ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	Kaindl Boards GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-KAI-20220232-IBJ1-EN
Issue date	10.11.2022
Valid to	09.11.2027

Particle board, raw and coated

Kaindl Boards GmbH

Institut Bauen und Umwelt e.V.

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ECO PLATFORM EPD VERIFIED

1. General Information

Kaindl Boards GmbH

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

Declaration number
EPD-KAI-20220232-IBJ1-EN

This declaration is based on the product category rules:
Wood based panels, 09.2022
(PCR checked and approved by the SVR)

Issue date
10.11.2022

Valid to
09.11.2027

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

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))

Particle board, raw and coated

Owner of the declaration
Kaindl Boards GmbH
Kaindlstraße 2
A-5071-Wals/Salzburg
Österreich

Declared product / declared unit
The declared unit involves the manufacture and disposal of one cubic metre Kaindl particle board uncoated with 3 different coatings (APPENDIX) of one square metre each (melamine, veneer, CPL laminate).

Scope:
The LCA refers to raw and uncoated particle board produced in the following plants:
Kaindl Boards GmbH, Kaindlstraße 2, 5071 Wals / Salzburg, Austria
Kaindl Boards GmbH, Gappen 38, 5523 Lungötz, Austria

The LCA for Kaindl particle board, coated and uncoated, was drawn up for the Lungötz/Austria and Salzburg/Austria plants which corresponds with 100% of the production volume of the declared products of Kaindl Boards GmbH.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
The EPD was created according to the specifications of *EN 15804+A2*. In the following, the standard will be simplified as *EN 15804*.

Verification

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

Matthias Klingler
(Independent verifier)

2. Product

2.1 Product description/Product definition

Raw and coated particle boards are board-shaped wood materials in accordance with *EN 13986*, *EN 312*, *EN 14322* and EN 438. The coating is applied using wood veneer, laminate or paper soaked in melamine resin, and serves towards decorative refinement of the product. The corresponding haptics are achieved by pressing through various textured plates / structure reinforcers.

Directive (EU) No. 205/2011 of the European Parliament and Council dated 9 March 2011 establishing harmonised conditions for marketing construction products and replacing Council Guideline 89/106/EEC applies for placing the product on the market in the EU/EFTA (with the exception of Switzerland (*CPR*)). The requisite Declarations of Performance and CE markings were drawn up in accordance with the specifications of the harmonised *EN 13986:2004+A1:2015* standard: *Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking.*

2.2 Application

Coated wood materials manufactured by Kaindl are largely used in the area of interior design, furniture construction and trade fair/store-fitting.

2.3 Technical Data

Technical data in accordance with Directive (EU) No. 305/2011 *CPR*. The declared product performance in

line with the *MKSPA102* and/or *MKSPA202* Declaration of Performance was drawn up in accordance with *EN 13986:2004+ A1:2015*: *Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking.*
Declared performance of particle board P2: Boards for interior design (including furniture) for use in dry areas (as per *EN 312*).

Essential characteristics	Output	Harmonised technical specifications
Aging resistance (bending strength)	$F_m \geq 8.5$ N/mm²	EN 13986:2004+A1:2015
Bonding quality	NPD	EN 13986:2004+A1:2015
Transverse tensile strength	$F_t \geq 0.3$ N/mm	EN 13986:2004+A1:2015
Formaldehyde emissions	E1	EN 13986:2004+A1:2015
Reaction to fire	D-s2,d0	EN 13986:2004+A1:2015
Water vapour permeability	NPD	EN 13986:2004+A1:2015
Airborne sound insulation	NPD	EN 13986:2004+A1:2015
Sound absorption	NPD	EN 13986:2004+A1:2015
Thermal conductivity	NPD	EN 13986:2004+A1:2015
Biologische Dauerhaftigkeit	Use class 1	EN 13986:2004+A1:2015
Pentachlorphenol content	< 5ppm	EN 13986:2004+A1:2015

Declared performance of particle board P3: Boards for non-supporting purposes for use in humid areas (as per *EN 312*).

Essential characteristics	Output	Harmonised technical specifications
Aging resistance (bending strength)	$f_m \leq 14$ N/mm²	EN 13986:2004+A1:2015
Bonding quality	NPD	EN 13986:2004+A1:2015
Transverse tensile strength	$f_t \leq 0.45$ N/mm	EN 13986:2004+A1:2015
Durability (thickness swelling)	$G_t \leq 14\%$	EN 13986:2004+A1:2015
Durability (moisture resistance)	$G_t \leq 13\%$	EN 13986:2004+A1:2015
Formaldehyde emissions	E1	EN 13986:2004+A1:2015
Reaction to fire	D-s2, d0	EN 13986:2004+A1:2015
Water vapour permeability	NPD	EN 13986:2004+A1:2015
Airborne sound insulation	NPD	EN 13986:2004+A1:2015
Sound absorption	NPD	EN 13986:2004+A1:2015
Thermal conductivity	NPD	EN 13986:2004+A1:2015
Biological durability	Use class 1+2	EN 13986:2004+A1:2015
Pentachlorphenol content	< 5ppm	EN 13986:2004+A1:2015

Add. formaldehyde class:
1) Limit value acc. to test method *EN120/ISO 12460-5* for class E1 = 8 mg and moving half-year average of 6.5 mg HCHO/100g
2) Formaldehyde emissions in accordance with the *Chemicals Prohibition Ordinance* (01/2017); measurement acc. to *EN 16516*
(APPENDIX) Surface properties of decorative particle board (to *EN 14323)*

	Unit	Classification as per EN 14322			Test process
Reaction to scratches:	N	≥ 1.5			EN 14323
Surface flaws:	mm²/m² mm/m	Points < 2 Longitudinal defects < 20			EN 14323 EN 14323
Stain resistance:	Level	≥ 3			EN 14323
Susceptibility to cracks:	Level	≥ 3			EN 14323
Reaction to water vapour	degrees	4 = moderate changes in gloss and/or colour			EN 14323
Light fastness (xenon arc lamp):	Level	> 6			EN 14323
Abrasion resistance:		Print décors without overlay: wood, fantasy and metallic	Print décors with overlay, plain décors 70-110g	Plain décors ≥ 120g	EN 14323
	Class	1	3A	3B	
	IP rotations	< 50	> 150	≥ 250	

Technical construction data
Requirements as per *EN 312* (for board types P2 and P3)

Technical construction data:

Name	Value	Unit
Gross density	654	kg/m³
Grammage	11.5	kg/m²
Bending strength (longitudinal)	7 - 15	N/mm²
Bending strength (transverse)	0.2 - 0.5	N/mm²
E-module (transverse)	1050 - 2050	N/mm²
Material dampness at delivery	5 - 13	%

2.4 Delivery status

Board types	Length x with [mm]	Board thickness [mm]													
		8	10	12	13	15	16	18	19	22	25	28	30	32	38
P2 (as per EN 312)	5600 x 2070	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	2800 x 2070	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P3 (as per EN 312)	5600 x 2070	x					x	X			X				
	2800 x 2070	x					x	x			X				

2.5 Base materials/Ancillary materials

Raw particle boards with a thickness of 8-38 mm and an average density of 654 kg/m³ comprise the following base materials (details provided as mass percentages per 1m³ manufactured):

- Up to 75% of wood mass is covered by the use of recycled wood. Sawmill by-products, wood chips and calamity wood are used in addition.
- Water, approx. 5-13%
- UF glue / MUF glue (urea-formaldehyde resin, melamine-urea formaldehyde resin) 8-10%
- Water-repellent finish: Paraffin emulsion < 1 %

(ANNEX) 2.5.1 In addition as coatings:

- Melamine coating with decorative paper with basis weights of 60-140 g/m², wood veneer or Continuous Pressure Laminates (CPL) with a thickness of 0.2-1.2 mm

1) The product / At least one partial product contains substances from the ECHA list of candidates of Substances of Very High Concern (SVHC) exceeding 0.1% by mass: no
2) The product / At least one partial product contains other CMR substances in categories 1A or 1B which are not on the candidate list, exceeding 0.1 percentage by mass in at least one partial product: no
3) Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products No. 528/2012): no

2.6 Manufacture

Manufacture of the raw particle board:

- Chipping the wood mass
- Treating the wood mass
- Drying the chips
- Sorting the chips
- Glueing the chips
- Scattering the chips onto a transport belt
- Pressing the chip cake under pressure and temperature (ContiRoll®)
- Formatting the raw board
- Cooling the raw board
- Grinding the top and bottom side
- Stacking the boards

(ANNEX) 2.6.1 Manufacturing directly-coated decorative particle boards:

- Manufacturing impregnated paper: Clamping the untreated paper rolls; impregnating the paper with a melamine urea resin; drying the impregnated film; formatting the paper
- Positioning impregnated films under or over a raw particle board
- Feeding a short cycle press with the bundle of impregnated base board
- Pressing under pressure and temperature
- Visual inspection of bonded boards
- Stacking

(ANNEX) 2.6.2 Manufacturing composite boards:

- combining several layers of impregnated paper (see 2.6.1) to a laminate in a continuous process under pressure and temperature
- Rolling up the laminate
- Glueing the base board on both sides
- Feeding a continuous press with base board and laminate on the top and bottom side
- Pressing the bundle under pressure and temperature
- Formatting the ensuing composite board
- Stacking

(ANNEX) 2.6.3 Manufacturing wood-veneered boards:

- Sorting real wood veneer strips
- Glueing and joining the sorted strips as wood veneer sheets
- Glueing the base board on both sides
- Positioning wood veneer sheets on the top and bottom side of the base board
- Bonding the bundle in a multi-level press
- Clean-cutting the top and bottom sides
- Stacking

2.7 Environment and health during manufacturing

In the manufacture of particle board, the health protection measures (high-visibility vests, safety shoes, dust masks, ear protection etc.) specified by the authorities must be observed. No other, more extensive, measures are required. The waste air incurred during production is cleaned according to regulations. In addition, the waste air from production is used to recover district heat. Emissions are below the statutory specifications. Water and soil are not polluted by production.

2.8 Product processing/Installation

Kaindl particle boards can be treated and processed using standard wood processing machinery. Prior to processing, Kaindl decorative particle boards must be examined for visible damage. In order to obtain good cutting quality, various measures such as feed rate, tooth geometry and pitch, saw blade projection, saw blade chip space etc. are to be considered.

2.9 Packaging

Kaindl particle boards are protected from transport damage by way of a protection board on top and underneath. Strips are positioned on the top to facilitate stacking. Packs are secured in place using plastic straps. Both the protection boards and plastic straps can be utilised thermally or as material.

2.10 Condition of use

Composition of the finished products complies with the base materials listed in 2.5. When the boards are pressed, the binding agent hardens under pressure and heat in a polycondensation process and forms a duroplastic, three-dimensional interlinked plastic. Certain applications may require information on other properties. These shall be subject to separate agreement and can be provided on request in accordance with the test procedures specified in the *EN 14322* standard (see Table 2.3: Surface properties of decorative particle board).

2.11 Environment and health during use

Environment

When the products are used as designated, the current state of knowledge indicates that there are no risks involved for water, air or soil (see section 7. Evidence).

Health

When the products are used as designated, the current state of knowledge indicates that there are no risks involved for health. In low volumes, natural ingredients inherent to wood can be emitted. Emissions of all other substances fall below the statutory limit values (see

section 7. Evidence). Contact with skin or food is harmless.

2.12 Reference service life

The reference service life is defined via the particle board's application classes. The resistance of the products is dependent on the intensity of use and environmental factors (UV rays; humidity).

2.13 Extraordinary effects

Fire

Raw and/or coated particle boards display the following fire performance in accordance with *EN 13501-1*:
Change in aggregate state: Burning dripping material is not possible as raw and coated wood materials from Kaindl do not liquefy when heated.

Fire protection

Name	Value
Building material class	D (normally flammable)
Burning droplets	d0 (non-dripping)
Smoke gas development	s2 (normally fuming)

Water

The product does not contain any substances which represent a hazard to water when washed out. Continuous exposure to moisture leads to destruction of the composite board. Accordingly, the products must be protected from permanent exposure to water.

Mechanical destruction

The product displays brittle breakage behaviour under mechanical loads. Splinters and sharp edges can arise. Resistance to mechanical effects comply with the respective board types P2 and P3.

2.14 Re-use phase

Reuse / Further use
When de-constructed by type, Kaindl wood materials can be reused for the same purpose. This is only possible if the boards do not feature full-surface glueing.
Recycling
When sorted by type, the material can be crushed and redirected to the wood materials manufacturing process.
Further use
Owing to their components, Kaindl wood materials display a high calorific value and can be utilised thermally. This is conditional to approval of the heating plant and official acceptance for this application. This should only, however, be striven towards if the products cannot be reused or further used.

2.15 Disposal

Leftovers after treating and processing raw and coated wood materials should be primarily directed to reuse or further use. These measures should be given preference over incineration. Waste code in accordance with the European Waste Catalogue (EWC): 030105

2.16 Further information

More information is available on the website:
http://www.kaindl.com

3. LCA: Calculation rules

3.1 Declared Unit

This Declaration refers to the manufacture of 1 m³ raw particle board with an average density of 654 kg/m³ and product humidity of approx. 5%.

Details on declared unit

Name	Value	Unit
Declared unit	1	m^3
Mass reference	654	kg/m^3

Additionally, coated particle boards with coatings made from veneer (13.3 kg/m²), melamine (11.8 kg/m²) and CPL laminate (11.8 kg/m²) per 1 m² are indicated. The average board thickness was weighted and calculated on the basis of the individual board strengths produced.

3.2 System boundary

This is a "cradle-to-gate, with options" EPD. This LCA addresses the life cycle stages A1-A3, A5, C1, C2, C3, C4 and D in accordance with *EN 15804.*
The product stage begins with consideration of the production of all requisite raw materials including all upstream chains as well as CO2 absorption by raw materials (wood growth in the forest). The next processes involve production of the Kaindl raw and coated particle board in the plant including the provision of energy taking consideration of the respective upstream chains. All necessary transport for raw materials and ancillaries is considered in the LCA. The assessment also includes packaging as far as the product ready for delivery at the plant gate.
Product stage A5 (recovery of packaging) is considered in this study.
Rejects, PET strapping, pallets and boxes are used as packaging. Apart from boxes, the packaging materials are thermally recycled.
Expenses associated with installation and/or assembly are not considered.

Module C1 is declared as zero. No loads are generated in the course of manual dismantling.
In Module C2, the transport to the biomass plant was taken into account. A distance of 100 km was assumed.
The emission of biogenic C02 bound in the product is listed in Module C3 in order to safeguard CO2 neutrality within the product system.
No substances are disposed of in the waste treatment process, Module C4 is declared as zero.
Once the product has achieved end-of-waste status after dismantling, it is assumed that the product is directed to biomass incineration which produces thermal energy and electricity.
The ensuing effects and potential credits (energy substitution) are declared in Module D.

3.3 Estimates and assumptions

It is assumed that the product leaving the system displays the same characteristics as the waste wood entering the system. The bound CO2 and primary energy are considered for the waste wood.
The rejected boards incurred during production enter

the process without any environmental impact. Some of these rejected boards (B-goods) are used as packaging or for internal generation of thermal energy.
The end-of-life system boundary between Module C3 and Module D is set where outputs such as secondary material or combustion material reach their end-of-waste status.
End-of-waste status for particle boards is reached after dismantling from the building, sorting by type and preparation.
Transport from waste wood treatment to the biomass power plant is ignored.
Energy produced in the form of electricity and thermal energy from biomass incineration replaces thermal energy from natural gas as well as electric energy (EU-28).

3.4 Cut-off criteria

All operating data was taken into consideration, i.e. all of the starting materials used, transport thereof to the plant, thermal and electrical energy used, packaging materials, all direct production waste as well as all emission measurements available were taken into consideration in the analysis. Accordingly, material and energy flows accounting for a share < 1% were also considered.
The limit of 5% of processes to be ignored as required in PCR Part A is therefore complied with.
Machinery, plants and infrastructure required in the manufacturing process were not considered.
Transport expenses for packaging were ignored.
Expenses associated with installation and/or assembly were not considered.
Rejected boards sent to customers as packaging material are excluded from the LCA (cut-off).

3.5 Background data

GaBi 2022 – the software system for comprehensive analysis developed by Sphera – was applied for modelling the life cycle of the declared product. The respective database is the GaBi 2022, version 10.

3.6 Data quality

The primary data collated at the manufacturer's is based on annual volumes and/or extrapolations from measurements at specific plants.
Data sets are largely available in the GaBi database *GaBi 2022* for the basic materials used in the corresponding formulae. The database was last updated in early 2022.
Other data sets on the upstream chain associated with the manufacture of basic materials are approximated with data sets of similar chemicals or estimated by merging existing data sets.

3.7 Period under review

The primary data was made available by Kaindl. The primary data for manufacturing represents an average of the period from 01.10.2020 to 30.09.2021.

3.8 Allocation

Allocation relates to the assignment of input and output flows for a Life Cycle Assessment module to the product system tested (*EN ISO 14040: 2009-11*.
Energy credits for electricity and thermal energy produced in the biomass power plant at the end of life are allocated according to the calorific value of the input, whereby the efficiency of the plant is also considered. The credit for thermal energy is calculated on the basis of "EU-28: Thermal energy from natural gas PE"; the credit for electricity is calculated from the "EU-28: Power mix".
The emissions dependent on input at the end of life are calculated in line with the content composition of the ranges used. Emissions dependent on technology (e.g. CO) are added in terms of waste gas volume.
Waste is also allocated throughout production.
The upstream chain associated with forestry is analysed in accordance with *Hasch 2002*. In the case of sawmill by-products, the forest process and associated transports are allocated to the wood according to the volume share (or dry mass); no loads are allocated to sawmill by-products from sawmill processes.
No loads are considered for waste wood from the upstream chains. But the expenses associated with crushing as wood chips and transport (30% wood moisture) from the crusher and/or waste wood dealer to the production site are considered.

3.9 Comparability

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

GaBi 2022, the software system for comprehensive analysis developed by Sphera, was used. The respective database is the GaBi 2022, version 2022.1.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic carbon
The calculation of the biogenic carbon content is based on the assumption that the absolute dry wood/paper/cardboard mass consists of 50% biogenic carbon.
The amount of biogenic carbon in the associated packaging corresponds to 0 kg, since the raw board has no renewable packaging.

Information describing the biogenic carbon content at the plant gate

Name	Value	Unit
Biogenic carbon content in product	271.02	kg C
Biogenic carbon content in accompanying packaging	0	kg C

Rejected boards are usually used as packaging; this was taken into consideration in the model. As for the remaining packaging, it is assumed that it is supplied along with the product (except for raw particle board where no renewable packaging is supplied).
It is assumed in the model that the packaging (PET plastic foil) is incinerated in the corresponding waste incineration plant.
The incineration plant comprises an incineration line fitted with a grate and a steam generator. Steam generation efficiency is almost 100%. Steam used for producing electricity accounts for 12%. The steam produced is used internally as process steam and the surplus is supplied to industry or households.

Energetic utilisation of packaging and the ensuing credits are allocated to Module D.

Construction installation process (A5)

Name	Value	Unit
Output substances following waste treatment on site	0.108	kg

End of Life (C1–C4)

The total waste wood from external sources (secondary fuels) which is also burned in the biomass power plant is applied to calculate the net flows.
To calculate the net flows, the mass which could theoretically be used as waste wood in A1–A3 for energy supply and as a raw material is deducted from the total product mass (654 kg/m³).

Name	Value	Unit
Energy recovery Waste wood (with 16% moisture)	347	kg

Incinerating the 347 kg waste wood in the biomass power plant produces 1500 MJ electricity and 2122 MJ thermal energy.
It is assumed that the end-of-life scenario is identical for each of the four products analysed.
This is explained by the calorific value which is around 18.6 MJ per kg for each product.

5. LCA: Results

The following tables depict the environmental impacts and life cycle inventory parameters according to the EN 15804 standard for the production and end-of-life of 1 m³ of raw particle board. The emissions of biogenic CO2 and material primary energy contained in the boards are declared in Module C3. Loads from incineration (with the exception of biogenic CO2) and credits are declared in Module D.

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

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

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 654 kg raw particle board

Core Indicator	Unit	A1-A3	A5	C1	C2	C3	C4	D
GWP-total	[kg CO_2-Eq.]	-7.59E+2	2.47E-1	0.00E+0	2.65E+0	1.00E+3	0.00E+0	-7.63E+2
GWP-fossil	[kg CO_2-Eq.]	2.19E+2	2.47E-1	0.00E+0	2.65E+0	0.00E+0	0.00E+0	-3.12E+2
GWP-biogenic	[kg CO_2-Eq.]	-9.78E+2	1.82E-5	0.00E+0	-2.60E-2	1.00E+3	0.00E+0	-4.51E+2
GWP-luluc	[kg CO_2-Eq.]	5.50E-2	5.63E-7	0.00E+0	1.79E-2	0.00E+0	0.00E+0	-1.36E-2
ODP	[kg CFC11-Eq.]	2.77E-10	2.63E-14	0.00E+0	2.61E-13	0.00E+0	0.00E+0	-1.70E-9
AP	[mol H^+-Eq.]	8.12E-1	3.31E-5	0.00E+0	2.97E-3	0.00E+0	0.00E+0	3.17E-1
EP-freshwater	[kg P-Eq.]	2.37E-4	5.85E-9	0.00E+0	9.51E-6	0.00E+0	0.00E+0	-8.42E-5
EP-marine	[kg N-Eq.]	2.62E-1	7.47E-6	0.00E+0	9.57E-4	0.00E+0	0.00E+0	5.65E-2
EP-terrestrial	[mol N-Eq.]	3.61E+0	1.58E-4	0.00E+0	1.15E-2	0.00E+0	0.00E+0	6.49E-1
POCP	[kg NMVOC-Eq.]	1.07E+0	1.98E-5	0.00E+0	2.56E-3	0.00E+0	0.00E+0	2.24E-1
ADPE	[kg Sb-Eq.]	5.21E-5	6.42E-10	0.00E+0	2.68E-7	0.00E+0	0.00E+0	-2.71E-5
ADPF	[MJ]	3.91E+3	4.40E-2	0.00E+0	3.50E+1	0.00E+0	0.00E+0	-5.93E+3
WDP	[m^3 world-Eq deprived]	3.13E+0	2.18E-2	0.00E+0	2.97E-2	0.00E+0	0.00E+0	-3.95E-1

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

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 654 kg raw particle board

Indicator	Unit	A1-A3	A5	C1	C2	C3	C4	D
PERE	[MJ]	1.17E+3	1.23E-2	0.00E+0	2.42E+0	0.00E+0	0.00E+0	9.50E+3
PERM	[MJ]	1.00E+4	0.00E+0	0.00E+0	0.00E+0	-1.00E+4	0.00E+0	0.00E+0
PERT	[MJ]	1.12E+4	1.23E-2	0.00E+0	2.42E+0	-1.00E+4	0.00E+0	9.50E+3
PENRE	[MJ]	3.03E+3	1.10E+0	0.00E+0	3.51E+1	0.00E+0	0.00E+0	-6.81E+3
PENRM	[MJ]	8.82E+2	-1.06E+0	0.00E+0	0.00E+0	-8.81E+2	0.00E+0	0.00E+0
PENRT	[MJ]	3.91E+3	4.40E-2	0.00E+0	3.51E+1	-8.81E+2	0.00E+0	-6.81E+3
SM	[kg]	2.68E+2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	6.40E+2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.00E+4
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	8.81E+2
FW	[m^3]	4.88E-1	5.13E-4	0.00E+0	2.80E-3	0.00E+0	0.00E+0	-3.95E-1

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

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 654 kg raw particle board

Indicator	Unit	A1-A3	A5	C1	C2	C3	C4	D
HWD	[kg]	7.28E-7	4.62E-12	0.00E+0	1.86E-10	0.00E+0	0.00E+0	-6.83E-7
NHWD	[kg]	2.27E+0	1.18E-3	0.00E+0	1.82E-2	0.00E+0	0.00E+0	1.49E+0
RWD	[kg]	1.71E-2	1.36E-6	0.00E+0	1.38E-2	0.00E+0	0.00E+0	-6.06E-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	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	3.00E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.50E+3
EET	[MJ]	0.00E+0	7.01E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.12E+3

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

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 654 kg raw particle board

Indicator	Unit	A1-A3	A5	C1	C2	C3	C4	D
PM	[Disease Incidence]	5.62E-6	1.89E-10	0.00E+0	2.04E-8	0.00E+0	0.00E+0	-1.31E-7
IRP	[kBq U235-Eq.]	1.80E+0	1.34E-4	0.00E+0	9.84E-3	0.00E+0	0.00E+0	-8.87E+1
ETP-fw	[CTUe]	1.80E+3	1.81E-2	0.00E+0	2.48E+1	0.00E+0	0.00E+0	-1.12E+3
HTP-c	[CTUh]	2.44E-6	1.39E-12	0.00E+0	5.11E-10	0.00E+0	0.00E+0	3.84E-10
HTP-nc	[CTUh]	3.71E-6	4.87E-11	0.00E+0	2.77E-8	0.00E+0	0.00E+0	1.57E-6
SQP	[-]	4.93E+4	1.38E-2	0.00E+0	1.48E+1	0.00E+0	0.00E+0	-3.38E+2

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

Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”.
This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.

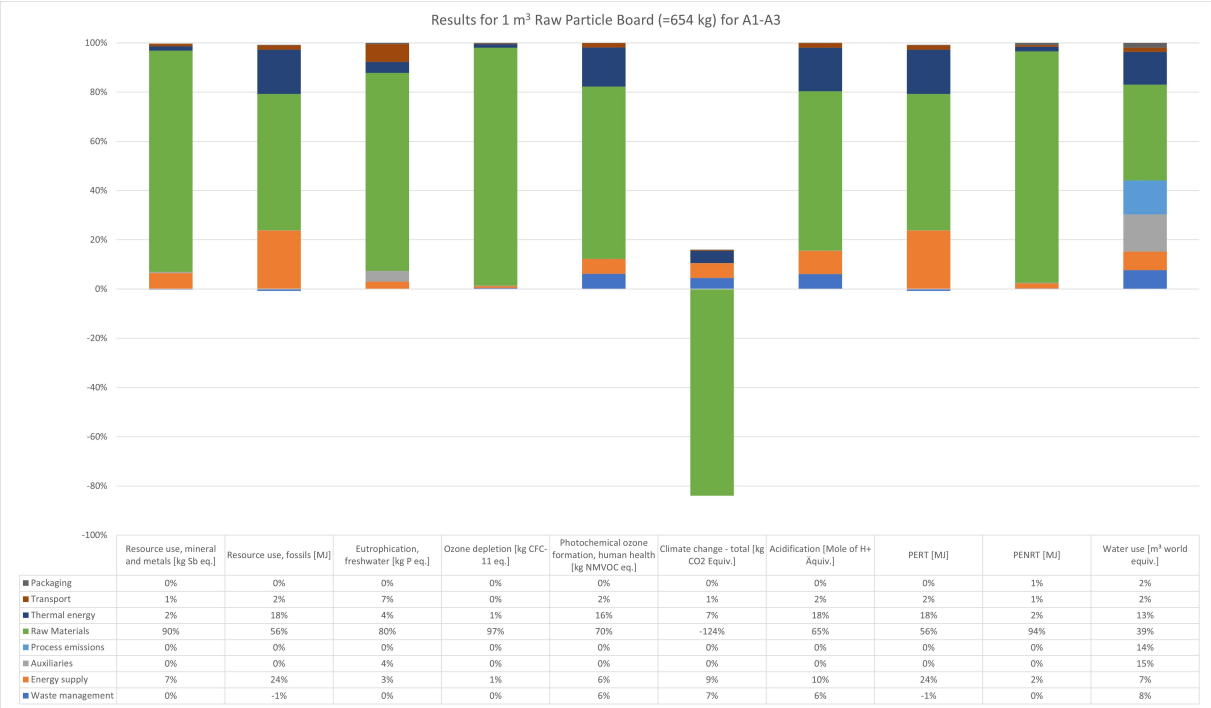
Disclaimer 2 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit for humans – cancerogenic”, “Potential comparative toxic unit for humans - not cancerogenic”, “potential soil quality index”.
The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator.

6. LCA: Interpretation

This interpretation [1] is based on the assumptions and restrictions outlined in this background report, both in terms of methods and data. A dominance analysis is used for interpretation. The following figure contains a dominance analysis of the results for the declared unit – 1 m³ of particle board from Kaindl.

Analysis of the global warming potential is most obvious – large volumes of CO2 are bound during wood growth. This CO2 is released again during thermal utilisation of the particle board at the end of life.
In almost all impact categories, the provision of raw materials plays a significant role (56-97% of impact). It has the lowest impact on water use (39%), where the provision of thermal energy has a relevant influence, and contributes 1-18% to the respective overall impact. Electricity supply also has some influence with 24% of resource consumption fossil and PENRT, 10% in warming potential (total) acidification potential and 9% in global warming potential (total).
Waste processing has a minor influence, as does the provision of electricity and transport in some impact categories. This is unusual as transport generally has a certain influence on the photochemical ozone creation potential (POCP). However, as Kaindl has extensively transferred transport by truck to rail, this is also reflected in the results.
Packaging (raw material supply), the ancillaries used and transport have a negligible influence.
There are no special products among the declared products (P2 and P3 boards) which do not correspond with the base material volumes indicated and their fluctuation margin.
It can therefore be assumed that the fluctuation margin of the results can be ignored within the product group. Other products indicated on the website (e.g. P5 boards or flame-retardant boards) are bought in and are not produced in the plant. No data was recorded for these products, nor are they part of the EPD.

[1] Interpretation based on terminology in ISO 14040ff, EN ISO 14044, EN ISO 14040: maximum importance, significant influence (contribution > 50 %); very important, relevant influence (contribution of 25% to 50%); moderately important, certain influence (contribution of 10% to 25%); less important, low influence (contribution of 2.5% to 10%); unimportant, negligible influence (contribution < 2.5%)



	Resource use, mineral and metals [kg Sb eq.]	Resource use, fossils [MJ]	Eutrophication, freshwater [kg P eq.]	Ozone depletion [kg CFC-11 eq.]	Photochemical ozone formation, human health [kg NMVOC eq.]	Climate change - total [kg CO2 Equiv.]	Acidification [Mole of H+ Äquiv.]	PERT [MJ]	PENRT [MJ]	Water use [m³ world equiv.]
Packaging	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%
Transport	1%	2%	7%	0%	2%	1%	2%	2%	1%	2%
Thermal energy	2%	18%	4%	1%	16%	7%	18%	18%	2%	13%
Raw Materials	90%	56%	80%	97%	70%	-124%	65%	56%	94%	39%
Process emissions	0%	0%	0%	0%	0%	0%	0%	0%	0%	14%
Auxiliaries	0%	0%	4%	0%	0%	0%	0%	0%	0%	15%
Energy supply	7%	24%	3%	1%	6%	9%	10%	24%	2%	7%
Waste management	0%	-1%	0%	0%	6%	7%	6%	-1%	0%	8%

7. Requisite evidence

7.1 Formaldehyde

Measuring agency:
Entwicklungs- und Prüflabor Holztechnologie GmbH (EPH), Zellescher Weg 24, 01217 Dresden, Germany

Test certificate:
Testing formaldehyde emissions in accordance with *EN 16516*, *ISO 12460-5*, *ISO 12460-3* and *ASTM D6007-14*: PT-21-12-21-04 dated 21.12.2021; PT-21-12-21-06 dated 21.12.2021; PT-21-12-21-02 dated 21.12.2021

Test result:
Formaldehyde emissions are below the maximum permissible values of the *Chemicals Prohibition Ordinance* dated 1 January 2020. The products comply with the requirements of class E1 in accordance with *EN 13986*. The *ASTM D6007-14* formaldehyde concentration of the raw particle board is below the maximum allowable level of *EPA/CARB/TSCA Title VI* requirements.

7.2 MDI

Issuing agency:
RAL gemeinnützige GmbH, Siegburger Straße 39, 53757 Sankt Augustin

Test report:
Contract no. 10899; extension: 19242

Test result:
Kaindl raw and coated particle boards do not emit any monomer MDI (analysis method determination limit: 0.1 µg/m³). Accordingly, Kaindl raw and coated particle boards meet the requirements of the corresponding award criteria for low-emission wood-based boards *RAL-UZ76* (Blue Angel).

7.3 Test according to AltholzVO (Waste Wood Ordinance)

Measuring agency:
Entwicklungs- und Prüflabor Holztechnologie GmbH (EPH), Zellescher Weg 24, 01217 Dresden, Germany

Test report:
Determination and evaluation of pollutant parameters according to Annex II – Limit values for wood chips and wood shavings for the production of wood-based materials according to the Waste Wood Ordinance (Federal Gazette No. I 2002, 3306); job no. 2514577/24/1

Test result:
All parameters of the Waste Wood Ordinance are observed by the samples tested.

7.4. Fire gas toxicity

Measuring agency:
Energie- und Prozesstechnik Aachen GmbH, Jülicher Straße 338, 52070 Aachen

Test reports:
Raw particle board – Test in accordance with *DIN 53436-1*; job number 22/2011 dated 05.09.2011
Decorative particle board – Test in accordance with *DIN 53436-1*; job number 23/2011 dated 05.09.2011

Test result:
The results indicate that under the selected test conditions at a temperature of 400 °C, no chlorine compounds (HCl detection limit: 1 ppm) and no sulphur compounds (SO2 detection limit: 1 ppm) could be detected. The gaseous emissions released under the selected test conditions largely comply with the

emissions released by solid wood under the same conditions.

Measurement results for raw particle board:

Material number B1080901		400 °C	
Values measured after		30 min.	60 min.
Carbon monoxide	[ppm]	15000	20000
Carbon dioxide	[ppm]	-	30000
Hydrogen cyanide	[ppm]	-	n.a.
Hydrogen chloride	[ppm]	-	n.a.
Ammonium	[ppm]	-	20
Aldehydes	[ppm]	-	n.a.
Sulphur dioxide	[ppm]	-	n.a.
COHb (calculated from CO value)	[%]	-	>50

Measurement results for decorative particle board:

Material number B1080902		400 °C	
Values measured after		30 min.	60 min.
Carbon monoxide	[ppm]	10000	14000
Carbon dioxide	[ppm]	-	20000
Hydrogen cyanide	[ppm]	-	n.a.
Hydrogen chloride	[ppm]	-	n.a.
Ammonium	[ppm]	-	20
Aldehydes	[ppm]	-	n.a.
Sulphur dioxide	[ppm]	-	n.a.
COHb (calculated from CO value)	[%]	-	>50

As the formula was not altered, the test reports referred to above remain valid.

7.5 VOC emissions

Measuring agency:
Entwicklungs- und Prüflabor Holztechnologie GmbH (EPH), Zellescher Weg 24, 01217 Dresden, Germany

Test report:
Emissions test in accordance with *AgBB Scheme* 2021; job no. 2522002/2/1 dated 20.04.2022

Test result:
The product tested complies with the requirements of the *AgBB scheme*.

AgBB-overview of results (28 days [µg/m³])

Name	Value	Unit
TVOC (C6 - C16)	95	µg/m³
Sum SVOC (C16 - C22)	0	µg/m³
R (dimensionless)	0.17	-
VOC without NIK	0	µg/m³
Carcinogenic Substances	0	µg/m³

8. References

Standards

ASTM D6007-14
ASTM D6007-14, Standard test method for determining formaldehyde concentrations in air from wood products using a small-scale chamber; issue date: 1 October 2014

CEN/TR 15941
CEN/TR 15941:2010, Sustainability of construction works – Environmental product declarations – Methodology for selection and use of generic data; CEN/TR 15941:2010

DIBt 100:1994-06
DIBt 100:1994-06, Guideline on classification and monitoring of wood-based boards with regard to formaldehyde emissions (DIBtGuideline 100)

DIN 53436-1
DIN 53436-1:2015-12, Generation of thermal decomposition products from materials for their analytic-toxicological testing - Part 1: Decomposition apparatus and determination of test temperature

EN 120
ÖNORM EN 120, Particle board – Determining the formaldehyde content – Extraction process referred to as the perforator method; Issue date: 1 June 1985

EN 13501-1
ÖNORM EN 13501-1:2020-01 15, Classification of building products and methods by fire performance – Part 1: Classification with the results of tests on reaction to fire of construction products

EN 15804
DIN EN 15804+A2:2019+AC:2021, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

EN ISO 14040: 2009 - 11
EN ISO 14040: 2009-11, Environmental management – Life cycle assessment – Principles and framework

EN ISO 14044: 2006 - 10
EN ISO 14044: 2006-10, Environmental management – Life cycle assessment – Requirements and guidelines

EN 13986:2004+A1:2015
EN 13986:2004+A1:2015, Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking. Harmonised standard in accordance with EU Gazette 2018/C 092/06

EN 14322
DIN EN 14322:2022-02, Wood-based panels – Melamine-faced boards for interior use – Definition, requirements and classification

EN 14323
DIN EN 14323:2022-02, Wood-based panels – Melamine-faced boards for interior use – Test methods

EN 16516
DIN EN 16516: 2020-10, Construction products: Assessment of release of dangerous substances – Determination of emissions into indoor air

ISO 15686:2011-05
ISO:15686-8:2011-05, Buildings and constructed assets – Service life planning

EN 312
DIN EN 312-5:2010-12, Particle board – Requirements

EN 438-1
DIN EN 438-1:2016-06, High-pressure decorative laminates (HPL) – Boards based on thermosetting resins (laminates) – Part 1: Introduction and general information

ISO 12460-3
DIN EN ISO 12460-3:2021-02, Determining formaldehyde emissions – Part 3: Gas analysis method

ISO 12460-5
DIN EN ISO 12460-5:2016-05, Wood materials – Determining formaldehyde emissions – Part 5: Extraction method (called the perforator method)

Other literature

AgBB Scheme
Procedure for health-related evaluation of emissions of volatile organic compounds (VVOC, VOC and SVOC) from construction products; Committee for the Health Assessment of Construction Materials (AgBB); last revised: 2018/2021

CARB
California Air Resources Board.ww2.arb.ca.gov

Chemicals Prohibition Ordinance
Chemicals Prohibition ordinance (ChemVerbotsV) Annex 1 to §3 dated 20 January 2017 in conjunction with announcement of analytical methods, published on 26 November 2018, BAnz AT 26.11.2018 B2

CPR
Directive (EU) No. 305/2011 of the European Parliament and Council dated 9 March 2011 on specifying harmonised conditions for marketing building products (EU-BauPVO) (Construction Products Regulation – CPR)

EWC
European Waste Catalogue (EWC) in the version of the Commission Decision 2001/118/EC dated 16 January 2001 amending Decision 2000/532/EC on a waste directory

EPA
United States Environmental Protection Agency.www.epa.gov

GaBi 2022
GaBi data set documentation for the software system and databases, LBP, University of Stuttgart and Sphera, Leinfelden-Echterdingen, 2022 (http://www.gabi-software.com/international/index/)

Hasch 2002
J. Hasch (2002), Ökologische Betrachtung von Holzspan und Holzfaserplatten (Ecological analysis of wood chip and wood fibre boards), Dissertation, University of Hamburg – revised in 2007: S. Rueter, (BFH HAMBURG; Wood Technology), S. Albrecht, (University of Stuttgart, GaBi)

MKSPA102
MKSPA102, Declaration of Performance number of Kaindl Boards GmbH for the P2 particle board product; valid from 14.06.2022 (www.kaindl.com/DOP)

MKSPA202
MKSPA202, Declaration of Performance number of Kaindl Boards GmbH for the P3 particle board product; valid from 14.06.2022 (www.kaindl.com/DOP)

PCR, Part A
Product category rules for building-related products and services Part A: Calculation rules for the Life Cycle Assessment and requirements on the Project Report, in accordance with EN 15804+A2:2019 (v. 1.2); Berlin: Institut Bauen und Umwelt e.V. (pub.); 17.11.2021; www.ibu-epd.com

PCR: Wood materials
Product category rules for building-related products and services Part B: Requirements on the EPD for wood materials, version 1.2, Institut Bauen und Umwelt e.V., www.ibu-epd.com, 2022

RAL-UZ 76
“Blue Angel” environmental mark foe low-emission board-shaped materials (construction and furniture boards) for interior design.

TSCA Title VI
Toxic Substances Control Act (TSCA) Title VI – Formaldehyde Standards for Composite Wood Products; www.regulations.gov/document/EPA-HQ-OPPT-2016-0461-0001

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