CAPEM

Cycle Assessment Procedure for Eco-impacts of Materials

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Environmental Product Declaration

In accordance with EN 15804

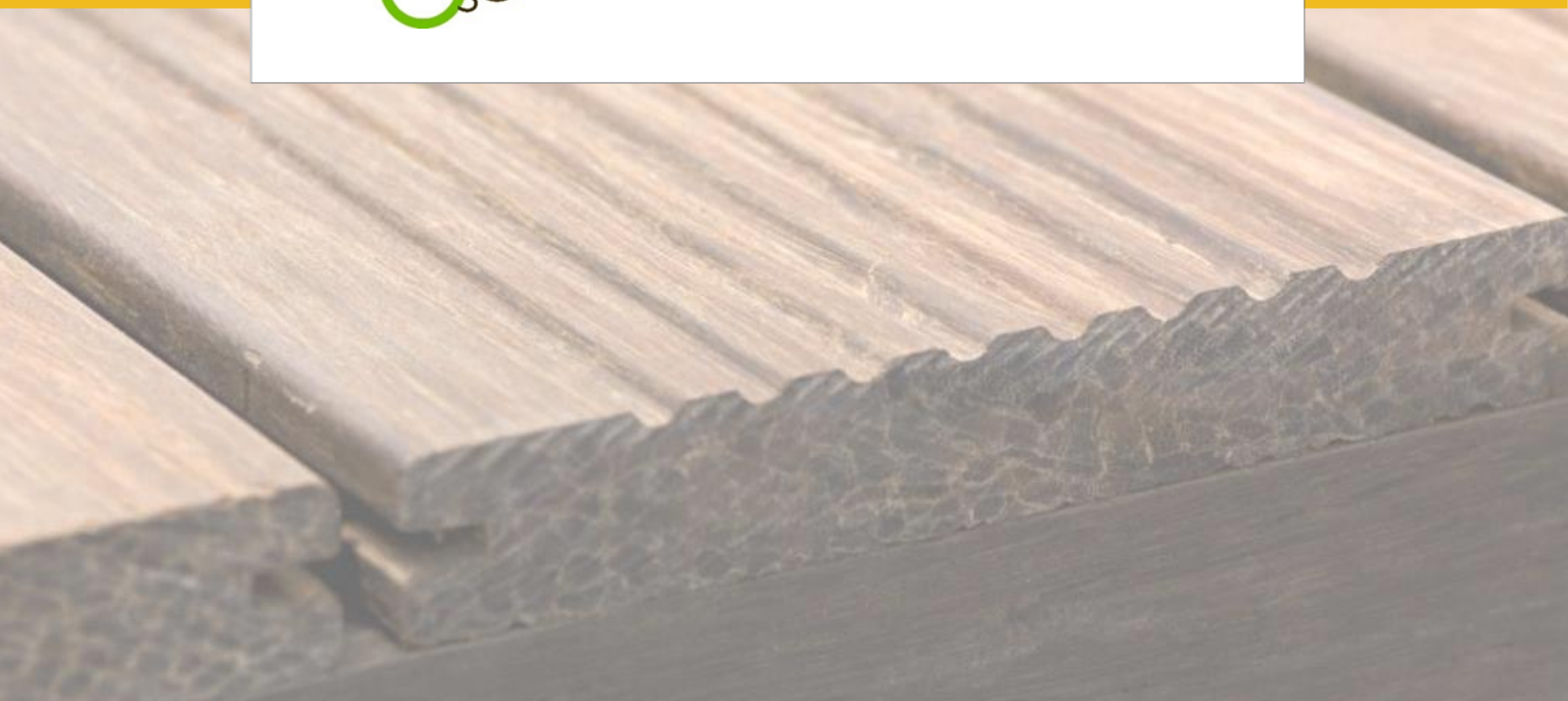
Product name:	MOSO Bamboo X-treme
Date of Issue:	8th March 2017
Validity:	5 years
Functional Unit:	MOSO Bamboo X-treme boards (1850x137x20mm), 24,8 kg/m2 for outdoor applications (decking, cladding, outdoor furniture, etc), including substructure (beams and clips) with a life span of 35 years, measured in m2.

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 Bamboo X-treme is an innovative variation on the compressed MOSO Bamboo Density® indoor products. The 'input strips' are thermally modified to increase the durability to class 1 according to EN 350. As a result, this product is an excellent substitute for tropical hardwood in outdoor applications such as decking and cladding.



Goal and scope

Goals of the research is to gather data regarding the environmental effects during the lifespan of the MOSO Bamboo X-treme products 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 Bamboo X-treme products compared to other materials.

Product

Application

For the LCA calculation the application of MOSO Bamboo X-treme was assumed as cladding or decking including subsystem (beams and clips). The same product can very well be used in other outdoor applications such as fencing, outdoor furniture, canal piling, etc.

MOSO Bamboo X-treme is made of thermally modified, compressed bamboo strips. The result is an extremely durable (class 1 following EN 350) and hard (Brinell Hardness ≥ 9,5 kg/mm2 following EN 1534) material with a look that is hardly distinguished from tropical hardwood. As also the dimensional stability is strongly improved the material can substitute tropical hardwood in many challenging outdoor applications. MOSO Bamboo X-treme products consists for 92-93 % of thermally modified 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	1200 kg/m3
Hardness (Brinell)	> 9,5kg/mm2 (EN 1534)
Durability	Class 1 (EN 350)
Fireresistance class	B, EN 13501-1
Heat transfer (λ)	0,26 W/mK

Bill of Materials

Material	Amount
Bamboo strips	93%
Other substances	7%

Reference service life

According to the supplier the lifespan of MOSO Bamboo X-treme products is at least 35 years if the product is applied and maintained following the installation and maintenance instructions.

Temporary carbon storage

Bamboo is a fast growing crop that absorbs CO2 during the growth of the material. As long as the product is in use this carbon is stored in the product. This amount is 1,54 kg CO2 / kg for MOSO Bamboo X-treme materials[1] and is not included in the overall LCA results.

[1] Calculation: 0,96 (bamboo content) x 0,9 (factor 10% > 0% moisture content) x 0,5 (carbon content) x 3,67 (mol ratio CO2 – C) = 1,58 kg CO2 / kg MOSO Density® materials

LCA calculations rules

Functional unit

MOSO Bamboo X-treme boards (1850x137x20mm) for outdoor applications (decking, cladding), including substructure (beams and clips) with a life span of 35 years, measured in m2.

Name	Value	Unit
Declared unit	1,00	m2
Weight	24,8	Kg/m2

System boundary

This EPD is made for "Cradle to Grave" 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.

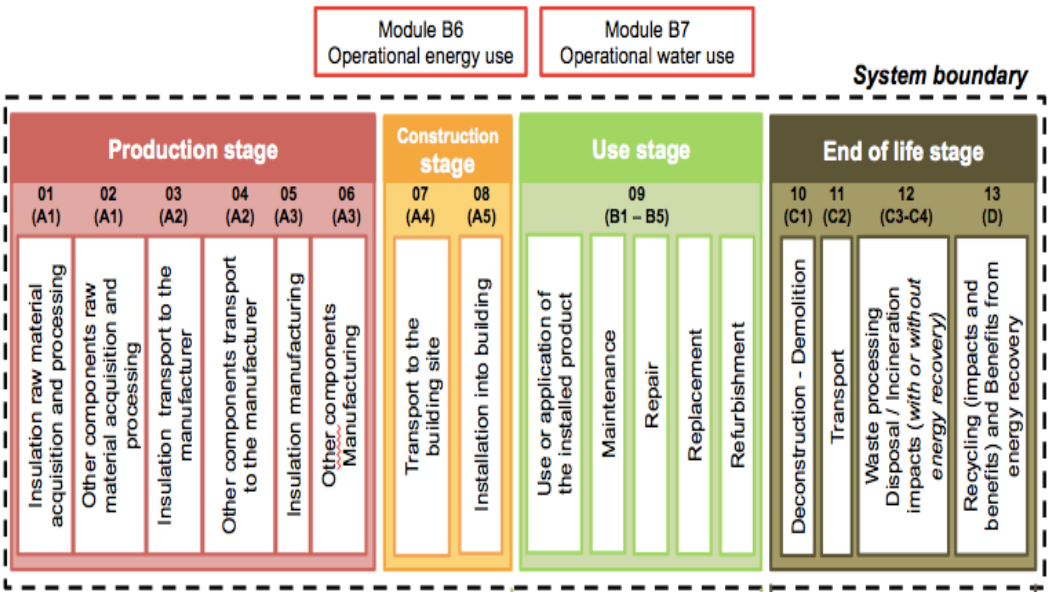


Figure 1: Division of the modules over the lifecycle of a building material as determined in EN 15804

This EPD gives information about the stages A1-3, A4, A5, B1-7, C1-4 and D.

LCA-results

In the table below the results for the various environmental categories are provided for 1 m2 of MOSO Bamboo X-treme decking or cladding.

Basic profiles										
Stage(s) EN 15804	Unit	A1-3	A4	A5	B1	B2	C1	C2	C3 + C4	D
Abiotic depletion, non fuel	kg antimoon eq.	2,26E-05	1,47E-06	2,69E-05	0	0	0	1,06E-06	-1,03E-05	0
Abiotic depletion, fuel	kg antimoon eq.	1,41E-01	3,60E-03	3,58E-03	0	0	0	2,59E-03	-1,31E-01	0
Global warming (GWP100)	kg CO2 eq.	1,87E+01	4,97E-01	6,73E-01	0	0	0	3,59E-01	-1,44E+01	0
Ozone layer depletion (ODP)	kg CFK-11 eq.	1,16E-06	7,98E-08	3,03E-08	0	0	0	5,76E-08	-1,13E-06	0
Photochemical oxidation	kg ethyleen eq.	1,53E-02	3,66E-04	4,39E-04	0	0	0	2,64E-04	-1,22E-03	0
Acidification	kg SO2 eq.	2,12E-01	2,69E-03	7,72E-03	0	0	0	1,94E-03	-1,71E-02	0
Eutrophication	kg PO4- eq.	2,28E-02	7,43E-04	3,30E-04	0	0	0	5,36E-04	1,46E-03	0
Human toxicity	kg 1,4- DB eq.	1,58E+01	1,72E-01	2,12E+00	0	0	0	1,24E-01	-3,06E+00	0
Fresh water aquatic ecotox.	kg 1,4- DB eq.	1,28E+00	4,90E-02	3,59E-02	0	0	0	3,53E-02	5,99E-02	0
Marine aquatic ecotoxicity	kg 1,4- DB eq.	2,30E+03	9,96E+01	5,57E+02	0	0	0	7,18E+01	-1,00E+03	0
Terrestrial ecotoxicity	kg 1,4- DB eq.	1,03E-01	1,14E-03	3,09E-02	0	0	0	8,22E-04	-3,02E-02	0
Total renewable energy	MJ	7,85E+00	1,04E-01	8,66E+00	0	0	0	7,50E-02	-1,24E+01	0
Total non renewable energy	MJ	2,91E+02	8,35E+00	9,73E+00	0	0	0	6,02E+00	-2,76E+02	0
Total Energy	MJ	2,99E+02	8,46E+00	1,84E+01	0	0	0	6,10E+00	-2,89E+02	0
Water, fresh water use	m3	2,51E+01	6,05E-01	5,28E-02	0	0	0	4,36E-01	-6,54E+00	0
Waste, non hazardous	kg	7,51E-01	1,05E-01	8,66E+00	0	0	0	7,57E-02	2,75E+03	0
Waste, hazardous	kg	5,24E+00	1,96E-01	4,06E-03	0	0	0	1,42E-01	-1,36E+01	0

Representativeness production process

This product is made following the production protocols of MOSO in the factories in China, which is representative for all MOSO Bamboo X-treme material sold worldwide.

Representativeness Geographically

MOSO Bamboo X-treme material 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 information

MOSO Bamboo X-treme material is produced in ISO 9001 and 14001 certified factories. Various MOSO products are available with CE mark and FSC certification.

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

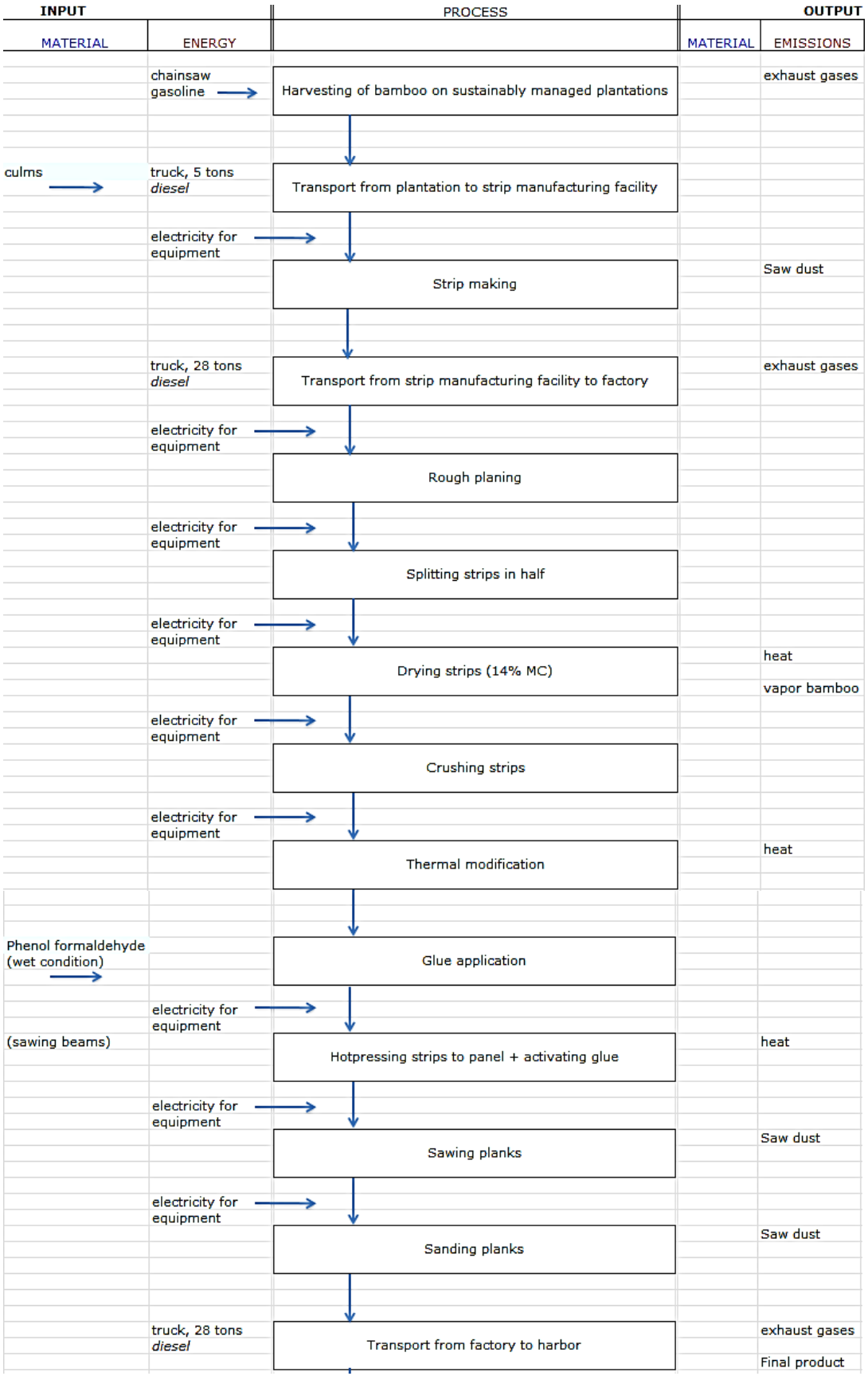
The data about the process and products are mainly based upon the LCA study documented in the INBAR Technical-Report-No.35: The Environmental Impact of Industrial Bamboo Products: Life-cycle Assessment and Carbon Sequestration by: P. van der Lugt and J. Vogtländer of Delft University of Technology.

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. There were no adaptions on the data necessary. 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

Flowchart for the production of Bamboo X-treme



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.

After harvesting the mature bamboo stems are split in longitudinal direction and the inner and outer skin is removed. Then the strips are mechanically roughened / crushed, thermally modified, put in a glue bath, placed in moulds and under high pressure and temperature pressed to large, dense panels. From these panels, boards and beams are sawn to acquire the final product. Because of the patented Thermo-Density® treatment the durability, hardness and dimensional stability of the product is strongly increased.

Construction 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)
The Bamboo X-treme boards are fixed on the Bamboo X-treme subbeams using clips and screws.

Use stage (B1-7)

The product has an expected lifespan of at least 35 years. Throughout this period no structural maintenance is required and is therefore not included in the LCA.

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%) for the bamboo and glue. For the metal parts 90% recycling, 5% incineration and 5% landfill.

Benefits and loads beyond the system boundary (D)

The avoided energy use as a result from the incineration of the Moso Density® are not considered as benefits beyond the system boundary, but is calculated in the waste processing. (C3-C4).

Accountability

The LCA research for this EPD was executed by Agrodome in 2015, 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 the 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 (emissions 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, 2017, Agrodome, Wageningen, the Netherlands. Authors: S. Verspeek and F. van der Burgh.

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