ENVIRONMENTAL PRODUCT DECLARATION

in accordance with */ISO 14025/* and */EN 15804/*

Owner of the declaration	Verband der Deutschen Holzwerkstoffindustrie e.V.
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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Interior doors made of wood and wood-based panels

Verband der Deutschen Holzwerkstoffindustrie e.V. (VHI)

Institut Bauen und Umwelt e.V.

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1. General Information

Verband der Deutschen Holzwerkstoffindustrie e.V. (VHI)

Programme holder
Institut Bauen und Umwelt e.V. (IBU),
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Germany

Declaration number
EPD-VHI-20200102-IBG1-DE

This declaration is based on the following product category rules:
Windows and doors, 12/2018
(PCR tested and approved by the independent advisory board (SVR))

Issue date
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Valid to
03/09/2025

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

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

Interior doors made of wood and wood-based panels

Owner of the declaration
Verband der Deutschen Holzwerkstoffindustrie e.V.
Schumannstrasse 9
10117 Berlin
Germany

Declared product/declared unit
An interior door, consisting of the insert and the frame whic surrounds the insert and measuring 1.23 m x 2.18 m.

Scope of application:
This declaration is a Verband der Deutschen Holzwerkstoffindustrie association EPD and represents an average product of VHI member companies which produce interior doors. 7.17 million interior leaves and 5.6 million wooden frames were manufactured in Germany in 2017. Of these, 75 % of the door leaves and 72 % of the doorframes were produced by VHI member companies.

The owner of the declaration is liable for the basic information and supporting evidence; any liability of the IBU in relation to manufacturer's information, LCA data and supporting evidence is excluded. This document is a translation from German to English. It is based on the original declaration number EPD-VHI-20200102-IBG1-DE.

Verification

The European */EN 15804/* standard serves as the core PCR

Independent verification of the declaration and statements by an independent body in accordance with */ISO 14025:2010/*

☐ internal ☒ external

Dr.-Ing. Andreas Ciroth,
Independent verifier appointed by SVR

2. Product

2.1 Product description/Product definition

Single-leaf interior doors generally consist of the insert, the frame which surrounds the insert on all four sides and the cover panels and in some cases also skins if these are not already part of the cover panels. Wood-based panels such as particle boards, mainly extruded particle boards (boards with tubes), honeycomb boards, fibre boards, multilayer wood-based inserts and also rigid foam boards are used for the inserts. MDF boards, particle boards, softwoods and hardwoods or plywood are used as frame material. MDF boards, HDF boards, thin particle boards and plywood amongst other things are used as barriers (cover panels).

With door frames, we distinguish between two basic types; the block frame and the closed frame which is fitted round three sides of a wall opening as a ready-made element. Doors with glass panels in different sizes are also to be found amongst the many different design variants.

This EPD describes an average door produced by VHI member companies. In addition to standard doors, VHI member companies also produce special function doors. These offer additional functions such as protection from damp, smoke, fire, noise, burglary and radiation. The doors have a modified structure for these purposes.

The entire production of doors by VHI member companies is divided into the following groups:

90 % standard doors
5 % sound insulation doors
2 % fire protection doors
1.4 % burglary protection doors
0.8 % damp/wet room doors
0.8 % smoke protection doors
< 0.1 % radiation-proof doors

The average values which this EPD describes are quantity-weighted according to the above production ratios.

The respective national regulations apply to use of the product at the use location, for example in Germany the /building regulations of the federal states/ and the technical regulations based on these regulations.

2.2 Application

Interior doors are mainly fitted in general housing construction. Interior doors for the commercial sector are sometimes subject to higher standards which are to be complied with in accordance with statutory building regulations.

2.3 Technical data

The following characteristics are those relevant for interior doors. The technical data to be listed according to the *product category rules for doors and windows* (air permeability coefficient of joints, installation depth, etc.) are only of significance for windows and exterior doors and are therefore not mentioned here.

- Mechanical stress according to */RAL-GZ 426/* or */DIN EN 1192/*
- Climatic stress according to /*RAL-GZ 426*/ or */DIN EN 1121/*
- Fire protection in accordance with */DIN EN 16034-1/*, division into classes T30, T60, T90
- Smoke protection in accordance with */EN 18095-1/*
- Sound protection in accordance with */DIN 4109-1/*, division into reference values
- Burglary protection in accordance with /DIN EN 1627/, division into classes WK1, WK2, WK3 and RC1, RC2, RC3
- Radiation protection in accordance with */EN 6834-1/*
- Suitability for wet and damp rooms in accordance with /*RAL-GZ 426/*

Product performance values in relation to its characteristics are in accordance with the relevant technical purpose (no CE labelling).

2.4 Delivery status

Single-leaf door panels from VHI member companies are available in the following sizes:
Width: 485 mm – 1360 mm
Height: 1597 mm – 2735 mm
According to */DIN 68706-1/* the door panel must be at least 39 mm thick. The door frame formats are adapted to the door leaf sizes. Special formats are available on request.

2.5 Base materials/ancillary materials

Wood-based panels (mainly particle boards and fibre boards or plywood) are mainly used for VHI interior doors and/or solid wood for the frames. The inserts mainly consist of wood-based panels (extruded panel boards); the barrier is made of thin particle boards or fibre boards, the skin of solid wood (veneer) or synthetic materials (HPL, CPL or other synthetic resin-impregnated decor papers). UF glue: This aminoplastic adhesive hardens completely during the compression process through polycondensation. PVAC glue: This thermoplastic adhesive hardens through evaporation.

The materials and ingredients are averaged for the environmental product declaration per door are as follows:

- Wood-based materials and solid wood approx. 83 %
- HP / CP laminate approx. 7 %
- Fittings approx. 3 %
- Glass inserts approx. 1 %
- HDF composite materials approx. 1 %
- Synthetic resin-impregnated decor paper approx. 1 %
- PVAC adhesive approx. 1 %
- UF/ EVA adhesive approx. 1 %
- Miscellaneous (lacquers, seals, sound protection inserts,...) approx. 2 %

Does the product or at least one part product contain materials from the *ECHA candidate list* of materials which are especially problematic for approval: Substances of Very High Concern – SVHC) (Date 27/06/2018) above a mass % of 0.1: no.

Does the product or at least one part product contain further CMR Category 1A or 1B substances which are not on the candidate list in doses above 0.1 mass % in at least one part product: no
Were biocidal products added to this building product or was it treated with biocidal products (is this therefore a processed product in terms of /EU Biocide Product Directive no. 528/2012/: no

2.6 Manufacturing

2.6.1 Door leaves Pre-assembly/basic

Production: The individual frame elements are assembled and the appropriate insert placed in position, and the barriers and skins are then added to the presses. Cutting is automatic or manual depending on the door design as is the frame construction.

Presses: When pressing the doors, the frames and inserts are joined up with the barrier and the skins by means of an adhesive. Bonding in the presses takes place by means of pressure and temperature. After pressing, the door blanks are generally pre-trimmed, i.e. cut to size with a certain allowance for trimming and a label is affixed to the lower edge of the door on which the further processing steps up to the finished product are saved in barcodes. Each door is uniquely identifiable by means of this label.

Edging: In the next processing stage, the doors are formatted to their final dimensions and the door edges are processed in accordance with production specifications.

Intermediate processing: Doors that are given a cutout, for example to accommodate glazing or a panel, are processed after pre-trimming in an automatic cutout router and the cutout(s) specified in the order are cut out.

Surface finish: The skins of doors due to be painted are sanded in several sanding steps.

Painting: After sanding, the doors are painted in separate automated painting systems depending on the finish.

Milling and installation of fittings: A control station is attached to the painting systems which inspects all doors from all sides for possible surface flaws before they are forwarded to the automatic drilling and milling machines, where holes are drilled for the fittings.

Packaging, order picking and shipping: The finished doors are now packaged, partly by machine, partly by hand, labelled and stored in the shipping hall.

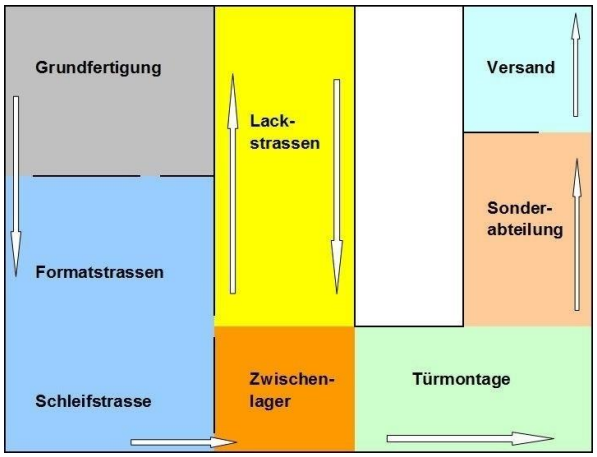

Fig. 1: Diagram of the production process (Source: LEBO)

2.6.2 Door frames

Basic considerations: Generally, wooden closed frames are made of particle wood or MDF wood-based materials. Plywood boards may also be used depending on requirements.
The basic production of a standard frame in accordance with /DIN 68706-2/ is described here.

Pressing frame boards: First, the wood-based boards for the lining board and the facings on the visible side are given some kind of covering, for example veneer, synthetic laminate or priming film and in some cases the reverse side is covered with bracing material to prevent the boards from warping.

Surface finish: The visible side of the boards, whether veneered or covered with priming film, is then sanded in several sanding passes.

Painting: The boards are painted after sanding.

Cutting and edging: The finished lining boards are cut to the width required to fit the respective wall thickness. A groove is then cut in the narrow surface on the door rebate side for the frame seal and milling is carried out to accommodate the rebate facing. The narrow surface on the decorative facing side is given an edge coating and the groove for accommodating the decorative facing.

Facing production: The finished facing boards are cut to the width required for the rebate and decorative facings and folded in a separate station to form a facing.

Final frame production and packaging: After the lining board, rebate facing and decorative facings have been completed these three parts are processed further in a frame completion station.

Order picking and shipping: The finished frames are labelled on the front side of the cardboard packaging and stored in the shipping hall. Order picking and preparation for shipping are done here. The production process is completed at this point.

2.7 Environment and health during use

The production conditions require no special health protection measures. The normal occupational protection measures (work gloves, hearing protection, safety shoes, dust masks for sanding and milling work, dust extraction, etc.) must be complied with as well as any measures provided for specific work areas required by local authorities. Sound-proof hoods are used to minimise noise.
No additional measures are prescribed by the association beyond the statutory requirements.

No direct contamination for water or soil is produced. Production-related waste water is treated internally and returned to production.

2.8 Product processing/installation

Interior doors are supplied ready to install. The doorframe is assembled and the door leaf installed. Interior doors made of wood and wood-based materials can be sawn, machined, planed, sanded and drilled with normal machines. The manufacturer's installation instructions should be followed.

2.9 Packaging

Solid wood and wood materials (EWC 15 01 03), cardboard (EWC 15 01 01), polyethylene and polystyrene
(EWC 15 01 02) and also metals to a small extent (EWC 15 01 04) are used. With the exception of the metal parts, which are recycled, individual packaging components are generally recycled thermally.

2.10 Condition of use

The composition for the period of use complies with the base material composition in accordance with Section 2.5 Base materials.
Approximately 26 kg of carbon dioxide are bound up in the product during use. This is equivalent to approximately 95 kg of CO_2 when fully oxidised.

2.11 Environment and health during use

According to the current state of knowledge, no hazards for water, the air/atmosphere and soil emanate from the products described.

According to the current state of knowledge, no hazards or impairments to health are to be expected if interior doors are used normally as intended. Emissions can only be detected at levels which are harmless to health.

Extensive inspections of door leaves and doorframes in 2010 and 2011 have shown that all of the materials investigated fulfil national requirements with regard to indoor hygiene and permissible emissions *AiF project 16210 N.*

2.12 Reference period of use

The service life of interior doors is at least 100.000 door movements.

2.13 Extraordinary influences - Fire

Fire class in accordance with */EN 13501-1/*

Fire protection

Name	Value
Building material class	D
Flaming droplets	d0
Flue gas development	s2

Change in physical condition (burning dripping/falling material): Not possible as the products described do not liquefy when heated.

Water

Interior doors are generally not exposed to weather or the unforeseen effects of water. Doors in damp or wet rooms are protected against the ingress of dampness or wetness by a special insert. Separate quality criteria for this are laid down in *RAL-GZ 426*.

Mechanical destruction

Sharp edges can form at points of fracture on mechanical destruction.

2.14 End-of-life phase

The main parts of interior doors can be recycled thermally in suitable incinerators to produce heat and electricity after use. Waste wood from the demolition and dismantling of door leaves and frames which originate from interior doors without harmful impurities is assigned to waste code 17 02 02 according to Appendix III of the German Waste Wood Ordinance. Construction and demolition wood with harmful impurities falls under waste code 17 02 04. The fittings, which are mainly made of metal, can be recycled as scrap.

2.15 Disposal

Disposal of waste wood in landfill is not permissible according to Section 9 of the /Waste Wood Ordinance/.

2.16 Further information

Further information is available from VHI'S Internet pages (http://www.vhi.de) or the RAL Quality Assurance Association for Interior Doors (http://www.gg- innentueren.de).

3. LCA: Calculation rules

3.1 Declared unit

The declared unit is an interior door element consisting of the door leaf and doorframe 1.23 m x 2.18 m in size (reference door based in */DIN EN 14351-1/*). The total weight of this average door based on VHI member company products and in accordance with production quantity weighing is 72.82kg. The frame share (door frame share) is 42 %.

Declared unit

Name	Value	Unit
Declared unit	1	Reference door (frame), 1.23m x 2.18m
Conversion factor to 1 kg	0.0137318	-

The balanced production volume included in the average is based on figures from 16 manufacturers of interior doors made of wood and wood-based materials who belong to the Verband der Holzwerkstoffindustrie association. The underlying production process varies only slightly from one manufacturer to another. Overall, both the representativeness and the robustness of the data can be regarded as good.

3.2 System boundary

The declaration type is an EPD *from cradle to gate with options*. The contents are the stages of production, in other words from the provision of the raw materials to the factory gate (*Cradle-to-Gate*, Modules A1 to A3), and Module A5 and parts of the end-of-life (Modules C2 to C4). It also contains an analysis of the potential benefits and loads beyond the lifecycle of the product (Module D).

In detail, Module A1 analyses the provision of all semi-finished products which are found in the declared unit. The transport of these materials is included in Module A2. Module A3 covers the provision of fuels, operating materials, product packaging and use of electricity on-site. Module A5 deals exclusively with the disposal of the product packaging which includes the output of the biogenic carbon and also the primary energy (PERM and PENRM) it contains.

Module C2 contains the transport to disposal. Module C3 contains the preparation and sorting of the waste wood share of the product before this is passed on for reuse as a secondary fuel. Beyond this, Module C3 contains the thermal recycling of the product share which remains within the system boundary as waste. The disposal in landfill of small quantities of product is included in Module C4. In addition, the CO_2 equivalents of the biogenic carbon present in the product (GWP) and the renewable and

non-renewable primary energy (PERM and PENRM) are registered as outputs in Module C3 and Module C4 depending on their proportions in accordance with */EN 16485/*.

The assessment of loads and possible benefits from recycling and disposal in landfill in Module D represent a system extension.

3.3 Estimations and assumptions

Generally, all material and energy flows for the processes required for production are determined on the basis of questionnaires. The emissions from burning wood which occur on-site are estimated on the basis of a background data record from the /*GaBi Professional Database 2019 Edition/*. All other data is based on average values.

3.4 Cut-off rules

As a minimum, at least those material and energy flows which account for 1 % of the use of renewable and non-renewable primary energy or mass, whereby the total of flows not included is not greater than 5 %. Beyond this, it was ensured that no material and energy flows which exhibit special potential for significant influences in relation to environmental indicators were ignored.
The loads for providing infrastructure (machines, buildings, etc.) from the entire foreground system were not included. This is based on the assumption that the above overall loads for setting up and maintaining the infrastructure do not exceed the 1% of total loads already described above. On the other hand, the energetic loads required to operate the infrastructure in the form of heat and electricity are included.

3.5 Background data

The data for wood and wood materials was taken from the *ÖkoHolzBauDat* database based on *Rüter, Diederichs (2012).* All other background data originates from the *GaBi Professional Database 2019*. The former depicts the production of wood semi-finished products based on primary data collections, information from scientific literature and the latterly named database.

3.6 Data quality

The foreground data was collected from each manufacturer for twelve consecutive months in the period from 2010 to 2011. The continuing currentness and validity of this data is certified by confirmation from the association on the basis of a member questionnaire.
The foreground data queried was validated on the basis of the mass and in accordance with plausibility criteria.
The background data taken from the literature for material and energetically used wood raw products with the exception of forest timber originates from 2008 to 2012. The provision of forest timber was taken from a publication from 2008 which is mainly based in information from 1994 to 1997. The models used in the *ÖkoHolzBauDat* database are constantly updated and externally appraised in the course of numerous EPD certifications.

All further background data was taken from the *GaBi Professional Database 2019* and is less than three years old.

Since the main information originates from primary data collections with a high degree of representativeness, the data quality can be described as good.

3.7 Period under review

The foreground data was collected from each manufacturer for twelve consecutive months in the period from 2010 to 2011. The continuing currentness and validity of this data is certified by confirmation from the association on the basis of a member questionnaire.

The production volumes for the calendar year of 2017 for the manufacturers involved were collected in a further questionnaire in order to calculate an updated quantity-weighted production average.

3.8 Allocation

No CO emission allocations occurred in the modelling of the foreground system.

Waste wood used to provide wood materials (material or energy) within the supply pre-chains is included in the modelling without impacts from the preceding product system. Waste wood to produce energy is dealt with in the same way in Module A3.

Energy produced from the thermal recycling of production waste is returned as a calculated value within Module A3. The energy generated and calculated as a loop represents less than 5 % of the energy deployed in Module A3.

Module D represents a system extension in which the following aspects are included:

- Potential benefits from energy recovery from the packaging material (exported electrical energy - EEE) and exported thermal energy (EET) from Module A5.
- Potential benefits from energy recovery from the product share in waste incineration (EEE and EET from Module C3).
- Potential benefits from energy production by the disposal in landfill of a small share of product (EE from Module C4).
- Impacts and potential benefits from the use of a product share as secondary fuel.

3.9 Comparability

Generally, a comparison or evaluation of EPD data is only possible if all data to be compared was created in accordance with */EN 15804/* and the building context and product-specific features are taken into account.

The LCA modelling was performed with the aid of */GaBi ts/*. All background data was taken from the */GaBi Professional Database 2019/* in Service Pack 39 and the */ÖkoHolzBauDat/* database based on */Rüter, Diederichs (2012)/*.

4. LCA: Scenarios and further technical information

The scenarios on which the LCA after the *cradle to gate* phase is based are described in more detail below.

Installation into the building (A5)
Module A5 is declared but merely contains information on the disposal of product packaging and no information on the actual installation of the product in buildings. The quantity of packaging material which accrues as waste for thermal recycling per unit in Module A5 and the resulting exported energy are shown the following table as technical scenario information.

Name	Value	Unit
Packaging wood for thermal recycling	3.069	kg
Plastic packaging for thermal recycling	0.266	kg
Paper and cardboard for thermal recycling	2.51	kg
Metal packaging for recycling	0.0009	kg
Total efficiency of thermal waste disposal	38	%
Total exported electrical energy	9.5	MJ
Total exported thermal energy	21.5	MJ

A transport distance of 20 km and a collection rate of 100 % is assumed for the disposal of product packaging. The metal share goes to recycling and leaves the system boundary as materials for recycling (MFR). Energy recovery is assumed for the remaining packaging. The total efficiency of waste incineration and the proportion of electricity and heat generation by combined heat and power correspond to the allocated waste incineration process in the */GaBi Professional Database 2019/*.

End-of-life (C2-C4)
Whilst the hundred-percent thermal/material recycling of packaging materials is assumed, the end-of-life scenario for the product provides for a collection rate of 95 %. Disposal in landfill is assumed to be the reason for the material loss. A transport distance of 20 km to the disposal company is assumed for all shares.

Name	Value	Unit
Collected separately	69.18	kg
As mixed building waste (Disposal in landfill C4)	3.64	kg
To energy recovery (C3)	10.15	kg
To recycling (MFR from C3)	1.85	kg
For use as secondary fuel (share Wood materials, MER from C3)		

A total of 27,5 MJ of heat and 11.8 MJ of electricity are exported from Module C3 from energy recovery (non-wood share of the product in MVA). The heating value of this share and the incineration efficiency are derived from the corresponding MVA data record from the */GaBi Professional Database 2019/*.
1.27 MJ of electricity are exported from Module C4 from disposal in landfill of the 5 % share as a result of the assumed collection.

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

Name	Value	Unit
Waste wood (atro, per net flow of the declared unit)	39.84	kg
Adhesives and additives in wood-based panels (per net flow of the declared unit)	5.05	kg
Electricity produced from secondary fuels (per net flow of the declared unit)	179.8	MJ
Waste heat from secondary fuels used (per net flow of the declared unit)	363.9	MJ
Total electricity substituted in Module D	202.36	MJ
Total heat substituted in Module D	412.88	MJ

Overall efficiency of 55 % and electrical efficiency of 18.19 % from energetic recycling in a biomass power station are assumed for the wood materials contained after deduction of the assumed collection rate of 95 %. The waste wood entered in Module A3 as a secondary fuel is deducted from 50.76 kg atro wood so that a net flow of 39.84 kg atro wood as a renewable secondary fuel (RSF) is added to Module D.
In addition, a share of 5.05 kg as non-renewable secondary fuel (NRSF) from the adhesives and additives present in the wood materials is entered in Module D. A combined heating value of 17.28 MJ is assumed for the wood materials. A total of 179.8 MJ of electricity and 363.9 MJ of thermal energy per declared unit are produced through their use as secondary fuels.

The energy exported from Modules A5, C3 and C4 and produced in Module D through secondary fuels replaces fuels from fossil sources, whereby it is assumed that thermal energy is produced with natural gas and the electricity replaced corresponds to the German network's electricity mix in 2016.

5. LCA: Results

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

Production stage			Construction process stage		Use stage							End of life stage				Credits and loads beyond the stem boundary
Raw material supply	Transport	Manufacturing	Transport from the gate to the location of use	Assembly	Use/application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse, recovery or recycling potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	MND	X	MND	MND	MNR	MNR	MNR	MND	MND	MND	X	X	X	X

RESULTS OF THE LCA – ENVIRONMENTAL IMPACTS: 1 interior door made of wood and wood-based materials (1.23 m x 2.18 m)

Parameter	Unit	A1	A2	A3	A5	C2	C3	C4	D
GWP	[kg CO_2 eq.]	-4.18E+1	1.40E+0	2.14E+1	1.06E+1	8.63E-2	9.43E+1	7.36E+0	-4.74E+1
ODP	[kg CFC11 eq.]	5.46E-11	4.74E-16	4.21E-11	4.01E-15	2.92E-17	2.95E-14	6.65E-16	-1.02E-12
AP	[kg SO_2 eq.]	1.12E-1	1.89E-3	6.70E-2	3.49E-3	1.17E-4	6.16E-3	8.67E-4	-2.70E-2
EP	[kg $(PO_4)^{3-}$e.]	2.17E-2	4.55E-4	1.56E-2	7.91E-4	2.81E-5	1.16E-3	3.32E-3	-1.70E-3
POCP	[kg Ethene eq.]	2.46E-2	-4.65E-4	1.15E-2	2.04E-4	-2.87E-5	3.63E-4	8.54E-4	-3.19E-3
ADPE	[kg Sb eq.]	2.65E-3	1.31E-7	1.41E-5	3.72E-7	8.10E-9	1.32E-6	3.67E-8	-1.06E-5
ADPF	[MJ]	8.61E+2	1.86E+1	3.71E+2	3.22E+0	1.14E+0	1.07E+1	2.82E+0	-5.94E+2
Key	GWP = Global warming potential; ODP = Depletion potential for the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential for tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources (ADP – materials); ADPF = Abiotic depletion potential for fossil resources (ADP – fossil energy carriers)								

RESULTS OF THE LCA – RESOURCE USE: 1 interior door made of wood and wood-based materials (1.23 m x 2.18 m)

Parameter	Unit	A1	A2	A3	A5	C2	C3	C4	D
PERE	[MJ]	3.53E+2	1.13E+0	5.69E+2	8.70E+1	6.99E-2	4.88E+0	2.92E+0	-1.70E+2
PERM	[MJ]	8.70E+2	0.00E+0	4.32E+1	-4.32E+1	0.00E+0	-8.27E+2	-4.35E+1	0.00E+0
PERT	[MJ]	1.22E+3	1.13E+0	6.12E+2	4.38E+1	6.99E-2	-8.22E+2	-4.06E+1	-1.70E+2
PENRE	[MJ]	7.56E+2	1.86E+1	4.29E+2	2.75E+1	1.15E+0	1.82E+2	2.92E+0	-6.69E+2
PENRM	[MJ]	1.78E+2	0.00E+0	1.20E+1	-1.20E+1	0.00E+0	-1.69E+2	-8.92E+0	0.00E+0
PENRT	[MJ]	9.35E+2	1.86E+1	4.41E+2	1.55E+1	1.15E+0	1.28E+1	0.00E-6	-6.69E+2
SM	[kg]	5.89E+0	0.00E+0	3.33E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.54E+0
RSF	[MJ]	1.15E+2	0.00E+0	9.53E+1	6.42E+0	0.00E+0	0.00E+0	0.00E+0	7.24E+2
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.69E+2
FW	[m^3]	3.93E-1	1.30E-3	2.59E-1	2.29E-2	8.01E-5	3.97E-2	4.76E-4	8.71E-2
Key	PERE = Renewable primary energy as energy carrier; PERM = Renewable primary energy as material utilisation; PERT = Total use of renewable primary energy resources; PENRE = Non-renewable primary energy as energy carrier; PENRM = Non-renewable primary energy as material utilisation; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary materials; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water								

RESULTS OF THE LCA: – OUTPUT FLOWS AND WASTE CATEGORIES: 1 interior door made of wood and wood-based materials (1.23 m x 2.18 m)

Parameter	Unit	A1	A2	A3	A5	C2	C3	C4	D
HWD	[kg]	5.41E-5	1.06E-6	6.81E-6	1.57E-8	6.54E-8	3.82E-8	1.47E-8	-3.82E-7
NHWD	[kg]	2.47E+0	1.25E-3	8.77E-1	2.47E-1	7.70E-5	7.72E-1	2.81E+0	1.88E-1
RWD	[kg]	2.92E-2	2.21E-5	2.76E-2	1.15E-4	1.36E-6	8.47E-4	4.01E-5	-2.95E-2
CRU	[kg]	0.00E+0	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	8.28E-4	0.00E+0	1.85E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	5.72E+1	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	0.00E+0	9.49E+0	0.00E+0	1.18E+1	1.27E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	0.00E+0	2.15E+1	0.00E+0	2.75E+1	0.00E+0	0.00E+0
Key	HWD = Hazardous waste disposal; NHWD = Non-hazardous waste disposal; RWD = Radioactive waste disposal; CRU = Components for reuse; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy EET = Exported thermal energy								

The materially used primary energy (PERM and PENRM) is regarded as a materially inherent property in accordance with */EN 16485/*. Consequently ,it always leaves the product system with the material and is logged out of the corresponding indicator as a negative value. Materially or energetically used secondary material contains no primary energy according to *PCR Part A,* Version 1.8. The energy bound up in secondary material for material use (SM) is therefore not included in PERM or PENRM. This secondary material is exclusively waste wood as a share of the wood-based materials used, whereby the absolute dry mass is stated which has a lower heating value of 19.27 MJ/kg. The secondary material used as energy is included exclusively in the indicators for using secondary fuels (RSF or NRSF). It is not included in the primary energy indicators.

6. LCA: Interpretation

The focus of the result interpretation lies on the production phase (Modules A1 to A3) as this is based on concrete information from the companies. The interpretation is done by means of a dominance analysis of the environmental impacts (GWP, ODP, AP, EP, POCP, ADPE, ADPF) and renewable/non-renewable primary energy use (PERE, PENRE). In addition, the maximum deviations of the works assessed from the average and also changes compared to the previous EPD are also described and interpreted.

The most significant factors for the respective categories are therefore listed below.

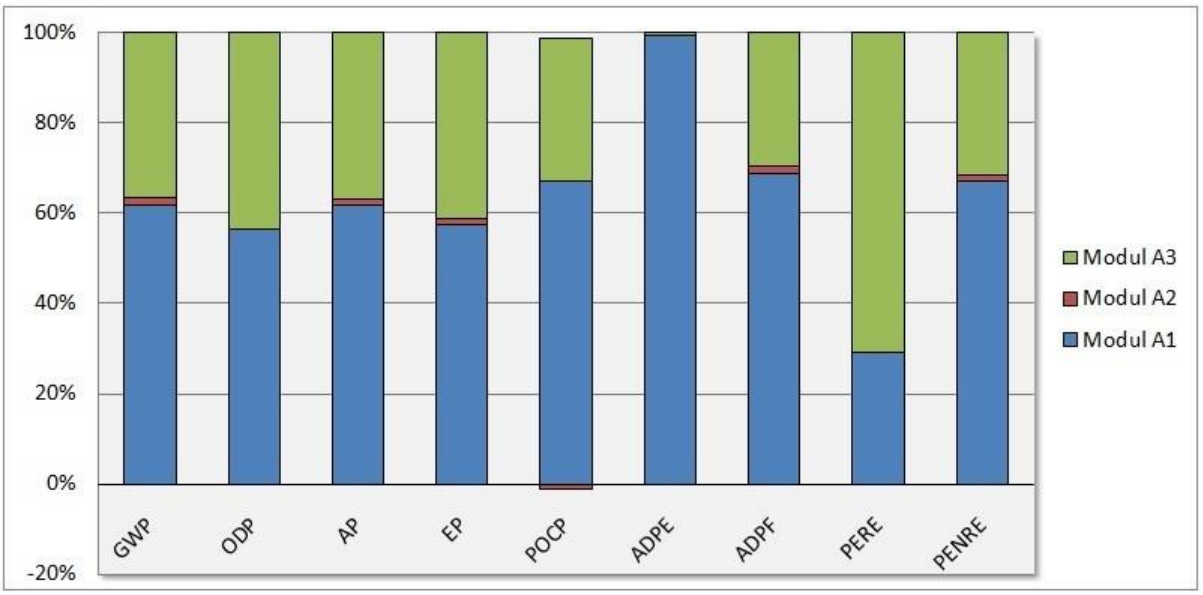

Fig.2: Relative shares of Modules A1-A3 on the influence of environmental impact categories and primary energy use (cradle-to-gate)

6.1 Global warming potential (GWP)

Wood-inherent CO_2 product system inputs and outputs require special examination with regard to global warming potential.

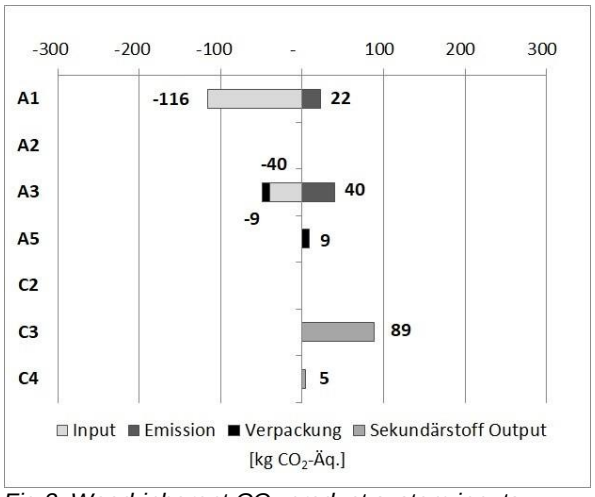

Fig.3: Wood-inherent CO_2 product system inputs and outputs [kg CO_2 eq.]. The inverse signing of the inputs and outputs allows for the LCA CO_2 flow from the point of view of the atmosphere to be examined.

116 kg of CO_2 are bound up through the growth of the wood required for interior door production, of which 22 kg are emitted again in the course of heat production from wood in the wood-based materials pre-chains. The growth of the wood used for energy in the production process additionally binds up 40 kg of CO_2 which goes into Module A3 and is also emitted again in this module by incineration in situ. Some 9 kg of CO_2 which enter the product system in Module A3 and are emitted into the atmosphere again by the thermal recycling of the packaging in Module A5 are bound up by the provision of the wood for product packaging. The 94 kg of CO_2 stored in the product leave the product system in Module C3 in the form of recyclable waste wood (89 kg CO_2) and to a small extent as unsorted waste for landfill (5kg CO_2) in Module C4.

The main causes of fossil-based greenhouse gases are the provision of non-wood components (Module A1) at 37 %, the provision of wood-based materials (Module A1) at 25 % and electricity consumption in the works (Module A3) at 22 %. In addition, heat production in the works (Module A3) contributes around 11 % to fossil GWP.

6.2 Ozone depletion potential (ODP)

55 % of ODP occurs mainly through the provision of plastic components (Module A1). 42 % of ODP is attributable to the provision of paper and cardboard as packaging material (Module A3).

6.3 Acidification potential (AP)

Emissions with acidification potential are distributed across Module A1 as the provision of wood as raw material with 24 % and non-wood components with 38 %. In Module A3, electricity consumption (16 %) and heat production (15 %) contribute mainly to acidification potential.

6.4 Eutrophication potential (EP)
25 % of total eutrophication potential is attributable to processes for providing adhesives and additives and a further 33 % to the provision of raw wood material (both Module A1). Electricity consumption for the production process contributes 12 % and heat production in the works 20 % to eutrophication potential (both Module A3).

6.5 Formation potential for tropospheric ozone photochemical oxidants (POCP) Positive POCP contributions of 52 % are mainly caused by provision of the raw wood material and above all by chip drying and adhesive hardening (Module A1). Provision of the non-wood components (Module A1) contributes 17 % and heat production in the works (Module A3) 20 % to POCP. The negative values for POCP in Module A2 are attributable to the negative characterisation factor for carbon monoxide emissions of /EN 15804+A1/-compliant CML-IA Version (2001-Apr. 2013) in combination with the currently used truck transport process in the */GaBi Professional Database 2019/* for modelling the transport processes. They influence total emissions by -1 %.

6.6 Abiotic depletion potential for non-fossil resources (ADPE)
ADPE at 99 % is almost completely attributable to the provision of fittings (Module A1).

6.7 Abiotic depletion potential for fossil resources (ADPF)
41 % of the total eutrophication potential is attributable to the provision of non-wood components and 27 % to the provision of raw wood material (both Module A1). In Module A3, electricity consumption in the works at 14 % and heat production at 11 % further influence the overall ADPF.

6.8 Renewable primary energy as energy carrier (PERE)
45 % of PERE use is attributable to incinerating wood to produce heat and 16 % to electricity consumption in the works (both Module A3). In addition, the provision of non-wood components contributes 19 % and the provision of raw wood materials 10 % to PERE use (both Module A1).

6.9 Non-renewable primary energy as energy carrier (PENRE)
40 % of PENRE use is attributable to the provision of non-wood components 27 % to the provision of raw wood materials (both Module A1). As the largest influence in Module A3, electricity consumption in the works causes some 17 % of total PENRE whilst heat production, also in Module A3, is responsible for some 11 %.

6.10 Waste
6 % of special waste accrues through the provision of the raw wood materials (Module A1), whereby diesel consumption in the forest pre-chain and adhesive and additives used contribute a large proportion of this load. A further 81 % of special waste (Module A1) accrues through the provision of non-wood components, particularly plastic components, and 8 % come from the use of operating materials in the works (Module A3).

6.11 Range of results
The individual results of the participating companies differ from the average results in the environmental product declaration. Maximum deviations of +347 %/-23 % (GWP_{fossil}), +219 %/- 92 % (ODP), +335 %/-23 % (AP), +270 %/-23 % (EP), +197 %/-17 % (POCP), +426 %/- 47 % (ADPE) and +306 %/-23 % (ADPF) per declared unit in relation to the results described in Chapter 5 were calculated. The cause of the partly large deviations is the inclusion of functional door manufacture in the average calculation.

6.12 Difference to previous versions of the EPD
The new weighting by means of current production quantities from 2017 merely leads to a slight displacement of the environmental effect indicators (+/-5 %) in the weighted average and the energy used. The influence of the update to the background system for these indicators on the updating of the background database is significantly higher, rendering indicators like ODP (-99.9 %) no longer comparable to the old version of the EPD. Overall, the following changes have ensued (total of Modules A1-A3) which are mainly attributable to the update of the background system:
GWP: -30 %; ODP: -99.9 %; AP: -38 %; EP: -33 %; POCP: -37 %; ADPE: -13 %; ADPF: +4 %; PERE: +/-0 %; PENRE: -49 %.

7. Requisite evidence

7.1 Formaldehyde
Interior doors contain wood-based materials such as supporting plates whose adhesive systems also contain forrmaldehyde. The manufacturers of these wood-based materials bear responsibility for compliance with national requirements for formaldehyde emissions in accordance with the Chemicals Prohibition Act. The new analytical prescriptions for formaldehyde emissions (Federal Gazette dated 26/11/2018 Appendix 1 - so-called E05 standard in accordance with N 717-1 from 01/01/2020) refer to wood-based materials and thus lie within the area of responsibility of wood-based product manufacturers.

7.2 MDI
MDI can be present in subproducts; the manufacturer is responsible for the corresponding subproducts.

7.3 Test for the pre-treatment of raw materials
Interior doors can contain waste wood as particle board as a subproduct. Compliance with the requirements of the Waste Wood Ordinance is the responsibility of the manufacturer of the corresponding supporting plates.

7.4 Toxicity of flue gases

Checks in accordance with */DIN 53436/ are the responsibility of the raw wood material manufacturer.* Compliance with the requirements is verified to the interior door manufacturer by means of corresponding test certificates and technical documentation from the supplier.

7.5 VOC emissions

Indoor pollution through VOC emissions has been investigated on a broad scale in a research project (final report of *AiF Project 16210 N* - Investigation of interior air-relevant emissions from interior doors to evaluate the behaviour of building products in relation to hygiene, health and environmental protection).

All interior door variants which were investigated (door leaves, doorframes) fulfilled the requirements of the AgBB schema which was relevant at the time: “All interior door variants investigated (door leaves, doorframes) fulfil the requirements of the AgBB schema - the corresponding threshold values were very clearly complied with by a large margin without exception (including as door leaf and doorframe combinations)”.

The Fraunhofer Wilhelm-Klauditz Institute confirmed on 22/11/2019 that the test samples investigated for *AiF Project 16210 N* also fulfilled the emissions requirements of the currently valid *MVV TB 2017/1* Appendix 8, Requirements of Buildings with Regard to Health Protection (ABG)

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/DIN EN 1192:2000-06/: Doors - Classification of strength requirements

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/DIN EN 14351-1/: Windows and doors - Product standard, performance characteristics

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Further literature

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Processes for sampling and investigations for substances and substance groups named in Appendix 1 of the Chemicals Prohibition Ordinance

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Candidate list of substances of very high concern for authorisation (date: 27/06/2018) in accordance with Article 59 Paragraph 10 of the /REACH/ regulations. European Chemicals Agency.

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