ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	**Überwachungsgemeinschaft Konstruktionsvollholz e.V.**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-SHL-20180036-IBG1-EN
Issue date	18.09.2018
Valid to	17.09.2023

KVH® structural timber

Überwachungsgemeinschaft Konstruktionsvollholz e.V.

Institut Bauen und Umwelt e.V.

www.ibu-epd.com / https://epd-online.com

1. General Information

Überwachungsgemeinschaft Konstruktionsvollholz e.V.	KVH® structural timber
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the declaration** Überwachungsgemeinschaft Konstruktionsvollholz e.V. Heinz-Fangman-Straße 2 42287 Wuppertal
Declaration number EPD-SHL-20180036-IBG1-EN	**Declared product / declared unit** 1m³ KVH® structural timber
This declaration is based on the product category rules: Solid wood products, 07.2014 (PCR checked and approved by the SVR)	**Scope:** The content of this Declaration is based on information provided by 69% of members of Überwachungsgemeinschaft Konstruktionsvollholz e.V., whereby the technology presented here is representative for all members. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Issue date 18.09.2018	
Valid to 17.09.2023	**Verification** The standard /EN 15804/ serves as the core PCR Independent verification of the declaration and data according to /ISO 14025:2010/ ☐ internally ☒ externally
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	
Dipl. Ing. Hans Peters (Head of Board IBU)	Matthias Klingler (Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

KVH® structural timber is an industrially-manufactured product for supporting construction applications. It comprises finger-jointed, i.e. joined lengthwise by load-bearing finger joints, or non-finger-jointed squared timber from coniferous wood which is subject to requirements which go over and beyond the binding technically approved regulations.
KVH® structural timber is manufactured from spruce, fir, pine, larch or Douglas fir. Adhesives in accordance with 2.5 are used for gluing. KVH® structural timber is manufactured with a maximum wood moisture of 18 %.
KVH® structural timber is supplied with measurements in accordance with 2.4 and measurement tolerances as per the /KVH® agreement/ by Überwachungsgemeinschaft Konstruktionsvollholz e.V.
Owing to tighter specifications regarding cutting and wood moisture, 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 that conventional finger-jointed or non-finger-jointed sawn timber.
Apart from the requirement of technically approved monitoring, manufacturing is also subject to supplementary private monitoring in accordance with the provisions of Überwachungsgemeinschaft Konstruktionsvollholz e.V..

Directive (EU) No. 305/2011 /CPR/ applies for placing the product on the market in the EU/EFTA (with the exception of Switzerland). The product requires a Declaration of Performance taking consideration of the /EN 15497/, Timber structures – Cross-laminated timber - Requirements, and CE marking.
Use is governed by the respective national provisions and the national /DIN 20000-7/ application standard in particular.
Für das Inverkehrbringen des Produktes in der EU/EFTA (mit Ausnahme der Schweiz) gilt die Verordnung (EU) Nr. 305/2011 /CPR/. Das Produkt benötigt eine Leistungserklärung unter Berücksichtigung der /EN 15497/, Holzbauwerke - Brettsperrholz - Anforderungen und die CE-Kennzeichnung.
Für die Verwendung gelten die jeweiligen nationalen Bestimmungen, insbesondere die nationale Anwendungsnorm /DIN 20000-7/.

2.2 Application

KVH® structural timber is used as structural components in buildings and bridges.
Use of wood preservatives in accordance with /DIN 68800-3/, Wood preservation – Part 3 is not typical and only permissible if other protective means as per /DIN 68800-2/, Wood preservation – Part 2 are not sufficient

on their own. Where wood preservatives are used in exceptional cases, they must be regulated in the form of a national technical approval or an approval in accordance with the /Biocides Directive/.

2.3 Technical Data

The product's performance values can be found in the Declaration of Performance based on /EN 15497/, Timber structures.

Technical construction data

The following depicts the technical construction data for finger-jointed solid timber made from coniferous wood or poplar in accordance with /DIN EN 15497/.

Name	Value	Unit
Wood species in accordance with /EN1912/ and letter codes, where available, corresponding with /EN 13556/	Various species of wood[1]□	-
Wood moisture content as per /DIN EN 13183-1/[2]□	≤ 15	%
Use of wood preservative (the test description as per /DIN 68800-3/ must be indicated)[3]□	Iv, P and W	-
Characteristic compression strength parallel to the grain in accordance with /DIN EN 338/□□	18-24	N/mm²
Characteristic compression strength perpendicular to the grain in accordance with /DIN EN 338/□□	2.2-2.7	N/mm²
Characteristic tension strength parallel to the grain in accordance with /DIN EN 338/□□	10-19	N/mm²
Characteristic tension strength perpendicular to the grain in accordance with /DIN EN 338/□□	0.4	N/mm²
Characteristic modulus of elasticity parallel to the grain in accordance with /DIN EN 338/□□	9,000-12,000	N/mm²
Characteristic shear strength in accordance with /DIN EN 338/□□	3.4-4.0	N/mm²
Mean shear modulus in accordance with /DIN EN 338/□□	560-750	N/mm²
Deviation in sizes according to /DIN EN 336/	Dimensional tolerance class 2: Width and height ≤ 100 mm: ±1 mm Width and height > 100 mm: ±1.5 mm	mm or %
Mean gross density in accordance with /DIN EN 338/□□	320-460	km/m³
Surface quality in accordance with /KVH agreement/	Industrial quality, visual quality, supreme quality	-
Suitability for use classes (GK) in accordance with /DIN 68800-1/□□	All wood types: GK 0; Southern pine heartwood: also GK 1; Scots pine heartwood: also GK 1 and 2; heartwood of Douglas fir, larch, yellow cedar: also GK 1, 2 and 3.1	-
Thermal conductivity (vertical to the grain) in accordance with /DIN EN 12664/□□	0.13	W/(mK)
Specific thermal capacity in accordance with /DIN EN 12664/	1600	kJ/kgK
Water vapour diffusion resistance factor in accordance with /DIN EN ISO 12572/□□	Dry at a mean density of 500 kg/m³: 50	-

1) Norway spruce (Picea abies, PCAB), fir (Abies alba, ABAL), Scots pine redwood (Pinus sylvestris, PNSY), Douglas fir (Pseudotsuga menziesii, PSMN), western hemlock (Tsuga heterophylla, TSHT), Corsican pine and Austrian pine (Pinus nigra, PNNL), European larch (Larix decidua, LADC), Siberian larch (Larix sibirica, LASI), Dahurian larch (Larix gmelinii (Rupr.) Kuzen.), maritime pine (Pinus pinaster, PNPN), poplar (applicable clones: Populus x euramericana cv "Robusta", "Dorskamp", "I214" and "I4551", POAL), Radiata pine (Pinus radiata, PNRD), Sitka spruce (Picea sitchensis, PCST), Southern yellow pine (Pinus palustris, PNPL), Western red cedar (Thuja plicata, THPL), Yellow cedar (Chamaecyparis nootkatensis, CHNT). Norway spruce and the fir may be treated as a single wood species.

2) /DIN EN 15497/ permits other equivalent measurement methods.

3) Treatment with a wood preservative in accordance with /DIN 68800-1/ is only permissible if the structural measures have been exploited and is therefore not typical.

4) In accordance with /DIN EN 15497/ with /EN 338/, more elasto-mechanical properties and bending properties in particular can be declared. An indication of strength classes is typical. Strength classes C18, C24 and C30 are typical. The ranges indicated here refer to mean or characteristic values of the respective strength classes. Deviating values can be declared. The declared density values can deviate from these average values owing to varying densities of the wood species used.

5) As /DIN 68800-1/ demands that structural measures are exploited before using a preventive chemical wood preservative, only allocations for untreated glued laminated timber are provided here.

6) Design values of thermal conductivity shall be calculated from the declared values in accordance with /DIN 4108-4/.

7) The air layer thickness equivalent to the water vapour diffusion is calculated by adding the layer thickness and the water vapour diffusion resistance factor.

2.4 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)

2.5 Base materials / Ancillary materials
Finger-jointed KVH® structural timber comprises technically dried coniferous wood planks or squared timber glued together 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-resorcinol-formaldehyde (PRF) adhesives are used. Formaldehyde emissions are declared in accordance with /DIN EN 14080/. Substances on the /ECHA List of Candidates/ for including substances of very high concern in Annex XIV of the /REACH Directive/ (last revised: 15.01.2018) are not included.
The percentage averages of ingredients per cubic metre of KVH® structural timber established for the Environmental Product Declaration:
- Coniferous wood, primarily spruce, approx. 89.20 %
- Water approx. 10.70 %
- PUR adhesives: approx. 0.06 %
- MUF adhesives: approx. 0.04 %

The product has a mean gross density of 468.62 kg/m³.

2.6 Manufacture
The manufacture of KVH® structural timber involves drying conventional sawn timber to less than 18 % wood moisture, followed by pre-planing and sorting visually and/or mechanically by strength. Sections identified as having strength-reduced areas are removed depending on the requisite strength class. In the case of finger-jointed KVH® structural timber, the ensuing sawn wood sections are joined 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. If necessary, they can be treated with wood preservative.

2.7 Environment and health during manufacturing
Waste air incurred is cleaned in accordance with statutory specifications. There are no risks for water or soil. The waste water incurred is fed into the local waste water system.

2.8 Product processing/Installation
KVH® structural timber can be processed using the standard tools suitable for processing solid timber. The information concerning industrial safety must also be observed during processing/assembly.

2.9 Packaging
Polyethylene (/AVV/ 15 01 02), metal (/AVV/ 15 01 04), solid timber (/AVV/ 15 01 03), paper and cardboard (/AVV/ 15 01 01), and smaller quantities of other plastics (/AVV/ 15 01 02) are used.

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2.10 Condition of use
Composition for the period of use complies with the base material composition in accordance with section 2.5. “Base materials”.
Approx. 209 kg of carbon are bound in the product during use. This complies with approx. 766.33 kg of CO_2.for full oxidation.

2.11 Environment and health during use
Environmental protection: According to current knowledge, there are no risks for water, air and soil when the products are used as designated.
Health protection: According to current knowledge, no health risks 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 timber glued with MUF adhesives emits formaldehyde subsequently. Measured at the limit value of 0.1 ml/m³ of the Chemical Restriction Regulation, the values can be classified as very low after testing /EN 15497/.
KVH® structural timber or KVH® non-finger-jointed structural timber glued with PUR or EPI adhesives displays formaldehyde emission values according to /EN 15497/ in the range of natural wood (approx. 0.004 ml/m³).
MDI emissions by KVH® structural timber glued with PUR or EPI adhesives cannot 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 timber glued this way already displays MDI emissions in the zero-value range shortly after manufacture.

2.12 Reference service life
In terms of its components and manufacturing, KVH® structural timber complies with lamellas for glued laminated timber (glulam). 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 building when used as designated.

Influences on ageing when the recognised rules of technology are applied.

2.13 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 leached which could be hazardous to water.

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

2.14 Re-use phase
In the event of selective rebuilding after the end of the usage phase, KVH® structural timber can be easily reused.
If KVH® structural timber cannot 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.
During energetic recycling, the requirements outlined in the /Federal Immission Control Act (BImSchG)/ must be maintained: Untreated KVH® structural timber is allocated to waste code 17 02 01 in accordance with Annex III of the /Waste Wood Act (AltholzV)/ dated 15.02.2002 (depending on the type of wood preservative, treated KVH® structural timber is allocated to waste code 17 02 04).

2.15 Disposal
Waste wood may not be landfilled in accordance with §9 of the /Waste Wood Act (AltholzV)/.

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

3. LCA: Calculation rules

3.1 Declared Unit
The declared unit in the LCA is the provision of 1 m³ KVH® structural timber with a mass of 468.62 kg/m³, 12 % wood moisture, 10.704 % water content and 0.098 % adhesive content. All details on adhesives used were calculated on the basis of specific data. Averaging was weighted by production volume.

Details on declared unit

Name	Value	Unit
Declared unit	1	m³
Gross density	468.62	kg/m3
Conversion factor to 1 kg	0.0021339	-
Wood moisture on delivery	12	%
Adhesive content in relation to overall mass	0.098	%
Water content in relation to overall mass	10.704	%

3.2 System boundary
The Declaration complies with an EPD "from cradle to plant gate, with options". It includes the production stage, i.e. from provision of the raw materials through to production (*cradle to gate*, Modules A1 to A3), Module A5, and parts of the end-of-life stage (Modules C2 and C3). It also contains an analysis of the potential benefits and loads over and beyond the product's entire life cycle (Module D).
Module A1 analyses the provision of wood from forestry resources, the provision of other pre-treated wood products and the provision of adhesives. Transport of these substances is considered in Module A2. Module A3 comprises the provision of fuels, resources and electricity as well as the production processes on site. These essentially involve debarking, cutting, drying, planing and profiling processes as well as glueing and packing the products. Module A5 exclusively covers the disposal of product packaging which includes the disposal of biogenic carbon and primary energy (PERM and PENRM).
Module C2 considers transport to the disposal company and Module C3 is concerned with preparing and sorting waste wood. In accordance with /EN 16485/, Module C3 also includes as outflows the CO2 equivalents of the carbon inherent in the wood product as well as the renewable and non-renewable primary energy (PERM and PENRM) contained in the product.
Module D analyses the thermal utilisation of the product at its end of life as well as the ensuing potential benefits and loads in the form of a system extension.

3.3 Estimates and assumptions
As a general rule, all of the material and energy flows for the processes required by production are established on site. The emissions from incineration and other processes on site could only be estimated on the basis of literary references. All other data is based on average values. More detailed information on all estimates and assumptions made is documented in /S. Rüter, S. Diederichs: 2012/.
The basis for the calculated application of fresh water resources is depicted by *blue water consumption*.

3.4 Cut-off criteria
No known material or energy flows were ignored, including those which fell below the limit of 1%. Accordingly, the total sum of input flows ignored is certainly less than 5% of the energy and mass applied. This also safeguards against the possibility of any material or energy flows being ignored which display a particular potential for significant influences in terms of the environmental indicators. Detailed information on the cut-off criteria is documented in /S. Rüter, S. Diederichs: 2012/.

3.5 Background data
All background data was taken from version 6.155 of the /GaBi professional data base/ and the “Ökobilanz-Basisdaten für Bauprodukte aus Holz” final report /S. Rüter, S. Diederichts: 2012/.

3.6 Data quality
The data surveyed was validated on a mass basis and in accordance with plausibility criteria. With the exception of forest wood, the background data used for wood materials for material and energy purposes originates from 2008 to 2012. The provision of forest wood was taken from a 2008 publication which is essentially based on information from 1994 to 1997. All other information was taken from version 6.115 of the /GaBi professional data base/. Following written confirmation of the topicality of primary data used on the part of Überwachungsgemeinschaft Konstruktionsvollholz e.V. and the topicality of all background data used, the overall data quality can be regarded as good.

3.7 Period under review
Data for the primary system was surveyed during the period 2009 to 2011, whereby data was always provided for the full calendar year. The data is therefore based on 2008 to 2010. All information is based on averaged data for 12 consecutive months. There is an Überwachungsgemeinschaft Konstruktionsvollholz e.V. document in place

confirming that the primary data used continues to depict the association in a representative manner.

3.8 Allocation

The allocations comply with the specifications of the /EN 15804:2012/ and /EN 16485:2014/ and are explained in detail in /S. Rüter, S. Diederichs: 2012/. Essentially, the following system extensions and allocations were carried out.

General information

Flows of properties inherent to the material (biogenic carbon and primary energy contained therein) were allocated in accordance with physical causalities. All other allocations of associated co-products were carried out on an economic basis. One exception is represented by allocation of the requisite heat combined heat and power which was allocated on the basis of the exergy of electricity and process heat products.

Module A1

- Forestry: All expenses in the upstream forest chain were allocated using economical allocation methods to logs and industrial wood on the basis of their prices.
- The provision of waste wood does not take consideration of expenses incurred during the previous life cycle.

Module A3

- Wood-processing industry: For associated co-products, expenses were allocated economically to primary products and residual materials on the basis of their prices.
- With the exception of wood-based materials, the expenses incurred by the disposal of production waste are based on a system extension. The heat and electricity generated are credited to the system in the form of substitution processes. The credits achieved here account for significantly less than 1% of overall expenses.
- All expenses associated with firing were allocated to firing after exergy of these two products in the case of combined generation of heat and power.
- The provision of waste wood does not take consideration of expenses incurred during the previous life cycle (as in Module A1).

Module D

- The system expansion process performed in Module D complies with an energetic recycling scenario for waste wood.

3.9 Comparability

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

The used background database has to be mentioned. The LCA was conducted using the /GaBi ts 2017/ software. All background data was taken from version 6.115 of the /GaBi professional data base/ or literary sources.

4. LCA: Scenarios and additional technical information

The scenarios on which the LCA is based are outlined in more detail below.

Construction installation process (A5)

Module A5 is declared but only contains details on disposal of the product packaging and no details on actual installation of the product in the building. The volume of packaging material incurred as waste material for thermal utilisation per declared unit in Module A5 and the ensuing exported energy are indicated below as technical scenario information.

Name	Value	Unit
Solid timber for thermal waste processing	2.121	kg
Biogenic carbon contained in solid timber	3.889	kg CO2 equiv.
PE foil for thermal waste processing	0.568	kg
Other plastic for thermal waste processing	0.007	kg
Paper and cardboard for thermal waste processing	0.016	kg
Total efficiency of paper and cardboard waste incineration	38 - 44	%
Percentage of electricity generated in exported energy	27 - 28	%
Total exported electrical energy	8.265	MJ
Total exported thermal energy	20.263	MJ

A transport distance of 20 km is assumed for disposal of the product packaging. As a conservative approach, disposal of all packaging components as waste in a waste incineration plant is assumed without waste wood being sorted as a material for energy recovery in a biomass heating power plant. Total efficiency of waste incineration for the respective packaging as well as the percentages of electricity and heat generation by means of heat and power combinations correspond with the allocated waste incineration processes in the /GaBi professional data base/.

End of life (C2-C4)

Name	Value	Unit
Waste wood for energy recovery	468.62	kg
Redistribution transport distance for waste wood (Module C2)	20	km

A collection rate of 100% without losses incurred by crushing the material is assumed for the scenario of thermal utilisation.

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

Name	Value	Unit

Electricity generated (per t atro waste wood)	968.37	kWh
Waste heat used (per t atro waste wood) (je t atro Altholz)	7053.19	MJ
Electricity generated (per net flow of declared unit)	395.54	kWh
Waste heat used (per net flow of declared unit)	2881.77	MJ

The product is recycled in the form of waste wood in the same composition as the declared unit at the end-of-life stage. Thermal recovery in a biomass power station with an overall degree of efficiency of 54.69 % and electrical efficiency of 18.09 % is assumed, whereby incineration of 1 tonne atro wood (mass value in atro, consideration of efficiency, yet ~18 % wood moisture content) generates approx. 968.37 kWh electricity and 7053.19 MJ useful heat. Converted to the net flow of the atro wood percentage included in Module D and taking consideration of the percentage of adhesives in waste wood, 395.54 kWh electricity and 2881.77 MJ thermal energy are produced per declared unit in Module D. The exported energy substitutes fuels from fossil sources, whereby it is alleged that the thermal energy is generated from natural gas and the substituted electricity complies with the German power mix for 2017.

5. LCA: Results

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

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

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m³ KVH®

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
GWP	[kg CO_2-Eq.]	-7.28E+2	6.48E+0	4.03E+1	5.83E+0	4.70E-1	7.70E+2	-4.25E+2
ODP	[kg CFC11-Eq.]	1.13E-7	6.34E-9	8.31E-8	5.70E-12	9.40E-10	1.75E-11	-9.01E-10
AP	[kg SO_2-Eq.]	2.23E-1	2.75E-2	2.09E-1	5.07E-4	2.02E-3	6.90E-3	-4.21E-1
EP	[kg $(PO_4)^{3-}$-Eq.]	5.15E-2	6.58E-3	4.42E-2	1.08E-4	4.68E-4	1.10E-3	-6.24E-2
POCP	[kg ethene-Eq.]	4.58E-2	-4.47E-3	5.10E-2	4.33E-5	1.79E-4	4.78E-4	-4.26E-2
ADPE	[kg Sb-Eq.]	5.47E-4	4.19E-7	1.05E-4	6.73E-8	1.00E-8	2.34E-6	-1.23E-4
ADPF	[MJ]	4.35E+2	8.87E+1	4.68E+2	9.95E-1	6.61E+0	4.52E+1	-5.34E+3

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

RESULTS OF THE LCA - RESOURCE USE: 1 m³ KVH®

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
PERE	[MJ]	6.31E+2	3.19E+0	1.14E+3	4.11E+1	8.79E-3	2.54E+1	-1.33E+3
PERM	[MJ]	8.06E+3	0.00E+0	4.09E+1	-4.09E+1	0.00E+0	-8.06E+3	0.00E+0
PERT	[MJ]	8.69E+3	3.19E+0	1.18E+3	1.99E-1	8.79E-3	-8.03E+3	-1.33E+3
PENRE	[MJ]	4.85E+2	8.95E+1	5.75E+2	2.61E+1	6.67E+0	5.88E+1	-6.15E+3
PENRM	[MJ]	4.58E+0	0.00E+0	2.50E+1	-2.50E+1	0.00E+0	-4.58E+0	0.00E+0
PENRT	[MJ]	4.90E+2	8.95E+1	6.00E+2	1.10E+0	6.67E+0	5.43E+1	-6.15E+3
SM	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	6.32E+1	0.00E+0	1.24E+2	0.00E+0	0.00E+0	0.00E+0	7.87E+3
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.58E+0
FW	[m³]	6.20E-1	1.03E-3	3.09E-1	1.22E-4	3.76E-5	1.49E-2	-7.70E-1

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

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m³ KVH®

Parameter	Unit	A1	A2	A3	A5	C2	C3	D
HWD	[kg]	9.20E-3	0.00E+0	6.00E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NHWD	[kg]	1.14E-2	0.00E+0	2.58E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RWD	[kg]	2.12E-2	2.32E-4	4.18E-2	4.31E-5	1.17E-5	5.41E-3	-2.80E-1
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.69E+2	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	0.00E+0	8.26E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	0.00E+0	2.03E+1	0.00E+0	0.00E+0	0.00E+0

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

6. LCA: Interpretation

The interpretation of results focuses on the production phase (Modules A1 to A3) as it is based on specific data provided by the company. The interpretation takes the form of a dominance analysis of the environmental impacts (GWP, ODP, AP, EP, POCP, ADPE, ADPF) and the use of renewable/non-renewable primary energy (PERE, PENRE).

Accordingly, the most significant factors for the respective categories are listed below.

6.1 Global Warming Potential (GWP)

When considering the GWP, the CO_2 product system inputs and outputs inherent in wood require separate analysis. A total of approx. 930 kg CO_2 enter the system in the form of carbon stored in the bio-mass, of which 59 kg CO_2 are emitted along the preliminary chains and 101 kg CO_2 are emitted within the framework of heat generation on site. Around 4 kg of CO_2 bound in the form of the packaging material are emitted in Module A5. The carbon ultimately stored in the structural timber is withdrawn again from the system during recycling in the form of waste wood.

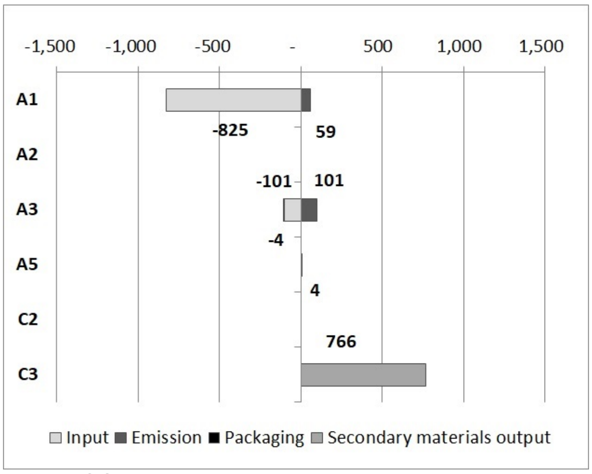

Fig. 1: CO_2 product system inputs and outputs inherent in wood [kg CO_2 equiv.]. The inverse indications suggested by inputs and outputs is in line with the LCO CO_2 flow analysis in terms of the atmosphere.

43 % of the analysed fossil greenhouse gases are accounted for by the provision of raw materials (entire Module A1), 7 % by transporting the raw materials (entire Module A2) and 50 % by the manufacturing process for structural timber (entire Module A3). Electricity consumption in the plant as part of Module A3 represents 37 % and the provision of wood as a raw material as part of Module A1 accounts for 41 % of fossil greenhouse gases, making them essential influential factors.

6.2 Ozone Depletion Potential (ODP)
43 % of emissions with an ozone depletion potential are incurred by the provision of wood as a raw material and 13 % by the provision of adhesives (both Module A1). The consumables used as well as product packaging (Module A3) contribute another 32 % to overall ODP.

6.3 Acidification Potential (AP)
The combustion of wood and diesel are the sources of essential relevance for emissions representing a potential contribution towards the acidification potential. Drying the bought-in products, provision of the requisite heat and utilisation of fuels in forestry account for around 48 % of emissions (Module A1). Transporting raw materials accounts for a further 6% (Module A2) and heat generation on site contributes a total of 26 % to the entire *cradle-to-gate* emissions (Module A3).

6.4 Eutrification Potential (EP)
50 % of the entire EP is attributable to drying and incinerating processes in the upstream chains for the provision of wood as a raw material (Module A1). During the manufacturing process, heat generation contributes 27 % to the EP while electricity consumption and the consumables and/or packaging materials used each account for 8 % (Module A3).

6.5 Photochemical Ozone Creation Potential (POCP)
The primary POCP contributions are accounted for by the provision of wood as a raw material for the product (49 %) (Module A1) and the drying process as part of product manufacturing (36 %) (Module A3). Generation of heat required in the manufacturing process accounts for a further 16 % of the entire POCP (Module A3). The negative values recorded for the POCP in Module A2 are attributable to the negative characterisation factor for nitrogen monoxide emissions in the standard-conformant CML IA version (2001 - April 2013) in combination with the /GaBi Professional data base/ truck transport process used for modelling log transport.

6.6 Abiotic Depletion Potential non-fossil resources (ADPE)
The essential contributions to the ADPE are represented by the provision of wood as a raw material (83 %) (Module A1) and the consumables and packaging materials used during manufacturing (8 %) (Module A3).

6.7 Abiotic Depletion Potential Fossil Resources (ADPF)
Provision of wood as a raw material for the product accounts for 41 % and the manufacture of adhesives processed contributes 3 % to the entire ADPF (both Module A1). Other essential influences are represented by transporting wood as a raw material (9 %) (Module A2), electricity consumption during the manufacturing process (32 %) and the consumables and packaging materials used there (11 %) (both Module A3).

6.8 Renewable Primary Energy as energy carrier (PERE)
26 % of PERE is attributable to the provision of wood for the product (Module A1). But most of this application is accounted for by the manufacturing process (Module A3), i.e. electricity consumption (64 %) and heat generation (6 %).

6.9 Non-renewable primary energy as energy carrier (PENRE)
The use of PENRE in Module A1 is largely incurred by the provision of wood as a raw material, accounting for 40 % of the entire *cradle-to-gate* applications. Transporting wood to the plant (Module A2) represents a further 8 %. In Module A3, PENRE is distributed across electricity consumption for manufacturing processes (36 %), heat generation (6 %) and the consumables and packaging materials used (10 %).

6.10 Waste
Special waste is primarily incurred during the provision of adhesives (approx. 19 %) and wood as a raw material (approx. 42 %) in Module A1 as well as the consumables and packaging materials used (approx. 37 %) in Module A3.

6.11 Range of results
The individual results for the participating companies differ from the average results in the Environmental Product Declaration. Maximum deviations of +47 %/-33 % (GWP), +195 %/-87 % (ODP), +28 %/-23 % (AP), +57 %/-25 % (EP), +27 %/-51 % (POCP), +57 %/-86 % (ADPE) and +47 %/-35 % (ADPF) were

calculated for the environmental impacts in relation to the results outlined in section 5. These deviations are primarily attributable to differences in the fuels used and specific electricity consumption values during the processes.

7. Requisite evidence

7.1 Formaldehyde

The formaldehyde emissions are to be determined in accordance with /DIN EN 15497/ and are established with reference to /DIN EN 717-1/. /DIN EN 15497/ specifies testing with a loading factor of 0.3 m²/m³ for finger-jointed solid timber. Formaldehyde emissions are to be declared as class E1 or E2. In accordance with /DIN 20000-7/, exclusively finger-jointed solid timber with formaldehyde class E1 is permissible for application in Germany.
Emission values are not available for KVH® structural timber glued with adhesives containing formaldehyde. The values for cross-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/m³ indoor air). A value which is significantly below the limit value in accordance with the Chemical Restriction Regulation can therefore be assumed for structural timber.
Emission values by KVH® structural timber glued with adhesives which do not contain formaldehyde or by KVH® structural timber without finger-jointed connections incur area-specific emission rates in the area of unglued wood.

7.2 MDI

During the KVH® structural 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.
In tests based on the measuring method for determining formaldehyde emissions from /DIN EN 717-2/, MDI emissions are not detectable (detection limit: 0.05 µg/m³).

7.3 Fire gas toxicity

The toxicity of fire gases incurred when finger-jointed solid timber burns corresponds with that which arises when natural wood burns.

7.4 VOC

Evidence of VOC is optional when the EPD is valid for a shorter period of time (1 year).

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Agreement governing KVH® (structural timber) made from spruce, fir, pine, larch and Douglas fir between Holzbau Deutschland and Überwachungsgemeinschaft KVH in the respective valid version

	Publisher Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	Tel Fax Mail Web	+49 (0)30 3087748- 0 +49 (0)30 3087748- 29 info@ibu-epd.com **www.ibu-epd.com**
	Programme holder Institut Bauen und Umwelt e.V. Panoramastr 1 10178 Berlin Germany	Tel Fax Mail Web	+49 (0)30 - 3087748- 0 +49 (0)30 – 3087748 - 29 info@ibu-epd.com **www.ibu-epd.com**
	Author of the Life Cycle Assessment Thünen-Institut für Holzforschung Leuschnerstr. 91 21031 Hamburg Germany	Tel Fax Mail Web	+49(0)40 73962 - 619 +49(0)40 73962 - 699 holzundklima@thuenen.de **www.thuenen.de**
	Owner of the Declaration Überwachungsgemeinschaft Konstruktionsvollholz e.V. Heinz-Fangman-Str. 2 42287 Wuppertal Germany	Tel Fax Mail Web	0202/7697273-4 0202/7697273-5 info@kvh.de **www.kvh.de**