ENVIRONMENTAL PRODUCT DECLARATION

to *ISO 14025* and *EN 15804+A1*

Declaration holder	**Verband der Deutschen Holzwerkstoffindustrie e.V.**
Issuer	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-VHI-20190095-IBG2-DE
Issue date	06/10/2020
Valid until	05/10/2025

Particleboard, raw

Verband der Deutschen

Holzwerkstoffindustrie e.V.

Institut Bauen und Umwelt e.V.

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ASSOCIATION OF THE GERMAN WOOD-BASED PANEL

1. General information

Verband der Deutschen Holzwerkstoffindustrie e.V.

Programme holder

IBU - Institut Bauen und Umwelt e.V.

Panoramastr. 1

10178 Berlin

Germany

Declaration number

EPD-VHI-20190095-IBG2-DE

This declaration is based on the Product Category Rules:

Wood-based panels, 12.2018

(PCR reviewed and approved by the independent Council of Experts (SVR))

Issue date

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Valid until

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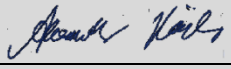
Dipl. Ing. Hans Peters

(Chairman of Institut Bauen und Umwelt e.V.)



ur. Alexander Roder

(Managing Director Institut Bauen und Umwelt e.V.)

Particleboard, raw

Declaration holder

Verband der Deutschen Holzwerkstoffindustrie e.V. Schumannstraße 9

10117 Berlin

Declared product/declared unit

1 m^3 particleboard, raw

Scope:

The contents of this declaration are based on the information on the production of raw particleboards of the following manufacturers organised within the Verband der Deutschen Holzwerkstoffindustrie e.V.:

- Pfleiderer Deutschland GmbH (Gütersloh, Neumarkt, Leutkirch)
- Sonae Arauco Deutschland GmbH, Beeskow
- elka-Holzwerke GmbH, Morbach
- Rauch Spanplattenwerk GmbH, Markt Bibart
- Rheinspan GmbH & Co. KG, Germersheim

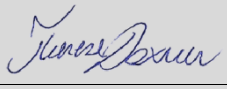
The life cycle assessment of this declaration covers 100 % of the production of raw particleboards of the named manufacturers or factories in 2017. This declaration can be used for raw particleboards of the above-named manufacturers.

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 has been prepared according to the requirements of *EN 15804+A1*. In the following, the standard is referred to in the simplified form *EN 15804* .

Verification

The European standard EN 15804 is used as the core PCR
Independent verification of the declaration and Information in accordance with *ISO 14025: 2010*
☐ internal ☒ external



Therese Daxner,

Independent verifier

2. Product

2.1 Product description / product definition

Raw particleboards are panel materials. They mainly consist of small wood particles such as chips and wood flour and are pressed with thermosetting binders. They are not overlaid.

The placing of the products on the market in the EU/EFTA (with the exception of Switzerland) is governed by 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. The required declarations of performance and the CE marking have been created 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 Application

Particleboards can be used in decorative interior design, furniture making, in timber construction and in trade fair stand construction and shop fitting.

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2.3 Technical data

Requirements to /EN 312/

(simplified representation for board types P1 - P7)

Structural data

Name/description	Value	Unit
Density	600-730	kg/m³
Tensile strength in bending (flexural strength) (longitudinal) /EN 310/	7-22	N/mm²
Tensile strength in bending (flexural strength) (transverse) /EN 319/	0.14-0.75	N/mm²
Modulus of elasticity (length) /EN 310/	1.2-3.35	N/mm²
Material moisture content on delivery /EN 322/	5-13	%
Thermal conductivity /EN13986/	0.12	W/(mK)
Water vapour resistance factor	moist 15 / dry 50	-
Sound absorption coefficient	0.1-0.25	%
Formaldehyde emissions to EN 717-1, see verifications	Requirements met	µg/m³

Note: Specific technical data are provided in the technical data sheets of the manufacturers' 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

Particleboards of the companies in the Association of the German wood-based panel industry are available in the following dimensions:

Width: 200 – 6250 mm

Length: 200 – 2800 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/ Table to 2 to 10 (/EN 312/), special qualities available on request.

2.5 Basic materials/auxiliaries

Product composition

Raw particleboards are made from small wood particles, binders and other additives. The main binders used are urea formaldehyde binder (UF), melamine urea formaldehyde binder (MUF) and phenol formaldehyde binder (PF). Paraffins are used for hydrophobic impregnation of the wood particles.

67 % of the wood used is from fresh softwoods, 13 % from fresh hardwoods and 20 % from reclaimed wood. The ratios considered for the environmental product declaration are listed in the following table (details of all basic materials in % by mass, the middle value is the weighted average, the outer values are the minimum and maximum average figures provided by the manufacturer).

Name/description	Value	Unit
Wood (abs.dry portion), mainly softwood	82.9 | 84.4 | 86.6	%
Reclaimed share of the wood used	0 | 20 | 42.9	%
Water	5.2 | 6.2 | 7	%
UF	0 | 7.6 | 10.6	%
MUF	0 | 1.03 | 2.2	%
PF	0 |0.075 | 7.04	%
Paraffins	< 1	%
Urea	< 0.3	%
Fire retardant	< 0.05	%

The product has an average density of 641.7 kg/m³. The functional chemical groups of the fire retardants are phosphate and nitrogen compounds.

The product/article/at least one subarticle contains substances on the /ECHA candidate list/ (Date 27/06/2018) above 0.1 % by mass: no.

The product/article/at least one subarticle partial article contains other category 1A or 1B CMR substances, which are not on the /ECHA candidate list, above 0.1 % by mass in at least

subarticle: no

Biocidal products have been added to this construction product or it has been treated with biocidal products (it is thus a treated article as defined in the Biocidal Products Regulation (EU) No. 528/2012): no

2.6 Production

Wood raw materials from forest wood (industrial wood or forest wood chips), industrial wood waste (industrial wood waste, chips, wood flour) and recycled wood (reclaimed wood, scrap from own production), initially prepared and dried, are used for the production of raw particleboards. The fractions are sorted (partly before drying) and are mixed with binders before they are spread uniformly in horizontal layers and are then subjected to pressure (pressed). The pressed boards or pressed endless board is cut and formatted (sized). After the adhesives have fully hardened and cured, the boards are packed.

2.7 Environment and health during production

The manufacturing conditions do not require any particular health protection measures, except those planned for by the authorities for the specific work area, for example, high-visibility vest, safety footwear, dust mask. The MAC values (Germany) are below the specified limits at every point in the production process.

Air: The production-related exhaust air is cleaned according to the legal requirements. Emissions are below the values specified in the /TA Luft/ /TA Air).

Water/soil: No impacts (contamination) on water or soil occur.

Sound insulation: All values determined within and outside the production facilities are below the requirements applicable in Germany.

Noise-intensive parts of the facilities, such as the machining, are insulated accordingly by appropriate structural measures.

2.8 Product processing/installation

VHI particleboards can be sawn, milled, planed, sanded and drilled with standard machines. Machining recommendations are given in the relevant data sheets. Attention must be paid to proper installation in building physics terms. When choosing additive products, make sure that they do not have a negative effect on the described properties of the named construction products. When processing/working with the products, the usual protective measures must be taken (dust mask, gloves, protective clothing, dust extraction, etc.).

2.9 Packaging

Depending on the manufacturer, VHI particleboards are delivered with solid wood, wood-based panel, cardboard and plastic packaging materials. If their reuse is impractical, the materials should be recycled or used thermally (waste-to-energy).

2.10 In-use condition

The composition for the period of use corresponds to the basic material composition according to section 2.5 “Basic materials”. During its use, around 270.9 kg of carbon is sequestered in 1 m³ of the product. With complete oxidation, this is equal to around 993.3 kg carbon dioxide.

2.11 Environment and health during use

Environmental protection: Based on currently available knowledge, hazards for water, air and soil cannot occur if the described products are used as intended (see verifications).

Health protection: Based on current knowledge, health damage and impairments are not to be expected if particleboards are used normally as intended. Emissions are only determinable in safe quantities (see verifications).

2.12 Reference service life

The resistance in the in-use condition depends on the use classes. (/EN 312/)

2.13 Extraordinary effects

Fire

Raw particleboards have the following reaction to fire to /EN 13501/:

Fire protection

Name/description	Value
Building material class	D (normally flammable)
Burning drips	d0 (no droplets / particles)
Smoke gas development	s2 (limited smoke development)

Change in state of aggregation: Burning droplets are not possible as raw particleboards do not become liquid on heating.

Toxicity of fire gases. Verification of the toxicity of fire gases is not required for class D building materials.

Water

No constituents are washed out/leached, which could be hazardous to water. VHI particleboards are not resistant to continuous water action. However, damaged areas can be replaced locally.

Mechanical destruction

Sharp edges can occur at the breakpoints when destroyed mechanically.

2.14 Post-use (circular economy) phase

Reuse: In case of conversion or at the end of the in-use phase of a building or other products, VHI particleboards can be collected separately as part of selective dismantling and can be reused for the same or for a different use to the original application.

Recovery: In case of homogeneous separation, VHI particleboards can be added back into a wood-based panel manufacturing process. If reuse or recovery is not practical, the aim should be to use the particleboards for energy recovery due to their high calorific value.

2.15 Disposal

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 List Ordinance (AbfallverzeichnisVerordnung - /AVV/): 17 02 01.

2.16 Further information

Further information can be found on the VHI website: https://www.vhi.de

3. LCA: Calculation rules

3.1 Declared unit

The declared unit of the ecological consideration is the supply of 1 m³ raw particleboard with a weight of 641.7 kg/m³ at water content of 6.25 % and an adhesive and additive fraction of 9.3 %.

The composition corresponds to that of the weighted average by production volume.

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Details of the declared unit

Name/description	Value	Unit
Declared unit	1	m^3
Reference weight	641.7	kg/m^3

The mass balance production volume input into the average is based on information received from five of the manufacturers or raw particleboards organised in the Verband der Deutschen Holzwerkstoffindustrie e.V. The underlying production process varies only slightly between the manufacturers. In total, both the representativeness and the robustness of the data can be assessed as good.

3.2 System boundary

The declaration type corresponds to a *Cradle to Gate – with* options type EPD. The contents are the production stage, i.e. from the supply of the raw materials up to the production factory gate (*Cradle-to-Gate*, Module A1 to A3), and module A5 and parts of the end-of-life (Modules C2 and C3). Furthermore, the potential benefits and loads are considered beyond the product's life cycle (Module D).

Furthermore, the potential benefits and loads are considered beyond the product's life cycle (Module D).

In detail, in Module A1, the supply of the wood raw materials and the supply of the adhesive and additives are assessed. 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).

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, the CO2 equivalents of the carbon inherently in wood and the renewable and non-renewable primary energy contained in the product (PERM and PENRM) are entered as outputs in accordance with /EN 16485/ .

Module D assessed 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.

3.3 Estimations 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 by the incineration of wood are estimated on the basis of a background dataset of the /GaBi Professional Database 2019 Edition/. Emissions from the wood drying and curing of the adhesives are based on information from the literature and are documented in /Rüter, Diederichs 2012/. The transport distance of the adhesives and additives to the factory are assumed with a conservative value of 500 km truck and 500 km rail transport. 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 that material or 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. More detailed information on the cut-off criteria are documented in /Rüter, Diederichs 2012/.

3.5 Background data

All background data were taken from the /GaBi Professional Database 2019 Edition/ and the final "Basic life cycle assessment data for construction products made of wood" report by /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 chapter 3.3 were taken.

3.6 Data quality

The foreground data were acquired for each manufacturer for twelve consecutive months in the 2009-2011 period. A confirmation of the Association exists, based on a member survey, which certifies the continued up-to-dateness and validity of these data.

The foreground data were validated on the basis of the mass and plausibility criteria. The background data for wood raw materials used as material and energy, with the exception of forest wood, come from the years 2008 to 2012. The supply of forest wood was taken from a publication from 2008, which is essentially based on information from 1994 to 1997. All other information was taken from the /GaBi Professional Database 2019 Edition/ and are not older than three years.

The overall data quality can be described as good.

3.7 Consideration period

The foreground data were acquired for each manufacturer for twelve consecutive months in the 2009 to 2011 period. A confirmation of the Association exists, based on a member survey, which certifies the continued up-to-dateness and validity of these data.

To calculate and updated production quantity-weighted average, the production volumes of the manufacturers involved for the calendar year 2017 were acquired in a further survey.

3.8 Allocation

The implemented allocations meet the requirements of /EN 15804/ 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

- Forestry: 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

- Woodworking industry: Expenditures for associate coproductions were allocated economically to the main products and residual materials on the basis of 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.

3.9 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 with the help of the /GaBi ts 2019/ software with service pack 39. All background data were taken from the /GaBi Professional Database 2019 Edition/ or are taken from the relevant literature.

4. LCA: Scenarios and other technical information

The scenarios on which the life cycle assessment is based are described in greater detail in the following.

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 as technical scenario information in the following table.

Name/description	Value	Unit
Packaging wood for thermal waste processing	2.346	kg
Plastic packaging for thermal waste processing	0.141	kg
Paper and cardboard for thermal waste processing	0.059	kg
Total efficiency of the thermal waste recovery	38–44	%
Total exported electrical energy	6.1	MJ
Total exported thermal energy	13.8	MJ

A transport distance of 20 km is assumed for the disposal of the product packaging. The total efficiency of the waste incineration and the shares of electrical power and heat generation by combined heat and power (cogeneration) correspond to the assigned waste incineration process of the /GaBi Professional Database 2019 Edition/.

End-of-life stage (C1-C4)

Name/description	Value	Unit
Product fraction for use as secondary fuel	641.7	kg
Redistribution transport distance of the reclaimed wood (Module C2)	20	km

A collection rate of 100 % without losses due to crushing of the material is assumed for the thermal recovery scenario.

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

Name/description	Value	Unit
Reclaimed wood (absolutely dry, per net flow of the declared unit)	480.92	kg
Adhesives and additives (per net flow of the declared unit)	59.80	kg
Generated electrical power (per net flow of the declared unit)	505.06	kWh
Waste heat used (per net flow of the declared unit)	3679.75	MJ

The product is recovered with the same composition as the described declared unit at the end-of-life. Energy recovery in a biomass power plant with a total efficiency of 55 % and an electrical efficiency of 18.19 % is assumed. Around 909.48 kWh electricity and 6626.2 MJ usable heat are generated by the incineration of 1 t wood (air dry, approx. 6.16 % wood moisture content, 18 MJ/kg) . The reclaimed wood input into Module A3 as secondary fuel is deducted from the gross flow of 541.8 kg abs.dry (absolutely dry) wood, so that a net flow of 480.9 kg abs.dry wood is input into Module D. Taking into consideration the fraction of adhesives and additives, 505.06 kWh electricity and 3679.75 MJ thermal energy are produced per declared unit in Module D.

The exported energy substitutes fuels from fossil sources, whereby it is assumed that thermal energy is produced from natural gas and the substituted electricity corresponds to the German electricity mix of 2016.

5. LCA: Results

DETAILS OF THE SYSTEM BOUNDARIES (X = INCLUDED IN TEH LIFE CYCLE ASSESSMENT; MND = MODULE NOT DECLARED; MNR = MODULE NOT RELEVANT)

Product			Construction		Use stage							End-of-life				Benefits and loads outside the system boundary
Raw material supply	Transport	Manufacturing	Transport from the manufacturer to the place of use	Construction	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Demolition	Transport	Waste processing	Disposal	Reuse / Recovery / Recycling potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	MND	X	MND	MND	MNR	MNR	MNR	MND	MND	MND	X	X	MND	X

RRESULTS OF THE LIFE CYCLE ASSESSMENT – ENVIRONMENTAL IMPACTS to EN 15804+A1: 1 m³ VHI particleboard, raw

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
GWP	[kg CO2 eq.]	-9.01E+2	8.24E+0	7.65E+1	4.81E+0	7.50E-1	9.97E+2	-3.72E+2
ODP	[kg CFC11 eq.]	6.82E-13	1.96E-14	3.46E-12	9.74E-16	1.26E-16	1.80E-13	-1.15E-11
AP	[kg SO2 eq.]	1.51E-1	3.39E-2	1.49E-1	5.54E-4	3.17E-3	6.64E-3	-4.28E-1
EP	[kg (PO4)3 eq.]	7.40E-2	8.33E-3	2.93E-2	1.05E-4	8.06E-4	1.08E-3	-6.88E-2
POCP	[kg ethene eq.]	8.92E-3	-1.31E-2	2.02E-1	3.44E-5	-1.31E-3	4.39E-4	-3.91E-2
ADPE	[kg Sb eq.]	1.81E-5	8.02E-7	3.84E-5	9.58E-8	5.86E-8	1.80E-6	-1.00E-4
ADPF	[MJ]	2.20E+3	1.11E+2	9.44E+2	1.01E+0	1.03E+1	4.18E+1	-6.40E+3
Key	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of soil and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for non-fossil resources (ADP materials); ADPF = Abiotic depletion potential for fossil resources (ADP fossil energy sources)							

RESULTS OF THE LIFE CYCLE ASSESSMENT – INDICATORS FOR DESCRIBING THE USE OF RESOURCES to EN 15804+A1: 1 m³ VHI particleboard, raw

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
PERE	[MJ]	1.27E+2	1.08E+1	8.38E+2	3.07E+1	6.00E-1	2.96E+1	-1.90E+3
PERM	[MJ]	8.35E+3	0.00E+0	3.05E+1	-3.05E+1	0.00E+0	-8.35E+3	0.00E+0
PERT	[MJ]	8.48E+3	1.08E+1	8.69E+2	2.15E-1	6.00E-1	-8.32E+3	-1.90E+3
PENRE	[MJ]	1.52E+3	1.17E+2	1.13E+3	6.27E+0	1.03E+1	5.49E+1	-7.23E+3
PENRM	[MJ]	7.28E+2	0.00E+0	5.09E+0	-5.09E+0	0.00E+0	-7.28E+2	0.00E+0
PENRT	[MJ]	2.25E+3	1.17E+2	1.13E+3	1.18E+0	1.03E+1	-6.73E+2	-7.23E+3
SM	[kg]	1.08E+2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	1.17E+3	0.00E+0	0.00E+0	0.00E+0	9.27E+3
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	7.28E+2
FW	[m³]	4.35E-1	1.59E-2	6.47E-1	1.15E-2	1.01E-3	1.60E-2	1.51E+0
Key	PERE = Use of renewable primary energy resource, as energy source; PERM = Use of renewable primary energy resource, 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 resource, 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 fresh water							

RESULTS OF THE LIFE CYCLE ASSESSMENT – WASTE CATEGORIES AND OUTPUT FLOWS to EN 15804+A1: 1 m³ VHI particleboard, raw

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
HWD	[kg]	2.55E-5	5.85E-6	4.32E-6	4.05E-9	5.78E-7	4.26E-8	-3.80E-6
NHWD	[kg]	5.00E-1	1.71E-2	2.04E+0	6.96E-2	8.41E-4	5.68E-2	1.61E+1
RWD	[kg]	2.00E-2	2.05E-3	7.33E-2	6.75E-5	1.40E-5	5.17E-3	-3.30E-1
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	6.42E+2	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	0.00E+0	6.07E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	0.00E+0	1.38E+1	0.00E+0	0.00E+0	0.00E+0
Key	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							

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. Secondary material used as raw material or for energy does not contain any primary energy according to /IBU 2019/ PCR Part A, Version 1.8. The energy sequestered in the secondary material for use as raw material (SM) is accordingly not considered in the PERM or PENRM. This secondary material is solely waste/reclaimed wood, whereby the absolutely dry mass is given, which has a lower calorific value of 19.27 MJ/kg. The secondary material used as energy is solely input into the indicators for the use of secondary material (RSF or NRSF). It is not included in the primary energy indicators.

6. LCA: Interpretation

The interpretation of the results focuses on the production phase (Modules A1 to A3), since these are based on specific information received from the companies. The interpretation is carried out by means of a dominance analysis of the environmental impacts (GWP, ODP, AP, EP, POCP, ADPE, ADPF) and the renewable/nonrenewable primary energy uses (PERE, PENRE). In addition, the average maximum deviations of the assessed factories and the changes to the previous EPD are described and interpreted.

The most important factors for the respective categories are thus listed in the following.

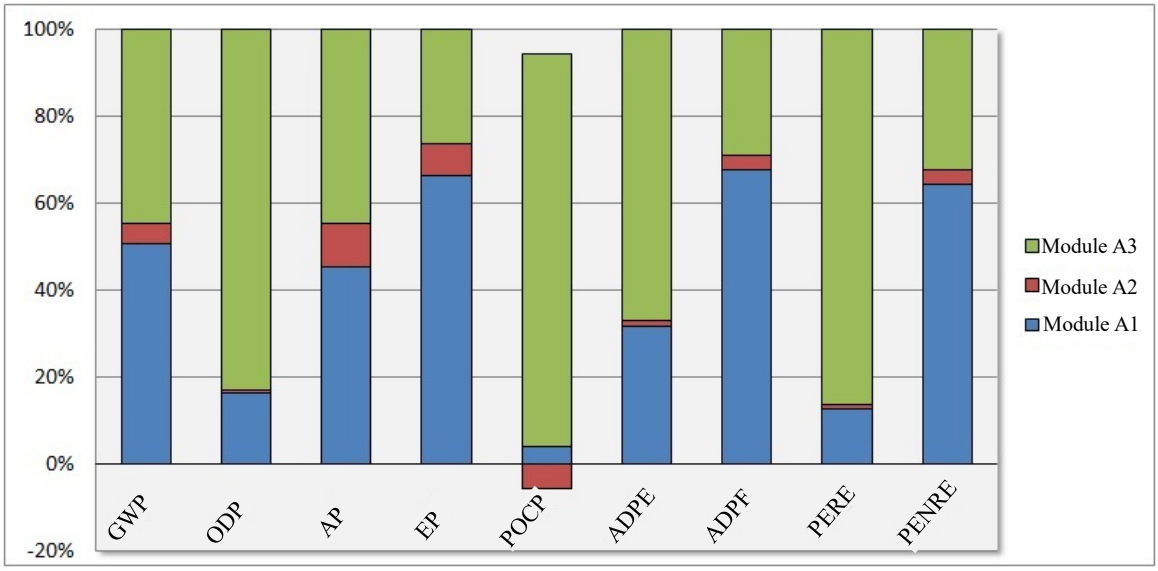

Fig.1: Relative percentages of Modules A1-A3 in the influence on the environmental impact indicators and the primary energy use (Cradle-to-Gate)

6.1 Global warming potential (GWP)

The CO_2 product system inputs and outputs inherent in wood earn separate consideration with regard to the GWP.

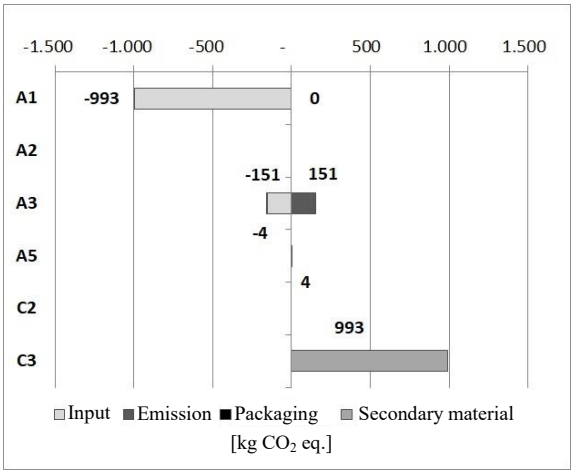

Fig.2: CO_2 product system inputs and outputs inherent in wood [kg CO_2 eq.]. The inverse sign of the inputs and outputs takes into account the life cycle assessment CO_2- flow consideration from the view of the atmosphere.

Due to the growth in the quantity of wood required for particleboard production, 993 kg CO_2 are sequestered in Module A1. The growth in the quantity of wood used for energy in product sequesters a further 149 kg CO_2, which is input into Module A3 and are also emitted again in this module due to the incineration on site. Around 4 kg CO_2 are sequestered due to the supply of wood for the product packaging, which are input into the product system in Module A3 and are emitted back into the atmosphere by the thermal waste processing of the packaging in Module A5. The remaining 993 kg CO_2 leave the product system in Module C3 in the form of usable waste wood.

With 40 %, the supply of adhesives and additives (Module A1) and with 31 % the power consumption in the factory (Module A3) are the main causers of fossil greenhouse gas. The supply of wood raw material (Module A1) and the heat generation in the factory (Module A3) each contribute to the fossil GWP with a good 10 %.

6.2 Ozone depletion potential (ODP)

With 56 %, ODP is mainly caused by the power consumption in the factory (Module A3). In addition, the supply of the packaging material (Module A3) is input into the ODP with around 22 % and the supply of adhesives and additives (Module A1) with around 12 %.

6.3 Acidification potential (AP)

Emissions with acidification potential are spread relatively uniformly between the supply of the wood raw material with 26 % and the adhesives and additives with 19 % via Module A1. In Module A3, it is mainly the power consumption with 26 % and the heat generation with 12 % that contribute to the AP.

6.4 Eutrophication potential (EP)

47 % of the total EP caused are due to the processes for the supply of adhesives and additives and a further 19 % for the supply of wood raw material (both Module A1). The power consumption for the manufacturing process with 13 %, the heat generation in the factory with 9 % contribute to the EP (both Module A3).

6.5 Formation potential of tropospheric ozone (POCP)

The positive POCP contributions of 94% are largely caused by the chip drying and the curing of the adhesives in the factory (both Module A3). The negative POCP values notes in Module A2 are based on the negative characterisation factor for nitrogen monoxide emissions of the EN 15804+A1-compliant CML-IA Version (2001-Apr. 2013) in combination with the current truck transport process of the /GaBi Professional Database 2019 Edition/ used for the

modelling of the transport processes. They influence the total emissions by -4 %.

6.6 Abiotic depletion potential for non-fossil resources (ADPE)

The main contributions to the ADPE are caused with 41 % by the power consumption in the factory (Module A3), with 26 % by the supply of adhesives and additives (Module A1) and 18 % can be attributed to the supply of the resources(Module A3).

6.7 Abiotic depletion potential for fossil resources (ADPF)

60 % of the total ADPF caused are due to the supply of adhesives and additives and a 7 % for the supply of wood raw material (both Module A1). In Module A3, the power consumption in the factory with 17 % and the heat generation with 11 % are further influences on the total ADPF.

6.8 Renewable primary energy resource (PERE)

44% of the PERE use is due to the wood firing for heat generation 38 % is due to power consumption in the factory (both Module A3). In addition, the supply of the adhesives and additives input 9 % and the supply of wood raw material input 4 % into the PERE use (both Module A1).

6.9 Non-renewable primary energy resource (PENRE)

57% of the PENRE use is attributable to the supply of adhesives and additives and 7 % to the supply of the wood raw material (both Module A1). The power consumption in the factory, as the largest input in Module A3 causes around 20 % of the total PENRE use, while the heat generation, also in Module A3, accounts for around 10 %.

6.10 Waste

37% of the special (hazardous) waste is produced by the supply of the wood raw material (Module A1), whereby the diesel consumption in the upstream forestry chain causes the main load. A further 34 % of the hazardous waste is due to the supply of product additives and adhesives (also Module A1) and 10 % is due to transport of the wood raw material to the factory (Module A2).

6.11 Range of the results

The individual results of the assessed factory differ from the average results in the environmental product declaration. Maximum deviations of +38 %/-25 % (GWP), +42 %/- 22 % (ODP), +88 %/-26 % (AP), +46 %/-21 % (EP), +28 %/- 9 % (POCP), +45 %/-20 % (ADPE) and +58 %/-22 % (ADPF) for the environmental impacts in relation to the results described in chapter 5. The reason for these deviations is mainly differences in the fuels used for heat generation, in the need for chip drying, the fraction of reclaimed wood used as material and differences in the glue system used.

6.12 Differences from the previous version of the EPD

The omission of one of the assessed factories and the reweighting of the remaining factories using mode up-to-date production quantities from 2017 only led to a slight shift (+/-5 %) in the weighted average in the environmental impact indicators and the energy used. An exception is the ADPE with -16 %. In contrast, the influence of the updating of the background system on these indicators via the updating of the background database is substantial, as a result of which, several indicators such as the ODP (- 99.9 %) are no longer comparable with the previous version of the EPD. Overall, the following changes result (sum of Modules A1–A3), which are mainly due to the updating of the background system: GWP: -6 %; ODP: -99.9 %; AP: -33 %; EP: -27 %; POCP: -20 %; ADPE: -73 %; ADPF: -11 %; PERE: +73 %; PENRE: -30 %.

7. Verifications

7.1 Formaldehyde

Test body:

WKI Fraunhofer-Institut für Holzforschung WilhelmKlauditz-Institut.

Test objective: Determination of the formaldehyde release to /EN 717-1/

Test results:

According to the Ordinance on the prohibition and restriction of the placing on the market and release of certain substances, mixtures and articles according to the Chemicals Act (/ChemVerbotsV/), Annex 1(re. § 3), Prohibition of placing on the market, "Entry 1 Formaldehyde" Column 2 (1) overlaid and non-overlaid wood based panels (particleboards, blockboards, veneer panels and fibreboards) may not be placed on the market if the

steady-state formaldehyde concentration

in the air of a test chamber caused by the wood-based panel exceeds 0.1 mL/cbm (ppm).

The tested material meets the requirements of the Banned Chemicals Ordinance as follows:

Requirement of limit value fulfilled?	Test method *[test result]*	Evaluation acc. limit value	German Chemicals Prohibition Ordinance (ChemVerbotsV) [BGA Part 34, 10/91] valid up to 2019-12-31	German Chemicals Prohibition Ordinance (ChemVerbotsV) [BMU publication of test methods 2018-11-26] valid from 2020-01-01
Chamber method	EN 717-1	0.1 ppm	☒ yes ☐ no	
Chamber method	EN 717-1 *[x factor 2.0]*	0.1 ppm		☒ yes ☐ no

/ChemVerbotsV/

[BGA Part 34, 10/91]

valid until 31/12/2019

Chamber test EN 717-1: Requirements met

/ChemVerbotsV/

[BMU publication of test methods 2018-11-26] valid from 1/1/2020

Chamber test EN 717-1 [x factor 2.0]: Requirements met

7.2 MDI

Test body:

EPH Entwicklungs- und Prüflabor Holztechnologie GmbH,

Test objective: Determination of the methylene diphenyl isocyanate (MDI) emissions from a wood-based panel in accordance with ISO 16000-9 and OSHA Method No. 42

Test results:

MDI (CAS No. 101-68-8) Concentration < detection limit (detection limit 0.1 µg/mL)

No MDI emissions from the product were detected.

7.3 Test for pretreatment of the materials used

Test body:

MPA Eberswalde Materialprüfanstalt Brandenburg GmbH.

Test objective: Testing of board material regarding their PCP, tetrachlorophenol and lindane levels.

Analysis method: Quantitative gas chromatography with mass-selective detection (GC-MS) Extraction: multi-hour Soxhlet extraction with methanol or with n-Hexane; PCP/Tetrachlorophenol analysis after derivatisation with acetane hydride under alkali conditions according to /CEN/TR 14823:2003/ or Annex IV /AltholzV/

Test results:

PCP: 0.2 mg/kg

Tetrachlorophenol: 0.1 mg/kg

Lindane: n.d.

(non-determinable; limit of quantification: 0.1 mg/kg)

7.4 Toxicity of the fire gases

The toxicity of the fire gas produced by the burning of raw particleboards equals the toxicity of the fire gases produced by the burning of natural wood.

7.5 Volatile Organic Compounds VOC

Test body: Entwicklungs- und Prüflabor

Holztechnologie GmbH,

Zellescher Weg 24,

01217 Dresden, Germany

Test reports, Date: Test report 2519161/1 dated

10/12/2019

Test objective: Determination of the VOC emission in accordance with the AgBB schematic / MVVTB

Method of measurement: EN 16516

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

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

Name/description	Value	Unit
TVOC (C6 - C16) <	<1000	µg/m³
SVOC sum (C16 - C22) <	<100	µg/m³
R (dimensionless) <	<=1	-
VOC without LCI <	<100	µg/m³
Carcinogenic <	<1	µg/m³

AgBB results overview (3 day [µg/m³])

Name/description	Value	Unit
TVOC (C6 - C16)	<10000	µg/m³
SVOC sum (C16 - C22)	-	µg/m³
R (dimensionless)	-	-
VOC without LCI	-	µg/m³
Carcinogenic	<10	µg/m³

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EN 120:1992-08, Wood Based Panels - Determination of Formaldehyde Content - Extraction Method Called the Perforator Method .

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

/EN 312/

EN 312:2010-12, Particleboards - Specifications.

/EN 319/

EN 319:1993-08, Particleboards and fibreboards. Determination of tensile strength perpendicular to the plane of the board.

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/EN 717-1/

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Durability of wood and wood-based products. Quantitative determination of pentachlorophenol in wood. Gas chromatographic method.

/AltholzV/

German Waste Wood Ordinance (Altholzverordnung - AltholzV): Ordinance on the requirements for the reuse and removal of waste wood, 2017.

/AVV/

Waste Register Ordinance (Abfallverzeichnis-Verordnung - AVV) dated 10 December 2001 (BGBl. I p. 3379), last amended by Article 2 of the ordinance of 17 July 2017 (BGBl. I p. 2644) (Dated: 17/07/2017).

/BImSchG/

German Federal Immission Control Act (Bundes-Immissionsschutzgesetz - BImSchG): Law for protection against harmful environmental impacts caused by air pollution, noise, vibrations and similar processes, 2013.

/ChemVerbotsV/

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Technical instructions on air quality control. Version dated 24 July 2002 and all VDI guidelines, DIN standards and legal regulations quoted in it.

/Regulation (EU) No. 305/2011/

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