-25% of the mature stems (ready for harvest after 4-5 years). As a result by default no deforestation occurs.

The bamboo stems are transported to strip making factories for first processing. Transport of the stems is done with trucks in various sizes. Distances for this EPD are based on projections by the producer.

In the factory the mature bamboo stems are split in longitudinal direction and the inner and outer skin is removed. The strips are planed and a selection in colour and size is executed after which the strips are dried. Glue is applied on the dry strips which are hot-pressed to produce a 1-layer panel. Subsequently, glue is applied on the separate 1-ply panels to press them into a multi-layer panel. The panel / beam is then sawn and sanded to come to the final product.

Construction process stage (A4-5)

Transport to building site (A4)

Transport to the building site is assumed to be based on full load with empty return. The default value of 150 km has been applied.

Installation of the product in the building (A5)

This phase was excluded as it is dependent on the final application.

Use stage (B1-7)

This phase was excluded as it is dependent on the final application.

End of life stage (C1-4)

Demolition (C1)

Demounting and demolition assumed manually, no industrial process.

Transport (C2)

Assumptions transport phase: 50 km to sorting installation and 100 km from sorting location to final waste processing. Transport with a >16-ton lorry.

Waste processing (C3-C4)

As waste scenario after the demolition stage, incineration for energy production was assumed as scenario following default values for division between incineration (95%) and dump (5%)

Benefits and loads beyond the system boundary (D)

The avoided energy use as a result from the incineration of the MOSO solid panel and beam is a benefit beyond the system boundary.

Accountability

The LCA research for this EPD was executed by Agrodome in 2015, largely based on the following report:

- INBAR Technical Report No. 35
  The Environmental Impact of Industrial Bamboo Products: Life-cycle Assessment and Carbon Sequestration (2014). Authors: J.G. Vogtländer and P. van der Lugt.

Furthermore the following publications were used:

- Design Interventions for Stimulating Bamboo Commercialization (2008) PhD thesis. Author: Pablo van der Lugt (Delft University of Technology).
- Life Cycle Assessment and Carbon Sequestration, Bamboo products of MOSO International (2014). Author: J.G. Vogtländer (Delft University of Technology).

The LCA was executed following EN 15804 and was verified following SBK-bepalingsmethode 2.0, versie november 2014.

When calculating the environmental impact categories Simapro version 8.0.4.30 was used as well as environmental data from de Dutch SBK-basisprocessendatabase, versie 1.7 juni 2015 and in some case, where no SBK data was available was made use of Ecoinvent-database, version 2.2.

When making calculations in Simapro long term effects (emisisons occurring after 100 years) were not included. Effects of capital goods and infrastructural processes have been included.

References

Agrodome
LCA-rapport Moso massieve plaat, Density®, Bamboo X-treme, February 2016, Agrodome, Wageningen, the Netherlands. Authors: S. Verspeek and F. van der Burgh.

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