ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	**Binderholz Bausysteme GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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binderholz Brettsperrholz BBS - binderholz X-LAM BBS - binderholz Cross Laminated Timber CLT BBS

Binderholz Bausysteme GmbH

Institut Bauen und Umwelt e.V.

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1. General Information

Binderholz Bausysteme GmbH	binderholz CLT BBS
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the declaration** Binderholz Bausysteme GmbH Zillertalstraße 39 6263 Fügen Österreich
Declaration number EPD-BBS-20190021-IBB1-EN	**Declared product / declared unit** 1 m³ binderholz CLT (Cross Laminated Timber) BBS
This declaration is based on the product category rules: Solid wood products, 12.2018 (PCR checked and approved by the SVR)	**Scope:** The CLT (Cross Laminated Timber) production data from the CLT production facility of Binderholz Unternberg GmbH in Lungau (AT) and the CLT production facility of Binderholz Burgbernheim GmbH based in Burgbernheim in Middle Franconia in Germany, is used as the basis for the life cycle assessment. Together these facilities account for 100 % of the total production of binderholz CLT BBS. This Environmental Product Declaration applies for binderholz CLT BBS. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Issue date 20.03.2019	
Valid to 19.03.2024	
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	**Verification** The standard /EN 15804/ serves as the core PCR Independent verification of the declaration and data according to /ISO 14025:2010/ ☐ internally ☒ externally
Dr. Alexander Röder (Managing Director IBU)	Matthias Klingler (Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

binderholz Brettsperrholz BBS ist ein massives, plattenförmiges Holzbauelement, welches aus zueinander rechtwinklig verklebten Nadelholzlagen besteht. Hergestellt wird das binderholz Brettsperrholz BBS nach der /ETA-06/0009/ or /PRG-320/ and /ESR-4081/ according to the respective project-specific requirements.

binderholz CLT (Cross Laminated Timber) BBS is a solid, wooden construction element in panel form that consists of softwood layers that are glued together at right angles to each other. binderholz CLT BBS is produced in accordance with /ETA-06/0009/.

The crosswise orientation of the individual lamellae and the usually symmetrical construction of binderholz CLT BBS has the benefit of extremely high dimensional stability, as well as load-bearing potential both lengthways and transversely to the main load-bearing direction.

The cross-section structure of binderholz CLT BBS is characterised by a minimised number of layers, with no less than three and no more than nine layers.

binderholz CLT BBS is available in 2 different formats:

- System format BBS 125: system width 125 cm
- Large format BBS XL: max. width 350 cm

A very high degree of pre-fabrication and thus an extremely short building time can be achieved, thanks to the existing trimming options that are integrated at the production facilities.

EU Regulation No. 305/2011 of 9 March 2011 applies for putting the product into circulation in the EU/EFTA (with the exception of Switzerland).
The products require a declaration of performance under consideration of /ETA-06/0009/ and CE marking. The respective national provisions apply for use. In Germany this means that general building inspectorate approval /abZ-9.1-534/ by the German Institute for Building Technology (Deutsches Institute für

Bautechnik) in Berlin is required. The /CSTB Avis Technique 3.3/14-784_V1/ applies in France.

Performance declarations are available for the production facilities Unternberg (BBS 125 / BBS XL) and Burgbernheim (BBS XL).

2.2 Application

binderholz CLT BBS is used in all constructional areas of modern timber construction, ranging from traditional single-family house construction through to structural and bridge engineering.

The respective national regulations apply for using binderholz CLT BBS.

2.3 Technical Data

binderholz CLT BBS is produced with a wood moisture content of 12 % +/- 2 %.

The data included in the declaration of performance applies.
Building-physical properties, such as component resistance and fire resistance, vary depending on the cross-section structure (number of layers, layer thickness) and the load position of the binderholz CLT BBS product. These therefore have to be determined for the structure in question, based on the applicable measurement regulations.

Pursuant to /EN 1995-1-1/ binderholz CLT BBS can be used in service classes 1 and 2 with predominantly static loads.

Preventive chemical wood treatment in accordance with /DIN 68800-3/ can be applied by request. In this context, binderholz CLT BBS can be treated with a class 2 impregnation pursuant to /DIN 68800-3/ to protect it against fungi and insect infestation.

Structural wood protection according to /DIN 68800-2/ is generally preferable.

Constructional data binderholz CLT BBS 125/XL according to ETA

Name	Value	Unit
Wood types by trade names pursuant to /EN 1912/	Spruce, fir, pine, larch, and stone pine	-
Wood moisture content according to /EN 13183-2/	12 +/- 2	%
Use of wood preservatives (wood preservative with approval seal in accordance with /DIN 68800-3/)	Iv, P	-
Modulus of elasticity of slab under stress parallel to the direction of the grain according to /EN 338/	12000	N/mm^2
Modulus of elasticity of panel under stress paraelell to the direction of the grain according to /EN 338/	12000	N/mm^2
Rolling shear strength of panel under stress according to /EN 338/ (5% fractile value)	1,0	N/mm^2
Rolling shear modulus of panel under stress according to /EN 338/ (mean)	50	N/mm^2
Length tolerances (BBS 125/XL) according to /ETA-06/0009/	+/- 2	mm
Width tolerances (BBS 125/XL) according to /ETA-06/0009/	+/- 2	mm
Thickness tolerances (BBS 125/XL according to /ETA-06/0009/	+/- 1	mm
Average bulk density (u = 12%)	471	kg/m^3
Surface quality	AB - one side residential visible quality BC - one side industrial visible quality NH - C - non-visible	
Thermal conductivity according to /ISO 10456/	0.12	W/(mK)
Specific heat capacity according to /ISO 10456/	1.6	kJ/kgK
Water vapour diffusion resistance factor according to /ISO 10456/	20 - 50	-

2.4 Delivery status

The existing trimming options allow for binderholz CLT BBS to be individually provided in the following dimensions:

BBS 125
Thickness range: 54 to 350 mm
Width range: up to 1.25 m
Length range: up to 5.00 m

The elements of the BBS 125 system format can be connected up to a total length of 20 metres, using a universal finger joint pursuant to /EN 14080/.

BBS XL
Thickness range: 51 to 350 mm
Width range: up to 3.50 m
Length range: up to 22.00 m

2.5 Base materials / Ancillary materials

binderholz CLT BBS consists of at least three panel lamellae that are glued together crosswise, after having been kiln dried and been graded according to strength, either visually or using machinery.

1 component thermoset polyurethane adhesives (1-K-PUR) are used for surface bonding of the board layers. Hot-melt adhesives and small amounts of melamine-urea-formaldehyde glues (MUF) are used for gluing the narrow sides of the lamellae.

Formaldehyde emissions are declared in accordance with /EN 14080/. No very high concern substances according to the /ECHA Candidate List/ (as of: 27 June 2018) for inclusion in appendix XIV of the /REACH Regulation/ are used.

The following averaged percentage shares of materials are assumed per m^3 of binderholz CLT BBS in the Environmental Product Declaration:

- Softwood (primarily spruce): 88.28 %
- Water: 10.70 %
- 1-K-PUR glues: 0.985 %

- MUF glues: 0.03 %

An average bulk density (u = 12.1 %) of 470.88 kg/m³ is calculated for binderholz CLT BBS.

2.6 Manufacture

binderholz CLT BBS is made from spruce, fir, pine, larch, and stone pine wood. The wood types fir, larch, and stone pine are used primarily for top layers in visible residential quality.

Kiln dried softwood lamellae with a wood moisture of 12 % +/-2 % are used in production. These are pre-planed on four sides and graded according to strength, either visually or by means of machinery. If individual lamellae posses strength-reducing properties, these can be cut out, and be joined together to form lamellae of unlimited length. The range of thickness for the individual planed lamellae is between 18 and 45 mm at a width ranging between 80 and 250 mm.

The lamellae are glued crosswise using the adhesives listed in chapter 2.5.

Solid wood panels according to /EN 13986/ may be used for producing visual quality top-layers.
After the product has been fully hardened and glued, the surface is finished and the product is trimmed according to customer specifications.

2.7 Environment and health during manufacturing

Arising exhaust air is cleaned pursuant to legal requirements. Process waste water produced is fed into the local sewage system. Structural measures are taken to encase any noisy machinery in sound absorbing housings.

2.8 Product processing/Installation

binderholz CLT BBS can be processed with customary tools that are suitable for solid wood processing. Work safety information must be observed, also in processing / installation.
The current processing guidelines for binderholz CLT BBS are available at www.binderholz.com.

2.9 Packaging

Polyethylene films are used as packaging (/AAV/ waste code 15 01 02).

2.10 Condition of use

The structure of raw materials indicated in chapter 2.5 applies for the composition during the period of use. Around 208 kg of carbon are bound in one m³ of binderholz CLT BBS while in use. This corresponds to a full oxidation of around 762 kg CO2 equivalent.

2.11 Environment and health during use

Protection of the environment: No risks to water, air, and soil can arise if binderholz CLT BBS is used as intended.
Health protection: No health damage or adverse effects are to be expected based on current knowledge.
With regard to formaldehyde, binderholz CLT BBS is to be considered low in emission, due to the low adhesive content, the product's structure, and its type of use. binderholz CLT BBS features formaldehyde emissions of 25 µg/m³ (0.02 ppm), due to the fact that mostly 1-K-PUR glues and only a small share of MUF glues are used.
According to /EN 717-1/ these figures are to be classified as low, based on the limit of 0.1 ml/m³ provided for in the Chemicals Prohibition Ordinance.

The release of methylene diphenyl diisocyanate (MDI) due to the use of PUR glues is not measurable, within the detection limit of 0.05 µg/m³. Owing to MDI's high reactivity towards water (air humidity and wood moisture), it can be assumed that soon after production, binderholz CLT BBS has MDI emissions approaching zero.

2.12 Reference service life

The components and production processes of binderholz CLT BBS correspond to those of glued laminated timber (glulam). Glulam has been used in construction for more than 100 years.
If used as intended, a limit of durability is therefore not known or to be expected.

It is therefore assumed that if used as intended, the duration of use of binderholz CLT BBS corresponds to the overall service life of the respective building.

Age-related factors may apply for binderholz CLT BBS if used in accordance with the rules of engineering.

2.13 Extraordinary effects

Fire

binderholz CLT BBS is categorised as fire safety class D according to /EN 13501-1/. The toxicity of combustion gases corresponds to that of natural, untreated wood.

Fire resistance

Name	Value
Building material class	D
Burning droplets	d0
Smoke gas development	s2

Water

No substances that might pose a threat to water are washed out.

Mechanical destruction

Solid wood lamellae are used for producing binderholz CLT BBS.
binderholz CLT BBS therefore features breaking characteristics that are typical of solid wood.

2.14 Re-use phase

Thanks to its monolithic structure, binderholz CLT BBS can be provided for further or re-use without problems, in the context of selective dismantling.

If material re-use is not possible, binderholz CLT BBS can be used for producing process heat and electricity, thanks to its high heating value of approx. 19 MJ/kg. The requirements of the Federal Pollution Control Act (/BImSchG/) must be observed in energy recovery: according to appendix III of the Waste Wood Ordinance (/AltholzV/) as of 15 February 2002, untreated binderholz CLT BBS is assigned to the /AVV/ waste code 17 02 01. Waste code 17 02 04 applies for treated binderholz CLT BBS, depending on the type of wood preservative used.

2.15 Disposal
Pursuant to § 9 of the Waste Wood Ordinance (/AltholzV/), waste wood must not be disposed of in landfill.

2.16 Further information
Detailed information is available at:
www.binderholz.com

3. LCA: Calculation rules

3.1 Declared Unit
The declared unit for the ecological assessment is 1 m³ of CLT BBS, under consideration of the mixture of adhesive used according to chapter 2.5 and a mass of 470.88 kg/m³ at 12.1 % wood moisture content, which corresponds to a water content of 10.7 %. The proportion of adhesives is 1.015 %. All specifications regarding adhesives used were calculated based on specific data.

Specification of the declared unit

Name	Value	Unit
Declared unit	1	m³
Gross density	470.88	kg/m³
Wood moisture at point of delivery	12.1	%
Conversion factor to 1 kg	0.0021236	-
Adhesive content based on total mass	1,015	%
Water content based on total mass	10,7	%

The figures reflect the production volume-weighted average of the following production sites:

- Binderholz Unternberg GmbH, CLT factory, Stranach 26 A-5585 Unternberg
- Binderholz Burgbernheim GmbH, CLT factory, Rothenburger Strasse 46 · D-91593 Burgbernheim

3.2 System boundary
The declaration type corresponds to a “cradle to gate with options” EPD. It covers the production phase from provision of the raw materials through to the factory gates (cradle-to-gate, modules A1 to A3), as well as module A5 and parts of end-of-life (modules C2 and C3). In addition to this, potential benefits and burdens are considered beyond the product’s life cycle (module D).
The provision of wood from the forest and provision of glues are considered in module A1. The transport of these materials is considered in module A2. Module A3 covers the provision of fuels, operating materials, and electricity, as well as the production processes on site. These are primarily trimming, gluing, planing, and profiling processes, as well as packaging of the products. Module A5 covers solely the disposal of the product packaging, including the output of contained biomass carbon and contained primary energy (PERM and PENRM).
Transport to the disposer is considered in module C2, and module C3 covers the processing and sorting of waste wood. In addition to this, the CO2 equivalents of the inherent carbon stored in the wood and renewable and non-renewable primary energy (PERM and PENRM) in accordance with /EN 16485/, are registered as output in module C3.

Thermal recovery of the product at the end of its life, and the resulting benefits and burdens are addressed in module D in the form of a system Extension.

3.3 Estimates and assumptions
All material and energy flows of the processes required for production are generally determined based on questionnaires. The emissions that occur on site, due to combustion and other processes, were in part determined using the results of flue gas analyses, and in part estimated based on literature references. The latter have been documented in detail in /Rüter, S; Diederichs, S: 2012/. All other data is based on average values.
Fresh water resource use was calculated based on blue water consumption.

3.4 Cut-off criteria
No known material or energy flows have been neglected, this applies also to those below the 1 % threshold. It is therefore ensured that the total amount of neglected input flow is below 5 % of energy and mass use. It is therefore further ensured that no material or energy flows are neglected that feature particular potential for significant impact with regard to environmental indicators.

3.5 Background data
All background data was obtained from an integrated life cycle assessment using the /(GaBi) Professional Database 2018 Edition/ and the concluding report “Life cycle assessment source data for wood construction products” ("Ökobilanz-Basisdaten für Bauprodukte aus Holz" /Rüter, S; Diederichts, S: 2012/).

3.6 Data quality
All production sites of binderholz CLT BBS were considered individually, and summarised as production volume-weighted average. The production process at the different facilities is largely identical. In addition to this, a detailed account was drawn up of the relevant upstream chains for any semi-finished wood products used. This also took place based on questionnaires. It can therefore be concluded that the life cycle assessment data feature a good level of robustness. The requested foreground data was validated based on quantity and plausibility criteria. The background data of raw wood materials used for material and energy purposes refers to the years 2008 to 2012, with the exception of forest wood. Data regarding the provision of forest wood was obtained from a publication from 2008 that is based largely on data from the years 1994 to 1997. All other data was obtained from the /GaBi Professional Database 2018 Edition/. The overall quality of the data can be described as good.

3.7 Period under review

The factory data collected for modelling the foreground system refers to the calendar year of 2017 as the reference period. Any information is therefore based on the averaged values for 12 consecutive months.

3.8 Allocation

The allocations performed are in accordance with the requirements of /EN 15804/ and /EN 16485/ and are explained in detail in /Rüter, S; Diederichs, S: 2012/. The following system extensions and allocations have been performed primarily.

General information

Flows of inherent material properties (biomass carbon and primary energy contained) were generally allocated based on physical causalities. All other allocations for related co-productions were made on an economic basis.

Module A1

- Forest: All expenses of the forest wood upstream chain were allocated to the products wood logs and industrial wood based on prices, using economic allocation factors.
- Sawn timber upstream chain: All expenses of the sawn timber upstream chain were allocated to the respective main products (logs without bark (peeled), sawn timber (fresh), sawn timber (dry)) and by-products (bark, industrial residual wood) in the processes of debarking, cutting, as well as drying and finishing, using an economic allocation factor.

Module A3

- All factory expenses for the two locations were attributed to CLT as the main product. No allocations were made.
- The disposal of waste arising in production (except wood-based materials) was carried out based on a system extension.

Module D

- The system extension performed in module D corresponds to an energy recovery scenario for waste wood.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

The used background database has to be mentioned. The life cycle assessment was modelled using the software /GaBi ts/ in its 8.7.0.18 version. All background data was obtained from the /GaBi Professional Database 2018 Edition/ or from literature references.

4. LCA: Scenarios and additional technical information

The scenarios on which the life cycle assessment is based are detailed in the following.

Installation in the building (A5)

While module A5 is declared, it merely contains information about the disposal of the product packaging and no information about the actual installation of the product in the building. The amount of packaging material that arises as waste material for thermal recovery per declared unit in module A5, and the resulting exported energy are indicated below as technical scenario information.

Name	Value	Unit
PE film for thermal waste treatment	1,01	kg
PE plastic for thermal waste treatment	0,63	kg
Total efficiency of thermal waste treatment	44	%
Total of electrical energy exported	9,05	MJ
Total of thermal energy exported	16,31	MJ

A transport distance of 20 km is assumed for disposal of the product packaging. The total efficiency of waste incineration and the proportions of electricity and heat produced through cogeneration correspond to the allocated waste incineration process of the /GaBi Professional Database 2018 Edition/.

End of life (C1 - C4)

Name	Value	Unit
Waste wood for use as secondary fuel	470,88	kg
Redistribution transport distance of waste wood (module C2)	20	km

A collection rate of 100 % without any losses from shredding the material is assumed in the thermal recovery Scenario.

Re-use, recovery, and recycling potential (D), relevant scenario details

Name	Value	Unit
Electricity produced (per t adry waste wood)	968,37	kWh
Exhaust heat used (per t adry waste wood)	7053,19	MJ
Electricity produced (per net flow of the declared unit)	404,91	kWh
Exhaust heat used (per net flow of the declared unit)	2950,04	MJ

At the end of its life, the product is used as waste wood with identical composition as the declared unit. Thermal recovery in a biomass power plant with a total efficiency of 54.69 % and electrical efficiency of 18.09 % is assumed in this context. Around 968.37 kWh electricity and 7053.19 MJ usable heat are produced when burning 1 t adry wood (mass indicated as adry, however, a wood moisture of ~ 18 % is considered when calculating efficiency). Converted into the net flow of the adry wood share flowing in in module D, and considering the adhesive content in the waste wood, 404.91 kWh electricity and 2950.04 MJ thermal energy are produced per declared unit in module D. The exported energy substitutes fossil fuels. It is assumed in this context that the thermal energy would be produced from natural gas, and that the substituted electricity corresponds to the German electricity mixture of 2018.

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	X	MND	MND	MNR	MNR	MNR	MND	MND	MND	X	X	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m³ CLT BBS

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
GWP	[kg CO_2-Eq.]	-6.83E+2	7.56E+0	1.84E+1	4.08E+0	5.48E-1	7.66E+2	-4.12E+2
ODP	[kg CFC11-Eq.]	3.57E-7	2.09E-13	8.38E-9	1.02E-13	1.51E-14	6.58E-12	-3.46E-10
AP	[kg SO_2-Eq.]	2.85E-1	3.19E-2	9.88E-2	9.74E-4	2.31E-3	6.81E-3	-3.89E-1
EP	[kg $(PO_4)^{3-}$-Eq.]	6.54E-2	8.19E-3	2.07E-2	7.94E-5	5.93E-4	1.11E-3	-6.04E-2
POCP	[kg ethene-Eq.]	6.82E-2	-1.33E-2	1.26E-2	3.38E-5	-9.62E-4	4.52E-4	-3.41E-2
ADPE	[kg Sb-Eq.]	8.01E-5	6.28E-7	2.47E-5	2.89E-7	4.55E-8	3.05E-6	-1.63E-4
ADPF	[MJ]	1.08E+3	1.04E+2	2.64E+2	1.42E+0	7.53E+0	4.33E+1	-5.35E+3

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources

RESULTS OF THE LCA - RESOURCE USE: 1 m³ CLT BBS

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
PERE	[MJ]	1.89E+3	5.76E+0	9.89E+2	2.83E-1	4.17E-1	2.71E+1	-1.42E+3
PERM	[MJ]	8.01E+3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-8.01E+3	0.00E+0
PERT	[MJ]	9.90E+3	5.76E+0	9.89E+2	2.83E-1	4.17E-1	-7.98E+3	-1.42E+3
PENRE	[MJ]	1.15E+3	1.04E+2	2.99E+2	6.07E+1	7.56E+0	5.78E+1	-6.08E+3
PENRM	[MJ]	4.78E+1	0.00E+0	5.90E+1	-5.90E+1	0.00E+0	-4.78E+1	0.00E+0
PENRT	[MJ]	1.19E+3	1.04E+2	3.58E+2	1.62E+0	7.56E+0	9.99E+0	-6.08E+3
SM	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	8.01E+3
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.78E+1
FW	[m³]	9.53E-1	1.06E-2	3.43E-1	1.01E-2	7.68E-4	1.72E-2	9.21E-1

Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m³ CLT BBS

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
HWD	[kg]	4.68E-2	6.04E-6	1.48E-4	8.92E-9	4.37E-7	4.41E-8	-3.47E-6
NHWD	[kg]	6.90E-1	8.74E-3	3.74E-1	3.80E-1	6.33E-4	5.94E-2	-8.94E-1
RWD	[kg]	4.45E-2	1.43E-4	1.39E-2	7.81E-5	1.03E-5	5.72E-3	-3.01E-1
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.71E+2	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	0.00E+0	9.05E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	0.00E+0	1.63E+1	0.00E+0	0.00E+0	0.00E+0

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EEE = Exported thermal energy

6. LCA: Interpretation

The focus area of the interpretation of results is the production phase (modules A1 to A3), as this phase is based on specific information from the company. Interpretation takes place based on a dominance analysis concerning the environmental impact (GWP, ODP, AP, EP, POCP, ADPE, ADPF) and renewable / non-renewable primary energy used (PERE, PENRE).

The most important factors of the respective categories are therefore specified in the following.

6.1 Global warming potential (GWP)

Wood inherent CO2 product system input and output deserve special attention when considering the GWP.

A total of around 961 kg CO2 enter the system in the form of carbon stored in the biomass.

140 kg CO2 thereof are emitted in the course of heat production in the upstream chains (module A1). Another 60 kg CO2 are released into the atmosphere as a result of wood combustion during the production process (module A3). The amount of carbon that is finally stored in CLT is removed from the system when the CLT is recovered as waste wood.

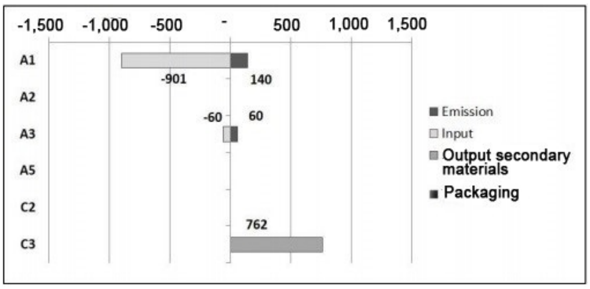

Image 1: Wood inherent CO2 product system input and output [kg CO2 equiv.]. With the inverted algebraic signs of input and output, the CO2 flow consideration is taken into account from the perspective of the atmosphere.

Owing to the pronounced upstream chains and a large share of green electricity used in production, the accounted for fossil greenhouse gases are distributed among the provision of raw materials (75 %, entire module A1), the transport of raw materials (7 %, entire module A2), and the CLT production process (18 %, entire module A3). The provision of sawn timber and solid wood panels (at 54 %), and the provision of adhesives (at 21 %) constitute significant factors of fossil greenhouse gas emissions in particular (both part of module A1), while electricity used in the factory (module A3) accounts for only 7 % of the overall greenhouse gas emissions.

6.2 Ozone depletion potential (ODP)
86 % of emissions with ozone depletion potential arise due to the provision of adhesives (module A1). The provision of semi-finished wood products accounts for 12 % of ODP (also module A1).

6.3 Acidification potential (AP)
Combustion of wood and diesel fuel are the most relevant sources of emissions that potentially contribute to acidification potential. Heat production for infrastructural purposes on site accounts for a total of 15 % of the AP (module A3). Provision of semi-finished wood products and the associated combustion for wood drying, meanwhile account for 61 % of emissions with acidification potential (module A1).

6.4 Eutrophication potential (EP)
62 % of the total arising EP has its origin in the processes of the upstream chains for providing semi-finished wood products, and another 8 % are accounted for by the provision of adhesives (both module A1). The transport of all resources to the factory accounts for 17 % of the EP (entire module A2).

6.5 Ground-level ozone creation potential (POCP)
The key POCP contributors are also accounted for by the provision of semi-finished wood products (95 %, module A1), and by heat production in the factory (14 %, module A3). The negative POCP values registered in module A2 allow for the seeming exceedance of 100 %. These are accounted for by the negative characterisation factor for nitrogen monoxide emissions of the standard compliant /CML-IA/ version (2001 - Apr. 2013) combined with the lorry transport process from the /GaBi Professional Database 2018 Edition/ that was applied for modelling log transport.

6.6 Abiotic depletion potential, concerning resources of non-fossil origin (ADPE)
Significant contributors of ADPE are electricity consumption in the factory (17 %, module A3), the semi-finished wood product upstream chain (24 %, module A1), and the provision of the adhesives used (52 %, module A1).

6.7 Abiotic depletion potential, concerning fossil fuels (ADPF)
ADPF is accounted for mostly by module A1. It arises due to the semi-finished wood product upstream chain (45 %), and the provision of adhesives (30 %). Operating and packaging materials together account for around 10 % of the ADPF.

6.8 Primary energy renewable, energy resources (PERE)
65 % of PERE use is accounted for by the semi-finished wood product upstream chain (module A1), 11 % by electricity consumption, and 23 % by wood combustion for heating purposes in the factory (both module A3).

6.9 Primary energy non-renewable, energy resources (PENRE)
The use of non-renewable primary energy is also accounted for by the semi-finished wood product upstream chain by 46 % (module A1). In addition to this, around 28 % of PENRE use can be attributed to the provision of adhesives in module A1, and only 6 % are accounted for by electricity consumption in the factory (module A3), thanks to the high proportion of green electricity used.

6.10 Waste:
Special waste is produced almost exclusively in the provision of adhesives (approx. 95 %) in module A1.

7. Requisite evidence

7.1 Formaldehyde
Measuring station
TÜV Rheinland LGA Products GmbH.
Place of the inspection
Tillystrasse 2, 90431 Nuremberg.
Inspection report and period
Inspection report no. 21268049 003
Inspection period from 13 December 2016 until 11 January 2017
Measurement method and result
The measurements in accordance with /EN 717-1/ took place in a uniform manner in testing chambers at a temperature of 23 °C, a relative humidity of 50 %, and

an air exchange rate of 0.5/h. The loading factor was 1 m²/m³.
The formaldehyde emissions analysed in accordance with /EN 717-1/ or /ISO 16000-3/ respectively, are 0.02 ppm. Formaldehyde emissions are thus significantly lower than the E1 limit of 0.1 ppm.

7.2 MDI

The MDI contained in the 1-K-PUR glue reacts completely in the gluing process of binderholz CLT BBS. MDI emissions from the set binderholz CLT BBS are therefore not possible.
No MDI emissions can be detected in testing in accordance with /EN 717-2/ (detection limit: 0.05 µg/m³).

7.3 Toxicity of combustion gases

The toxicity of combustion gases that arise when burning CLT corresponds to that of burning natural, untreated Wood.

7.4 VOC emissions

Measuring station
TÜV Rheinland LGA Products GmbH.

Place of the inspection
Tillystraße 2, 60431 Nuremberg.
Inspection report and period
Inspection report no. 21268049 003
Inspection period from 13 December 2016 until 11 January 2017
Measurement method and result
The test chamber examination was performed in accordance with /ISO 16000-9/. The VOC emissions were analysed in accordance with /16000-6/.

AgBB (German Committee for Health-related Evaluation of Building Products) results review after 28 days

Name	Value	Unit
TVOC (C6-C22)	218	µg/m³
Total SVOC (C16-C22)	not detected	-
R (non-dimensional)	0,4	µg/m³
VOC without LIC (lowest concentration of interest)	1,8	µg/m³
carcinogens	n.n.	µg/m³

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