ENVIRONMENTAL PRODUCT DECLARATION

according to *ISO 14025* and *EN 15804+A2*

Declaration holder	Pfleiderer Deutschland GmbH
Issuer	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-PFI-20240495-IBI1-DE
Issue date	04/04/2025
Valid until	03/04/2030

Particleboard (raw)

Pfleiderer Deutschland GmbH

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1. General information

Pfleiderer Deutschland GmbH

Programme holder

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

Declaration number

EPD-PFI-20240495-IBI1-DE

This declaration is based on the product category rules:

Wood-based materials, 01/08/2021
information (PCR verified and approved by the independent Council of Experts (SVR)

Issue date

04/04/2025

Valid until

03/04/2030

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

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Particleboard (raw)

Declaration holder

Pfleiderer Deutschland GmbH
Ingolstädter Str. 51
92318 Neumarkt i.d.OPf.
Germany

Declared product/declared unit

1 m³ particleboard, raw

Scope:

The contents of this declaration are based on the manufacturing for raw particleboard from the following manufacturer:
Pfleiderer Deutschland GmbH
(Gütersloh, Neumarkt, Leutkirch)

The life cycle assessment of this declaration covers 100% of the production of raw particleboards of the named factories in 2023. This declaration can be used for raw particleboards of the above-named manufacturer.
The holder of the declaration is liable for the underlying information and verifications; any liability of the IBU in relation to manufacturer information, life cycle assessment data and verifications is ruled out.

The EPD was prepared in accordance with the requirements of EN 15804+A2. In the following, the standard is referred to in the simplified form *EN 15804* .

The European standard EN 15804 is used as the core PCR
Independent verification of the declaration and information in accordance with ISO 14025:2011
☐ internal ☒ external

Matthias Klingler,
(Independent verifier)

2. Product

2.1 Product description/product definition

The resource-saving, low-emission, raw particleboard of **Pfleiderer Deutschland GmbH** are wood-based sheet materials. These consist mainly of crushed wood particles (chip to dust-like quality) and are pressed with thermosetting binders and additives. The product qualities are based on *EN 13986* and *EN 312*. The finished end product is not coated or faced within the scope of this declaration.

For the placing on the market of products in the EU/EFTA (with the exception of Switzerland), Regulation (EU) No. 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC applies. The required declarations of performance and the CE marking have been drawn up according to the requirements of the harmonised standard *EN 13986:2004+A1:2015*, Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.

2.2 Use

Pfleiderer raw particleboards can be used (according to their type classification) for the following applications:

- **Furniture & interior fitout**
- **Fire protection**
- **Door construction**
- **Wood/structural construction**
- **Packaging & formwork construction**

2.3 Technical data

The following table shows examples of the range of technical data for the following product classes: P2-P7. Specific information can be found in the respective declarations of performance and technical data sheets for the products (https://www.pfleiderer.com/dach-de/service/downloads).

Structural data

Name/description	Value	Unit
Density EN 323	540 - 740	kg/m3
Bending strength (longitudinal) EN 310	7 - 22	N/mm2
Modulus of elasticity (longitudinal) EN 310	1050 - 3350	N/mm2
Material moisture content on delivery EN 322	5 - 13	%
Length- and width tolerance EN 324-1	+- 5	mm
Perpendicular tensile strength EN 319	0.2 - 0.75	N/mm2
Thermal conductivity EN 13986	0.12	W/(mK)
Water vapour diffusion resistance factor EN 13986; µ	15 - 100	-
Sound absorption EN 13986	0.1 - 0.25	
Formaldehyde emissions to EN 717-1 or EN 16516	E1E05 (TSCA, F****)	µg/m3
Reaction to fire	E (d<9 mm) - B-s2,d0	
Emission (content), pentachlorophenol (PCP)	< 3	mg/kg
Swelling in thickness, 24 h EN 317	12-17	%

Note: Specific technical data can be found in the
Refer to the technical data sheets for the respective products.

Performance values of the product correspond to the declaration of performance in relation to its main characteristics according to *EN 13986:2015-06*, Wood-based panels for use in construction. Voluntary information for the product: None (not part of the CE marking)

2.4 As-delivered condition

The various Pfleiderer raw particleboards are available in the following sizes and thickness ranges:

- **Width: 615–2500 mm**
- **Length: 2050-6000 mm**
- **Thickness: 8–64 mm**

Special sizes with regard to length, width and thickness are available on request. Classification requirements in accordance with *EN 312* Tables 2 to 10, special qualities available on request.

2.5 Base materials/auxiliary materials

Pfleiderer raw particleboards consist of crushed, processed wood particles (chips and dust), adhesives and other additives. These are clearly shown in the table below.
The wood mix used is made up of the following components:

- **Freshwood/thinnings: 14%**
- **Industrial waste wood (sawmill waste): 35%**
- **Recycled material in accordance with AltHolzV (German Waste Wood Ordinance): approx. 50%**
- **Bark: approx. 1%**

Urea--formaldehyde (UF), melamine--urea--formaldehyde (MUF) and polymeric diphenylmethane diisocyanate (PMDI) are used as adhesives for raw particleboard.
Paraffin, ammonium phosphate, urea, ammonium nitrate and polyol are added as product-specific additives.

Name/description	Value	Unit
Wood (-absolutely dry fraction) freshwood & recycled wood	83-86	%
Water	Approx. 5	%
Adhesive I PMDI	0-4	%
Adhesive II MUF (>20% melamine)	0-10	%
Adhesive III UF	0-11	%
Hydrophobising paraffin	<1	%
Fire retardant, ammonium phosphate	0-14	%
Hardener, ammonium nitrate	<1	%
Adhesive I additive, polyol	<1	%
Adhesive III additive, urea	<2	%

The product has an average density of approx. 650kg/m³. The functional chemical groups of the fire retardants include phosphate- and nitrogen compounds.

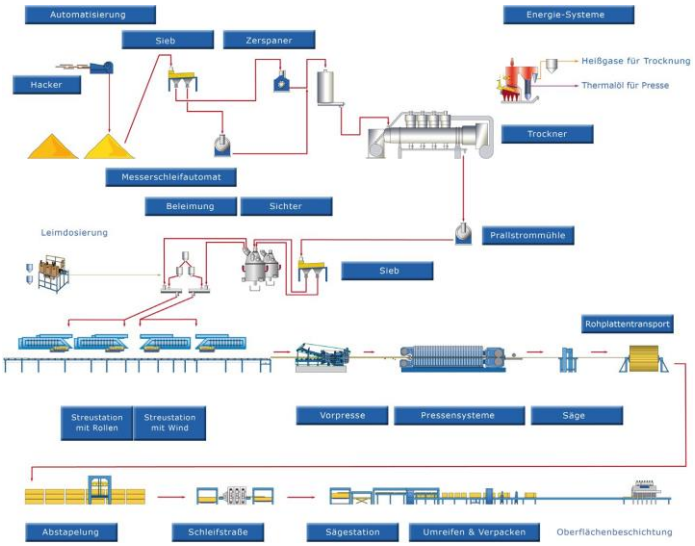
This product/article/at least one partial article contains substances listed in the *ECHA candidate list* (date: 27/06/2018) exceeding 0.1 % by mass: no

The product/article/at least one partial article contains other CMR- substances in categories 1A or 1B which are not listed on the candidate list , exceeding 0.1% by mass: no

Biocidal products were added to this construction product or it has been treated with biocidal products (this then concerns a treated article as defined by the

Biocidal Products Regulation (*EU No. 528/2012*): no

2.6 Manufacture



2.7 Environment and health during manufacturing All products manufactured by Pfleiderer Deutschland GmbH are manufactured in accordance with the applicable legal requirements regarding occupational health and safety.

The existing hazards and danger zones are marked accordingly. Employees are provided with the necessary protective equipment for working in these areas (high-visibility vests, dust-/respiratory masks, safety clothing, etc.).
The specified occupational exposure limit values for emissions of all kinds are complied with (e.g. installation of ventilation systems, enclosure of noise sources).

All wastewater and service water is treated in accordance with the applicable guidelines/directives or is sent to the appropriate treatment companies. The production-related exhaust air is treated in accordance with the legal requirements.

The combined heat and power -plants (CHP) at the sites (Neumarkt and Gütersloh) are the key components of Pfleiderer Deutschland GmbH's energy resilience. They enable the sites to be self-sufficient and, if necessary, feed surplus energy into the public grids.

All sites (scope: Germany) have received the following certifications:

- **ISO 9001**
- **ISO 14001**
- **ISO 45001**
- **ISO 50001**

2.8 Product processing/installation

Raw particleboard from Pfleiderer Deutschland GmbH can be processed using standard woodworking machinery (sawing, planing, sanding, milling, drilling).
Detailed machining and processing instructions can be found in the relevant product brochures.-

When machining and processing in a commercial environment, the occupational safety guidelines/-requirements of the relevant Berufsgenossenschaft (German statutory accident insurance and prevention) (e.g. BG-Bau) apply.
In general, we recommended maintaining adequate extraction during processing. If this is not possible, dust masks must be worn.

2.9 Packaging

For the storage/transport of the finished Pfleiderer raw particleboards, protective panels (in-house production), square timber made from particleboard offcuts (in-house production) and plastic or steel strapping are used in some cases.

2.10 Condition of use

The composition of the raw particleboards corresponds to the raw materials listed in section 2.5 (base materials). The binders cure by thermosetting.

2.11 Environment and health during use To ensure that Pfleiderer raw particleboards can be used safely, the legal requirements for emissions are complied with and are
tested by accredited institutes.

2.12 Reference service life

The resistance in the use condition depends on the performance classes (see *EN 312*).

The German BBSR (Federal Ministry of Housing, Urban Development and Construction) specifies a service life of at least 50 years for the correct use of particleboard/wood-based panels (according to Table: Service lives of components for life cycle assessment according to BNB (sustainable building assessment system))

2.13 Extraordinary effects Fire

Pfleiderer raw particleboards have different fire performances (*EN 13501-1, EN 13986*):

- without flame retardants: D-s2, d0 (thickness: ≥ 9 mm/density: ≥ 600 kg/m³)
- with flame retardant: B-s2,d0 (Premiumboard Pyroex)

Fire protection

Name/description	Value
Building material class	B - D
Burning droplets	d0
Smoke gas development	s2

Water
No constituents are washed out/leached, which could be hazardous to water.
Pfleiderer raw particleboards are not resistant to prolonged exposure to water. However, damaged areas can be replaced locally.

Constructive wood protection in accordance with generally accepted rules of sound engineering practice (e.g. *DIN 68800-2*) is recommended.

Mechanical destruction
The product exhibits fracture behaviour under destructive mechanical stress.
This can result in sharp edges, which may cause injury.

2.14 Re-use phase

Reuse:
In case of conversion or the end of the use phase

of a building, Pfleiderer raw particleboards, or other products in the event of selective dismantling, can be collected separately and reused for the same or for a different application than the original one (cascade principle). Highly damaged products should be sent for waste wood recycling.

Recovery/recycling:
Pfleiderer raw particleboards can be sorted, processed and returned to the wood-based panels manufacturing process via certified waste wood recycling companies.

2.15 Disposal
The circular economy is one of the fundamental principles of Pfleiderer Deutschland GmbH, which is why any product residues (where appropriate) are recovered/recycled and used for further production of wood-based panels.

Placing waste wood in landfill sites is not permitted according to *§9 of the German Waste Wood Ordinance (Altholzverordnung - AltholzV)*.
Waste code according to the Waste Register Regulation (*WRR*):
17 02 01 /
03 01 05
If reuse or recovery is not practical, energy recovery of the particleboards is recommended due to their high calorific value.

2.16 Further information
Further information can be found on the following website:
https://www.pfleiderer.com/dach-de/

3. LCA: calculation rules

3.1 Declared unit
The reference for this declaration is 1 m³ of raw particleboard with an average mass of 662 kg/m³.

Declared unit and mass reference

Name/description	Value	Unit
Declared unit	1	m3
Mass reference	662	kg/m3
Layer thickness	0.019	m
Weight per unit area	12.578	kg/m2
Density	662	kg/m3

The declared unit of the ecological consideration is the provision of 1 m³ raw particleboard with a weight of 650 kg/m³ and a water content of 5.0% and an adhesive and additive fraction of 8.85%. The composition corresponds to that of the weighted average by production volume.

3.2 System boundary
The declaration type corresponds to a Cradle to Gate – with options type EPD. Contents are the stage of production, i.e. from the provision of raw materials to the factory gate of production (cradle--to--gate, modules A1 to A3), as well as module A5 and parts of the end of the life cycle (modules C1 to C4). Furthermore, the potential benefits and loads are considered beyond the product's life cycle (module D). Specifically, module A1 assesses the supply of wood raw materials and the supply of adhesives- and additives. Recovered (waste) wood used as material is input into the system without loads. Transport of the raw materials used, including recovered wood, to the factory are taken into consideration in module A2. Module A3 includes the supply of the fuels, resources, product packaging and electricity as well as the manufacturing processes on site. These are essentially the preparation, drying (incl. emissions), sorting and pressing of the raw materials. Module A5 solely maps the disposal of the product packaging, which includes the output of the biogenic carbon it contains and its primary energy (PERM and PENRM). For module C1, manual dismantling without any loads is assumed. Module C2 takes into account transport to the disposal company and module C3 the processing and sorting of the reclaimed wood. In addition, in module C3, in accordance with *EN 16485* , the CO_2-equivalents of the wood-inherent carbon contained in the product and the renewable and non--renewable primary energy (PERM and PENRM) contained in the product are recorded as outputs. Module C4 was calculated according to normative requirements and does not contain any waste for disposal at a landfill site. This is because, at the end of its life, the product system becomes waste wood which, according to the German Waste Wood Ordinance (*AltholzV) (2020)* , must not be placed in landfill but must be recycled thermally or materially. Module D balances the thermal recovery of the product at the end of its life and the resulting potential benefits and loads in the form of a system extension. Alternatively, a scenario D/1 for the material use of secondary materials (SM) is presented, as the product currently already contains a high proportion of SM.

3.3 Estimates and assumptions
All material and energy flows of the processes required for production are determined on the basis of questionnaires. The emissions that occur on site from the incineration of wood combustion are estimated based on background data from 2019 taken from the *Sphera MLC CUP 2023.2* database. Emissions from the wood drying and curing of the adhesives are based on information from the literature and are documented in detail in *Rüter, Diederichs (2012*). The distance travelled to transport the adhesive- and additives to the factory is assumed to be 550 km by truck- and, if necessary, 550 km by rail as a conservative estimate, or it is calculated using actual values if available. All other data are based on average values.

3.4 Cut-off criteria
A decision regarding the flows to be considered results from existing studies on the life-cycle assessment of wood products. At least the material and energy flows that account for 1 % of the use of renewable or non-renewable primary energy or mass (weight) were evaluated, whereby the total sum of flows not considered is not greater than 5%. In addition, it was ensured that no material and energy flows with a particular potential for significant influences with regard to the environmental indicators were ignored.
The expenditure for provision of the infrastructure (machines, buildings, etc.) of the whole foreground system was not considered. This is based on the assumption that the expenditures for erection and maintenance of the overall infrastructure do not exceed the 1% of the total expenditures described above. On the other hand, the energy expenditures in the form of heat and power (electricity) necessary to operate the infrastructure were taken into account.
-Material and energy flows for the installation (A5) and dismantling (C1) were neglected by applying the cut-off criteria.
Detailed information on the cut-off criteria is documented in

Rüter, Diederichs 2012.

3.5 Background data

All background data has been taken from the *Sphera MLC CUP 2023.2* database and the final report, Life Cycle Assessment- - Basic Data for Construction Products Made of Wood ("Ökobilanz- Basisdaten für Bauprodukte aus Holz") *Rüter, Diederichs 2012* . The latter is the basis of a regularly updated internal database, from which the modelling of the upstream forestry chain and the processes for mapping the assumptions listed in section 3.3 were taken.

3.6 Data quality

The foreground data were collected for the manufacturer for twelve consecutive months in the period 01/2023 - -12/2023. The manufacturer has confirmed that these data continue to be current and valid.
The foreground data were validated on the basis of the mass and plausibility criteria. The overall data quality of the foreground data can be described as very good.

The background data taken from the literature for wood raw materials used for material and energy purposes, with the exception of forest wood, are from the years 2008 to 2012. The provision of forest wood was taken from a publication from 2008, which is mainly based on data from the years 1994 to 1997. All other information was taken from the *Sphera MLC CUP 2023.2* database and is no more than three years old. The overall data quality can be described as good.

3.7 Period under review

The foreground data was collected by the manufacturer for three plants for twelve consecutive months each in the period from 01/2023 to 12/2023. The manufacturer has confirmed that these data continue to be current and valid.

3.8 Geographic representativeness

Country or region in which the declared product system is manufactured and, where applicable, used and treated at the end of its life: Germany

3.9 Allocation

The allocations made meet the requirements of *EN 15804+A2* and *EN 16485* and are explained in detail in *Rüter, Diederichs (2012)*.

Essentially, the following system extensions and allocations were undertaken.

General

Flows of the inherent material properties (biogenic carbon and primary energy contained) were assigned according to physical causalities. All other allocations for related coproductions were made on an economic basis. An exception is the allocation of the heat required in combined heat and power, which was allocated on the basis of the exergy of the electricity and process heat products.

Module A1

- Forest: All expenditures of the upstream forestry chain were allocated to the logs and industrial wood via economic allocation factors on the basis of their prices.
- The supply of reclaimed wood does not allow for any expenditures from the preceding life cycle.

Module A3

- Wood processing industry: In the case of associated coproductions, expenses were allocated economically to the main products and residual materials based on their prices.
- Thermal and electrical energy produced from the disposal of the waste produced in module A3 (with the exception of the wood-based materials) is returned to the product system in the form of a calculation loop. The energy produced and offset as a loop accounts for less than 1% of the energy used in module A3.
- In case of combined generation of heat and power, all furnace expenditures were allocated according to the exergy of these two products.
- The supply of reclaimed/waste wood as fuel does not take into account any expenditures from the preceding life cycle (similar to module A1).

Module D

- The extension of the system boundary undertaken in module D corresponds to an energy use scenario for waste wood.

3.10 Comparability

A comparison or assessment of EPD data is only possible if all datasets to be compared were produced according to *EN 15804* and the product-specific performance characteristics are taken into account. The life cycle assessment modelling was carried out using the *Sphera LCA for Experts* software, version 10.7.1.28. All background data was taken from the *Sphera MLC CUP 2023.2* database or comes from literature references.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

The raw particleboard is mainly made from wood and therefore contains biogenic carbon.

Information on describing the biogenic carbon content at the factory gate

Name/description	Value	Unit
Biogenic carbon in the product	281.34	kg C
Biogenic carbon in the associated packaging	2.23	kg C

At the factory gate and during use,

the product contains approx. 281.3 kg of biogenic carbon per cubic metre, which corresponds to a CO_2-equivalent of 1038.6 kg. The wooden packaging contains 2.23 kg of C.

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

The following technical information forms the basis for declared the
modules or can be used for the development of

specific scenarios in the context of a building assessment if modules are not declared (ND).

Installation in the building (A5)

Module A5 is declared, however, it only contains information on disposal of the product packaging and no details of the actual installation of the product in the building. The quantity of packaging material produced as waste material for thermal recovery in module A5 for each m³ of product and the resulting exported energy are given in the following table as technical scenario information.

Name	Value	Unit
Plastic packaging for thermal Waste processing	0.33	kg
Overall efficiency of the thermal waste recycling (plastics)	38	%
Wooden packaging for thermal waste treatment	4.45	kg
Overall efficiency of the thermal waste recycling (wood)	44	%
Total exported electrical energy	1.28	MJ
Total exported thermal energy	2.95	MJ
Paper- and cardboard packaging	0.32	kg

A transport distance of 50 km is assumed for the disposal of the product packaging. The overall efficiency of waste incineration and the percentages of electricity- and heat generation through combined heat- and power- correspond to that assigned to the waste incineration process in the *Sphera 2023b* database.

Use periods are given in the reference use periods table of the *BNB* .

End-of-life stage (C1-C4)

A scenario for the end of life in Germany is assumed. The German electricity mix is therefore used to calculate the energy required for processing the material.

Name	Value	Unit
Product fraction at the end of the waste property	662	kg
Redistribution transport distance of the reclaimed wood (module C2)	50	km

For a scenario in which the product reaches the end of its property of being waste, a collection rate of 100% without losses is assumed due to the shredding of the material.

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

Module D describes all loads and potential benefits that arise from the complete treatment of waste in terms of energy or material recycling/recovery of the product.

Name	Value	Unit
Scenario 1: generable electricity (per net flow of the declared unit)	579.17	kWh
Scenario 1: usable waste heat (per net flow of the declared unit)	4222.16	MJ
Scenario 2 material recycling: potential for substitution of primary material (absolutely dry, per net flow of the declared unit)	118.99	kg

The product is recovered with the same composition as the described declared unit at the end-of-life. As required in *PCR Part A*, both scenarios are presented as 100% -scenarios.

Scenario 1 (energy recovery)

Scenario 1 assumes purely energy recovery in a biomass cogeneration plant with an overall efficiency of 55% and an electrical efficiency of 18.19%. Around 435 kWh electricity and 3171 MJ usable heat are potentially generated by the incineration of 1 t wood (air dry, approx. 6.16% wood moisture content, 18 MJ/kg).
As secondary fuel is used in the manufacturing phase (A1–A3), the net flow entering module D corresponds to the product composition at the factory gate minus the waste wood fraction. Taking into account the adhesives fraction, each unit declared in module D potentially produces 140.40 kWh of electricity and 1024.84 MJ of thermal energy.
The exported energy has the potential to substitute fuels from fossil sources, whereby in this scenario, for recovery in Germany, it is assumed that the thermal energy is generated from natural gas and the substituted electricity corresponds to the German electricity mix (consumption mix).

Scenario 2 (material recycling)

Scenario 2 assumes that the waste wood has purely material recycling potential. The waste wood produced can be used entirely in the same or a comparable use, e.g. particleboard or fibreboard. The net flow of waste wood with potential for substitution of primary material in terms of secondary material is 270.43 kg (absolutely dry, per net flow of the declared unit). For the assessed material factor derived from the ratio of waste wood to wood chips, it is assumed that waste wood can be purchased at a price of €11/kg and wood chips at €25/kg, resulting in an assessment factor of 0.44. This results in a material-based benefit of 118.99 kg of secondary material.

5. LCA: results

The declared unit of 1 m³ of raw particleboard causes the following environmental impacts.

DESCRIPTION OF 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	Deconstruction, demolition	Transport	waste treatment	Disposal	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	X	X	X	X	X

RESULTS OF THE LIFE CYCLE ASSESSMENT – ENVIRONMENTAL IMPACTS to EN 15804+A2: 1 m3 raw particleboard

Indicator	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D	D/1
GWPtotal	kg CO_2-eq.	-9.93E+02	7.12E+01	-9.12E-01	9.32E+00	0	9.61E-01	1.05E+03	0	-3.6E+02	-3.45E-01
GWP-fossil	kg CO_2-eq.	4.56E+01	7.12E+01	7.73E+00	6.78E-01	0	9.61E-01	9.87E+00	0	-3.6E+02	-3.45E-01
GWP-biogenic	kg CO_2-eq.	-1.04E+03	0	-8.64E+00	8.64E+00	0	0	1.04E+03	0	0	0
GWP-luluc	kg CO_2-eq.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ODP	kg CFC11-eq.	1.79E-10	6.37E-12	4.17E-10	1.3E-12	0	8.59E-14	2.71E-10	0	-6.72E-09	-4.25E12
AP	mol H+-eq.	1.21E-01	4.46E-01	1.2E-02	4.47E-04	0	6.02E-03	1.51E-02	0	-3.27E-01	-3.5E-04
EP-freshwater	kg P-eq.	9.86E-05	2.65E-04	5.34E-05	3.42E-07	0	3.58E-06	5.93E-05	0	-1.48E-03	-9.41E-07
EP-n marine	kg N-eq.	8.3E-02	2.19E-01	5.29E-03	1.23E-04	0	2.95E-03	4.96E-03	0	-1.4E-01	-1.3E-04
EP-terrestrial	mol N-eq.	5.58E-01	2.43E+00	5.55E-02	1.64E-03	0	3.27E-02	5.13E-02	0	-1.07E+00	-1.38E-03
POCP	kg NMVOC-eq.	1.19E-01	4.12E-01	4.57E-02	3.38E-04	0	5.56E-03	1.19E-02	0	-3.54E-01	-3.33E-04
ADPE	kg Sb-eq.	2.62E-06	4.72E-06	1.29E-06	2.68E-06	0	6.37E-08	1.8E-06	0	-4.73E-05	-3.02E-08
ADPF	MJ	1.18E+03	9.89E+02	1.93E+02	2.06E+00	0	1.33E+01	1.4E+02	0	-7.86E+03	-5.41E+00
WDP	m3 World-Equivalent withdrawn	1.45E+00	8.38E-01	3.33E-01	8.16E-02	0	1.13E-02	2.84E-01	0	1.18E+02	-4.58E-03

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 (ADP materials); ADPF = Abiotic depletion potential for fossil resources (ADP fossil energy sources); water (user) deprivation potential

RESULTS OF THE LIFE CYCLE ASSESSMENT – INDICATORS FOR DESCRIBING RESOURCE USE in accordance with EN 15804+A2: 1 m3 raw particleboard

Indicator	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D	D/1
PERE	MJ	1.59E+02	7E+01	8.53E+01	8.64E+01	0	9.44E-01	1.31E+02	0	-1.42E+04	0
PERM	MJ	5.21E+03	0	8.58E+01	-8.58E+01	0	0	-5.21E+03	0	0	-2.29E+03
PERT	MJ	5.37E+03	7E+01	1.71E+02	6.7E-01	0	9.44E-01	-5.08E+03	0	-1.42E+04	-2.29E+03
PENRE	MJ	1.18E+03	9.91E+02	1.93E+02	1.39E+01	0	1.34E+01	1.4E+02	0	-7.09E+03	0
PENRM	MJ	7.74E+02	0	1.19E+01	-1.19E+01	0	0	-7.74E+02	0	0	0
PENRT	MJ	1.96E+03	9.91E+02	2.05E+02	2.07E+00	0	1.34E+01	-6.35E+02	0	-7.09E+03	0
SM	kg	2.96E+02	0	0	0	0	0	0	0	0	2.7E+02
RSF	MJ	1.12E+03	0	1.18E+03	0	0	0	0	0	1.09E+04	0
NRSF	MJ	0	0	0	0	0	0	0	0	7.74E+02	0
FW	m3	1.93E-01	7.71E-02	1.14E-01	1.99E-03	0	1.04E-03	4.61E-02	0	1.77E+00	-7.35E-04

PERE = Use of renewable primary energy resource, as energy source; 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 resource, as energy source; 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 = Non-renewable secondary fuels use; FW = Net use of freshwater

RESULTS OF THE LIFE CYCLE ASSESSMENT – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m3 raw particleboard

Indicator	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D	D/1
HWD	kg	9.6E-03	1.28E-03	2.5E-02	7.16E-05	0	1.73E-05	1.36E-02	0	-9.31E-08	-6.58E-11
NHWD	kg	4.67E-01	1.43E-01	1.81E-01	1.88E-02	0	1.93E-03	1.28E-01	0	-1.26E+03	-8.47E-01
RWD	kg	3.97E-06	3.67E-09	3.14E-08	3.4E-08	0	4.95E-11	-2.73E-08	0	-3.57E+01	-2.26E-02
CRU	kg	0	0	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	6.57E+02	0	0	0

MER	kg	0	0	0	5.1E+00	0	0	6.57E+02	0	0	0
EEE	MJ	0	0	0	1.28E+00	0	0	0	0	0	0
EET	MJ	0	0	0	2.95E+00	0	0	0	0	0	0

HWD = hazardous waste disposed (for landfill); NHWD = non-hazardous waste disposed; RWD = radioactive waste disposed; CRU = components for reuse; MFR = materials for recycling; MER = materials for material recovery; EEE = export energy – electrical; EET = export energy – thermal

RESULTS OF THE LIFE CYCLE ASSESSMENT – additional impact categories according to EN 15804+A2-optional: 1 m3 raw particleboard

Indicator	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D	D/1
PM	Cases of illness	2.26E-06	2.62E-06	6.46E-08	4.98E-09	0	3.54E-08	1.19E-07	0	-2.69E-06	-2.55E-09
IR	kBq U235-eq.	1.05E+00	1.85E-01	1.94E+00	7.45E-03	0	2.5E-03	1.44E+00	0	-3.57E+01	-2.26E-02
ETP-fw	CTUe	3.46E+02	6.96E+02	2.04E+01	4.08E-01	0	9.39E+00	5.31E+01	0	-1.26E+03	-8.47E-01
HTP-c	CTUh	2.33E-07	1.41E-08	4.77E-07	9.48E-11	0	1.9E-e 10	2.72E-09	0	-9.31E-08	-6.58E-11
HTP-nc	CTUh	4.46E-07	6.2E-07	6.13E-08	2.17E-09	0	8.37E-09	3.81E-08	0	-2.36E-06	-1.76E-09
SQP	SQP	8.85E+02	4.12E+02	3.38E+01	5.25E-01	0	5.57E+00	9.13E+01	0	-2.23E+03	-1.44E+00

PM = Potential incidence of diseases 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 (carcinogenic effect); HTP-nc = Potential comparative toxic unit for humans (non-carcinogenic effect); SQP = Potential soil quality index

Supplement 1

-The GWP biogenic indicator shown in the EPD covers biogenic GHG (greenhouse gas) emissions from upstream chains, such as fuels, lubricants, adhesives and packaging plastics, which are presumed to contain renewable resources. The indicator shown must be clearly distinguished from the biogenic GWP, which is attributable to wood as a raw material and represents a carbon store inherent in the material. This GWP, which is sequestered in the wood content of the product-, is shown in detail again in Chapter 6.

Supplement 2

The indicator **GWP-luluc** was not declared because it accounts for less than 5% of the total GWP -across the declared modules A - C. Furthermore, detailed information on the origin of raw materials was requested as part of the primary data collection. According to this, in the case of this product, approximately 15% of the industrial wood used in bark comes from Germany (from the federal states of Baden--Württemberg, Bavaria, Hesse, Lower Saxony, North Rhine-Westphalia, Rhineland--Palatinate and Thuringia). A very small part comes from the Czech Republic and Switzerland.
Industrial waste wood mainly comes from Germany, but also from France, Italy, the Netherlands, Austria, Switzerland and the Czech Republic (approx. 3-8%). Waste wood is purchased in Germany, France, Italy, the Netherlands, Austria, Switzerland and the Czech Republic. The average waste wood percentage is 56% of the wood content of the raw particleboard. Waste wood contains various assortments of former solid wood products and wood-based materials, and it is currently not possible from a technological point of view to trace the wood back to its original harvest locations. Therefore, we can only comment on the primary system and determine that the secondary use of the raw material does not result in deforestation, as it originates from an earlier product life cycle. On the other hand, as part of international greenhouse gas reporting under the Climate Change Convention (*UNFCCC*) and *EU Regulation (EU) 2018/841*, the amount of annual deadwood removal from existing forests in Germany is estimated, including the percentage of wood originating from the land use change 'deforestation' (*Federal Environment Agency 2023*). For the reference year 2021, the percentage of wood removals associated with deforestation was 1.86% nationwide. At the same time, it can be assumed that wood assortments associated with a change in land use are unlikely to be used by wood-processing companies due to irregular supply (in terms of space and time, and can therefore not be planned logistically), as they rely on a continuous supply of specific raw wood assortments of consistent quality and dimensions (in this case: industrial wood for wood-based panel production).

Supplement 3

The primary energy used as raw materials (PERM and PENRM) is construed as an inherent material property to EN 16485. As a consequence, it always leaves the product system with the material and is entered as a negative value from the corresponding indicator. RSF and NRSF are to be understood as part of PERE and PENRE and are included therein.

6. LCA: Interpretation

The interpretation of the results focuses on the production phase (Modules A1 to A3), as these are based on specific information received from the company. The interpretation is based on a dominance analysis of environmental impacts (GWP-fossil, ODP, AP, EP-fw, POCP, ADPE, ADPF, WDP) and renewable/non-renewable primary energy uses (PERE, PENRE) as well as freshwater use (FW) and hazardous waste (HWD). The most important factors for the respective categories are thus listed in the following.

Interpretation of individual indicators

The results show that in most environmental categories, the transport of waste wood and SNP material (A2) and the use of UF adhesive (A1) are the most significant influencing variables. The transport of waste wood and SNP material is responsible for a significant proportion of the global warming potential (GWP-f), acidification potential (AP) and photochemical ozone formation (POCP) in particular. The use of UF adhesive (A1) is particularly relevant in cases of eutrophication (EP-fw), potential for abiotic degradation of fossil fuels (ADPF) and water use (WDP). Other significant factors in most categories include the transport of primary wood (A2) and emissions from electricity use (A3).

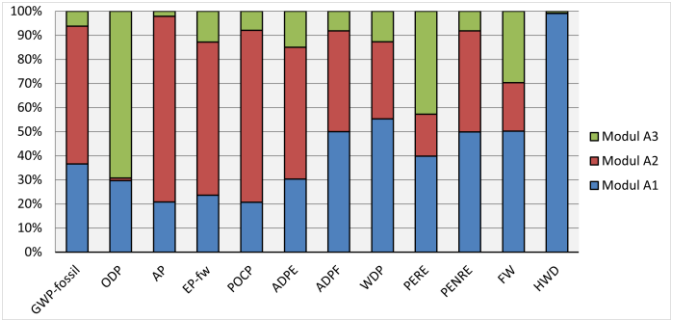


Fig. 2: Relative contributions of the modules considered to the individual environmental impacts and resource indicators.

Biogenic carbon

When wood is used in the form of wood chips, round timber or waste wood, the carbon sequestered in the wood enters the system space in the raw material provision module (A1), which means a negative CO_2- value from an atmospheric perspective. In information module C3, the carbon contained in the wood fractions of the product leaves the system space again in the form of usable waste wood. In module A3, the carbon sequestered in the (wood-) packaging is transferred from the atmosphere to the product system and leaves it again when it is disposed of in module A5. The biogenic carbon- or CO_2 flows directly attributable to the wood fractions in the product and packaging are not calculated using background datasets from the Sphera database/Sphera 2023b/. The conversion of wood mass into CO_2 is based on the quantity of carbon contained in the wood and the ratio of the molar masses of carbon dioxide to carbon (44/12). The carbon content in wood is assumed to be 50% of the absolutely dry wood mass for all species of wood (IPCC, 2006).
Thus, 1 kg of absolutely dry wood mass equals approximately 1.833 kg of CO_2.

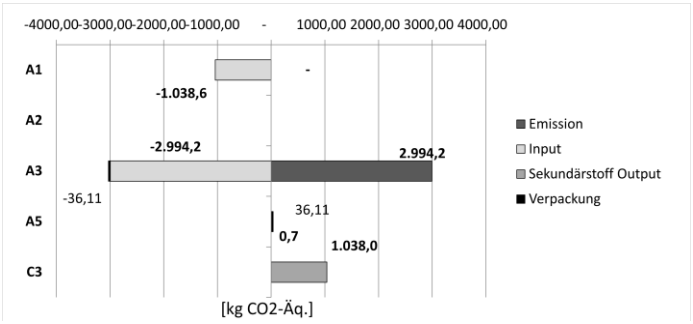


Figure 3: CO_2 inherent in wood - product system inputs and outputs. The inverse sign of the inputs and outputs takes into account the life cycle assessment CO_2 flow consideration from the view of the atmosphere.

The growth of the wood required for production sequesters 1,038.6 kg of CO_2 in module A1, see Fig. 3. The growth of the wood used for energy in production also sequesters 2,994.2 kg of CO_2, which is input into module A3 and is also emitted from this module again due to the combustion on the site. The 36.11 kg of biogenic CO_2 contained in wood- and paper packaging is also input in module A3. This leaves the system boundary when the packaging is disposed of in module A5. The remaining 1,038.6 kg of CO_2 leave the product system in module C3 in the form of recyclable waste wood.

Other indicators

Global warming potential fossil (GWP-f) [kg CO2-eq.]: 28.7% - Transport of waste wood for use as material (A2); 19.5% - Transport of SNP for use as material (A2); 18.3% - UF adhesive (A1); 7.8% - Transport of primary wood (A2); 7% - SNP for use as material (A1); 5.7% - muf adhesive (A1); remainder 13%

Ozone depletion potential (ODP) [kg CFC11-eq.]: 32.1% - Electricity, original form (A3); 15.7% - Electricity, drying (A3); 15.5% - UF adhesive (A1); 11.5% - Electricity, finishing (A3); 9.9% - Electricity, infrastructure (A3); 6.7% - SNP for use as material (A1); Remaining 8.6%

Acidification potential (AP) [mol H+-eq.]: 38.7% - Transport of waste wood for use as material (A2); 26.3% - Transport of SNP for use as material (A2); 10.6% - Transport of primary wood (A2); 7.1% - muf adhesive (A1); 5.6% - SNP for use as material (A1); 4.3% - UF adhesive (A1); remainder 7.5%

Eutrophication, freshwater (EP-fw) [kg P-eq.]: 31.9% - Transport of waste wood for use as material (A2); 21.7% - Transport of SNP for use as material A2); 10.7% - Production waste (A3); 10.3% - UF adhesive (A1); 8.7% - Transport of primary wood (A2); 6.1% - SNP for use as material (A1); remainder 10.6%

Photochemical Ozone Formation (POCP) [kg NMVOC-eq.]: 27.7% - Transport of waste wood for use as material (A2); 22.5% - Dryer emissions on site (A3); 18.9% - Transport of SNP for use as material (A2); 7.6% - Transport of primary wood (A2); 5.5% - SNP for use as material (A1); 4.2% - Adhesive curing (A3); Remaining 13.6%

Potential for abiotic degradation of non-fossil resources (ADPE) [kg Sb-eq.]: 27.4% - Transport of waste wood for use as material (A2); 18.7% - Transport of SNP for use as material (A2); 12.3% - UF adhesive (A1); 8.9% - SNP for use as material (A1); 7.5% - Transport of primary wood (A2); 6.3% - Electricity for primary production (A3); remaining 18.8%

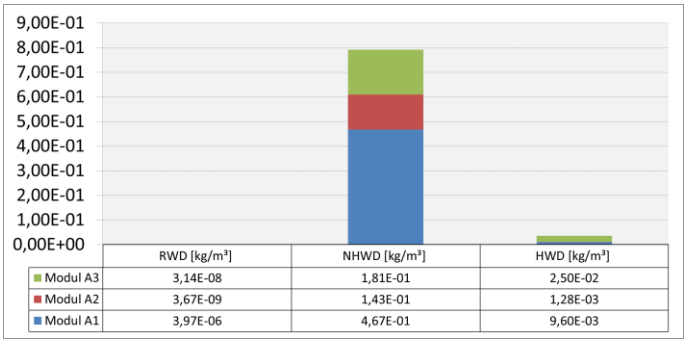
Potential for abiotic degradation of fossil fuels (ADPF) [MJ]: 29.6% - UF adhesive (A1); 21% - Transport of waste wood for use as material (A2); 14.3% - Transport of SNP for use as material (A2); 7.6% - muf adhesive (A1); 5.7% - Transport of primary wood (A2); 4.9% - SNP material (A1); remaining 16.9%

Water use (WDP) [m³ global water equivalent extracted]: 118.8% Operating resources (A3); 25% Packaging (A1); 19.4% UF adhesive (A1); 16% Transport of waste wood for use as material (A2); 10.9% Transport of SNP for use as material (A2); 5.4% Electricity for primary processing (A3); remaining 95.5%

Renewable primary energy as energy source (PERE) [MJ]: 19.7% - Electricity, primary forms (A3); 14.7% - Packaging (A1); 11.7% - UF adhesive (A1); 9.6% - Electricity, drying (A3); 8.8% - Transport of waste wood for use as material (A2); 7.1% - Electricity for finishing (A3); Remaining 28.4%

Non--renewable primary energy as energy source (PENRE) [MJ]: 29.5% - UF adhesive (A1); 21% - Transport of waste wood for use as material (A2); 14.3% - Transport of SNP for use as material (A2); 7.6% - muf adhesive (A1); 5.7% - Transport of primary wood (A2); 4.9% - SNP for use as material (A1); remaining 16.9%

Use of freshwater resources (FW) [m³]: 28.7% - UF adhesive (A1); 18.9% - Operating resources (A3); 13.6% - Electricity for primary production (A3); 10.1% - Transport of waste wood for use as material (A2); 7.6% - muf adhesive (A1); 6.9% - Transport SNP for use as material (A2); Remaining 14.2%



	RWD [kg/m³]	NHWD [kg/m³]	HWD [kg/m³]
Modul A3	3,14E-08	1,81E-01	2,50E-02
Modul A2	3,67E-09	1,43E-01	1,28E-03
Modul A1	3,97E-06	4,67E-01	9,60E-03

Fig. 4: Waste produced per declared unit at module level. HWD = Hazardous waste for landfill; NHWD = Non-hazardous waste disposed of; RWD = Radioactive waste disposed of.

The relative amounts of hazardous, non-hazardous and radioactive waste produced per declared unit of the product are summarised as follows. All relevant and verifiable waste must be assigned to module A1. This is because all production residues are fed back into the production cycle or incinerated in the factory's own furnace to provide process heat in A3.

The main drivers for hazardous waste to landfill (HWD) [kg]: 26.6% - Transport of waste wood
for use as material (A2); 18.1% - Transport SNP for use as material (A2); 13.8% - Packaging (A1); 13.7% - SNP for use as material (A1); 7.3% - Transport of primary wood (A2); 6.1% - muf adhesive (A1); remaining 14.5%.

Variability of the LCIA results
In the case of fossil GWP, the differences can be explained by the different combustion processes with and without biomass-CHP. In two plants, the entire electricity requirement is covered by self-generated 'green electricity', thus reducing the contribution to the fossil GWP-. In the third plant, only grey electricity is used, resulting in a higher fossil GWP value. The variabilities can also be explained by the very different production quantities at the different sites and thus by the proportion of operating resources and adhesive- and additives. For greater clarity, the deviations are summarised again here: (GWP- fossil) dev+244.7/-3.2%; (ODP) dev +213.7/-17.3%; (AP) dev+194/-11.9%; (EP-fw) dev +197.7/-14.4%; (POCP) dev
+291.2/16%; (ADPE) dev +312.8/21.7%; (ADPF) dev +257.8/-3.2%; (WDP) dev +238/-11%; (PERE) dev+213.5/-12.1%; (PENRE) dev +257.7/-3.2%; (FW) dev +230.7/-25.8 %; (HWD) dev +386.5/-31.3%.

7. Requisite evidence

7.1. Formaldehyde

Monitoring: **WKI Fraunhofer-Institut Braunschweig (Qualitätsgemeinschaft Holzwerkstoffe e.V.)**

Test body: **WKI Fraunhofer Institute Braunschweig**

Test standard: ***EN 717-1* Determination of formaldehyde release *EN 16516* Assessment of release of dangerous substances - Determination of emissions into indoor air**

The tested material meets the requirements of the German Banned Chemicals Ordinance (Chemikalien-Verbotsverordnung) as follows:

Formaldehyd	≤ 0,1 ppm nach EN 717-1 (x-Faktor 2,0 gem. Chemikalienverordnung, sog. Standard E 05)

Source: Qualitätsgemeinschaft Holzwerkstoffe e.V.

7.2. Testing for pretreatment of the input materials

Monitoring: **MPA Eberswalde (Qualitätsgemeinschaft Holzwerkstoffe e.V.)**

Test body: **MPA Eberswalde**

Purpose of the test: To examine panel material for its PCP, tetrachlorophenol and lindane content.

Analysis method: Quantitative gas chromatography with mass-selective detection (GC-MS)

Extraction: Soxhlet extraction for several hours with methanol or n--hexane; PCP/tetrachlorophenol-analysis after derivatisation with acetic anhydride under alkaline conditions according to */CEN/TR 14823:2003/ or Annex IV /AltholzV (German Waste Wood Ordinance)*

Pentachlorphenol	≤ 3,0 mg/kg
Lindan	≤ 1,0 mg/kg

Source: Qualitätsgemeinschaft Holzwerkstoffe e.V.

7.3. Toxicity of fire gases

The toxicity of the fire gases produced when raw particleboard burns is highly influenced or altered by the substances involved in the fire. A specific statement cannot be made at this point.

7.4. VOC emissions

Monitoring: **RAL GmbH**
Test body: **WKI Fraunhofer Institute Braunschweig**

Purpose of the test: Determination of VOC emissions in accordance with
AgBB Schema/MVVTB

Method of measurement: *EN 16516*

Result: The raw particleboards tested in accordance with *EN 16516* meet the requirements
according to the *AgBB Schema/MVVTB* of 2018 for VOC after 3 days and after 28 days.

Pfleiderer PremiumBoard MFP Living (No. 39821) and LivingBoard (face contiprotect) (No. 30992) particleboards bear the RAL quality seal (UZ-76) **Blaue Engel** (Blue Angel label).

AgBB results overview (28 day [µg/m³])

Name	Value	Unit
TVOC (C6 - C16)	327	µg/m3
Total SVOC (C16 - C22)	< 5	µg/m3
R (dimensionless)	0.65	-
VOC without LCI	< 5	µg/m3
Carcinogenic	< 1	µg/m3

AgBB results overview (3 days [µg/m³])

Name	Value	Unit
TVOC (C6 - C16)	894	µg/m3
Total SVOC (C16 - C22)	< 5	µg/m3
R (dimensionless)	1.592	-
VOC without LCI	10	µg/m3
Carcinogenic	< 1	µg/m3

The Pfleiderer **LivingBoard P4** product was used as the reference.

Precise measurements for all products can be provided on request.

8. References

EN 310:1993-08
-Wood-based panels. Determination of modulus of elasticity in bending and of bending strength; EN 310:1993

EN 311:2002-08
Wood-based panels. Surface soundness. Test method; EN 311:2002

EN 312:2010-12
-Particleboards. Specifications; EN 312:2010

EN 317:1993-08
Particleboards and fibreboards. Determination of swelling in thickness after immersion in water; EN 317:1993

EN 319:1993-08
Perpendicular tensile strength of particleboards and fibreboards; EN 319:1993

EN 322:1993-08
Wood-based panels. Determination of moisture content; EN 322:1993

EN 323:1993-08
Wood-based panels. Determination of density; EN 323:1993

EN 324-1:1993-08
Wood-based panels. Determination of dimensions of boards. Part 1: Determination of thickness, width and length; EN 324--1:1993

EN 324-2:1993-08
Wood-based panels. Determination of dimensions of boards. Part 2: Determination of squareness and edge straightness; EN 324--2:1993

EN 717-1:2005-01
Wood-based panels. Determination of formaldehyde release.- Part 1: Formaldehyde emission by the chamber method; EN 717--1:2004

EN 1087-1:1995-04
Particle boards. Determination of moisture resistance. Part 1: Boil test; EN 1087--1:1995

ISO 9001:2015
Quality management systems.- Requirements

EN 13501-1:2019-05
Fire classification of construction products and building elements.- Part 1: Classification using data from reaction to fire tests; EN 13501--1:2018

EN 13986:2015-06
-Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking; EN 13986:2004+A1:2015

ISO 14001:2015-09
Environmental management systems. Requirements with guidance for use

ISO 14025:2006-07
-Environmental labels and declarations. -Type III environmental declarations.- Principles and procedures

EN 15804+A2:2022-07
Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products

ISO 16000-3:2022-09
Indoor air. Part 3: Determination of formaldehyde and other carbonyl compounds in indoor and test chamber air. Active sampling method (ISO 16000-3:2022)

ISO 16000-6:2021-08
Indoor air.- Part 6: Determination of organic compounds (VVOC, VOC, SVOC) in indoor- and test chamber air by active sampling on sorbent tubes, thermal desorption and gas chromatography using MS or MS -FID (ISO 16000-6:2021)

EN ISO 16000-9:2006-03
Indoor air. Part 9: Determination of the emission of volatile organic compounds from building products and furnishing. Emission test chamber method (ISO 16000--9:2006); EN ISO 16000--9:2006

EN 16516:2017+A1:2020
Construction products: Assessment of release of dangerous substances. Determination of emissions into indoor air; EN 16516:2017+A1:2020

ISO 45001:2018-03
-Occupational health and safety management systems. Requirements with guidance for use

ISO 50001:2018-08
-Energy management systems. Requirements with guidance for use

Further references

AgBB Schema
Vorgehensweise bei der gesundheitlichen Bewertung der Emissionen von flüchtigen organischen Verbindungen (VVOC, VOC und SVOC) aus Bauprodukten; Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (German Committee for Health Assessment of Construction Products - Procedure for health assessment of VOC emissions). 2021 version.

AltholzV
Verordnung über Anforderungen an die Verwertung und Beseitigung von Altholz -'Altholzverordnung'(AltholzV) (German waste wood ordinance)

BBSR-Tabelle
BBSR- Tabelle zu Nutzungsdauern von Bauteilen

für Lebenszyklusanalysen nach Bewertungssystem Nachhaltiges Bauen (BNB), Bundesministerium des Innern, für Bau und Heimat, Dated: 24/02/2017 (Service life of building elements)

CARB
CARB Final regulation order § 93120-931120.12, title17, California Code of Regulations: 'Airborne toxic control measurement to reduce formaldehyde emissions from composite wood products'.

CPR
CPR Regulation (EU) No. 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products (EU CPR).

ChemVerbotsV
Chemikalien -Verbotsverordnung (ChemVerbotsV): Verordnung über Verbote und Beschränkungen des Inverkehrbringens und über die Abgabe bestimmter Stoffe, Gemische und Erzeugnisse nach dem Chemikaliengesetz (German Ordinance on the prohibition of certain substances).

ECHA candidate list
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IPCC (2006) IPCC Guidelines for Greenhouse Gas Inventories -Vol 4 Agriculture, Forestry and other Land Use. Hayama, Kanagawa, Japan: IEA/OECD, IPCC National Greenhouse Gas Inventories Programme, Technical Support Unit, 683 p.

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Product category-- rules for building-related products and services. Part A: Calculation rules for the life cycle assessment and requirements on the project report. Version 1.4. Berlin: Institut Bauen und Umwelt e.V. (Publisher), 30/04/2024

PCR Part B
Product category-- rules for building-related products and services. Part B: Requirements on the EPD for wood-based products. Version 10. Berlin: Institut Bauen und Umwelt e.V. (publisher), 04--2024.

REACH Regulation
Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No. 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

Rüter und Diederichs (2012)
Ökobilanz Basisdaten für Bauprodukte aus Holz, Hamburg: Johann Heinrich von Thünen Institut, Institut für Holztechnologie und Holzbiologie, Abschlussbericht.

Regulation (EU) No. 305/2011
Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC.

Sphera (2023a)
Sphera Software 'LCA for Experts' (Version 10.7.1.28). Sphera Solutions GmbH, 2023.

Sphera (2023b)
Sphera Datenbank Sphera MLC (fka GaBi) CUP 2023.02. Sphera Solutions GmbH, 2023.

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