ENVIRONMENTAL PRODUCT DECLARATION

According to /ISO 14025/ and /EN 15804/

Declaration holder	**Binderholz GmbH Glue-laminated timber factory**
Editor	Institut Bauen und Umwelt e.V. (IBU)
Programme operator	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-BBS-20190164-IBA1-EN
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Date issued	29.11.2019
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binderholz Glulam - binderholz Bois lamelle-colle BSH - Legno lamellare BSH binderholz - binderholz BSH glulam

Binderholz GmbH Glue-laminated timber factory

www.ibu-epd.com / https://epd-online.com

1. General information

Binderholz GmbH - Glulam factory

Programme operator
IBU - Institut Bauen und Umwelt e.V.
Panoramastrasse 1
10178 Berlin
Germany

Declaration number
EPD-BBS-20190164-IBA1-EN

This declaration is based on the following product category rules:
Solid wood products,12.2018
(PCR tested and approved by an independent expert council (IEC))

Date issued
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Valid until
28.11.2024

Prof. Dr.-Ing. Horst J. Bossenmayer
(President of the "Institut Bauen und Umwelt e.V.")

Dr. Alexander Röder
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binderholz BSH glue-laminated timber (glulam)

Declaration holder
Binderholz GmbH
Zillertalstraße 39
6263 Fügen
Austria

Declared product / unit
1 m³ binderholz BSH glue-laminated timber (glulam)

Area of application:
The data basis for preparing the ecological balance is the glue-laminated timber production data of "Binderholz GmbH glue-laminated timber factory" in Jenbach.

In total, the production data covers 100% of the overall production of binderholz BSH glue-laminated timber (glulam).

The present environmental product declaration applies to binderholz BSH glue-laminated timber.

The declaration holder is responsible for the underlying information and proofs. IBU cannot be held liable for any producer information, ecological balance data and proofs.

Verification

European standard /EN 15804/ serves as core PCR
Independent verification of the declaration and information according to /ISO 14025:2010/
☐ internal ☒ external

Matthias Klingler,
(Independent verifier, appointed by the IEC)

2. Product

2.1 Product description/definition

Binderholz BSH glue-laminated timber is a solid, bar-shaped wooden component. It consists of at least three grain-parallel lamella glued to each other and is produced in accordance with /EN14080/.

The lamellae are mechanically sorted for strength and the optical and physical properties of the material are homogenised. This results in a high degree of dimensional stability and load bearing capacity.

Binderholz BSH glulam comes as standard or as consignment product and also in specific sizes and setups.

Several manual and mechanical trimming options are integrated in the factory, enabling a high level of prefabrication, which results in very short construction and site installation times.

Regulation (EU) No. 305/2011 dated 09.03.2011 applies to the placing on the market of the panels in the EU /EFTA with the exception of Switzerland.For use in the building industry, the products must be accompanied by a declaration of performance having regard to /EN 14080/ as well as the CE certificate. Use of the timber is subject to the respective national stipulations.

The declarations of performance are available at **www.binderholz.com**.

2.2 Use

Binderholz BSH glue-laminated timber is used for all areas of up-to-date wood structures, from engineered residential and industrial constructions to bridge building.
Use of binderholz glulam is subject to the respective national stipulations.

2.3 Technical data

Binderholz glue-laminated timber is produced at 9-14% wood moisture.

The data contained in the Declaration of Performance shall be applicable.
Depending on the cross section structure (number and thickness of layers), and the position of the load acting on binderholz BSH glulam, the building-physics properties (building component resistance and fire resistance) will vary. The usual strength classes according to /EN 1995-1-1/ are GL 24, GL 28 and GL 30. These classes are valid both for the combined structure (c) and the homogenous structure (h).
Upon inquiry, Glulam is also available in strength class GL 32.
binderholz BSH glulam can be used in utility classes 1 to 3 in accordance with /EN 1995-1-1/.

Preventive chemical wood preservation according to /DIN 68800-3/ can be applied upon inquiry. Binderholz BSH glulam can be treated using a class-2 impregnation agent according to /DIN 68800-3/ to protect it against fungal decay and insect attacks.

As a general rule, constructive wood preservation in line with /DIN 68800-2/ is preferable.

Structural engineering data for binderholz BSH glulam

Designation	Values for	Unit
Wood types according to trade names under /EN 1912/	Spruce and fir	-
Wood moisture acc. to /EN 13183-2/	9 - 12	%
Use of wood preservatives (test ratings for the wood preservative according to /DIN 68800-3/)	Iv, P	-
Raw density of load-bearing elements according to /EN 338/ and /DIN 1052/, non load-bearing elements acc. to /DIN 68364/	459	kgs/m^3
Surface quality	Visible and non-visible quality	-
Width tolerance acc. to /EN 14080/	+/- 2	mm
Height tolerance acc. to /EN 14080/	+/- 2	mm
Length tolerance acc. to /EN 14080	+/- 0.1	%
Heat conductivity acc. to /ISO 1045	0.13	W/(mK)
Resistance to water vapour diffusion acc. to /ISO 10456/	40	-

The product performance values are those of the Performance Declaration in relation to its essential characteristics according to /EN 14080:2019-09/, Timber structures – Glue-laminated timber and laminated beams – Requirements.

2.4 Available dimensions and types

With the trimming options offered, binderholz BSH glulam can be provided in the following sizes up to lot size 1:

BSH Glulam Standard
Width range: 60 to 280 mm
Height range: up to 1,280 mm
Length range: 6.00 to 18.00 m

BSH Glulam Ceiling panels
Standard widths: 600 and 1000 mm, special width range 240 mm and up
Height and thickness range: 60 to 280 mm
Length range: 6.00 to 18.00 m

BSH Glulam Special elements
Width range: 120 to 480 mm
Height range: up to 2,000 mm
Length range: 6.00 to 32.5 m

2.5 Basic and auxiliary materials

Binderholz BSH glue-laminated timber is made from at least three grain-parallel softwood lamellae. Each lamella is first dried in a kiln and sorted for strength.

Two-component melamine urea formaldehyde glues (MUF glues) are used for finger jointing and surface bonding.

Binderholz BSH glue-laminated timber contains none of the substances on the /ECHA candidate list/ (status as of 15.01.2019) above 0.1% weight by weight. Binderholz BSH glue-laminated timber does not contain any further CMR category 1A / 1B substances not included in the candidate list, above 0.1% weight by weight. No biocide products were added to the present panels for construction and they were not treated with biocide products (thus, they are not deemed as treated goods acc. to the /Biocide Product Regulations / (EU) No. 528/2012).

For the environmental product declaration, the following constituents are calculated per cubic metre of binderholz BSH glue-laminated timber:

- softwood: 88.58%
- Water: 10.7%
- MUF glue: 0.72%

Binderholz BSH glue-laminated timber has a calculated averaged raw density (u=12.08%) of 459.2 kgs/m³.

2.6 Manufacture

Binderholz BSH glue-laminated timber is manufactured in visible and non-visible qualities from spruce and fir.

Kiln-dried softwood lamellae with 9-14% wood moisture are used after mechanical sorting according to their strength and joined by finger-jointing to form practically endlessly long lamellae, which are then trimmed, planed and bonded to form glulam beams in accordance with the length ordered.

Finger jointing and surface bonding along the grain is carried out using the glue mentioned in chapter 2.5.

When the glue has cured completely, the timber surface is subjected to a final machining process and the custom-tailored trimming process.

Impregnation with wood preservatives is possible depending on the purpose for which binderholz BSH glulam is used.

2.7 Environmental and health issues during manufacture

The exhaust air from the process is cleaned in accordance with the legal requirements. The waste water from the process is fed to the local sewer system. Where noise-intensive machines are used, they will be enclosed for sound absorption by constructional measures.

2.8 Product processing/installation

Binderholz BSH glue-laminated timber is processed with the usual tools suited for solid wood treatment. The instructions on the safety of work must be observed both when processing and installing the timber.

2.9 Packing

As packing material, polyethylene (PE) sheets are used (waste code 15 01 02 acc. to /AVV - Waste List Ordinance/).

2.10 Use status

The basic material composition stated in Chapter 2.5 corresponds to the composition over the time of use. During use, approximately 203 kgs of carbon are sequestered in one cubic metre of binderholz BSH glue-laminated timber, corresponding to approx. 745 kgs of CO_2 equivalent for complete oxidation.

2.11 Environmental and health issues during use

Environmental preservation: provided that binderholz BSH glue-laminated timber is used for the intended purposes, it does not pose any risk for water, air, and soil.
Health protection: According to the current state of knowledge, no harms to and adverse effects on health are to be expected.
Where formaldehyde is concerned, binderholz BSH glue-laminated timber is a low-emission product due to the low glue content, its structure and application.
As mainly MUF glues are used, binderholz BSH glue-laminated timber emits formaldehydes in the range of 25µg/m³ (0.02 ppm). Compared to the limit value (0.1 ml/m³) these values are to be classified as low acc. to /EN 717-1/.

2.12 Reference useful life

Glulam has been used in the building industry for over a hundred years. Accordingly, no end to the durability of binderholz BHS glulam is known or to be expected if it is used according to its purpose.

Therefore, the useful life of binderholz BSH glue-laminated timber is assumed to be identical to the overall useful life of the respective building, with the proviso of use for the intended purpose.

Age-related impacts on binderholz BSH glue-laminated timber may result from its use according to the rules of engineering.

2.13 Exceptional impacts

Fire
Binderholz BSH glue-laminated timber is classified under material class D (/EN 13501-1/), the toxicity of combustion gases being equivalent to that of natural wood.

Fire protection

Designation	Value
Material class	D
Flaming droplets	d0
Flue gas evolution	s2

Water
No substances are washed out that would pose a risk to water.

Mechanical destruction
Solid wood lamellae are used for the manufacture of binderholz BSH glue-laminated timber, which therefore has a fracture pattern that is characteristic of solid wood.

2.14 End-of-life use

Due to its monolithic structure, binderholz BSH glue-laminated timber can be reused or used for other purposes without any problem if it is selectively dismantled.

If it cannot be reused as such, binderholz BSH glue-laminated timber can be used for generating process heat and electricity in thermal utilisation thanks to its high thermal value of approx. 19 MJ/kg. If used for energy generation, the requirements of the Bundes-Immissionsschutzgesetz (/BImSchG/) must be observed. Untreated binderholz glue-laminated timber is classified under waste class 17 02 01 according to the /AVV/ Annex III (Waste Wood Ordinance (waste wood V/) dated 15.02.2002. Waste code 17 02 04 applies for treated binderholz BSH glulam depending on the wood preservative used.

2.15 Disposal

Waste wood must not be landfilled acc. to Article 9 /Waste Wood V/.

2.16 Further information

Extensive information is available at:
www.binderholz.com

3. LCA: Rules of calculation

3.1 Declared unit

The declared unit of ecological assessment is one cubic metre of binderholz BSH glue-laminated timber, by taking account of the glue used acc. to Chapter 2.5 and a weight of 459.260 kgs/m³ at 12.08% wood moisture, which corresponds to a water portion of 10.7%, the glues correspond to a 0.72% portion. The statements concerning the glues used were calculated on the basis of specific data.

Statement of the declared unit

Designation	Value	Unit

Declared unit	1	m^3
Raw density	459.2	kgs/m^3
Wood moisture at delivery	12.08	%
Conversion factor to1 kg	0.0021777	-

3.2 System limit

The declaration type corresponds to EPD, "from cradle to gate with options". Its contents are the production stage, from the provision of the raw materials to the gate of the producer (*cradle-to-gate*, Modules A1 to A3), as well as Module A5 and parts of the end of life (Modules C2 and C3). In addition, an assessment of the potential benefits and drawbacks beyond the end of life of the product is made (Module D).
In detail, Module A1 contains a balance of the provision of the semi-finished wood products and the provision of the glues. The transport of these materials is taken into account in Module A2. Module A3 comprises the provision of the fuels, operating and packing materials, electricity and the on-site manufacturing processes. These are in the essence: drying of the sawn timber, trimming and lengthwise bonding, side-dressing, thickness bonding, planing to achieve a visually attractive surface, and packing of the products. Module A5 exclusively covers the disposal of the packing, which includes the output of the primary energy (PENRM) contained.
Module C2 takes the transport to the disposal firm into account, and Module C3, the processing and sorting of the waste wood. In addition, in Module C3, the CO_2-equivalents of the wood-inherent carbon contained in the product are considered as outputs in accordance with /EN 16485/, as is the renewable and non-renewable primary energy contained in the product (PERM and PENRM).

Module D contains a balance of the thermal reuse of the product at the end of its life and the resulting potential benefits and drawbacks in the form of a system extension.

3.3 Assessments and assumptions

Basically, all material and energy flows in the processes required for manufacture are calculated on the basis of questionnaires. The emissions on site caused by the drying of the wood and the curing of the glue used were partly estimated from information in the scientific literature. The latter values are profoundly documented in /Rüter, Diederichs 2012/.

3.4 Cutting rules

None of the relevant material and energy flows was neglected, not even those below the 1% limit. The overall sum of the neglected input flows is thus securely under 5% of the energy and mass input. In addition, this ensures that no material and energy flows are neglected that would have a special potential for significant impacts in relation to environmental indicators.

3.5 Background data

The entirety of the background data was taken from /GaBi Professional Data Base 2019 Edition/ with Service Pack 39 and the concluding report *"Ökobilanz-Basisdaten für Bauprodukte aus Holz"* /Rüter, Diederichs 2012/ (ecological balance basis data for constructional products made from wood).

3.6 Data quality

Validation of the inquired foreground data was based on the mass and on the plausibility criteria. The background data used for materially and energetically exploited wood-based raw materials other than forest wood date from the period 2008 to 2012. The provision of forest wood was taken from a publication from 2008, essentially based on data from 1994 to 1997. The source of all other information is /GaBi Professional Data Base 2019 Edition/ with Service Pack 39. The quality can be generally termed "good".

3.7 Assessment period

The factory data gathered for modelling the foreground system refers to the 2017 calendar year (reference period). The entire information is therefore based on the averaged data of 12 consecutive months

3.8 Allocation

The allocations carried out correspond to the requirements of /EN 15804/ and /EN 16485/. In the essence, the following system extensions and allocations were applied:

In general terms:
Flows of the material-inherent properties (biogenic carbon and the primary energy contained) were basically allocated according to physical causalities. All other allocations to related co-productions were carried out on an economic basis.

Module A1

- Forest: all expenses connected to the forest upstream chain as part of the sawn timber provision were allocated to the products "logs" and "industrial wood" via economic allocation factors and based on their prices.
- Sawn timber upstream chain: all expenses connected to the sawn-timber upstream chain in the debarking, cutting, and drying processes as well as final treatment were allocated to the corresponding main products: logs over bark (oB), sawn timber (fresh), sawn timber (dry) and side products (bark, sawmill residue) via economic allocation factors.

Module A3

- The expenses at the factory can be exactly split among the products manufactured (without related co-production).
- In case of related co-production (e.g. for any industrial wood residues) all expenses previously falling to the main product are allocated to the main product and the side products on an economic basis.
- The disposal of the residues from manufacture is carried out on the basis of a system extension, whose calculation corresponds to a direct loop.

Module D

- The system extension carried out under Module D corresponds to an energetic use scenario for waste wood.

3.9 Comparability

Basically, EPD data cannot be compared or evaluated unless all data sets to be compared have been created acc. to /EN 15804/ and the building context and/or the product-specific performance criteria were taken into account.

The ecological balance modelling was carried out using the /GaBi ts/ software version 9.2.0.58. The entirety of the background data was taken from /GaBi Professional Data Base 2019 Edition/ with Service Pack 39 or from the literature.

4. LCA: Scenarios and further technical information

The scenarios on which the ecological balance is based are outlined in greater detail in the following:

Installation into buildings (A5)

Module A5 is declared, but it contains only information on the disposal of the product packing and none on the actual installation in buildings. The amount of packing material in Module A5 which is produced per declared unit as waste for thermal utilisation and the resulting exported energy are stated in the following in the form of technical scenario information.

Designation	Value	Unit
PE sheet for thermal waste treatment	0.84	kgs
Other synthetic materials for thermal waste treatment	0.72	kgs
Overall efficiency of thermal utilisation of waste	44	%
Total exported electric energy	8.76	MJ
Total exported thermal energy	18.18	MJ

A transport distance of 20 kilometres is assumed for the disposal of the product packing. The overall efficiency of the refuse combustion and the portions of the electric and thermal energy generation using cogeneration correspond to those of the allocated refuse combustion process in the data base /GaBi Professional Data Base 2019 Edition/.

End of life (C1–C4)

Designation	Value	Unit
Waste wood for use as secondary fuel	459.2	kgs
Redistribution transport distance of the waste wood (Module C2)	20	km

For the thermal utilisation scenario, a collection rate of 100% is assumed without losses caused by comminution of the material.

Reuse, recovery and recycling potential (D), relevant scenario data

Designation	Value	Unit
Lower calorific value of the waste wood when combusted (b.d.)	19.271	MJ/kg
Lower calorific value of the MUF glue	13.25	MJ/kg
Electric energy generated (per b.d. waste wood tonne)	965.5	kWh
Heat generated (per b.d. waste wood tonne)	7034.5	MJ
Electric energy generated (per net flow of declared unit)	394.95	kWh
Heat generated (per net flow of declared unit)	2877.48	MJ

At its end of life, the product is reused as waste wood in the same composition as the declared unit that has been described. Thermal reuse in a biomass power plant with an overall efficiency of 54.54% and electric efficiency of 18.04% is assumed. In doing so, approx. 965.5 kWh of electricity and 7034.5 MJ of usable heat would be produced when burning one tonne of b.d. wood (weight as bone dry, the wood moisture having been taken into account for the efficiency value). For the net flow of the b.d. wood portion input in Module D, with due consideration of the glue portion in the waste wood, this translates into the generation of 394.95 kWh of electricity and 2877.48 MJ of thermal energy per declared unit. The energy exported replaces fuels from fossil sources, whereby it is assumed that the thermal energy would be produced from natural gas and the substituted electricity would correspond to the German electricity mix of 2016.

5. LCA: Results

Information on the system limits (X = contained in the ecological balance; MND = module not declared)

Production stage			Building construction stage		Utilisation stage							Disposal stage				Credits and debits outside system limit
Raw material supply	Transport	Manufacture	Transport from manufacturer to place of use	Installation	Utilisation/use	Maintenance	Repair	Replacement	Renewal	Energy used for building operation	Water used for building operation	Dismantling/ demolition	Transport	Waste treatment	Removal	Reuse, recovery or 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 ecological balance - environmental impacts of 1 cubic m. of glue-laminated timber

Para-meter	Unit	A1	A2	A3	A5	C2	C3	D
GWP	[kgs CO_2 eq.]	-6.60E+2	6.26E+0	1.44E+1	4.42E+0	5.36E-1	7.49E+2	-3.95E+2
ODP	[kgs CFC11 eq.]	1.58E-12	1.05E-15	6.59E-13	1.16E-15	8.99E-17	1.80E-13	-9.20E-12
AP	[kgs SO_2 eq.]	3.17E-1	2.64E-2	6.04E-2	6.73E-4	2.27E-3	6.64E-3	-3.61E-1
EP	[kgs $(PO_4)^{3-}$ eq.]	7.46E-2	6.73E-3	1.29E-2	8.89E-5	5.77E-4	1.08E-3	-5.61E-2
POCP	[kgs Ethene eq.]	1.99E-2	-1.09E-2	3.57E-2	3.05E-5	-9.36E-4	4.39E-4	-3.18E-2
ADPE	[kgs Sb eq.]	2.11E-5	4.89E-7	1.40E-5	1.42E-7	4.19E-8	1.80E-6	-9.38E-5
ADPF	[MJ]	1.04E+3	8.60E+1	2.39E+2	1.03E+0	7.38E+0	4.18E+1	-5.13E+3

Caption	GWP = Global warming potential; ODP = Ozone depleting potential; AP = Acidification potential for soil and water; EP = Eutrophication potential; POCP = Photochemical ozone creation potential; ADPE = Abiotic depletion potential for elements (ADP - materials); ADPF = Abiotic depletion potential for fossil fuels (ADP – fossil energy sources)

Results of the ecological balance – resource use: 1 cubic metre of glue-laminated timber

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
PERE	[MJ]	1.06E+3	5.01E+0	1.40E+3	2.14E-1	4.29E-1	2.96E+1	-1.51E+3
PERM	[MJ]	7.84E+3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-7.84E+3	0.00E+0
PERT	[MJ]	8.90E+3	5.01E+0	1.40E+3	2.14E-1	4.29E-1	-7.81E+3	-1.51E+3
PENRE	[MJ]	1.13E+3	8.63E+1	2.59E+2	5.73E+1	7.40E+0	5.49E+1	-5.76E+3
PENRM	[MJ]	4.38E+1	0.00E+0	5.62E+1	-5.62E+1	0.00E+0	-4.38E+1	0.00E+0
PENRT	[MJ]	1.17E+3	8.63E+1	3.15E+2	1.15E+0	7.40E+0	1.11E+1	-5.76E+3
SM	[kgs]	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	7.84E+3
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.38E+1
FW	[m^3]	5.50E-1	8.47E-3	5.84E-1	1.01E-2	7.26E-4	1.60E-2	1.07E+0

Caption	PERE = Primary energy, renewable; PERM = Primary energy renewable, materials; PERT = Primary energy renewable, total; PENRE = Primary energy non-renewable, energy resources; PENRM = Primary energy non-renewable, materials; PENRT = Primary energy non-renewable, total; SM = secondary materials; RSF = renewable secondary fuels; NRSF = non-renewable secondary fuels; FW = fresh water resources

Results of the ecological balance - output flows and waste categories: 1 m^3 of glue-laminated timber

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
HWD	[kgs]	3.13E-5	4.82E-6	4.05E-6	5.11E-9	4.14E-7	4.26E-8	-3.27E-6
NHWD	[kgs]	9.83E-1	7.02E-3	8.99E-1	1.85E-1	6.02E-4	5.68E-2	2.84E+0
RWD	[kgs]	5.25E-2	1.17E-4	7.92E-3	4.59E-5	1.00E-5	5.17E-3	-2.65E-1
CRU	[kgs]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kgs]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kgs]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.59E+2	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	0.00E+0	8.76E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	0.00E+0	1.82E+1	0.00E+0	0.00E+0	0.00E+0

Caption	HWD = Hazardous waste disposal; NHWD = Non-hazardous waste disposal; RWD = Radioactive waste disposal; CRU = Components for reuse; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported energy electric; EET = Exported energy thermal

6. LCA: Interpretation

The focus of the interpretation of the results is placed on the production phase (Modules A1 to A3), because they are based on concrete data supplied by the company. Interpretation is founded on a dominance analysis of the environmental impacts (GWP, ODP, AP, EP, POCP, ADPE, ADPF) and the renewable and non-renewable primary energy sources (PERE, PENRE).

Therefore, the most important factors for the respective categories are mentioned in the following.

6.1 Global warming potential (GWP)

Regarding the consideration of the GWP, the wood-inherent CO_2 product system inputs and outputs need to be discussed separately. Over the entire life cycle, approx. 863 kgs of CO_2enter the system as carbon stored in the biomass. Of this amount, 41kgs of CO_2 are emitted in the course of heat generation in the

upstream chains (Module A1). A further amount of 77 kgs of CO_2 is emitted to the atmosphere as a result of the wood combustion during the manufacturing process (Module A3). The amount of carbon finally stored in the glue-laminated timber is extracted from the system in the course of its reuse as waste wood.

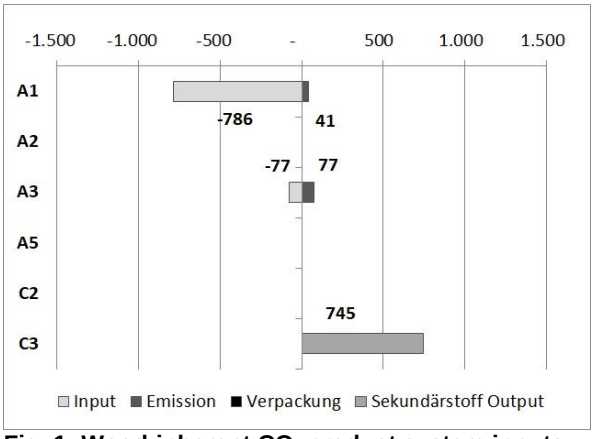

Fig. 1: Wood-inherent CO_2 product system inputs and outputs [kgs of CO_2 eq.]. The inverse signs given to the input and output take the ecological balance CO_2 flow consideration into account from the view of the atmosphere.

Due to the pronounced upstream chains and a high share of renewable energies in manufacture, the fossil global warming potential is distributed in the balance as follows: 80% for the provision of the semi-finished goods and raw materials (entire Module A1); 6% for the transport of the raw material (entire Module A2) and 14% for the manufacturing process of the glue-laminated timber (entire Module A3). Seen in detail, the provision of sawn timber - 75% (Module A1) - and the heat generation in the factory (Module A3), 13% of the fossil GWP, are essential impact values, while the electric power consumption in the factory (Module A3) makes up for only 1% of the total fossil GWP.

6.2 Ozone depleting potential (ODP)
Of the emissions with an ozone depleting potential, 69% is caused by the provision of the sawn timber (Module A1) and 19% by the energy consumption in the factory (Module A3).

6.3 Acidification potential (AP)
In the essence, the combustion of wood and Diesel are the major sources of emissions causing possible contributions to the acidification potential. The production of heat for on-site infrastructure projects contributes a total of 12% to the AP (Module A3). The provision of semi-finished wood products as well as the firing for wood drying purposes account for 77% of the emissions with an acidification potential (Module A1). 6% is due to the transport of the semi-finished goods to the factory.

6.4 Eutrophication potential (EP)
75% of the total EP caused is due to upstream chain processes for the provision of the semi-finished wood products and a further 4% to the provision of the glues (both in Module A1). Transport of the semi-finished wood products to the factory contributes 7% (Module A2), while heat generation on site accounts for 11% of the EP (Module A3).

6.5 Photochemical ozone creation potential (POCP)
The main POCP contribution of 43% is due to the provision of the semi-finished wood products (Module A1), 67% to the emissions from wood drying in the factory (Module A3) and 11% to heat generation (also Module A3). The negative values (-24%) in the POCP in Module A2 enable the supposed excess of 100% and are due to the negative characterisation factor for the nitrogen monoxide emissions of the /CML-IA/ Version (2001-Apr. 2013) conforming to the standards, in combination with the truck transport process used in /GaBi Professional Data Base 2019 Edition/ for modelling the log transport.

6.6 Abiotic depletion potential for elements (ADPE)
The main constituents of ADPE are caused by the consumption of electric power in the factory (26%, Module A3), the upstream chain of semi-finished wood products (57%, Module A1) and the provision of the operating materials (12%, Module A3).

6.7 Abiotic depletion potential for fossil fuels (ADPF)
ADPF is also mainly distributed over Module A1 and is caused by the upstream chain of semi-finished wood products (67%) and provision of the glues (9%). In addition, heat generation in the factory accounts for approximately 17% of the overall ADPF.

6.8 Primary energy renewable (PERE)
The use of PERE is 43% in the upstream chain of semi-finished wood products (Module A1), 20% in electric power consumption and 36% in the production of process heat with wood combustion in the factory (both in Module A3).

6.9 Primary energy non-renewable (PENRE)
The use of PENRE is 69% in the upstream chain of semi-finished wood products (Module A1). In addition, roughly 8%of the PENRE is used for the provision of the glues in Module A1 and 16% for heat generation in the factory (Module A3).

6.10 Wastes:
In Module A1, special wastes are created by the provision of sawn timber (78%) and in Module A2, by the transport of the semi-finished goods (11%).

Evidence

7.1 Formaldehydes
Test site
Entwicklungs- und Prüflabor Holztechnologie GmbH.
Testing location
Zellescher Weg 24, 01217 Dresden.
Test report and testing period
Test report No. 2516444
Testing period: 27.09.2016 to 25.10.2016
Measuring method and results
The measurements according to /ISO 16000-9/ were uniformly carried out in test chambers at a temperature of 23°C, a relative air humidity of 50% and an air exchange rate of 0.50 per hour. The loading factor was 0.3 m²/m³.
The formaldehyde emission values analysed according to /EN 717-1/ and /ISO 16000-3/ are 0.02 ppm and are thus clearly below the limit value of E1 (0.1 ppm).

7.2 Toxicity of the combustion gases
The toxicity of the combustion gases from glue-laminated timber is equivalent to that of natural wood.

7.3 VOC emissions
Test site
Entwicklungs- und Prüflabor Holztechnologie GmbH.
Testing location
Zellescher Weg 24, 01217 Dresden.
Test report and testing period
Test report No. 2516444
Testing period: 27.09.2016 to 25.10.2016
Measuring method and results
The test in the testing chamber was carried out in accordance with /ISO 16000-9/. The VOC emissions were analysed according to /ISO 16000-6/.

AgBB results overview after 28 days

Results	Value	Unit
TVOC (C6 - C16)	47	µg/m³
Sum SVOC (C16 - C22)	Not detected	µg/m³
R (w/o dimension)	0.278	-
VOC w/o NIK	5	µg/m³

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