ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Studiengemeinschaft Holzleimbau e.V.
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-SHL-20240270-IBO1-EN
Issue date	10.04.2026
Valid to	27.05.2030

Glued laminated timber (GL Timber)

Studiengemeinschaft Holzleimbau e.V.

Institut Bauen und Umwelt e.V.

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1. General Information

Studiengemeinschaft Holzleimbau e.V.

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-SHL-20240270-IBO1-EN

This declaration is based on the product category rules:

Solid wood products, 01.08.2021
(PCR checked and approved by the SVR)

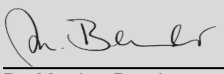
Issue date

10.04.2026

Valid to

27.05.2030

Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)



Dr. Martina Bender
(Managing Director Institut Bauen und Umwelt e.V.)

Glued laminated timber (GL Timber)

Owner of the declaration

Studiengemeinschaft Holzleimbau e.V.
Heinz-Fangman-Str. 2
42287 Wuppertal
Germany

Declared product / declared unit

1 m³ glued laminated timber

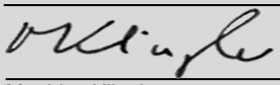
Scope:

The content of this declaration is based on information provided by approximately 50% of the association's members, with the technology represented here being representative of all members. The results of the life cycle assessment are therefore representative of
all glued laminated timber components manufactured in Germany by the Studiengemeinschaft Holzleimbau e.V.
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.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally



Matthias Klingler,
(Independent verifier)

2. Product

2.1 Product description/Product definition

Glued laminated timber (Glulam) is an industrial product for load-bearing structures. Glulam consists of at least two kiln-dried boards or laminations made of softwood or poplar, glued together parallel to grain. It is improved because of the strength grading of the raw material and homogenisation through layup and has higher load-bearing capacities than conventional structural timber. Glulam is a highly dimensionally stable and crack-minimised building material thanks to the way it is manufactured. Glulam can be made in a form that is curved or twisted in one plane or spatially. In addition to the quality control required under building regulations, manufacturing may be subject to additional private-law quality control in accordance with the provisions of the Glulam monitoring label. Glued laminated timber is made from spruce, fir (approx. 94%), pine (approx. 3%), larch (approx. 1%) or Douglas fir (approx. 2%). Other softwood species as well as poplar are permitted, albeit uncommon. The usual strength classes according to the GL timber data sheet of the Studiengemeinschaft Holzleimbau e.V. are GL24c, GL28c, and GL30c. DIN EN 14080 allows for the manufacturing of other, less common strength classes. The products can be fabricated according the Glulam data sheet in visual or industrial quality. The distribution of the product within the EU/EFTA (excluding Switzerland) is subject to the provisions of the Construction Products Regulation CPR. The product requires a declaration of performance in compliance with EN 14080:2013-09, Timber structures – Glued laminated timber and glued solid timber – Requirements and the CE label.

The respective national regulations at the place of use apply to the use of the product. In Germany, for example, these are the building regulations of the federal states and the technical regulations based on these regulations, particularly the national application standard DIN 20000-3.

2.2 Application

Glued laminated timber is used in load-bearing members in building and bridge construction. The use of preventive preservative chemical wood treatment in accordance with DIN 68800-3 is unusual and only permitted when the possibilities of constructive wood preservation measures in accordance with DIN 68800-1 and DIN 68800-2 have been exhausted. If, in exceptional cases, a preservative chemical wood treatment is used, it must be approved in accordance with the Biocidal Products Directive.

2.3 Technical Data

The key technical data for glued laminated timber made from softwood or poplar is listed below.

Structural properties

Name	Value	Unit
Timber species pursuant to /EN1912/ and letter codes, if any, according to /EN 13556/	Various timber species1)	-
Wood moisture content acc. to /DIN EN 13183-1/[2)]	≤ 15	%
Timber preservative treatment (indicate the test rating acc. to /DIN 68800-3/)[3)]	Iv, P and W	-
Characteristic bending strength	24 - 32	N/mm²
Characteristic compressive strength parallel to grain acc. to /DIN EN 14080/[4)]	21,5 bis 24,5	N/mm²
Characteristic compressive strength perpendicular to grain acc. to /DIN EN 14080/[4)]	2,5	N/mm²
Characteristic tensile strength parallel to grain acc. to /DIN EN 14080/[4)]	17,0 - 19,5	N/mm²
Characteristic compressive strength perpendicular to grain acc. to /DIN EN 14080/[4)]	0,5	N/mm²
Mean modulus of elasticity parallel to grain acc. to /DIN EN 14080/[4)]	11.000 to 13.500	N/mm²
Characteristic shear strength acc. to /DIN EN 14080/[4)]	3,5	N/mm²
Mean modulus of shear acc. to /DIN EN 14080/[4)]	650	N/mm²
Dimensional deviations acc. to /DIN EN 14080/5)	Width: +/- 2 mm; heights ≤ 400 mm: + 4 mm / - 2 mm; heights > 400 mm: + 1% / - 0,5%; lengths (≤ 2 m): +/- 2 mm; lengths (2 m < / ≤ 20 m): +/- 0.1%; lengths (> 20m): +/- 20 mm	mm or %
Mean density of different strength classes acc. to /DIN EN 14080/[4)]	400- 440	kg/m³
Surface quality acc. to /GL timber data sheet/	industrial quality, visual quality	-
Suitability for usage classes (UC) acc. to /DIN 68800-1/6)	All timber types: UC 0; southern pine heartwood: also UC 1; pine heartwood: also UC 1 and 2; Douglas fir, larch and yellow cedar heartwood: also UC 1, 2 and 3.1	-
Thermal conductivity acc. to /DIN EN 12664/7)]	Vertical to grain: 0.13	W/(mK)
Specific thermal capacity acc. to /DIN EN 12664/	1600	kJ/kgK
Water vapour resistance coefficient acc. to /DIN EN ISO 12572/8)]	Dry at 500 kg/m³ density: 50	-

1) Spruce (Picea abies, PCAB), Fir (Abies alba, ABAL), Scorts pine redwood (Pinus sylvestris, PNSY),Douglas fir (Pseudotsuga menziesii, PSMN), Western hemlock (Tsuga heterophylla, TSHT), Corsican pine and Austrian black pine (Pinus nigra, PNNL), European larch (Larix decidua, LADC), Siberian larch (Larix sibirica, LASI), Dahurian larch (Larix gmelinii (Rupr.) Kuzen.), Maritime pine (Pinus pinaster, PNPN), Poplar (applicable clones: Populus x euramericana cv 'Robusta', 'Dorskamp', 'I214' and 'I4551', POAL), Radiata-pine (Pinus radiata, PNRD), Sitka spruce (Picea sitchensis, PCST), Southern yellow pine (Pinus palustris, PNPL), Western red cedar (Thuja plicata, THPL), Yellow cedar (Chamaecyparis nootkatensis, CHNT).
Spruce and fir may be treated as one wood-species.
2) DIN EN 14800 allows for other, equivalent methods of measurement.
3) /DIN 68800-1/ only permits treatment with timber preservatives when constructive measures have been exhausted, which means it is uncommon.
4) According to DIN EN 14080, more elastomechanical properties, in particular bending strengths, can be declared. It is common practice to specify strength classes. Strength classes GL24c, GL28c, and GL30c are typical. The ranges indicated here refer to mean or characteristic values of these strength classes. Different values can be declared. The declared density values may differ from these average values due to differences in the densities of the timber species.
5) DIN EN 14080 specifies further tolerances, e.g. for angularity or curved components.
6) Since DIN 68800-1 requires that all constructive measures be exhausted before preservative chemical wood treatment is used, only classifications for untreated glued laminated timber are given here.
7) Design values for thermal conductivity must be determined from the declared values according to DIN 4108-4.
8) The water vapour equivalent air layer thickness is determined from the product of the layer thickness and the water vapour resistance factor.

Performance values of the product according to the declaration of performance in relation to its essential characteristics in accordance with EN 14080:2013, Timber structures – Glued laminated timber – Requirements.
Voluntary information for the product according to the Glulam data sheet of the Studiengemeinschaft Holzleimbau e.V. in its latest version. Refer to www.brettschichtholz.de (not a part of the CE label).

2.4 Delivery status

The products are made to the following preferential dimensions:
Min. height: 100 mm
Max. height: >2400 mm
Min. width: 60 mm
Max width: >240 mm
Max: length: > 50 m

2.5 Base materials/Ancillary materials

Base/Ancillary materials

Name	Value	Unit
Softwood, mostly fir	86,91	%
Water	11,5	%
PUR adhesive	0,07	%
MUF adhesive	1,52	%
PRF adhesive	0,00	%
EPI adhesive	0,00	%

The product has a mean density of 480 kg/m³ (averaged across all strength classes and wood species). The product/article/at least one partial product contains substances from the ECHA Candidate List 23 January 2024) above 0.1 mass %: no. The product or at least one partial product contain further CMR Category 1A or 1B substances which are not in the ECHA Candidate List above 0.1 mass % in at least one partial product: no.
The present construction product has added biocidal products or it was treated with biocidal products (meaning the product is a treated article in the meaning of the Biocidal Products Regulation (EU) No. 528/2012): no.

Glued laminated timber consists of at least two dried boards or laminations made of softwood, glued together in a parallel grain configuration.
For thermosetting bonding, melamine-urea-formaldehyde adhesives (MUF) or polyurethane adhesives (PUR) are used, as well as smaller proportions of phenol-resorcinol-formaldehyde adhesives (PRF) and emulsion-polymer-isocyanate (EPI) adhesives. Formaldehyde emissions are declared acc. to DIN EN 14080.

2.6 Manufacture

To manufacture glued laminated timber, conventional sawn timber is first dried to a moisture content of approx. 12%, pre-planned, and graded visually or mechanically according to strength. Any identified board sections with strength-reducing parts are cut out depending on the desired strength class and the resulting boards are joined together with finger joints to form endless laminations. In the subsequent pre-planning process, the lamellas are planned to a thickness of up to 45 mm so that, after adhesive has been applied to the broad side, they can be pressed into at least 3-layer glued laminated timber blanks in a straight or curved press bed.
After curing, the blank is planned, chamfered, bound, and packaged. If necessary, it can be treated with weather protection agents and, in exceptional cases, with timber preservatives.

2.7 Environment and health during manufacturing

Exhaust air is purified as per the statutory provisions.
There is no contamination of the water and soil. Process wastewater is routed to the local wastewater system.
Noisy pieces of machinery are suitably enclosed by constructive measures.

2.8 Product processing/Installation

Glued laminated timber can be processed using standard tools suitable for solid woodworking.

The occupational safety instructions must be observed during processing/assembly.

2.9 Packaging

Polyethylene and, to a lesser degree, other types of plastic are used.

2.10 Condition of use

The composition for the period of use corresponds with the base material composition in accordance with section 2.5. 'Base materials/Ancilliary materials'.

During use, approximately 208.6 kg of carbon is bound in the product, corresponding to approx. 764.8 kg carbon dioxide when fully oxidised.

2.11 Environment and health during use

Environmental protection:
Based on current knowledge, there are no known hazards to water, air and soil if the products are used as intended.

Health protection:
Based on current knowledge, no health hazards or impairments are to be expected.

With regard to formaldehyde, Glulam is low-emissive due to its adhesive content, structure and form of use.

Glulam glued with PUR or EPI adhesives has formaldehyde emission levels in the range of natural wood (approx. 0.004 ml/m³). MDI emissions from Glulam glued with PUR adhesives are not measurable within a detection limit of 0.05 µg/m³. Due to the high reactivity of MDI with water (air and wood moisture), it can be assumed that GL timber glued in this way has MDI emissions in the zero range shortly after manufacturing.

Glulam bonded with MUF adhesives subsequently emits formaldehyde. Measured against the limit value according to the REACH Regulation, the values after testing (DIN EN 717-1:2005) are classified as low. The average emissions are between 6 and 17 µg/m³.

2.12 Reference service life

Glulam has been in use for 120 years. This means that the service life of glued laminated timber is equal to the service life of the building when used as intended. When used as intended, i.e. in particular in compliance with the rules for constructive timber protection in accordance with DIN 68800-1 and DIN 68800-2, no end to its durability is known or expected.

2.13 Extraordinary effects

Fire
Specification of the reaction to fire class according to DIN EN 13501-1 or applicable national regulations.
The following classes are defined in accordance with DIN EN 13501-1:
Reaction to fire A1, A2, B, C, D, E and F
Burning drops/Falling drops: d0, d1 or d2
Smoke gas release: s1, s2 or s3.

Fire class for glued laminated timber in accordance with DIN EN 13501-1:

Name	Value
Reaction to fire class	D
Burning drops	d0
Smoke gas release	s2

The smoke gas produced has a similar toxicity to natural wood.

Water
There is no leaching of substances potentially hazardous to water.

Mechanical destruction
The cracking pattern of Glulam is typical of solid wood.

2.14 Re-use phase

Glulam is easily reusable or recyclable in the event of selective deconstruction at the end of its service life.
It can be processed into components in the form of boards or

laminations for the manufacturing of new glued solid wood products.
It can be processed into wood chips or fibres as material for wood-based materials or wood-based insulation materials.
If glued laminated timber cannot be recycled in any of the ways described above, it is sent for thermal recycling to generate process heat and electricity due to its high calorific value of approx. 16 MJ/kg (at a moisture content of u=12%).
When used for energy recovery, the requirements of the Federal Immission Control Act (BImSchG) must be observed: Untreated glued laminated timber is assigned to waste code 17 02 01 of the AVV in accordance with Annex III of the Waste Wood Ordinance (AltholzV) of 15 February 2002 (treated glued laminated timber is assigned to waste code 17 02 04, subject to the type of wood preservative used).

2.15 Disposal

The disposal of waste wood is not permitted under section 9 of the Waste Wood Ordinance (AltholzV).

The packaging materials used can be sent for thermal waste treatment. The following waste codes are assigned in accordance with the AVV: 150101 (paper and cardboard packaging), 150102 (plastic packaging), 150103 (wood packaging).

2.16 Further information

See www.brettschichtholz.de for further information.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit of ecological assessment is the provision of 1 m³ of Glulam with a mass of 480 kg/m³ at 12% wood moisture content or 10.48% water content and 1.59% adhesive content. All information on adhesives used was calculated using specific data. The average was weighted according to production volume.

Declared unit

Name	Value	Unit
Declared unit	1	m^3
Density	1	kg/m³
Conversion factor to 1 kg	0.0020833	-
Wood moisture on delivery	12	%
Adhesive content relative to total mass	1,59	%
Water content relative to total mass	10,48	%

3.2 System boundary

The type of declaration is a 'cradle-to-gate' EPD with options. It covers the stage of production, i.e. from the provision of raw materials up to the production plant gate (cradle to gate, modules A1 to A3), as well as module A5 and parts of the end of life (modules C1 to C4). In addition, the potential benefits and burdens are assessed beyond the product's life cycle (module D).

Specifically, module A1 covers the provision of timber from the forest, the provision of other pre-processed wood products, and the provision of adhesives. Transport of these materials are accounted for in module A2. Module A3 looks at the provision of fuels, operating materials, electricity, and the local production processes. These essentially comprise debarking, cutting, drying, planing and profiling processes, gluing, and packaging of the products. Module A5 covers only the disposal of product packaging, which includes the primary energy input (PENRM). Module C1 takes into account manual dismantling that does not generate any loads.

Module C2 considers the transport to the disposal provider and module C3 the processing and sorting of the wood waste. Furthermore, the CO2 equivalents of the wood-inherent carbon as well as the renewable and non-renewable primary energy (PERM and PENRM) contained in the product are recognised as wastage in module C3, in accordance with EN 16485. Module C4 has normatively mapped disposal and does not permit landfilling.

Module D assesses the thermal utilisation of the product at the end of its life cycle and the resulting potential benefits and burdens in the form of an expansion of the system.

3.3 Estimates and assumptions

Essentially all material and energy flows of the production processes were specifically determined on location. However, combustion or other process emissions occurring on location could only be estimated based on literature data. All other data is based on average values. Detailed information on all estimates and assumptions made is documented in Rüter, S; Diederichs, S: 2012.

The calculated use of freshwater resources is based on freshwater consumption.

3.4 Cut-off criteria

No known material or energy flows were neglected, including flows below the 1% threshold, leaving the total of neglected input flows well below 5% of the energy and mass input. This also ensures that no material and energy flows were neglected that have a considerable potential for significant impacts on the environmental indicators. Detailed information on the cut-off rules can be found in Rüter, S; Diederichs, S: 2012.

3.5 Background data

All background data was taken from the Sphera 2023b database, version 2023.2, additional secondary data was exclusively taken from the scientific field, Abschlussbericht – Ökobilanz- Basisdaten für Bauprodukte aus Holz, Rüter, S; Diederichs, S: 2012.

3.6 Data quality

A total of 7 sites were examined in detail, allowing for a full life cycle assessment of the production taking place at these plants to be drawn up. The plants are listed in Table K with their specific production volumes and percentages. The total production output of these plants during the survey period (2021 to 2022) was 322,364 m³/a. The available data refer to approximately 50% of the glued solid timbers produced by the association members in 2022. All company-specific data were provided directly by the plants and checked for plausibility. The data quality is considered as being very good. It is difficult to make conclusions as to the quality of the secondary data used, as the modelling was largely based on literature references, all of which, however, come from the scientific field. The data sets used from the Sphera 2023b database cannot be conclusively assessed in terms of quality. It complies with the standards ISO 14044, ISO 14064 and ISO 14025, but in most cases has not been subject to independent, external critical review. Its transparent documentation and internal critical reviews suggest that all data sets taken from the Sphera database are good quality.

3.7 Period under review

Data collection for the foreground system was carried out over a period from 2021 to 2023, with data being determined for the completed calendar year in each case. The data is therefore based on the years 2021 to 2022. All information is therefore based on the averaged data for 12 consecutive months.

3.8 Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Germany

3.9 Allocation

The allocations made comply with the requirements of DIN EN 15804:2022 and EN 16485:2014 and are explained in detail in Rüter, S; Diederichs, S: 2012. The following system space extensions and allocations were essentially made.

General

Flows of the material-inherent characteristics (biogenic carbon and primary energy) were principally allocated according to physical causalities. All other allocations for connected co-productions were made on an economic basis. An exception is the allocation of the heat required in combined heat and power systems, which was allocated on the basis of the exergy of the products electricity and process heat.

Module A1

Forest: all expenditures of the forest upstream chain were allocated to the products 'standing timber' and 'industrial timber' applying economic allocation factors and based on their prices.

Module A3

Woodworking industry: as to connected co-productions, applications were economically allocated to the primary products and raw materials on a price basis.
The disposal of production waste, with the exception of wood-based materials, is carried out via a system extension. Heat and electricity generated are credited to the system through substitution. The resulting credits well below 1% of the total expenditure.
In the case of combined heat and electricity generation, all combustion impacts were allocated to these two products according to their exergy.

Module D

The system space extension carried out in module D corresponds to a wood waste energetic utilisation scenario.

3.10 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.
In general, comparing or assessing EPD data is only possible if all datasets to be compared are generated as prescribed in EN 15804 and the building context and/or product-specific performance characteristics are accounted for. The life cycle assessment modelling was carried out using the Sphera 2023a software. All background data was taken from the Sphera 2023b database in version 2023.2. Other secondary data was taken from references.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

Since the product essentially consists of wood, biogenic carbon is declared.

Data used to describe the biogenic carbon content at the factory gate

When sawn timber is used, the carbon bound in the wood is introduced into the product system in the raw material supply module (A1), which is reflected as a negative CO_2 value from an atmospheric perspective. In module A3, the CO_2 system inputs are also shown through the use of wood that is used as fuel on site. However, the carbon from the wood being burned locally is reintroduced as emissions in module A3.

Name	Value	Unit
Biogenic carbon contained in product	208,72	kg C

At the gate of the production plant and during use, the product contains 208.72 kg of biogenic carbon per cubic metre, which corresponds to a CO_2 equivalent of approx. 765.31 kg CO_2. In module C3, the carbon contained in the wood components of the product then leaves the system area in the form of usable waste wood.

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO_2.

The scenarios underlying the life-cycle assessment are outlined in detail below.

Installation in building (A5)

Module A5 is declared, but only contains information about the disposal of the product packaging and no information on the actual installation of the product in the structure. The volume of packaging material incorporated as waste for thermal utilisation in module A5 per declared unit and the resulting exported energy are summarised below in the form of technical scenario data.

Name	Value	Unit
PE film for thermal waste processing	0,191	kg
Overall efficiency of other plastic in waste combustion	44	%
Proportion of electricity generation in exported energy	27 - 28	%
Total exported electric energy	38,3	MJ
Total exported thermal energy	72,2	MJ

A forwarding distance of 50 km is assumed for the disposal of the product packaging. As a conservative approach, it is assumed that all packaging components are disposed of as waste in a waste incineration plant for energy recovery. Waste incineration overall efficiency for the respective packaging components and the proportions of electricity and heat generated by combined heat and power generation correspond to the assigned waste incineration processes in the Sphera 2023b database.

If a reference service life (RSL) is declared in accordance with the applicable ISO standards, the assumptions and conditions of use on which the determined RSL is based must be declared. It must also be stated that the declared RSL only applies under the specified reference usage conditions. The same applies to a service life declared by the service life.
It is not necessary to declare relevant information on reference usage conditions for a service life in accordance with the BNB table.

End of life (C1-C4)

Name	Value	Unit
Waste wood for energy recovery	480	kg
Wood waste redistribution transport distance (module C2) (Modul C2)	20	km

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

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

The product is recycled in the form of waste wood with the same composition as the specified declared unit at the end of its life cycle. Energetic utilisation in a biomass heating plant with 54.69% overall efficiency and 18.09% electric efficiency is assumed. The combustion of 1 tonne of atro wood (mass specified in atro, but efficiency accounts for ~ 18% wood moisture) generates approximately 968.37 kWh of electricity and 7053.19 MJ of usable heat.

Name	Value	Unit
Generated thermal energy (per net flow of declared unit)	3013,7	MJ
Generated electricity (per net flow of declared unit)	414,4	kWh

Converted to the net flow of the atro wood content in module D and taking into account the adhesive content in the waste wood, 414.4 kWh of electricity and 3013.7 MJ of thermal energy is produced in module D per declared unit. The exported energy substitutes fossil fuels, whereby this scenario is based on the assumption that the thermal energy is generated from natural gas and the substituted electric power corresponds to the German electricity mix in 2021.

5. LCA: Results

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

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	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m³ 1m³ BS-Holz

Parameter	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	-7.25E+02	2.15E+01	8.25E+01	4.01E+00	0	7.01E-01	7.75E+02	0	-3.58E+02
GWP-fossil	kg CO_2 eq	3.95E+01	2.15E+01	8.25E+01	4.01E+00	0	7.01E-01	9.87E+00	0	-3.58E+02
GWP-biogenic	kg CO_2 eq	-7.65E+02	0	0	0	0	0	7.65E+02	0	0
GWP-luluc	kg CO_2 eq	ND	ND	ND	ND	ND	ND	ND	ND	ND
ODP	kg CFC11 eq	1.45E-10	4.77E-12	3.71E-09	2.58E-12	0	6.27E-14	2.71E-10	0	-4.84E-09
AP	mol H^+ eq	2.22E-01	4.74E-02	2.07E-01	4.64E-03	0	4.4E-03	1.51E-02	0	-2.47E-01
EP-freshwater	kg P eq	1.07E-04	5.69E-05	4.68E-04	9.23E-07	0	2.61E-06	5.93E-05	0	-1.07E-03
EP-marine	kg N eq	1.03E-01	2.05E-02	7.85E-02	1.33E-03	0	2.16E-03	4.96E-03	0	-1.03E-01
EP-terrestrial	mol N eq	1.14E+00	2.34E-01	8.35E-01	2E-02	0	2.39E-02	5.13E-02	0	-8.24E-01
POCP	kg NMVOC eq	2.95E-01	4.29E-02	2.58E-01	3.51E-03	0	4.06E-03	1.19E-02	0	-2.61E-01
ADPE	kg Sb eq	4.31E-06	1.54E-06	2.38E-05	2.72E-08	0	4.65E-08	1.8E-06	0	-3.41E-05
ADPF	MJ	5.9E+02	2.95E+02	1.5E+03	7.04E+00	0	9.74E+00	1.4E+02	0	-5.66E+03
WDP	m^3 world eq deprived	1.04E+00	1.43E-01	3.62E+00	2.84E+00	0	8.26E-03	2.84E-01	0	7.76E+01

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; WDP = Water (user) deprivation potential)

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m³ 1m³ BS-Holz

Parameter	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D
PERE	MJ	8.98E+02	2.01E+01	1.91E+03	1.63E+00	0	6.89E-01	1.31E+02	0	5.69E+03
PERM	MJ	8.04E+03	0	0	0	0	0	-8.04E+03	0	0
PERT	MJ	8.94E+03	2.01E+01	1.91E+03	1.63E+00	0	6.89E-01	-7.91E+03	0	5.69E+03
PENRE	MJ	5.91E+02	2.96E+02	1.5E+03	1.16E+01	0	9.77E+00	1.4E+02	0	-5.56E+03
PENRM	MJ	1.06E+02	0	4.57E+00	-4.57E+00	0	0	-1.06E+02	0	0
PENRT	MJ	6.97E+02	2.96E+02	1.5E+03	7.05E+00	0	9.77E+00	3.34E+01	0	-5.56E+03
SM	kg	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	8.04E+03
NRSF	MJ	0	0	0	0	0	0	0	0	1.06E+02
FW	m^3	8.33E-02	1.88E-02	8.33E-01	6.68E-02	0	7.6E-04	4.61E-02	0	-9.95E+01

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 – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m³ 1m³ BS-Holz

Parameter	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D
HWD	kg	1.42E-02	4.09E-04	2.05E-01	3.41E-04	0	1.26E-05	1.36E-02	0	0
NHWD	kg	1.89E-01	4.4E-02	1.3E+00	4.67E-01	0	1.41E-03	1.28E-01	0	0
RWD	kg	5.59E-09	6.09E-10	8.67E-07	1.4E-10	0	3.61E-11	-2.73E-08	0	-7.77E+02
CRU	kg	0	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0	0
MER	kg	0	0	0	1.27E-01	0	0	4.8E+02	0	0
EEE	MJ	0	0	6.23E-02	3.83E+01	0	0	0	0	0
EET	MJ	0	0	1.45E-01	7.22E+01	0	0	0	0	0

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; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional:
1 m³ 1m³ BS-Holz

Parameter	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D
PM	Disease incidence	1.35E-05	3.03E-07	4.01E-06	3.06E-08	0	2.58E-08	1.19E-07	0	-2.11E-06
IR	kBq U235 eq	1.95E+00	4.8E-02	1.86E+01	5.36E-02	0	1.82E-03	1.44E+00	0	-2.57E+01
ETP-fw	CTUe	3.47E+02	2.14E+02	5.09E+02	3.1E+00	0	6.86E+00	5.31E+01	0	-9.17E+02
HTP-c	CTUh	6.63E-08	4.28E-09	8.16E-08	2.78E-10	0	1.39E-10	2.72E-09	0	-6.84E-08
HTP-nc	CTUh	4.09E-07	1.81E-07	4.22E-07	1.41E-08	0	6.11E-09	3.81E-08	0	-1.8E-06
SQP	SQP	1.34E+04	1.09E+02	3.93E+03	2.23E+00	0	4.06E+00	9.13E+01	0	-1.61E+03

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Qualifier 1 – applies to indicator 'potential effect through human exposure to U235': this effect category mainly covers the possible impact of impact of low-dosage ionising radiation on human health in the nuclear fuel cycle. It does not account for effects caused by possible nuclear accidents and occupational exposure nor for the disposal of radioactive waste in subterranean installations. This indicator also does not cover the potential ionising radiation emitted by the ground, radon, and certain construction materials.

Qualifier 2 – applies to the indicators: 'abiotic resource depletion potential – non-fossil resources', 'abiotic resource depletion potential – fossil fuels', 'water deprivation potential (user)', 'potential toxicity reference unit for ecosystems', 'potential toxicity reference unit for humans – carcinogenic effect', 'potential toxicity reference unit for humans – non-carcinogenic effect', and 'potential soil quality index': the results of this environmental effect indicator must be applied with care, as they are fraught with uncertainties or experience with the indicator is limited.

Note 1: The GWP-luluc indicator has not been declared because its contribution, including the sum of all exclusions (modules A–C), is below the 5% threshold. The wood is certified as originating from the EU and Norway, is FSC-certified, meets the requirements of the EU Timber Regulation (EU) No. 995/2010 and is certified as being obtained from non-deforestation sources.

6. LCA: Interpretation

The energy interpretation focuses on the production phase (modules A1 to A3), as it builds on specific data provided by the company. The interpretation is based on a dominance analysis of the environmental impact (GWP, ODP, AP, EP, POCP, ADPE, ADPF) and the renewable / non-renewable primary energy consumption (PERE, PENRE). Therefore, the key factors for the respective categories are listed in fig. 1.

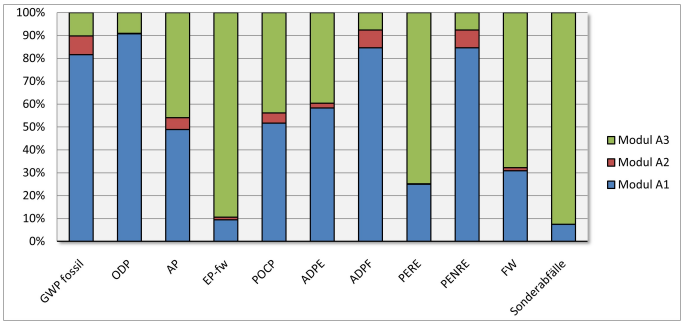


Fig. 1: Relative contributions of the assessed modules to each environmental impact.

6.1 Greenhouse gas potential (GWP)

The wood-inherent CO2 product system inputs and outputs deserve a separate analysis to assess the GWP. A total of approximately 764.8 kg of CO2 in the form of carbon stored in biomass is introduced into the system. The growth of the wood put to energetic utilisation at the production site binds another 48.2 kg CO2 which are incorporated in module A3 and re-emitted through combustion on site in the same module. For the provision of product packaging, 19.4 kg of biogenic carbon enters the system and leaves it again in A5. The amount of carbon stored in the glued laminated timber is removed from the system again when it is recycled in the form of waste wood.

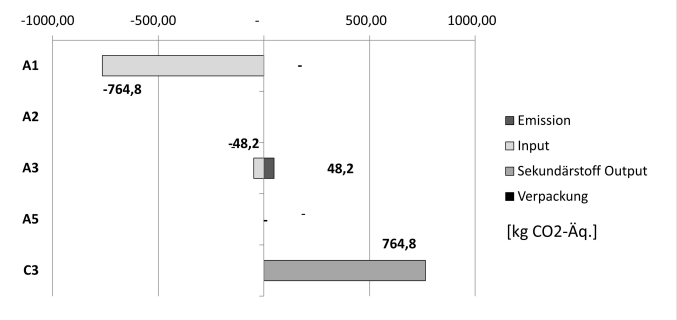


Fig. 2: Wood-inherent CO2 product system inputs and outputs [kg CO2 eq.]. The inverse signs of inputs and outputs accounts for the LCA
CO2 flow assessment from an atmospheric perspective.

The global warming potential fossil (GWP-f) is dominated by the global warming potential fossil (GWP-f) [kg CO2 eq.]: 41.6% - electricity for cutting process (A3); 12% - transport of round timber (A2); 10.8% - sawn timber (dry) upstream chain (A1); 9.1% - round timber upstream chain (A1); 5% - packaging (A3); 4.4% - plant logistics (A3); remainder 17.1%.
The three factors electricity consumption, transport and sawn timber drying together account for > 64% of the GWP-f. Diesel is mainly used for harvesting machines and thermal energy for the drying of wood to produce sawn timber

6.2 Analysis of additional indicators

The analysis clearly shows that the cut (A3) has the dominant influence in most categories. The upstream processes, round and sawn timber supply (A1) and the transport of sawn timber (A2) play an important role, too, albeit to a lesser extent.

Ozone depletion potential (ODP) [kg CFC11 eq.]: 52.7% -

electricity for cutting process (A3); 16.3% - electricity for thickness laminating process (A3); 7.6% - electricity for longitudinal laminating process (A3); 6.3% - electricity for levelling process (A3); 3.7% - electricity for dressing process (A3); 2.6% - electricity for drying process (A3); remainder 10.8%

Acidification potential (AP) [mol H+ eq.]: 21.8% - round timber upstream chain (A1); 19.5% - electricity for cutting process (A3); 16.3% - plant logistics (A3); 15.9% - sawn timber (dry) upstream chain (A1); 6.4% - sawn timber upstream chain (A1); 5.4% - transport of sawn timber (A2); remainder 14.7%

Eutrophication, freshwater (EP-fw) [kg P eq.]: 57.1% - electricity for cutting process (A3); 7.8% - sawn timber (dry) upstream chain (A1); 6.5% - transport of round timber (A2); 5.4% - round timber upstream chain (A1); 3.4% - packaging (A3); 3% - electricity for levelling process (A3); remainder 16.9%

Photochemical ozone formation (POCP) [kg NMVOC eq.]: 23.5% - round timber upstream chain (A1); 18% - sawn timber (dry) upstream chain (A1); 17% - plant logistics (A3); 12.2% - electricity for cutting process (A3); 7.9% - drying process (A3); 6.6% - sawn timber upstream chain (A1); remainder 14.8%

Potential for abiotic degradation of non-fossil resources (ADPE) [kg Sb-eq]: 40.3% - electricity for cutting process (A3); 12.7% - packaging (A3); 8.1% - operating materials (A3); 6% - electricity for thickness laminating process (A3); 4.9% - sawn timber (dry) upstream chain (A1); 4.2% - transport of round timber (A2); remainder 23.7%

Potential for abiotic degradation of fossil fuels (ADPF) [MJ]: 38.2% - Electricity for cutting process (A3); 9.9% - transport of round timber (A2); 9.5% - sawn timber (dry) upstream chain (A1); 7% - round timber upstream chain (A1); 6.3% - packaging (A3); 4.8% - electricity for thickness laminating process (A3); remainder 24.2%

Water use (WDP) [m³ world eq. deprived]: 41.7% - electricity for cutting process (A3); 16.2% - operating materials (A3); 14.3% - sawn timber (dry) upstream chain (A1); 9.6% - electricity for thickness laminating process (A3); 7% - packaging (A3); 4.7% - electricity for longitudinal laminating process (A3); remainder 6.5%

Renewable primary energy as energy source (PERE) [MJ]: 33.8% - electricity for cutting process (A3); 30.1% - sawn timber (dry) upstream chain (A1); 9.9% - packaging (A3); 9.1% - electricity for thickness laminating process (A3); 4.3% - electricity for longitudinal laminating process (A3); 3.7% - electricity for levelling process (A3); remainder 9.2%

Non-renewable primary energy as energy source (PENRE)

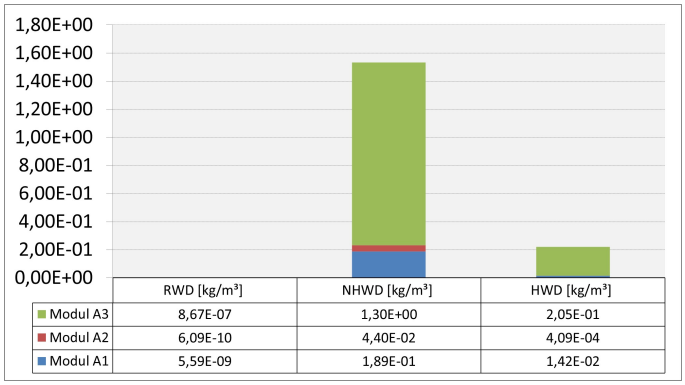
Non-renewable primary energy as energy source (PENRE) [MJ]: 38.2% - electricity for cutting process (A3); 9.9% - transport of round timber (A2); 9.6% - sawn timber (dry) upstream chain (A1); 7% - round timber upstream chain (A1); 6.3% - packaging (A3); 4.8% - electricity for thickness laminating process (A3); remainder 24.3%

Freshwater resource utilisation (FW) [m³]: 41.3% - electricity for cutting process (A3); 18.1% - electricity for thickness laminating process (A3); 8% - electricity for longitudinal laminating process (A3); 6.3% - electricity for levelling process (A3); 4.5% - sawn timber (dry) upstream chain (A1); 4.1% - electricity for dressing process (A3); remainder 17.6%

Conclusion: The sawn timber (dry) upstream chain (A1) is the most critical point for reduction of the environmental impacts. Improvements in this area would have the greatest positive impact on almost all assessed categories. Transport (A2) and power supply for processes (A3) are also important levers, particularly in terms of ODP and freshwater use.

6.3 Waste

Hazardous waste for landfilling is mainly generated during the provision of operating resources (A3), which has the greatest impact. This value above 100% indicates that there may be credits or negative contributions in other areas that are offset here. Packaging (A3), too, makes a contribution with 4.8%.



	RWD [kg/m³]	NHWD [kg/m³]	HWD [kg/m³]
Modul A3	8,67E-07	1,30E+00	2,05E-01
Modul A2	6,09E-10	4,40E-02	4,09E-04
Modul A1	5,59E-09	1,89E-01	1,42E-02

Fig. 3: Waste produced per declared unit at the module level. HWD = hazardous waste disposed;NHWD = disposed non-hazardous waste; RWD = disposed radioactive waste.

6.4 Range of results

The individual results of the participating companies differ from the average results in the environmental product declaration. The maximum deviations in environmental impact were (GWP-fossil) dev. +91.6/-30.5%; (ODP) dev. +463.5/-83.4%; (AP) dev. +84/-1.8%; (EP-fw) dev. +44.5/-50.5%; (EP-marine) dev. +102.5/4%; (EP-land) dev. +104.2/5%; (POCP) dev. +81.3/2.5%; (ADPE) dev. +167.6/-36.2%; (ADPF) dev. +138/-38.4%; (WDP) dev. +275/-59%; (PERE) dev. +377.7/-59%; (PENRE) dev. +138/- 38.4%; (FW) dev. +537.9/-75.8 %; (HWD) dev. +71.5/-120 %; calculated in relation to the results outlined in Chapter 5. These deviations are primarily caused by differences in the sawn timber supply chain, the fuels used and specific electricity consumption of the process.

7. Requisite evidence

The following environmental and health-related certifications were obtained: **7.1 Formaldehyde**

A total of 7 measurement reports on formaldehyde emissions were available. The measurements were carried out by accredited testing laboratories. The equilibrium concentrations were determined. The measurements were carried out in test chambers in accordance with DIN EN 717-1:2005 at a uniform temperature of 23°C, a relative humidity of 45% and an air exchange rate of 1.0 per hour. Volumetric loads differed to some extent. The area-specific emission rates were therefore first calculated from the measured values.

As expected, most of the measured values (22) are for glued

laminated timber with MUF gluing. The average area-specific emission rate is 34.8 µg/h x m². Based on the load factor of 0.3 m²/m³ recommended by the Stuttgart Materials Testing Institute and prescribed in DIN EN 14080:2005, this results in a test chamber formaldehyde equilibrium concentration of 0.008 ml/m³. This value is less than one tenth of the limit value of 0.1 ml/m³ specified in the Chemicals Prohibition Regulation. If the highest of the measured values of 71 µg/h x m² is used as the basis for the derivation, this results in a compensation concentration of 0.017 ml/m³. The glued laminated timber glued with the formaldehyde-free PUR adhesive results in area-specific emission rates in the range of unglued wood. The derived equilibrium concentration is approximately 0.004 ml/m³. Similar values were measured for other unglued timbers and correspond to the natural formaldehyde emission of wood.

7.2 MDI

When Glulam is glued, the MDI contained in the polyurethane adhesives used reacts completely. MDI emissions from the hardened glued laminated timber are therefore not possible; there is no test standard.

The tests presented cover MDI short-term emissions occurring in the gluing process in the factory. As there is currently no standardised measurement method for these emissions either, the MDI emissions were determined in one of the tests presented using the measurement method for determining formaldehyde emissions from EN 717-2:1995.
Result: No MDI emissions were detected in any of the 7 laminated glued laminated timbers tested within the detection limit (0.05 µg/m³).

An additional test based on a project-specific measurement method on a piece of laminated timber glued with PUR adhesive but not hardened showed MDI emissions just above (0.05 µg/m³) the detection limit during the first 2 hours after the adhesive was applied. After that, no MDI emissions were detectable.

7.3 Fume toxicity

The toxicity of the fumes produced by burning glued laminated timber is the same as the toxicity of the fumes produced by burning natural wood.

7.4 VOC emissions

Measurements in accordance with DIN EN 16516 on two samples taken from spruce glued laminated timber at a load factor of 0.3 m2/m3 TVOC produced values between 0.043 mg/m3 and 0.164 mg/m3 after 28 days, which were significantly lower than the limit value of 1 mg/m3.

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DIN 68800-1:2019-06, Wood preservation – Part 1: General

DIN 68800-2
DIN 68800-2:2022-02, Wood preservation – Part 2: Preventive constructional measures in buildings

DIN 68800-3
DIN 68800-3:2019-06, Wood preservation – Part 3: Preventive protection of wood with wood preservatives

DIN EN 717-1
DIN EN 717-1:2005-01, Wood-based panels – Determination of formaldehyde release – Part 1: Formaldehyde emission by the chamber method

DIN EN 717-2
DIN EN 7171-2:1995-01, Wood-based panels – Determination of formaldehyde release – Part 2: Formaldehyde release by the gas analysis method (retracted from the set of standards)

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DIN EN 13183-1:2002-07, Moisture content of a piece of sawn timber – Part 1: Determination by oven dry method

DIN EN 13501-1
DIN EN 13501-1:2019-05, Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire

DIN EN 13356
DIN EN 13556:2003-10, Round and sawn timber – Nomenclature of timbers used in Europe

DIN EN 14080
DIN EN 14080:2013-09, Timber structures – Glued laminated timber – Requirements

DIN EN 15804
DIN EN 15804:2022-03: Sustainability of construction works – Environmental product declarations – Fundamental rules for the product category construction products

DIN EN 16485
EN 16485:2014-07, Round and sawn timber – Environmental Product Declarations – Product category rules for wood and wood-based products for use in construction

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DIN EN ISO 14025
DIN EN ISO 14025:2011-10, Environmental labels and declarations – Type III environmental declarations – Principles and procedures (ISO 14025:2006)

ISO 14044
DIN EN ISO 14044 Environmental management – Life cycle assessment – Requirements and guidelines (ISO 14044:2006 + Amd. 1:2017 + Amd 2:2020)

ISO 14064
DIN EN ISO 14064-1 – Greenhouse gases – Part 1: Specification with guidance at the organization level for

quantification and reporting of greenhouse gas emissions and removals at the organisational level

ISO 14025
DIN EN ISO 14025:2011-10 Environmental labels and declarations – Type III environmental declarations – Principles and procedures (ISO 14025:2006) **Further sources:**

Waste Wood Ordinance (AltholzV)
Waste Wood Ordinance (AltholzV): Ordinance on requirements for the recycling and disposal of waste wood, 2022, last amended 19 June 2020

AVV
Waste Index Ordinance of 10 December 2001 (Federal Law Gazette I p. 3379) last amended by article 2 of the Ordinance of 30 June 2020 (Federal Law Gazette I p. 1533).

Biocidal Products Directive
Biocidal Products Regulation (EU) No. 528/2012

BNB
Leitfaden Nachhaltiges Bauen 2015, 3. latest edition (2019), ed. Federal Ministry of the Interior, Construction and Community (BMI)

Glulam Data Sheet
Glulam Data Sheet of the Studiengemeinschaft Holzleimbau e.V. in its latest version

Federal Immission Control Act (BImSchG)
Federal Immission Control Act (BImSchG): Act on the control of harmful environmental effects caused by air pollution, noise, vibrations and similar phenomena, 2013, last amended on 26 July 2023

Chemicals Prohibition Ordinance
Chemicals Prohibition Ordinance of 20 January 2017 (Federal Law Gazette I p. 94; 2018 I p. 1389), last amended by article 2 of
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CMR Materials
Regulation (EC) No. 1272/2008 (CLP Regulation)

CPR
Regulation (EU) No. 305/2011 OF THE EUROPEAN PARLIAMENT AND THE COUNCIL of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

ECHA Candidate List
List of candidate substances of very high concern (version of 15/01/2018) in accordance with article 59(10) of the REACH Regulation. European Chemicals Agency

Product Category Rules for Construction Products Part B
PCR Solid Timber Products 2023-08-01. Taken from the programme for environmental product declarations of the Institut Bauen und Umwelt e.V. (IBU)

REACH Regulation
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