ENVIRONMENTAL PRODUCT DECLARATION

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

Declaration holder	Elka Holzwerke GmbH
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Valid until	17 November 2030

Chipboard and esb boards

elka-Holzwerke GmbH

Institut Bauen und Umwelt e.V.

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1. General information

elka-Holzwerke GmbH

Programme holder

IBU – Institute for Construction and Environment Hegelplatz 1
10117 Berlin Germany

Declaration number

EPD-ELK-20250449-IBA1-DE

This declaration is based on the product category rules:

Wood-based materials, 09.07.2025
(PCR reviewed and approved by the independent expert council (SVR))

chipboard and esb boards.

Date of issue

18 November 2025

Valid until

17 November 2030

Dipl.-Ing. Hans Peters
(Chair of the Board of the Institute for Construction and Environment)

Chipboard and ESB boards

Owner of the declaration

Elka Holzwerke GmbH Hochwaldstrasse 44
54497 Morbach
Germany

Declared product/declared unit

1 m^3 average chipboard and esb board

Scope of validity:

The contents of this declaration are based on information provided by the following manufacturer regarding the production of raw chipboard and esb boards:
elka Holzwerke GmbH, Morbach, Germany

The life cycle assessment in this declaration covers 100% of the production of

and esb boards from the above-mentioned factory in 2022. This declaration can be used for chipboard and esb boards from the above-mentioned manufacturer. The owner of the declaration is liable for the underlying information and evidence; the IBU accepts no liability with regard to manufacturer information, life cycle assessment data and evidence.

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

Verification

The European standard EN 15804 serves as the core PCR
Independent verification of the declaration and information in accordance with ISO 14025:2011
☐ Internal ☒ External

Florian Pronold
(Managing Director of the Institute for Construction and Environment)

Manfred Russ,
(Independent Verifier)

2. Product

2.1 Product description/product definition

Chipboard, raw

Raw chipboard is a board-shaped wood-based material with a three-layer structure. It consists of a middle layer of coarser chips and two outer layers of finer material. Fresh sawmill residues in chip or dust form are mainly used. The product is sold uncoated.

esb board P5 (elka strong board)

The esb board is a homogeneous wood-based material made from defined, fresh coarse softwood chips. The board has a uniform structure. It is produced in type P5 and is therefore used in structural timber construction. The esb board is low in formaldehyde and meets extended requirements for emission properties. It is also manufactured and marketed uncoated.

Both products are manufactured at the Morbach plant.

Regulation (EU) *No. 305/2011* of 9 March 2011 applies to marketing in the EU/EFTA (with the exception of Switzerland). The products require a declaration of performance in accordance with *EN 13986:2015* Wood-based materials for use in construction — Properties, conformity assessment and marking and CE marking. EN 312:2010-12, Particleboard – Requirements; German version *EN 312:2010* also applies. The respective national regulations apply to the use of the products.

2.2 Application

Chipboard, raw

Raw chipboard from elka-Holzwerke GmbH is used for interior design, furniture construction, the door industry and non-load-bearing areas of structural construction. Typical areas of application are body and front components, wall and ceiling cladding, partition walls and substructures. The selection of the appropriate board type is made in accordance with *DIN EN 312*.

esb board P5 (elka strong board)

The esb board is a structural wood-based panel in accordance with *DIN EN 312:2010-12* and meets the requirements of panel class P5. It is suitable for use in damp areas and can be used for load-bearing and bracing purposes in timber construction, e.g. as cladding in walls, roofs or ceilings. The esb board is a wood-based material for use in construction in accordance with the harmonised standard *DIN EN 13986*, which regulates properties, conformity assessment and CE marking. The product therefore meets the requirements of Regulation (EU) *No. 305/2011* (Construction Products Regulation) for the European market.

2.3 Technical data

Requirements according to *EN 312*
(simplified representation for panel types P1 - P7)

Structural data

Exemplary technical values for an esb P5 panel.

Designation	Value	Unit
Bulk density	630 640	kg/m3
Flexural strength (longitudinal) EN 310	12-18	N/mm2
Modulus of elasticity (longitudinal) EN 310	1900 2550	N/mm
Material moisture on delivery EN 322	10-11	%
Thermal conductivity EN 13986	0.12	W/(mK)
Water vapour diffusion resistance factor Dry/Wet	80/40	-
Sound absorption	0.25	%
Formaldehyde emissions according to EN 312	0.05	µg/m3

Note: Specific technical data can be found in the technical data sheets for the manufacturer's products.

2.4 Delivery condition

The chipboard and esb boards from elka-Holzwerke GmbH are delivered uncoated. Both products are available in various thicknesses, widths and lengths.
The available dimensions are:

Thicknesses: 9 mm to 50 mm

Widths: 200 mm to 2,100 mm

Lengths: 200 mm to 5,500 mm

Special formats outside these standard dimensions are available on request. The boards are produced in accordance with the respective application classes according to *DIN EN 312:2010-12*.

2.5 Raw materials/auxiliary

materials Composition

Designation	Value	Unit
Wood (sawmill by-products)	80.83	%
Water	6.99	%
MUF adhesive	5.49	%
UF adhesive	5.41	%
Hydrophobisation	0.73	%
Hardener	0.32	%
Formaldehyde absorber	0.22	%
Flame retardant	0.02	%

The product has an average raw density of approx. 631.32 kg/m³. The functional chemical groups of the fire retardants are nitrogen compounds.

The chipboard and esb boards produced by elka-Holzwerke GmbH consist of small wood particles, binding agents and other additives. The wood content is 80.83% by mass and consists entirely of sawmill by-products (e.g. chips, wood chips) produced in the company's own sawmill. Spruce is the main type of wood used. The wood particles used are particularly low in emissions and have a very low VOC profile.

Urea-formaldehyde resins (UF) and melamine-urea-formaldehyde resins (MUF) are used as binding agents.
Other additives include paraffin-based water repellents, hardeners, formaldehyde scavengers and, if necessary, flame retardants.

Our chipboard does not contain any substances from *the ECHA list* of substances of very high concern (SVHC) above 0.1% by mass. Furthermore, it does not contain any CMR substances of category 1A or 1B, which are on the *candidate list*, above 0.1% by mass. They also do not contain any biocidal products within the meaning of the Biocidal Products Regulation (EU) No. 528/2012) and have not been treated with biocidal products.

2.6 Manufacture

Only waste wood from our own sawmill and suppliers in the region is used to manufacture the chipboard and esb boards of elka-Holzwerke GmbH. These are sawmill by-products such as wood chips, shavings and offcuts. Waste wood and recycled materials are not used.

The manufacturing process comprises the following steps:

1. Chip production and processing of the wood raw materials

2. Drying of the chips to the required moisture content

3. Sorting the chips according to size (top and middle layer)

4. Gluing the chips with thermosetting binders (UF, MUF); addition of flame retardants if required

5. Mat formation by scattering the glued chips in several layers

6. Compression of the chip cake under high pressure and temperature in a press
7. Conditioning of the raw boards to equalise moisture content

8. Sanding and formatting of the resulting raw boards to the desired dimensions

9. (Optional) Attachment of tongue and groove for laying panels

Subsequent packaging and labelling of the finished boards The adhesives used cure completely during the pressing process. The finished boards are stacked and packaged for storage.
The entire manufacturing process takes place at the Morbach site. Production waste such as offcuts or sanding dust is either recycled internally or used to generate energy.

2.7 Environment and health during production

The manufacturing conditions do not require any special health protection measures other than
those specified by the authorities for the specific work area, e.g. high-visibility vest, safety shoes, dust mask. The *MAK values* (Germany) are not exceeded at any point in the production process.

Air: The exhaust air generated during production is cleaned in accordance with legal requirements. Emissions are below the *TA Luft (Technical Instructions on Air Quality Control)* limits.

Water/soil: There is no impact on water or soil.

Noise protection: All values measured inside and outside the production facilities are below the requirements applicable in Germany.
Noisy plant components, such as machining, are appropriately insulated by structural measures.

Energy: Energy management *(ISO 50001)* is geared towards the continuous reduction of energy consumption and CO2 emissions.

2.8 Product processing/installation

Chipboard and esb boards from elka-Holzwerke GmbH can be processed using standard woodworking machines.
The products can be sawn, milled, planed, sanded and drilled.

During processing, care must be taken to ensure that the products are installed in accordance with building physics, especially when used in damp areas or in structural timber construction.

Wood dust is produced during processing. Therefore, standard occupational safety measures must be observed:

- Wear a dust mask
- Use gloves and protective clothing
- Use of extraction devices on machines

For certain applications, such as in floor areas or load-bearing structures, the relevant standard requirements and installation instructions must be observed.

2.9 Packaging

The products are packaged securely for transport. Materials such as solid wood, PE film, paper and cardboard are used in the following average quantities per cubic metre of product:

- Solid wood 0.17 kg/m³
- PE film 0.06 kg/m³
- Paper and cardboard 0.01 kg/m³

The transport packaging used for delivery – such as cardboard boxes, PE film/tape and solid wood bases – can be recycled if sorted by type. Alternatively, thermal recycling is permitted if material recycling is not possible.

2.10 Condition of use

The composition of the chipboard and esb boards corresponds to the raw materials listed in section 2.5 (Raw materials). The binding agents are chemically stable and firmly bound to the wood.

2.11 Environment and health during use

Environmental protection: Hazards to water, air and soil can occur if the products described are not used as intended
products described above, according to current knowledge.
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Health protection: Based on current knowledge, no health hazards or impairments are to be expected when chipboard is used normally in accordance with its intended purpose. Emissions are only detectable in quantities that are harmless to health.

2.12 Reference service life

The service life of chipboard and esb boards from elka-Holzwerke GmbH depends on the area of application and, when used properly, is up to 50 years (according to *the BBSR table*). Durability in use depends on the respective application class according to *DIN EN 312*.

2.13 Exceptional effects Fire

Raw chipboard has the following fire behaviour according to *EN 13501-1; EN 13986*.

Fire protection

Designation	Value
Building material class	D
Burning dripping	d0
Smoke gas development	s2

Change in physical state:
Burning dripping is not possible because raw chipboard does not become liquid when heated. Proof of the toxicity of fire gases for Class D building materials is not required.

Water
The product does not contain any ingredients that pose a water hazard through leaching. As prolonged exposure to water leads to the destruction of the board composite, the products must be protected from continuous exposure to moisture.

Mechanical destruction
The product exhibits brittle fracture behaviour under mechanical stress. Splintering and sharp break edges may occur. Resistance to mechanical impact corresponds to the respective board types P1-P7.

2.14 Reuse phase

Reuse:
Chipboard and ESB boards can be sorted by type during the demolition or conversion of buildings as part of selective demolition and sent for reuse. This can be done both for their original purpose and in alternative areas of application, provided that the structural and technical condition of the boards allows this.

Recycling:
If the boards are sorted by type, they can be recycled in the form of a return to the manufacturing process for wood-based materials. If reuse or recycling is not practical, the boards can be used for energy recovery due to their high calorific value. They are used as secondary fuel in suitable facilities (e.g. biomass power plants).

2.15 Disposal

Any waste or disused chipboard and esb boards should primarily be reused or recycled. These measures are in line with the principle of cascade use and are preferable to direct energy recovery.

The landfilling of waste wood is not permitted under Section 9 of the Waste Wood Ordinance (AltholzV). Disposal is usually carried out via approved collection and recycling systems.
Waste code (*AVV/EAK*): 17 02 01 – Wood

2.16 Further information

Further information can be found on the website: www.elka-holzwerke.de

3. LCA: Calculation rules

3.1 Declared unit

The reference for this declaration is 1 m^3 of chipboard and esb board with an average mass of 631.32 $^{kg/m3}$.

Declared unit and mass reference

Designation	Value	Unit
Declared unit	1	m^3
Mass reference	631.32	kg/m3
Layer thickness	0.019	m
Weight per unit area	12	kg/m2
Bulk density	631.32	kg/m3

The declared unit of ecological consideration is the provision of 1 m^3 of chipboard and esb board with a mass of 631.32 $^{kg/m3}$, a water content of approx. 7% and an adhesive and additive content of approx. 12.2%.

The composition corresponds to the average weighted by production volume.

3.2 System boundary

The declaration type corresponds to an EPD cradle to factory gate – with options. The content covers the production stage, i.e. from the provision of raw materials to the factory gate (cradle to gate, modules A1 to A3), as well as module A5 and parts of the end of life (modules C1 to C4).

In addition, the potential benefits and burdens beyond the product's life cycle are considered (module D).

Specifically, Module A1 covers the provision of wood raw materials and the provision of adhesives and

Additives are included in the balance sheet. The transport of the materials used

raw materials to the factory are considered in Module A2. Module A3 covers the provision of fuels, operating materials, product packaging and electricity, as well as the manufacturing processes on site. These are essentially
processing, drying (including emissions), sorting and pressing of raw materials.

Module A5 deals exclusively with the disposal of product packaging, which includes the output of the biogenic carbon and primary energy contained therein (PERM and PENRM).

For module C1, manual dismantling without incurring any costs is assumed. Module C2 takes into account transport to the disposal company and module C3 takes into account the processing and sorting of the waste wood. In addition, in module C3, in accordance with *EN 16485,* the CO_2equivalents of the wood-inherent carbon 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 specifications and does not show any waste for landfill. This is because the product system becomes waste wood at the end of its life (EoL), which, according to *the Waste Wood Ordinance (2020)*, may not be landfilled but must be recycled thermally or materially.

Module D balances the thermal recycling of the product at the end of its life cycle and the resulting potential benefits and burdens in the form of a system extension.

3.3 Estimates and assumptions

In principle, all material and energy flows of the processes required for production were determined on the basis of questionnaires. The emissions from wood combustion occurring on site are modelled on the basis of a background data set from 2023 from the *Sphera 2024b* database.
Emissions from wood drying, internal combustion plants and the setting of adhesives are based on literature references and are documented in detail in *Rüter, Diederichs (2012)*. The transport distance for disposal is assumed to be 50 km by truck as a conservative approach, the provision of packaging materials 100 km by truck, and the transport of the product from the construction site to processing and reuse 50 km by truck. All other data is based on real data, if available.
The use of spruce wood is assumed, with small quantities of other softwoods also covered. To calculate the environmental impact of upstream processes (e.g. sawn timber supply chain), a model described on pages 73-78 in *Rüter, Diederichs (2012)* was used.
For the end-of-life scenario, a collection rate of 100% is assumed, with no losses due to the shredding of the material.

3.4 Trimming rules

A decision on the flows to be considered is based on existing studies on the life cycle assessment of wood products. At least those material and energy flows that account for 1% of the input of renewable or non-renewable primary energy or mass were assessed, with the total sum of the flows not considered not exceeding 5%. In addition, it was ensured that no material and energy flows were neglected that have a particular potential for significant impacts in relation to the environmental indicators.
The costs of providing the infrastructure (machinery, buildings, etc.) for the entire foreground system were not taken into account. This is based on the assumption that the total costs of constructing and maintaining the infrastructure do not exceed the 1% of total costs described above. However, the energy costs in the form of heat and electricity required to operate the infrastructure were taken into account. Material and energy flows for installation (A5) and dismantling (C1) were neglected using the cut-off rules.
Detailed information on the truncation rules is documented in *Rüter, Diederichs 2012*.

3.5 Background data

All background data was taken from the *Sphera 2024 database* and the final report 'Life cycle assessment basic data for wood-based construction products' *Rüter, Diederichs 2012*. The latter forms the basis for a regularly updated internal database from which the modelling of the forestry supply chain and the processes for mapping the assumptions listed in section 3.3 were taken.

3.6 Data quality

The foreground data was collected at the plant for twelve consecutive months of 2022.
The foreground data collected was validated on the basis of mass and plausibility criteria. Overall, the 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, is 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 1994 to 1997. The data is up to date, regularly checked and updated if necessary. All other information was taken from the *Sphera 2024 database* and is no more than three years old. Overall, the data quality can be described as good. The data quality complies with *EN 15941:2024*.

3.7 Observation period

The foreground data was collected for the plant in Morbach (DE) for twelve consecutive months in the period from 01/2022 to 12/2022 inclusive.

3.8 Geographical representativeness

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

3.9 Allocation

The allocations made comply with 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 carried out.

General
Flows of material-inherent properties (biogenic carbon and primary energy contained) were generally allocated according to physical causalities. All other allocations for associated co-productions were made on an economic basis. One exception is the allocation of the heat required in combined heat and power plants, which was allocated on the basis of the exergy of the products electricity and process heat.

Module A1

- Forestry: All expenses in the forestry supply chain were allocated to the products trunk wood and industrial wood on the basis of their prices using economic allocation factors.

Module A3

- Wood processing industry: In the case of linked co-productions, expenses 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 waste generated in Module A3 (with the exception of wood-based materials) is returned to the product system in the form of a calculated loop. The energy generated and accounted for as a loop accounts for less than 1% of the energy used in Module A3.
- In the case of combined heat and power generation, all combustion expenses were allocated to these two products based on their exergy.
- The provision of waste wood as fuel does not take into account any expenses from the previous life cycle.

Module D

- The system space expansion carried out in Module D corresponds to an energy recovery scenario for waste wood.

3.10 Comparability

In principle, a comparison or evaluation of EPD data is only possible if all data sets to be compared have been created in accordance with *EN 15804* and the building context and product-specific performance characteristics are taken into account. The

Life cycle assessment modelling was carried out using the Sphera LCA for Experts software, see *Sphera 2025*. All background data was taken from the *Sphera 2024* database or comes from references.

4. LCA: scenarios and further technical information

Characteristic product properties of biogenic carbon

Raw chipboard and esb chipboard are mainly made from wood and therefore contain biogenic carbon.

Information on the description of the biogenic carbon content at the factory gate

Designation	Value	Unit
Biogenic carbon in the product	255.15	kg C
Biogenic carbon in the associated packaging	0.16	kg C

At the factory gate and during use, the product contains 255.15 kg of biogenic carbon per cubic metre, which corresponds to a CO_2equivalent of 935.55 kg. The wooden packaging contains 0.16 kg C.

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

The following technical information forms the basis for the declared modules or can be used to develop specific scenarios in the context of a building assessment if modules are not declared (ND).

Installation in the building (A5)

Module A5 is declared, but it only contains information on the disposal of the product packaging and no information on the actual installation of the product in the building.

Designation	Value	Unit
Plastic packaging for thermal waste treatment	0.06	kg
Overall efficiency of thermal waste treatment (plastics)	38	%
Wood/paper packaging for thermal waste treatment	0.17	kg
Overall efficiency of thermal waste treatment (wood)	44	
Total exported electrical energy	1.50	MJ
Total exported thermal energy	2.04	MJ

The amount of packaging material that accumulates as waste material for thermal recycling in Module A5 per m^3 of product and the resulting exported energy are specified in the previous table as technical scenario information.

Service lives can be found in the reference service life table of the BN*B*.

End of life (C1-C4)

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

Designation	Value	Unit
Product share until end of waste status	631.32	kg
Redistribution transport distance of waste wood (Module C2)	50	km

For a scenario in which the product reaches the end of its waste status, a collection rate of 100% is assumed, with no losses due to the shredding of the material.

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

Module D describes any burdens and potential benefits resulting from the energy recovery of the product after complete waste treatment.

Designation	Value	Unit
Thermal scenario: electricity that can be generated (per net flow of the declared unit)	537.42	kWh
Thermal scenario: usable waste heat (per net flow of the declared unit)	3918.49	MJ

The product is recycled in the same composition as the declared unit described at the end of its life cycle. As required in PCR Part A, the scenario is presented as a 100% scenario.

Scenario (energy recovery)

The scenario assumes purely energy recovery in a biomass cogeneration plant with a total efficiency of 55% and an electrical efficiency of 18.19%. Since 29.22 kg (atro) of waste wood is used in modules A1-A3, the net flow assessed in module D corresponds to 481.08 kg of waste wood (atro), including the adhesives contained therein. Taking into account the proportion of adhesives, Module D potentially produces 537.42 kWh of electricity and 3918.49 MJ of thermal energy per declared unit.
The exported energy has the potential to substitute fuels from fossil sources, whereby in this scenario for recycling 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).

5. LCA: Results

The declared unit of 1 m3 of esb chipboard causes the following environmental impacts.

**SPECIFICATION OF SYSTEM BOUNDARIES (X = INCLUDED IN LIFE CYCLE ASSESSMENT; MND = MODULE OR INDICATOR NOT DECLARED;
MNR = MODULE NOT RELEVANT)**

Production stage			Stage of construction of the building		Use stage							Disposal stage				Credits and debits outside the system boundary
Raw material supply	Transport	Manufacturing	Transport from manufacturer to place of use	Assembly	Use/application	Maintenance	Repair	Replacement	Renewal	Energy consumption for operating the building	Water consumption for operating the building	Demolition/dismantling	Transport	Waste treatment	Disposal	Potential for reuse, recovery or recycling
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 IMPACT according to EN 15804+A2: 1 m³ chipboard and esb board

Indicator	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D
Total GWP	kg CO_2 -eq.	-9.2E+02	2.71E+00	4.71E+01	4.06E-01	0	9.75E-01	1.15E+03	0	-2.73E+02
GWP fossil	kg CO_2 -eq.	1.52E+01	2.71E+00	4.7E+01	7.97E-02	0	9.73E-01	2.19E+02	0	-2.73E+02
GWP-biogenic	kg CO_2 -eq.	-9.35E+02	7.61E-03	5.84E-02	3.27E-01	0	2.74E-03	9.36E+02	0	-4.95E-01
GWP-luluc	kg CO_2 -eq.	ND	ND	ND	ND	ND	Not available	ND	Not available	Not available
ODP	kg CFC11 eq.	4.55E-11	2.74E-13	5.98E-10	2.64E-14	0	9.86E-14	5.17E-10	0	-8.49E-12
AP	mol H+-eq.	6.74E-02	1.62E-02	1.15E-01	4.2E-05	0	5.83E-03	2.24E-01	0	-1.48E-01
EP-freshwater	kg P-eq.	2.25E-03	4.59E-05	4.43E-02	2.47E-06	0	1.65E-05	2.22E-02	0	-5.81E-04
EP-marine	kg N-eq.	2.96E-02	7.95E-03	2.91E-02	1.11E-05	0	2.86E-03	6.11E-02	0	-6.83E-02
EP-terrestrial	mol N-eq.	2.88E-01	8.82E-02	3.62E-01	1.84E-04	0	3.17E-02	1.05E+00	0	-7.56E-01
POCP	kg NMVOC-eq.	8.02E-02	1.52E-02	7.61E-02	2.98E-05	0	5.48E-03	1.61E-01	0	-2.01E-01
ADPE	kg Sb-eq.	3.09E-06	2.32E-07	4.16E-06	2.86E-10	0	8.33E-08	3.9E-06	0	-6.27E-06
ADPF	MJ	3.88E+02	3.55E+01	5.61E+02	5.62E-02	0	1.28E+01	4.46E+02	0	-4.35E+03
WDP	m^3 global equivalent removed	1.44E+00	4.06E-02	-3.7E-01	2.53E-02	0	1.46E-02	1.19E+02	0	-2.06E-01

GWP = Global warming potential; ODP = Ozone depletion potential; AP = Acidification potential of soil and water; EP = Eutrophication potential; POCP = Tropospheric ozone creation potential; ADPE = Abiotic resource depletion potential – non-fossil resources (ADP – substances); ADPF = Abiotic Resource Depletion Potential – fossil fuels (ADP – fossil fuels); WDP = Water Depletion Potential (users)

RESULTS OF THE LIFE CYCLE ASSESSMENT – INDICATORS FOR DESCRIBING RESOURCE USE according to EN 15804+A2: 1 m³ chipboard and esb board

Indicator	Unit	A	A2	A3	A5	C1	C2	C3	C4	D
PERE	MJ	1.12E+03	3.01E+00	2.06E+03	3.23E+00	0	1.08E+00	2.49E+02	0	-9.31E+00
PERM	MJ	9.83E+03	0	3.21E+00	-3.21E+00	0	0	-9.83E+03	0	0
PERT	MJ	1.1E+04	3.01E+00	2.07E+03	1.55E-02	0	1.08E+00	-9.58E+03	0	-9.31E+00
PENRE	MJ	3.88E+02	3.55E+01	5.59E+02	2.22E+00	0	1.28E+01	4.46E+02	0	-3.26E+03
PENRM	MJ	1.09E+03	0	2.16E+00	-2.16E+00	0	0	-1.09E+03	0	0
PENRT	MJ	1.48E+03	3.55E+01	5.61E+02	5.62E-02	0	1.28E+01	-6.43E+02	0	-3.26E+03
SM	kg	0	0	0	0	0	0	0	0	0
RSF	MJ	1.1E+03	0	5.63E+02	0	0	0	0	0	9.83E+03
NRSF	MJ	0	0	0	0	0	0	0	0	1.09E+03
FW	m^3	5.57E-02	3.37E-03	1.22E-01	5.94E-04	0	1.21E-03	2.85E+00	0	-1.25E-02

PERE = Renewable primary energy as energy source; PERM = Renewable primary energy for material use; PERT = Total renewable primary energy; PENRE = Non-renewable primary energy as energy source; PENRM = Non-renewable primary energy for material use; PENRT = Total non-renewable primary energy; SM = Use of secondary materials; RSF = Renewable secondary fuels; NRSF = Non-renewable secondary fuels; FW = Net use of freshwater resources

**RESULTS OF THE LIFE CYCLE ASSESSMENT – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2:
1 m³ chipboard and esb board**

Indicator	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D
HWD	kg	2.25E-03	4.59E-05	4.43E-02	2.47E-06	0	1.65E-05	2.22E-02	0	-5.81E-04
NHWD	kg	8.67E-02	5.53E-03	1.57E+00	4.92E-03	0	1.99E-03	2.63E+01	0	-1.31E+00
RWD	kg	2.17E-05	1.15E-09	6.41E-07	3.27E-11	0	4.13E-10	5.74E-07	0	-7.82E-08
CRU	kg	0	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0	0
MER	kg	0	0	4.03E-02	2.4E-01	0	0	6.31E+02	0	0
EEE	MJ	0	0	0	1.5E+00	0	0	0	0	0

EET	MJ	0	0	0	2.04E+00	0	0	0	0	0

HWD = Hazardous waste sent to landfill; NHWD = Non-hazardous waste disposed of; RWD = Radioactive waste disposed of; CRU = Components for reuse; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported energy – electrical; EET = Exported energy – thermal

RESULTS OF THE LIFE CYCLE ASSESSMENT – additional impact categories according to EN 15804+A2-optional: 1 m³ chipboard and esb board

Indicator	Unit	A1	A2	A3	A5	C1	C2	C3	C4	D
PM	Cases of illness	6.88E-07	1.04E-07	8.07E-07	2.73E-10	0	3.73E-08	1.43E-06	0	-8.18E-07
IR	kBq U235 equivalent	2.42E-01	6.42E-03	3.47E+00	3.71E-04	0	2.31E-03	2.36E+00	0	-7.79E-02
ETP-fw	CTUe	2.74E+02	2.62E+01	2.47E+02	2.47E-02	0	9.4E+00	1.72E+02	0	-5.6E+01
HTP-c	CTUh	6.63E-09	5.26E-10	8.71E-09	2.29E-12	0	1.89E-10	1.22E-08	0	-1.88E-08
HTP-nc	CTUh	1.96E-07	2.34E-08	2.07E-07	9.61E-11	0	8.4E-09	3.58E-07	0	-1.93E-06
SQP	SQP	5.93E+01	1.76E+01	2.47E+02	1.84E-02	0	6.32E+00	2E+02	0	-1.08E+01

PM = Potential occurrence of diseases due to particulate matter emissions; IR = Potential effect of human exposure to U235; ETP-fw = Potential toxicity comparison unit for ecosystems; HTP-c = Potential toxicity comparison unit for humans (carcinogenic effect); HTP-nc = Potential toxicity comparison unit for humans (non-carcinogenic effect); SQP = Potential soil quality index

Limitation note 1 – applies to the indicator Potential effect of human exposure to U235: This effect category mainly addresses the potential effect of low-dose ionising radiation on human health in the nuclear fuel cycle. It does not take into account effects attributable to possible nuclear accidents and occupational exposure, nor does it take into account the disposal of radioactive waste in underground facilities. The potential ionising radiation emitted by soil, radon and some building materials is also not measured by this indicator.

Limitation note 2 – applies to the indicators Potential for abiotic resource scarcity – non-fossil resources, Potential for abiotic resource scarcity – fossil fuels, Water withdrawal potential (users), Potential toxicity comparison unit for ecosystems, Potential toxicity comparison unit for humans – carcinogenic effect, Potential toxicity comparison unit for humans – non-carcinogenic effect, Potential soil quality index: The results of these environmental impact indicators must be used with caution, as there is a high degree of uncertainty associated with these results or because there is only limited experience with the indicators.

Addendum 1
GWP biogenic: The reported GWP biogenic indicator aggregates biogenic GHG emissions from upstream chains with energy use (e.g. fuels with a bioethanol content) and material-inherent GWP biogenic (wood). The indicator shown must be clearly distinguished from GWP-biogenic (wood), which is attributable exclusively to wood as a raw material and represents a material-inherent carbon sink, see also Chapters 4 and 6.

Addendum 2
The GWP-luluc indicator was not declared because its contribution accounts for less than 5% of 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 process. In the case of this product, 100% of the industrial wood and industrial waste wood used comes from Germany (the federal states of Rhineland-Palatinate, Saarland, Hesse and North Rhine-Westphalia). Waste wood as a secondary fuel is purchased in Germany.
We can therefore only comment on the primary system and state that the use of the primary raw material does not result in deforestation. On the other hand, as part of international greenhouse gas reporting under the United Nations Framework Convention on Climate Change (*UNFCCC*) and *EU Regulation (EU) 2018/841*, the amount of deadwood lost annually from existing forests in Germany is estimated, including the proportion of wood originating from land use change due to deforestation (*Federal Environment Agency 2023*). For 2021, the proportion of wood loss 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 type can hardly be used by wood-processing companies due to the irregular supply (spatially and temporally and thus logistically unplannable), as they depend on a continuous supply of specific raw wood assortments of consistent quality and dimensions (in this case: industrial wood for wood-based material production).

Addendum 3
Primary energy used in materials (PERM and PENRM) is considered a material-inherent property in accordance with *EN 16485*. As a result, it always leaves the product system with the material and is removed from the corresponding indicator as a negative value. RSF and NRSF are to be understood as part of PERE and PENRE and are included therein.

6. LCA: Interpretation

The focus of the interpretation of results is on the production phase (modules A1 to A3), as this is based on specific information provided by the company. The interpretation is carried out by means of a dominance analysis of the environmental impacts (GWP-fossil, ODP, AP, EPfw, POCP, ADPE, ADPF, WDP) and the renewable/non-renewable primary energy inputs (PERE, PENRE) as well as fresh water use (FW) and hazardous waste (HWD). The most significant factors for each category are listed below.

Interpretation of the individual indicators

The analysis of the product's environmental impact shows that different phases and materials represent different drivers of environmental impact throughout the life cycle. Particularly striking are the upstream production (A1) and manufacturing (A3) phases, which have a significant impact on the environmental indicators.

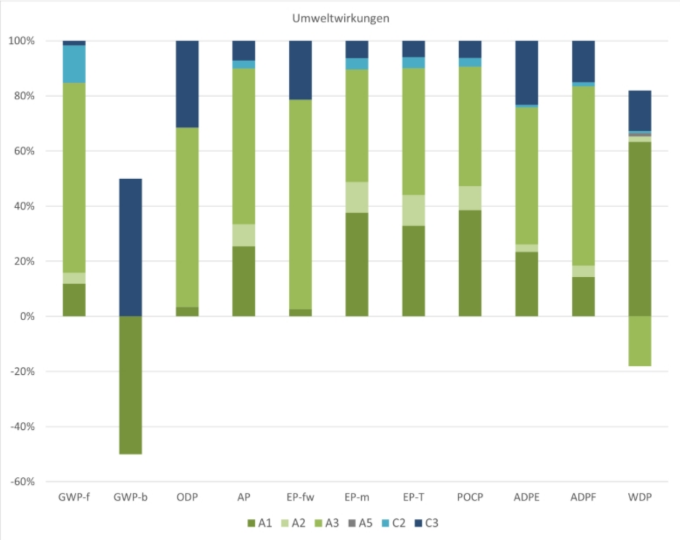

Fig. 2: Dominance analysis of the environment, relative contributions of the modules considered to the most important environmental impacts.

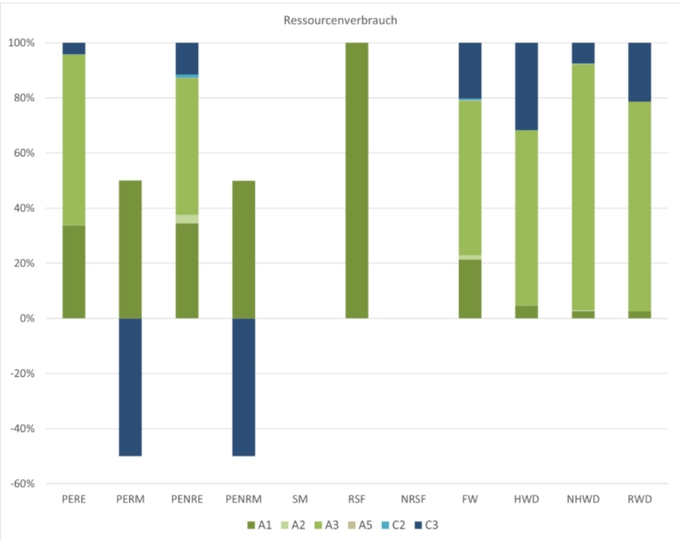

Fig. 3: Dominance analysis of resources, relative contributions of the modules considered to the most important resource indicators

6.1 Greenhouse gas potential (GWP)

Biogenic GWP (GWP-b): With regard to GWP, the CO_2inputs and outputs inherent in wood products deserve special attention. The following table shows how the GWP biogenic (total) is composed of GWP biogenic (M) from material use (material-inherent E.) plus GWP biogenic (E) from energy use (upstream chains).

Parameter	Einheit	A1	A2	A3	A1-A3	A5	C1	C2	C3	C4	A-C
a. (GWP-b) nur Holz, materialinhärente Eigenschaft	[kg CO_2-Äqv.]	-9,36E+02	0,00E+00	-3,15E-01	**-9,36E+02**	3,27E-01	0,00E+00	0,00E+00	9,36E+02	0,00E+00	**1,13E-02**
b. (GWP-b) Sphera	[kg CO_2-Äqv.]	7,81E-02	7,61E-03	3,74E-01	**4,60E-01**	1,55E-05	0,00E+00	2,74E-03	2,59E-01	0,00E+00	**7,21E-01**
Summe a.+b. (GWP-b)	[kg CO_2-Äqv.]	-9,35E+02	7,61E-03	5,84E-02	**-9,35E+02**	3,27E-01	0,00E+00	2,74E-03	9,36E+02	0,00E+00	**7,32E-01**

Fig. 4: GWP biogenic (total) composed of material

GWP biogenic (M) used for material purposes and GWP biogenic (E) used for energy purposes
biogenic (E) used for energy.

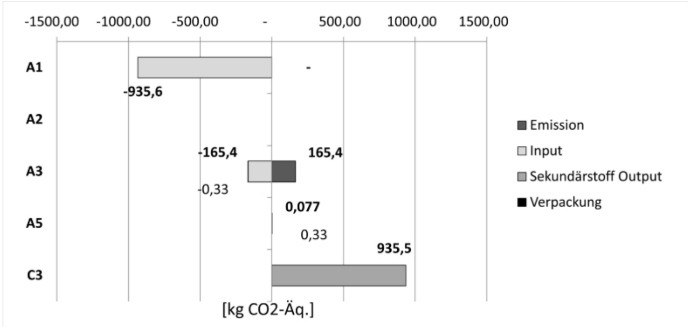

Figure 5: Wood-inherent CO_2 product system inputs and outputs. The inverse sign of the inputs and outputs takes into account the life cycle assessmentCO_2 flow analysis from the perspective of the atmosphere.

The growth of the wood required for production binds 935.6 kg $_{of}$ CO_2in module A1, see Fig. 3.
The growth of the wood used for energy in production also binds 165.4 kg $_{of\ CO_2}$, which is included in module A3 and is also emitted in this module through combustion at the site. Module A3 also includes the biogenic CO_2 contained in wood and paper packaging, amounting to 0.33 kg. This leaves the system boundary when the packaging is disposed of in module A5. The remaining 935.5 kg $_{of}$ CO_2leaves the product system in module C3 in the form of recyclable waste wood.

GWP fossil (GWP-f): The influencing factors on the global warming potential fossil (GWP-f) [kg CO2 equiv.] are as follows: 38% - electricity for primary forms (A3); 14.1% - IRH own (A3); 8.8% - electricity for final production (A3); 8.2% - hydrophobisation (A1); 6.3% - electricity for drying (A3); 5% - heat for initial forming (A3); remainder 19.6%.

6.2 Other indicators and their main contributors

Ozone depletion potential (ODP) [kg CFC11-eq]: 57.5% - electricity for initial forming (A3); 13.3% - electricity for finishing (A3); 12.3% - IRH own (A3); 9.6% - electricity for drying (A3); 3% - SNP material (A1); 1.6% - Hydrophobisation (A1); remainder 2.7%.

Acidification potential (AP) [mol H+ equiv.]: 17.6% - electricity for initial forming (A3); 16% - IRH own (A3); 13.4% - heat primary forming (A3); 12.8% - diesel (A1); 10.5% - heat drying (A3); 7.7% - SNP material (A1); remainder 22.1%.

Eutrophication, freshwater (EP-fw) [kg P-eq]: 57.6% - Primary processing (A3); 13.3% - Final processing (A3); 12.3% - IRH own (A3); 9.6% - Drying (A3); 1.8% - SNP material (A1); 1.6% - heat primary forming (A3); remainder 3.8%.

Photochemical ozone formation (POCP) [kg NMVOC equiv.]: 36.7% - Dryer emissions on site (A3); 13.3% - IRH own (A3); 11.5% - Diesel (A1); 9% - Electricity for primary forming (A3); 6.9% - SNP material (A1); 5.3% - heat primary forms (A3); remainder 17.2%.

Potential for abiotic degradation of non-fossil resources (ADPE) [kg Sb-eq]: 31.8% - electricity for primary production (A3); 15% - IRH own (A3); 12% - hydrophobisation (A1); 9.7% - operating materials (A1); 7.4% - electricity for final processing (A3); 6.7% - SNP material (A1); remainder 17.5%.

Potential for abiotic degradation of fossil fuels (ADPF) [MJ]: 31.7% - electricity for primary forms (A3); 22.2% - hydrophobisation (A1); 11.7% - IRH own (A3); 7.3% - electricity for finishing (A3); 5.3% - electricity for drying (A3); 3.9% - SNP material (A1); remainder 17.9%.

Water use (WDP) [m³ global equivalent extracted]: 60.7% - Operating resources (A1); 20.1% - Electricity for primary forming (A3); 3.3% - IRH own (A3); 6.1% - Hydrophobisation (A1); 5.4% - Electricity for finishing (A3); 4.2% - Electricity for drying (A3); remainder 0.2%.

Renewable primary energy as energy source (PERE) [MJ]: 43.3% - Heat for initial forming (A3); 34.1% - Heat for drying (A3); 12.2% - Electricity for initial forming (A3); 3.2% - IRH own (A3); 2.8% - electricity for finishing (A3); 2% - electricity for drying (A3); remainder 2.3%.

Non-renewable primary energy as energy source (PENRE) [MJ]: 31.7% - electricity from primary sources (A3); 22.2% - Hydrophobisation (A1); 11.7% - IRH own (A3); 7.3% - Electricity for final processing (A3); 5.3% - Electricity for drying (A3); 3.9% - SNP material (A1); remainder 17.9%.

Use of fresh water resources (FW) [m³]: 49.3% - electricity for primary forming (A3); 15.1% - IRH own (A3); 13.3% - Operating resources (A1); 10.9% - Electricity for finishing (A3); 7.4% - Electricity for drying (A3); 4% - SNP material (A1); remainder 0.1%.

The most important drivers of environmental impact in this analysis are electricity consumption, particularly in primary forming (A3), as well as specific processes such as IRH's own activities and the use of operating resources and hydrophobisation. Electricity consumption during primary forming is a dominant factor in almost all indicators, such as global warming potential (GWP-f), eutrophication (EP-fw), acidification (AP) and abiotic depletion (ADPE), and shows a close correlation with environmental impacts. Finishing and drying also play a role, especially in ozone depletion (ODP) and water use (WDP).
A significant proportion of the abiotic depletion of fossil fuels (ADPF) is caused by hydrophobisation (A1) and electricity consumption, which highlights the influence of materials and energy consumption. Freshwater resources (FW) are particularly affected by operating resources and electricity in primary formation and finishing.

Correlations and patterns can be seen between the results of the impact assessment in the various impact categories. Hazardous waste to landfill (HWD) is mainly influenced by IRH's own processes and SNP materials, which shows that these production steps generate significant amounts of waste.
Overall, material selection and energy consumption in primary forming and drying are the most important factors determining the environmental impact in this analysis.
The correlations identified are plausible, as they correspond well with the known material flows and typical manufacturing processes for this product system. For example, adhesives (A1) and heat (A3) are often key drivers in the production phase of products that place high demands on energy and resources. It is also understandable that industrial roundwood must play an important role in some categories, as the product consists largely of this material.

6.3 Hazardous waste
The relative amounts of hazardous, non-hazardous and radioactive waste per declared unit of the product are shown in Fig. 4 and are composed as follows.

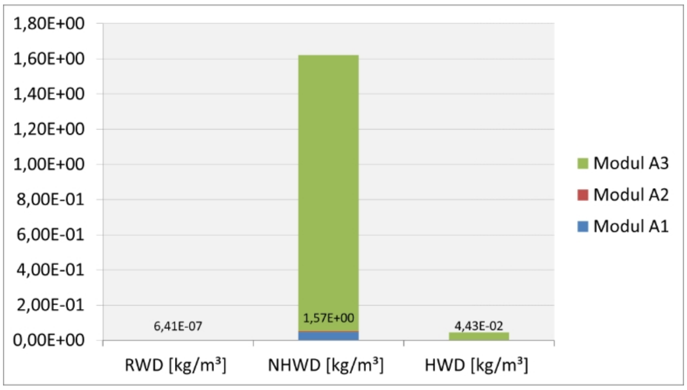

Fig. 4: Waste generation per declared unit at module level. HWD = hazardous waste for landfill; NHWD = non-hazardous waste disposed of; RWD = radioactive waste disposed of.

The relevant and verifiable waste is assigned to modules A1 and A3. 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] are: 32.1% - IRH own (A3); 17.3% - SNP material (A1); 14.1% - electricity primary forms (A3); 7.9% - heat primary forms (A3); 6.2% - heat drying (A3); 5.1% - hydrophobisation (A1); remainder 17.4%. The variance in the LCIA results was not investigated, as the product is manufactured at a single location.

The quality of the results can be assessed as robust and good, as the correlations and significant influences are plausible and largely correspond to the observations from the life cycle inventory.

As no life cycle assessment results or environmental impacts of manufacturing at the plant site are available to date, the EPD for esb chipboard cannot be compared with the current results.

7. Evidence

Formaldehyde and VOC evidence below

7.1 Formaldehyde

Monitoring: WKI Fraunhofer Institute Braunschweig (Quality Association for Wood-based Materials)
Testing centre: WKI Fraunhofer Institute Braunschweig Testing standard: *DIN EN 717-1* Determination of formaldehyde emissions *DIN EN 16516* Assessment of the release of hazardous substances – Determination of emissions into indoor air

No current use of MDI No waste wood is used in the manufacture of our chipboard and esb boards, so there is no heavy metal contamination.
Testing centre: ECO Institute

Aim of the test: Determination of VOC emissions in accordance with *the AgBB scheme* / MVVTB
Measurement method: *DIN*

EN 16516 2020-10

Result: The raw chipboard tested in accordance with *DIN EN 16516* complies with the requirements of the AgBB scheme/MVVTB of 2018 for VOC after 3 days and after 28 days.

esb Plus boards carry the RAL quality seal *(UZ-76)* Blue Angel.

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

Precise measurements for all products can be provided on request.

Designation	Value	Unit
TVOC (C6 - C16)	260	µg/m3
Total SVOC (C16 - C22)	<5	µg/m3
VOC without NIK	<5	µg/m3
Carcinogens	<1	µg/m3

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

Precise measurements for all products can be provided on request.

Designation	Value	Unit
TVOC (C6 - C16)	170	µg/m3
Total SVOC (C16 - C22)	<5	µg/m3
VOC without NIK	<5	µg/m3
Carcinogens	<1	µg/m3

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