ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025 and EN 15804

Declaration holder	**Überwachungsgemeinschaft Konstruktionsvollholz e.V.**
Publisher	Institut Bauen und Umwelt (IBU)
Programme holder	Institut Bauen und Umwelt (IBU)
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KVH® structural timber

Überwachungsgemeinschaft Konstruktionsvollholz e.V.

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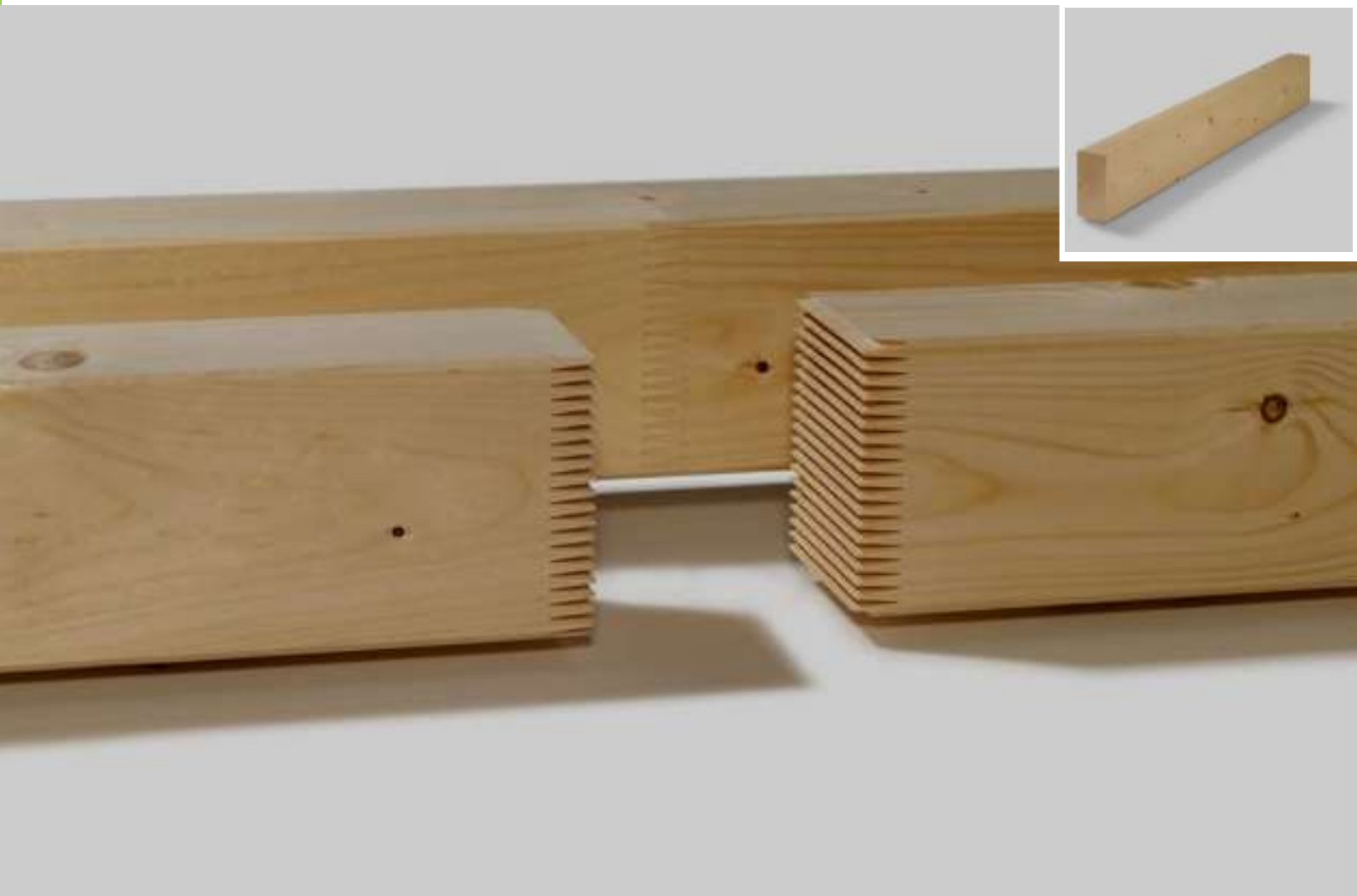

1 General information

Überwachungsgemeinschaft Konstruktionsvollholz e.V.	KVH® structural timber
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 D-10178 Berlin	**Holder of the Declaration** Überwachungsgemeinschaft Konstruktionsvollholz e.V. Elfriede-Stremmel-Straße 69 D-42369 Wuppertal
Declaration number EPD-ÜKH-2012111-EN	**Declared product/unit** 1 m³ KVH® structural timber
This Declaration is based on the Product Category Rules: PCR Part B Structural Timber, 29.06.2011 (PCR examined and approved by the independent Expert Committee, SVA)	**Area of applicability:** In Germany, approx. 2.3 million m³ of structural finger-jointed timber were manufactured in 2011, of which 1.6 million m³ were accounted for by members of Überwachungsgemeinschaft Konstruktionsvollholz e.V. The contents of this Declaration are based on information from 69% of the members, whereby the technology presented here is representative for all members.
Issue date 20.09.2017	**Verification** The CEN DIN EN 15804 standard serves as the core PCR. Verification of the EPD by an independent third party in accordance with ISO 14025 ☐ internal ☒ external
Valid to 19.09.2018	

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Dr. Frank Werner
(Independent verifier appointed by the SVA)

2 Product

2.1 Product description

KVH® structural timber is an industrially-manufactured product for load-bearing purposes. It comprises squared structural finger-jointed timber, i.e. jointed lengthwise by glued finger joints, or squared structural timber without finger joints from coniferous species subject to requirements which go over and beyond the regulations set by the building authorities. The manufacturing process corresponds with that of lamellas for glued laminated timber, whereby larger individual cross-sections are jointed together.

Owing to tighter specifications regarding cutting and moisture content, KVH® structural timber is very dimensionally stable and only tends to display minor cracks. KVH® structural timber can be manufactured with increased requirements on the surface quality than conventional structural timber with or without finger joints.

Apart from the quality control required by regulations set by the building authorities, manufacturing is also subject to supplementary private monitoring in accordance with the provisions of Überwachungsgemeinschaft Konstruktionsvollholz e.V..

2.2 Application

KVH® structural timber is used as load-bearing components in structural engineering and bridge-building construction.

2.3 Technical Data

KVH® structural timber is manufactured from spruce, fir, pine, larch or Douglas fir.

Adhesives in accordance with 2.6 are used for gluing.

KVH® structural timber is manufactured with a maximum moisture content of 18%.

KVH® structural timber is supplied with sizes in accordance with 2.5 and maximum deviations in sizes as per the agreement on KVH® structural timber by Überwachungsgemeinschaft Konstruktionsvollholz e.V..

The typical strength class to DIN 1052: 2008, *Design of timber structures - General rules and rules for buildings* is C24.

The products can be manufactured in accordance with the agreement on KVH® structural timber in Si (for surfaces remaining observable) or NSi (for surfaces not remaining observable) surface qualities.

The use of a preservative treatment in accordance with DIN 68800-3:2012-02, *Wood preservation* -

Part 3: Preventive protection of wood with wood preservatives is not typical as in most cases, preventive constructural measures in accordance with DIN 68800-2:2012-02, *Wood preservation - Part 2: Preventive constructional measures in buildings* are sufficient.

2.4 Placing on the market / Application rules

KVH® structural timber without finger-joints must comply with the requirements on structural timber in accordance with DIN EN 14081-1:2011-05, *Timber structures – Strength-graded structural timber with rectangular cros- section - Part 1: General requirements.*

The regulations from DIN 20000-5:2012-03, *Application of construction products in structures - Part 5: Strength-graded structural timber with rectangular cross-section* must be observed for applications in Germany.

KVH® structural finger-jointed timber must comply with the requirements on structural finger-jointed timber in accordance with DIN 1052: 2008.

Furthermore, all KVH® structural timber must comply with supplementary private provisions of the agreement on KVH® structural timber.

2.5 Delivery status

The products are manufactured in the following preferred dimensions:

Min. height:	100 mm
Max. height:	240 mm
Min. width:	60 mm
Max. width:	140 mm
Storage lengths:	13 m (for finger-jointed KVH®, longer lengths possible on request)

2.6 Base materials / Auxiliaries

KVH® structural timber comprises kiln-dried coniferous wood planks or squared timber, if finger-jointed, jointed with the fibres running in parallel. Polyurethane (PUR) or melamine-urea-formaldehyde (MUF) adhesives are essentially used for basic duroplastic gluing. In very rare cases, phenol-resorcinal-formaldehyde (PRF) adhesives are used.

The percentages of ingredients per m² KVH® structural timber established for the Environmental Product Declaration (rounded to two decimal points):

- Coniferous wood, primarily spruce: approx. 89.20%
- Water: approx. 10.70%
- PUR adhesives: approx. 0.04%
- MUF adhesives: approx. 0.06%

The product has an average gross density of 492.71 kg/m³.

No adhesive is used for KVH® structural timber. The gross density is 490.13 kg/m³ with a moisture content of 10.71%.

2.7 Manufacture

The manufacture of KVH® structural timber involves drying conventional sawn timber to less than 18% moisture content, followed by pre-planing and visual or machine-strength grading. Sections identified as having strength-reduced areas are removed depending on the requisite strength class. In the case of KVH® structural finger-jointed timber, the ensuing sawn wood sections are jointed to form lamellas of infinite length by means of finger-jointed connections. After hardening (or after removal of the defective areas in the case of non-finger-jointed KVH® structural timber), the cross-sections are planed, bevelled, bound and packed. Preservative treatment is possible if necessary.

2.8 Environment and health during manufacturing

Waste air generated during production is cleaned in accordance with statutory specifications. Water and soil do not incur any pollution. The waste water incurred is fed into the local waste water system.

2.9 Product processing / Installation

KVH® structural timber can be processed using the standard tools suitable for processing solid wood.

The information concerning industrial safety must also be observed during processing/assembly.

2.10 Packaging

Polyethylene,, metal, solid wood, paper and cardboard, and smaller quantities of other plastics are used.

2.11 Condition of use

Composition for the period of use complies with the compilation of base materials in accordance with section 2.6 "Base materials".

During usage, around 219 kg of carbon are bound in the product. This complies with approx. 805 kg of CO_2.for full oxidation.

2.12 Environment and health during use

Environmental protection: In accordance with the current state of knowledge, no hazards are incurred for water, air or soil when the products are used as designated.
Health protection: In accordance with the current state of knowledge, no damage to or impairments of health are to be anticipated.
With regard to formaldehyde, KVH® structural timber is low-emission thanks to its adhesive content, structure and form of use.

KVH® structural finger-jointed timber glued with MUF adhesives emits formaldehyde subsequently. In terms of the limit value of 0.1 ml/m³ specified in the Chemical Restriction Regulation, the values can be classified as very low after testing (prEN 15497:2011-09, *Structural finger-jointed solid timber - Performance requirements and minimum production requirements*).

KVH® structural timber without finger joints or KVH® structural finger-jointed timber glued with PUR or EPI adhesives display formaldehyde emission values in accordance with prEN 15497: 2011 in the range of natural wood (approx. 0.004 ml/m^3).

MDI emissions by KVH® structural finger-jointed timber glued with PUR or EPI adhesives can not be measured within the framework of the detection limit of 0.05 µg/m³. On account of the high reactivity of MDI towards water (air and wood moisture), it can be assumed that KVH® structural finger-jointed tim-

ber glued this way already displays MDI emissions in the zero-value range shortly after manufacture.

2.13 Reference service life

In terms of its components and manufacturing, KVH® structural timber complies with glued laminated timber lamellas. Glued laminated timber has been used for more than 100 years.

When used as designated, there is no known or anticipated limit to its durability.

The service life of KVH® structural timber is therefore in line with the service life of the respective building when used as designated.

2.14 Extraordinary effects

Fire

- Fire class D in accordance with DIN EN 13501-1
- Smoke class s2 – normal smoke development
- d0 – non-dripping
- The toxicity of combustion gases complies with that of natural wood.

Water

No ingredients are washed out which could be hazardous to water.

Mechanical destruction

KVH® structural timber breakage features display an appearance which is typical for solid wood.

2.15 Re-use phase

In the event of selective rebuilding after the end of the usage phase, KVH® structural timber can be easily re-used.

If KVH® structural timber can not be recycled, it is directed towards thermal recycling for generating process heat and electricity on account of its high calorific value of approx. 19 MJ/kg.

In the case of energetic recycling, the requirements outlined in the German Pollution Act must be observed. In accordance with Annex III of the directive governing requirements on recycling and disposing of waste wood (Waste Wood Act) dated 15.08.2002, untreated KVH® structural timber is allocated to waste key 17 02 01 (depending on the type of wood protection agent used, treated KVH® structural timber is allocated to waste key 17 02 04).

2.16 Disposal

Waste wood may not be used for landfilling in accordance with §9 of the Waste Wood Act (AltholzV).

2.17 Further information

More detailed information can be found at www.kvh.de.

3 LCA: Calculation rules

3.1 Declared unit

The declared unit under ecological review is

1. One m³ non-finger-jointed KVH® structural timber with a mass of 490.13 kg/m³, wood moisture of 12% and a water content of 10.714%

2. One m³ KVH® structural finger-jointed timber taking consideration of the mix of adhesives used in accordance with 2.6 and a mass of 492.71 kg/m³, wood moisture of 12%, water content of 10.703% and 0.101% adhesive content.

3.2 System limit

The Declaration type conforms with an EPD "from cradle to factory gate with options". Contents include the stage of production, i.e. from the provision of raw materials to the production gate (cradle to gate, Modules A1 to A3), as well as parts of the end-of-life stage (Modules C2 to C4). Furthermore, the credits and encumbrances are considered over and beyond the product life cycle (Module D).

Module A1 analyses the provision of wood from forestry, the provision of additional modified wood products as well as the provision of adhesives. Transport of these materials is considered in Module A2. Module A3 comprises the provision of fuels, operating resources and electricity as well as the manufacturing processes on site. These essentially involve debarking, cutting, drying, planing and profiling processes as well as gluing and packing the products.

Module C2 takes consideration of transport to the disposal company; Module C3 deals with preparing and sorting the waste wood; Module D analyses thermal recycling as well as the ensuing credits in the form of a system extension.

3.3 Estimates and assumptions

As a general rule, all material and energy flows for the processes required for production are established specifically on site. The emissions from incineration and other processes arising on site could only however be estimated on the basis of literary references. All other data is based on average values. Detailed information on all estimates and assumptions made can be referenced in (S. Rüter, S. Diederichs: 2012).

3.4 Cut-off criteria

The choice of material and energy flows considered depends on their use of renewable and non-renewable primary energy per unit process. A decision on the flows to be observed is the result of existing studies for analysing wood products. At least those material and energy flows were assessed which account for 1% of the use of renewable or non-renewable primary energy, whereby the total sum of flows not considered is not greater than 5% of the indicators referred to. No material or energy flows already detected have been ignored which fell below the 1% limit.

The inputs and outputs arising from information provided by the company were examined for plausibility.

The expenses associated with providing the infrastructure (i.e. machinery, buildings etc.) for the entire primary system were not taken into consideration. This is based on the assumption that the total expenses associated with building and maintaining the infrastructure do not exceed the 1% of overall expenses referred to above. The energetic expens-

es in the form of heat and electricity required for operating the infrastructure were taken into consideration. Detailed information on the cut-off criteria can be found in (S. Rüter, S. Diederichs: 2012).

3.5 Background data

All background data has been taken from the GaBi Professional data base.

3.6 Data quality

With the exception of forest wood, the background data used for wooden raw materials for material and energetic use originates from the years 2008 to 2010. The power mix originates from 2009; the provision of forest wood was taken from a publication dated 2008 which is essentially based on information from the years 1994 to 1997. All other information was taken from the GaBi Professional data base which does not permit any exact containment of quality. As the essential information originates from highly-representative primary data surveys, the data quality can be rated as very good.

3.7 Period under review

The data survey was performed over a period from 2009 to 2011, whereby data was established for the respective full calendar year. The data is therefore based on the years 2008 to 2010. Hence, all information is based on the data for 12 consecutive months.

3.8 Allocation

The allocations performed comply with the requirements outlined in EN 15804:2012 and are explained in detail in (S. Rüter, S. Diederichs: 2012). Essentially, the following system area extensions and allocations were performed.

General information

All properties inherent to materials were allocated in accordance with physical causalities; all other allocations were performed on an economic basis. An exception is presented by the allocation of heat required in heat and power combinations which were allocated on the basis of exergy of electricity and process heat products.

Module A1

- Forestry: Forestry expenses were allocated to logs and industrial wood on the basis of their prices.
- The provision of waste wood does not take consideration of any expenses from the previous life cycle.

Module A3

- Wood-processing industry: Expenses were allocated to the primary products and residuals on the basis of their prices.
- With the exception of wood-based materials, the waste incurred by disposal in production is based on a system extension. The heat and electricity generated are credited to the system via substitution processes. The credits achieved here are significantly less than 1% of the overall expenses.
- In the case of combined generation of heat and electricity, all firing expenses were allocated to these two products after exergy.
- The provision of waste wood does not take consideration of any expenses from the previous life cycle. (analogue to Module A1)

Module D

The system area extension performed in Module D complies with an energetic recycling scenario for waste wood.

3.9 Comparability

As a general rule, EPD data can only be compared or evaluated when all of the data records to be compared have been drawn up in accordance with EN 15804:2012 and the building context or product-specific performance features are taken into consideration.

4 LCA: Scenarios and further technical information

End of life (C2-C4)

For energy recovery	Waste wood 490.13 kg
and	
For energy recovery	Waste wood 492.71 kg

In the form of waste wood, the product is recycled at the end of the life cycle in the same composition as the declared unit described. 23% thermal recycling is assumed in a biomass power plant with a total supply level of 35% and combined heat and power efficiency of 35%, whereby for one tonne of wood (atro) (with approx. 18% moisture), approx. 1231 kWh electricity and 2313 MJ useful heat are generated during incineration.

Reuse, recovery and recycling potential (D)

The exported energy substitutes fossil fuels, whereby it is alleged that the thermal energy was generated from natural gas and the substituted electricity complies with the German power mix for 2009.

5 LCA: Results

Non-finger-jointed KVH® structural timber

SYSTEM LIMITS (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)																
Production stage			Building construction stage		Usage phase							Disposal stage				Credits and encumbrances outside the system limit
Provision of raw materials	Transport	Manufacture	Transport to the site	Installation in the building	Use / Application	Maintenance	Repairs	Substitution	Renewal	Energy used for operating the building	Water used for operating the building	Rebuilding / Demolition	Transport	Waste treatment	Landfilling	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

LIFE CYCLE ASSESSMENT RESULTS – ENVIRONMENTAL EFFECTS: 1m³ structural timber, non-finger-jointed

	Production			Disposal			Credit
Parameter	**Unit**	**A1**	**A2**	**A3**	**C2**	**C3**	**C4**	**D**
GWP	[kg CO_2 equiv.]	-7.77E+02	9.45E+00	3.77E+01	4.39E-01	8.06E+02	0.00E+00	-3.58E+02
ODP	[kg CFC11 equiv.]	2.01E-06	3.27E-08	7.61E-06	8.78E-10	1.19E-06	0.00E+00	-8.17E-05
AP	[kg SO_2 equiv.]	1.48E-01	4.12E-02	2.08E-01	1.89E-03	6.98E-03	0.00E+00	-3.69E-01
EP	[kg PO_4^3 equiv.]	3.20E-02	9.44E-03	4.05E-02	4.37E-04	5.89E-04	0.00E+00	-3.78E-03
POCP	[kg ethene equiv.]	2.94E-02	4.24E-03	6.40E-02	2.04E-04	4.64E-04	0.00E+00	-2.49E-02
ADPE	[kg Sb equiv.]	2.63E-04	2.76E-07	7.19E-04	9.27E-09	1.23E-07	0.00E+00	-1.95E-05
ADPF	[MJ]	3.01E+02	1.32E+02	4.17E+02	6.20E+00	4.62E+01	0.00E+00	-4.05E+03

Legend	GWP = Global Warming Potential; ODP = Ozone Depletion Potential; AP = Acidification Potential; EP = Eutrification Potential; POCP Ozone Creation Potential; ADPE = Abiotic Depletion Potential for Non-fossil Resources; ADPF = Abiotic Depletion Potential for Fossil Fuels

LIFE CYCLE ASSESSMENT RESULTS – USE OF RESOURCES: 1 m³ structural timber, non-finger-jointed

	Production			Disposal			Credit
Parameter	**Unit**	**A1**	**A2**	**A3**	**C2**	**C3**	**C4**	**D**
PERE	[MJ]	4.03E+02	2.15E-01	1.05E+03	8.21E-03	4.70E+00	0.00E+00	-3.34E+02
PERM	[MJ]	8.43E+03	0.00E+00	7.51E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	[MJ]	8.84E+03	2.15E-01	1.12E+03	8.21E-03	4.70E+00	0.00E+00	-3.34E+02
PENRE	[MJ]	3.69E+02	1.33E+02	6.76E+02	6.23E+00	8.78E+01	0.00E+00	-7.09E+03
PENRM	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	[MJ]	3.69E+02	1.33E+02	6.76E+02	6.23E+00	8.78E+01	0.00E+00	-7.09E+03
SM	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	[MJ]	3.08E+01	0.00E+00	3.11E+02	0.00E+00	0.00E+00	0.00E+00	4.25E+03
NRSF	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	[m³]	6.09E+02	3.08E+00	4.17E+02	1.17E-01	4.99E+01	0.00E+00	3.34E+03

Legend	PERE = Primary Energy, Renewable; PERM = Primary energy, non-renewable; PERT = Primary energy, renewable, total; PENRE = Primary energy, non-renewable; PENRM = Primary energy, non-renewable, for material usage; PENRT = Primary energy, non-renewable, total; SM = Use of secondary materials; RSF = Renewable secondary fuels; NRSF = Non-renewable secondary fuels; FW = Use of fresh water resources

LIFE CYCLE ASSESSMENT RESULTS - OUTPUT FLOWS AND WASTE CATEGORIES: 1 m³ structural timber, non-finger-jointed

	Production			Disposal			Credit
Parameter	**Unit**	**A1**	**A2**	**A3**	**C2**	**C3**	**C4**	**D**
HWD	[kg]	8.15E-03	0.00E+00	2.52E-02	0.00E+00	0.00E+00	0.00E+00	1.47E+00
NHWD	[kg]	1.14E-02	0.00E+00	1.70E-02	0.00E+00	0.00E+00	0.00E+00	1.37E-02
RWD	[kg]	2.44E-02	4.09E-04	9.26E-02	1.10E-05	1.49E-02	0.00E+00	-1.01E+00
CRU	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.90E+02	0.00E+00	0.00E+00
MER	[kg]	0.00E+00	0.00E+00	3.90E+00	0.00E+00	4.90E+02	0.00E+00	-4.94E+02
EE electricity	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE heat	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Legend	HWD = Hazardous waste for landfilling; NHWD = Non-hazardous waste disposed of; RWD = Radioactive waste disposed of; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy per type

KVH® structural finger-jointed timber

SYSTEM LIMITS (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

Production stage			Building construction stage		Usage phase							Disposal stage				Credits and encumbrances outside the system limit
Provision of raw materials	Transport	Manufacture	Transport to the site	Installation in the building	Use / Application	Maintenance	Repairs	Substitution	Renewal	Energy used for operating the building	Water used for operating the building	Rebuilding / Demolition	Transport	Waste treatment	Landfilling	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

LIFE CYCLE ASSESSMENT RESULTS – ENVIRONMENTAL EFFECTS: 1 m³ structural finger-jointed timber

	Production	Disposal	Credit

Parameter	Unit	A1	A2	A3	C2	C3	C4	D
GWP	[kg CO_2 equiv.]	-7.67E+02	6.52E+00	4.83E+01	4.42E-01	8.09E+02	0.00E+00	-3.65E+02
ODP	[kg CFC11 equiv.]	3.81E-06	3.63E-08	1.07E-05	8.83E-10	1.19E-06	0.00E+00	-8.33E-05
AP	[kg SO_2 equiv.]	2.26E-01	2.86E-02	2.18E-01	1.90E-03	6.98E-03	0.00E+00	-3.75E-01
EP	[kg PO_4^3 equiv.]	4.82E-02	6.47E-03	3.99E-02	4.39E-04	5.89E-04	0.00E+00	-3.67E-03
POCP	[kg ethene equiv.]	5.05E-02	2.96E-03	5.43E-02	2.05E-04	4.64E-04	0.00E+00	-2.51E-02
ADPE	[kg Sb equiv.]	5.56E-04	1.76E-07	8.62E-05	9.32E-09	1.23E-07	0.00E+00	-6.34E-06
ADPF	[MJ]	4.58E+02	9.12E+01	5.35E+02	6.23E+00	4.62E+01	0.00E+00	-4.11E+03

Legend	GWP = Global Warming Potential; ODP = Ozone Depletion Potential; AP = Acidification Potential; EP = Eutrification Potential; POCP Ozone Creation Potential; ADPE = Abiotic Depletion Potential for Non-fossil Resources; ADPF = Abiotic Depletion Potential for Fossil Fuels

LIFE CYCLE ASSESSMENT RESULTS – USE OF RESOURCES: 1 m³ structural finger-jointed timber

	Production	Disposal	Credit

Parameter	Unit	A1	A2	A3	C2	C3	C4	D
PERE	[MJ]	8.59E+02	2.49E-01	9.95E+02	8.25E-03	4.70E+00	0.00E+00	-3.35E+02
PERM	[MJ]	8.47E+03	0.00E+00	3.79E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	[MJ]	9.33E+03	2.49E-01	1.03E+03	8.25E-03	4.70E+00	0.00E+00	-3.35E+02
PENRE	[MJ]	5.82E+02	9.24E+01	9.05E+02	6.26E+00	8.78E+01	0.00E+00	-7.14E+03
PENRM	[MJ]	4.98E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	[MJ]	5.87E+02	9.24E+01	9.05E+02	6.26E+00	8.78E+01	0.00E+00	-7.14E+03
SM	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	[MJ]	6.60E+01	0.00E+00	1.13E+02	0.00E+00	0.00E+00	0.00E+00	4.27E+03
NRSF	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	[m³]	7.22E+02	2.68E+00	5.12E+02	1.17E-01	4.99E+01	0.00E+00	3.40E+03

Legend	PERE = Primary Energy, Renewable; PERM = Primary energy, non-renewable; PERT = Primary energy, renewable, total; PENRE = Primary energy, non-renewable; PENRM = Primary energy, non-renewable, for material usage; PENRT = Primary energy, non-renewable, total; SM = Use of secondary materials; RSF = Renewable secondary fuels; NRSF = Non-renewable secondary fuels; FW = Use of fresh water resources

LIFE CYCLE ASSESSMENT RESULTS – OUTPUT FLOWS AND WASTE CATEGORIES: [1 m³ structural finger-jointed timber]

	Production	Disposal	Credit

Parameter	Unit	A1	A2	A3	C2	C3	C4	D
HWD	[kg]	2.30E-02	0.00E+00	2.02E-02	0.00E+00	0.00E+00	0.00E+00	1.50E+00
NHWD	[kg]	2.43E-02	0.00E+00	7.66E-03	0.00E+00	0.00E+00	0.00E+00	4.52E-05
RWD	[kg]	4.61E-02	4.54E-04	1.32E-01	1.10E-05	1.49E-02	0.00E+00	-1.04E+00
CRU	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.93E+02	0.00E+00	0.00E+00
MER	[kg]	0.00E+00	0.00E+00	1.97E+00	0.00E+00	4.93E+02	0.00E+00	-4.95E+02
EE electricity	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE heat	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Legend	HWD = Hazardous waste for landfilling; NHWD = Non-hazardous waste disposed of; RWD = Radioactive waste disposed of; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy per type

6 LCA: Interpretation

6.1 General information

The results are interpreted on the basis of the results for structural finger-jointed timber as they are higher overall. The interpretation essentially focuses on the production phase (Modules A1 to A3) as it is based on specific company data. To this aim, the results established in Modules A1 to A3 are summarised and put in the context of national emissions. The relevance of the global warming potential (GWP) for globally effective emissions and that of the acidification potential (AP) and the potential formation of summer smog (POCP) becomes apparent for the emissions with local effects (Fig. 1).

(*) Standardisation of the greenhouse gas potential performed here exclusively relates to the emissions from fossil sources. The three essential indicators referred to here are outlined in more detail below.

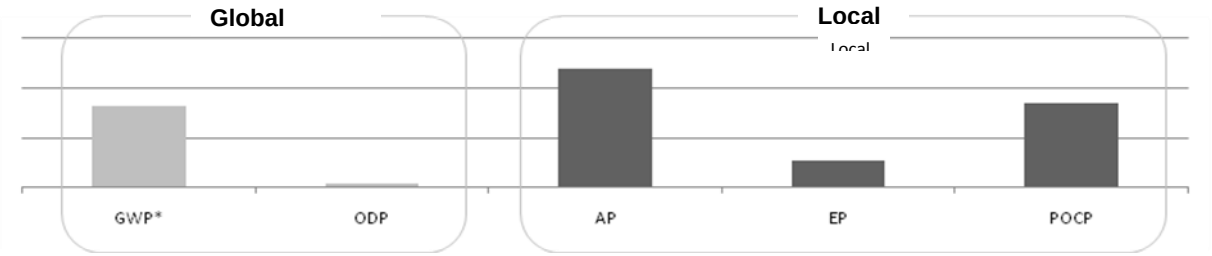

Fig. 1: Relative extent of impact indicators after standardisation to overall German emissions

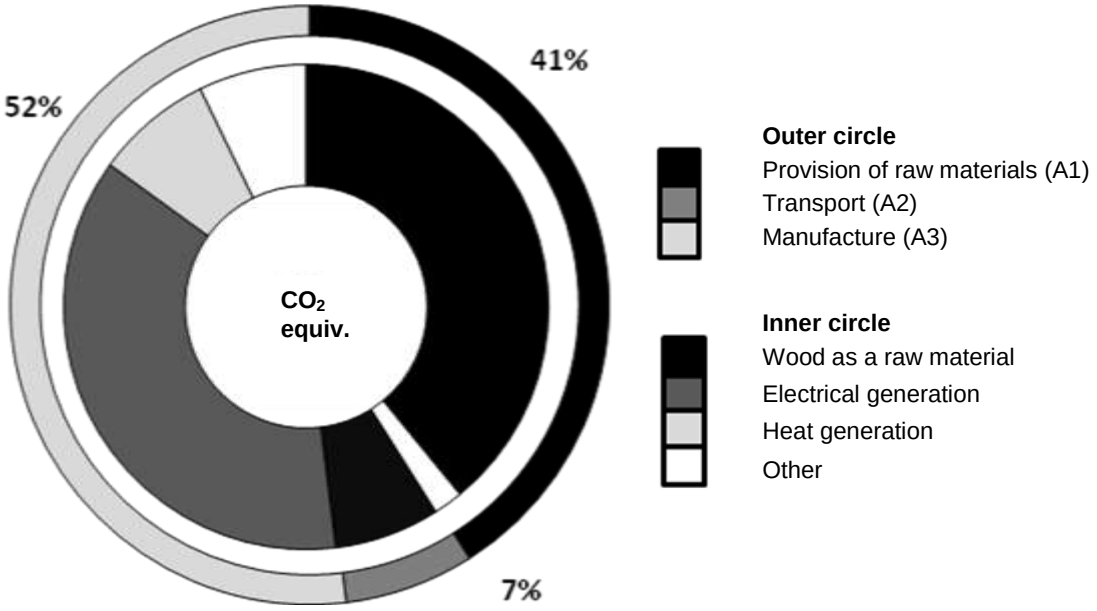

Fig. 2: Sources of fossil greenhouse gas emissions by module

Of the fossil greenhouse gases analysed in Modules A1 to A3, 41% is attributed to the provision of raw materials, 7% is accounted for by transport and 52% by manufacture, whereby the provision of wooden raw materials also includes extensive areas of the finishing chain as the corresponding finished products are bought in for production. Electricity consumption in the plant is an essential influential factor (35%). The contribution made by transporting the raw materials, generating heat and other emissions essentially comprising the combustion of diesel fuel on the plant site each account for 17% of cradle-to-gate emissions (Fig. 2). Fig. 3 depicts an analysis of carbon from biomass. In total, approx. 990 kg CO_2 enter the system in the form of carbon stored in biomass, of which 80 kg CO_2 are emitted along the preliminary chains and 101 kg CO_2 are emitted within the framework of heat generation on site. Approx. 4 kg CO_2 are directed to the system via packaging and re-emitted within the framework of packaging disposal. The carbon ultimately stored in the structural timber is withdrawn again from the system during recycling in the form of waste wood.

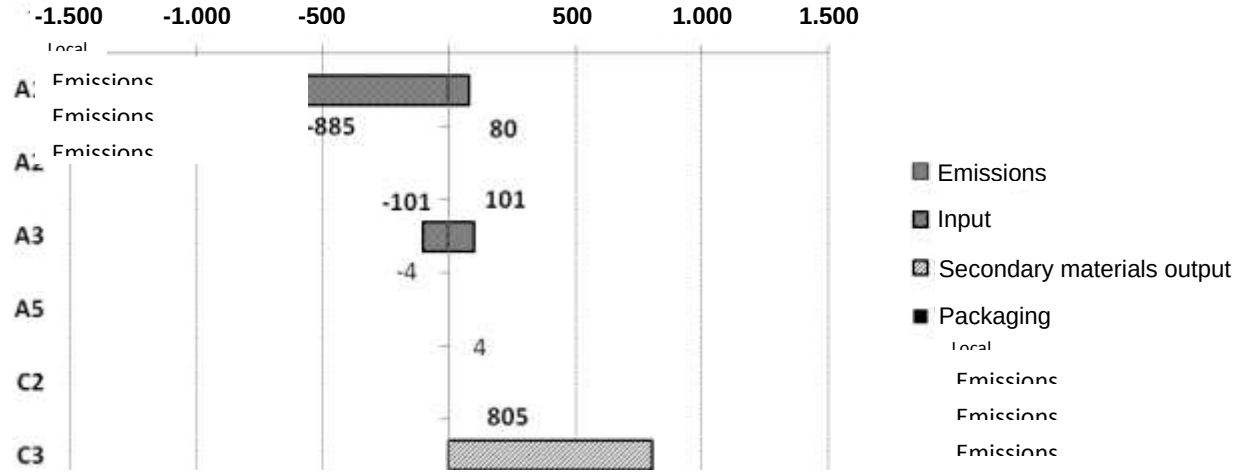

Fig. 3: Analysis of carbon flows from wooden raw materials and products

6.2 Acidification potential

The combustion of wood and diesel are essentially the relevant sources for emissions making a potential contribution towards the acidification potential. Drying bought-in products as well as the provision of heat required for this process and the use of fuels in forestry ensure a relatively high contribution by Module A1 (48%). In comparison, the emissions incurred by the provision of adhesives are insignificant (1%). Accounting for 6%, the transport of raw materials only accounts for a low percentage of overall cradle-to-gate emissions. Within the framework of manufacturing on site (A3), the provision of heat (25%) and electricity consumption (11%) play an essential role.

6.3 Summer smog formation potential

Emissions contributing towards the formation of near-ground ozone are primarily incurred during the wood drying process. Nitric oxides from combustion processes also play a role, whereby 32% of emissions are incurred by drying on site. Furthermore, essential percentages originate in the drying processes associated with the preliminary chains. Transport expenses only play a minor role.

6.4 Use of primary energy

Renewable fuels are primarily used in the form of wood for generating process heat. Of a total of 2034 MJ, 179 MJ is attributable to the incineration of waste wood.

Non-renewable energy is primarily used for generating electricity and in the form of fuels for the transport processes. Smaller quantities are also required for the manufacture of adhesives.

6.5 Range of results

The individual results of the participating companies are distinguished from the average results in the Environmental Product Declaration. In total, deviations of +33%/-20%, +25%/-15% and +17%/-11% were measured in relation to the results described here for the three indicators GWP, AP and POCP, respectively. These deviations are primarily attributable to differences in the fuels used and specific electricity consumption levels incurred by the various processes.

7 Requisite evidence

7.1 Formaldehyde

The formaldehyde emissions by KVH® structural finger-jointed timber are established in accordance with prEN 15497:2011, with reference to DIN EN 717-1:2005-01, *Wood-based panels - Determination of formaldehyde release - Part 1: Formaldehyde emission by the chamber method*. prEN 15497:2011 specifies a test with a ratio of loading of 0.3 m²/m³ for KVH® structural timber.

Emission values are not available for KVH® structural finger-jointed timber glued with adhesives containing formaldehyde. The values for glued laminated timber tested with a higher percentage of adhesives containing formaldehyde are approx. one-tenth of the limit value in accordance with the Chemical Restriction Regulation (0.1 ml HCHO/m^3 indoor air). A value which is significantly below the limit value in accordance with the Chemical Restriction Regulation can therefore be assumed for structural finger-jointed timber.

Emission values by KVH® structural timber glued with adhesives which do not contain formaldehyde or by KVH® structural timber without finger-joints incur area-specific emission rates in the area of unglued wood.

7.2 MDI

During the KVH® structural finger-jointed timber gluing process, the MDI contained in the moisture-binding single-component polyurethane adhesives used is cured in full. MDI emissions from the cured KVH® structural timber are therefore not possible; there is no test standard in place.

In tests based on the measuring method for determining formaldehyde emissions from DIN EN 717-2,

Wood-based panels - Determination of formaldehyde release - Part 2: Formaldehyde release by the gas analysis method, MDI emissions can not be detected (detection limit: 0.05 µg/m³).

7.3 VOC emissions

Evidence of VOC is optional when the EPD is valid for a shorter period of time.

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