ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	KLH Massivholz GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-KLH-20190027-ICA1-EN
Issue date	06.05.2019
Valid to	05.05.2024

KLH cross-laminated timber panels

KLH Massivholz GmbH

Institut Bauen und Umwelt e.V.

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1. General Information

KLH Massivholz GmbH	KLH cross-laminated timber panels
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the declaration** KLH Massivholz GmbH Gewerbestraße 4 A - 8842 Teufenbach-Katsch Österreich
Declaration number EPD-KLH-20190027-ICA1-EN	**Declared product / declared unit** one cubic metre (m³) of cross-laminated timber
This declaration is based on the product category rules: Solid wood products, 12.2018 (PCR checked and approved by the SVR)	**Scope:** This EPD applies for the production of cross-laminated timber at the Teufenbach-Katsch plant, Austria. 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 06.05.2019	
Valid to 05.05.2024	**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.)	
Dr. Alexander Röder (Managing Director IBU)	Matthias Klingler (Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

KLH cross-laminated timber panels are made from softwood boards or laminated plywood boards or wooden composite boards that can be glued together as cross- laminated timber (massive plate-shaped timber structural elements). The softwood boards are in general arranged to each other in consecutive vertical separate layers (at an angle of 90°).

Further details on the material properties and on the crossways section structure can be obtained from the European Technical Assessment (/ETA 06/0138/).

2.2 Application

KLH cross-laminated timber panels are for use as bearing, strengthening and also as non-bearing elements.

2.3 Technical Data

Differentiation is made in the material parameters between the plate actions and the membrane actions. The relevant national provisions shall apply for use. The performance values in accordance with the declaration of performance shall apply.

Constructional data

Name	Value	Unit
Gross density (Mean)	480	kg/m³
Weight per unit area according to panel thickness	-	kg/m²
Bending strength (longitudinal)	24	N/mm²
Bending Strength (transverse)	-	N/mm²
E-module (longitudinal)	12000	N/mm²
E-Module (transverse)	-	N/mm²
Material moisture content at delivery	10-14	%
Dimension change on plate level	lt.ETA	mm
Tensile strength rectangular	0,12	N/mm²
Impact resistance classification	-	
Mean gap opening	-	mm
Height difference between elements	+/-2	mm
Thermal conductivity	0,12	W/(mK)
Water vapour diffusion resistance factor	50-200	
Sound absorption coefficient	0,02-0,05	%
Room sound improvement	-	Sone

Various glues and adhesives are used for producing panels as listed in Section 2.5.

KLH is manufactured to the measurements and with the manufacturer specific tolerances as listed in Section 2.4.

The building component resistance under normal temperature conditions and the fire resistance depend on the layer properties, on the crossways sectional structure, the building static system and the load position. The building component resistance and fire resistance must be established to the applicable construction engineering rules and with the building work in hand.

For the bringing into circulation of the products in the EU/EFTA (with the exception of Switzerland) the regulation (EU) no. 305/2011 (CPR) applies. The product requires a declaration of performance taking account of /ETA no. 06/0138/, 20.2.2017, KLH Massivholzplatten / KLH solid wood slabs and the CE marking.
The relevant applicable national regulations apply for use.

The KLH cross-laminated timber panel is intended to be used in the classes of use 1 and 2 in accordance with EN 1995-1-1 (source: ETA06/0138).
ÖNORM B 1995-1-1:2010-08:Eurocode 5: Design of timber structures - Part 1-1: General - General rules and rules for buildings
- national provisions, national comments and national supplements concerning OENORM EN 1995-1-1.

2.4 Delivery status

maximum length 16.50 m
maximum width 2.95 m
maximum thickness 0.50 m
minimum production length 8 m
calculation widths 2.40/2.50/2.73/2.95 m

KLH is available with the following surfaces:
non-visible quality (NVQ)
industrial visible quality (IVQ)
domestic visible quality (DVQ)
special surfaces (S)

2.5 Base materials / Ancillary materials

KLH cross-laminated timber panels are largely produced from spruce (PEFC certified), which has a wood moisture content of u=12% (+/-2%) (pine, fir, arolla pine and other wood species on request).

For the gluing (area/finger joint) a polyurethane (PUR) adhesive according to EN 15425 is used. For the narrow-edge gluing with visible surfaces PVAC (white glue) is used. In this the glue proportion in the PUR adhesive is 0.66 m% and in the PVAC adhesive 0.01 M%.
A frequently used solution for wall panels with visible surfaces are wooden composite boards in accordance with EN 13986, or in accordance with a European Technical Assessment.

2.6 Manufacture

The narrow edges of the lamella are either glued to each other or the lengthways and crossways layers are laterally pressed together during the production process. The surface gluing is done using PUR adhesive.

The cutting or timber framing are done in the plant using CNC technology. The production and cutting plans released by the customer or the building company employed are used as the basis for this work.

2.7 Environment and health during manufacturing

Air: no measures required extending beyond the statutory provisions.
Water/ground: waste water seepage/sprinkling capacity in compliance with the standards is available for surface and roof water. No measures required extending beyond the statutory provisions.
Noise: noise-intensive plant parts, such as e.g. planing machines, crushing plant (chippers), are to be enclosed by appropriately adequate structural measures.
Various waste materials: no measures required extending beyond the statutory provisions.
All health and environmental aspects are monitored in the scope of /ISO 14001/ during the manufacturing process.

2.8 Product processing/Installation

The ready cut KLH cross-laminated timber panels are delivered to the construction site where a specialist for timber buildings or other construction company assembles them using a crane.
KLH cross-laminated timber panels can be processed using any standard wood processing machinery.
During processing and assembly the appropriate standard safety equipment must be used.

2.9 Packaging

The elements can be protected with various PE foil types (against rain, sun, snow,..). On request various edge protection systems (carton) can be placed. PE strap loops for unloading the elements or for assembly at the building site can also be ordered on customer request.

2.10 Condition of use

The composition of the finished product is compliant with the raw materials used, which are as listed in Section 2.6 (raw materials).

2.11 Environment and health during use

Environmental protection: risks for water, air and the ground will not occur on use of the products when used in accordance with the regulations as far as is known to date.
Heath and safety: no risk of damage to health occurs as far as is known to date.
In the context of formaldehyde cross-laminated timber (BSP) has low emissions due to its adhesive use quantity, its structure and its types of use.

2.12 Reference service life

KLH is compliant with laminated timber (glulam timber) in its components and manufacture. Glulam timber has been in use for over 100 years. When used correctly no limit is either known or expected from its service life stability. The service life that can be expected from KLH on correct use thus equals that of the service life of the building in which it is used.

The reference service life in the present EPD is not relevant since no environmental pollution results in the modules B1-B7.

2.13 Extraordinary effects

Fire

Commission decision /2005/610/EC/
mean bulk density of timber ≥ 380 kg/m³ Euroclass D-s2. d0
The smoke toxicity is identical to that of natural wood.

Fire protection

Name	Value
Building material class	D
Burning droplets	d0
Smoke gas development	s2

Water
KLH cross-laminated timber panels are not resistant to continuous contact with water.

Mechanical destruction
The fracture pattern for softwood sawn timber shows the typical appearance for solid wood.

2.14 Re-use phase
KLH cross-laminated timber panels can be used again in principle on conversions or disassembly. Use as an energy source in controlled furnace facilities for process heat or potentially for heat and electric power generation plant is to be regarded as a worthwhile solution due to the high calorific value of the wood.

2.15 Disposal
KLH cross-laminated timber panels from dismantling operations are first and foremost to be recycled as materials. Should this not be possible, they must be used as an energy source.
Waste disposal code number in accordance with the Austrian Waste Catalogue Ordinance /ÖNORM S2100/: 17218 (organically treated waste wood) Waste code numbers according to the European Waste Catalogue (/EAK): 170201
Landfill dumping is not permissible.

2.16 Further information
You can find more information on the website http://www.klh.at

3. LCA: Calculation rules

3.1 Declared Unit
The declared unit is one cubic metre (1 m³) cross-laminated timber with a bulk density of 480 kg/m³.

Details on declared unit

Name	Value	Unit
Declared unit	1	m³
Conversion factor to 1 kg	0.0020833	-
Gross density	480	kg/m³

This refers to an average product, as established from the annual input and output data of the manufacturer.

3.2 System boundary
EPD type: from cradle to grave. This ecological life cycle assessment addresses the life cycle phases A1–A3, A4, A5, B1, B2, B3, B4, B5, B6, B7, C1, C2, C3, C4 and D in accordance with /EN 15804/. Since on the use of KLH cross-laminated timber panels no pollution emissions or associated operative expenditures occur, B1 and B2 as also B6 and B7 are set to 0 (zero). B3 to B5 are declared as not relevant as MNR modules.
The product phase begins with the taking into account of all the necessary raw materials for production including all preliminary chains and also the CO2 absorption of the raw materials (growth of wood in the forest). The CO2 storage is balanced as an input for the trimmed timber used. Per kg wood atro 1.833 kg of CO2 removed from the atmosphere is taken into account.
The continued further production of the cross-laminated timber in the works includes the energy provision taking into account the concatenation involved. All the necessary transport for the raw materials and auxiliary materials are taken into account in the ecological life cycle assessment. Also included in the analysis is the packaging down to the ready for dispatch product at the factory gate.
Over and above this the transport of the finished product and also the energy and material requirements for the development also taking account of the machinery and the metal binding elements required are given on the balance sheet. The product packaging is used thermically.
There are no pollution emissions or associated operative expenditures during use.
Dismantling, transport to a disposal specialist company as also the recovery exploitation are declared. The product is utilized thermally in waste incineration plants as usual in Austria. All metal components are recycled. The balance sheet accounting of the recovery exploitation process is carried out taking into account the credit entries on the basis of the Austrian electricity mix or heat energy from a gas firing.

3.3 Estimates and assumptions
The same energy requirement is assumed for dismantling as that for assembly (worst-case-scenario), since no specific data is available for this. The transport distances to the recovery plant are assumed to be on average 50 km.
No further assessments or assumptions have been made.

3.4 Cut-off criteria
All the data from the company data ascertainment is taken into account. The material flows are thus also accounted with a proportion of < 1 %.
It can thus be assumed that the sum of the neglected processes for the impact categories does not exceed 5 %. The cutting criteria are thus fulfilled in accordance with PCR.

3.5 Background data
The software-system /Sima Pro/ was used for modelling the lifecycle for the manufacture and disposal of the cross-laminated timber. All the relevant background data records for the manufacture and disposal were taken from the database /ecoinvent/.

3.6 Data quality
The data capture for the products examined was done directly at the production location on the basis of a questionnaire. The input and output data was provided directly by KLH from its own company data survey and

this was checked for plausibility. Further to this an additional plausibility check was carried out on site at the plant in the scope of a company inspection visit. Against this background an excellent quality of representativity can be assumed for the data.
Much value was placed on achieving a thoroughly comprehensive picture for the acquisition and recording of environmentally relevant material and energy flow values.
The timber data from ecoinvent refer to the year 2014. The data used for MDI adhesive data set are from 2011. The production of cross-laminated timber cause only between 20% and 30 % of all the environmental effects resulting from the product. Since the production is in Austria and the Austria electricity mix is applied, the geographical representivity is high. A Monte Carlo analysis that was carried out showed an uncertainty level of under 5% for all characterisation categories and in all the data records used.

3.7 Period under review

The data used refer to the business year 01.01.2017 to 31.12.2017.

3.8 Allocation

In addition to the main product other side-line by-products with a significantly lower value are produced. The allocation of the environmental effects is thus done in economic terms in accordance with /EN 15804/. Subsequent to this the energy and the CO2 content in the main product is corrected, in order to establish physically correct flows once again.
Economic allocation is applied in the context of the preliminary processing in the sawmill. The sawmill by-products are thus given an allocation of approx. 4% of the environmental impacts.

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.

4. LCA: Scenarios and additional technical information

The following technical information provides the basis for the declared module or can be used for the development of specific scenarios in the context of a building evaluation, when modules have not been declared (MND).

Transport to the building site (A4)

Name	Value	Unit
Litres of fuel	-	l/100km
Transport distance	880	km
Capacity utilisation (including empty runs)	70	%
Gross density of products transported	480	kg/m³

The transport to the building site value (A4) was calculated by the producer as an average of the total production. On establishing of the utilization for the material transports (manufacturer's own records) on the return trips from the building site are taken into account.

Installation in a building

Name	Value	Unit
Auxiliary material brackets and screws	2.581	kg
Water consumption	0	m³
Other resources lifting straps	0.1624	kg
Electricity consumption power drills, power screwdrivers	0.0935	kWh
Other energy carriers diesel for cranes and lifts	100.43	MJ
Material loss	-	kg
Output substances following waste treatment on site packaging	0.515	kg
Dust in the air	-	kg
VOC in the air	-	kg

The data on erecting buildings (A5) was made available by the manufacturer. As a result of the complete prefabrication of the KLH panels there are no material losses and no dust caused by the erection work.
The packaging used such as disposable lifting straps and packaging plastic films are thermically recovered in waste incineration plants. Energy from waste incineration plants in Austria is converted to approx. one third into electricity and two thirds for use in district heating. An efficiency rate of 17% for conversion into electricity and 75% boiler efficiency for district heating is assumed as a worst-case-scenario from the /UBA 2007/ report.

Reference service life

The reference service life is not relevant for this product, because there are no operative expenditures during the service life.

Name	Value	Unit
Reference service life (to /ISO 15686/)	-	a
Life Span (to BBSR)	-	a
Life Span (to manufacturer)	100	a
Declared product properties (at the gate) and finishes	-	-
Design application parameters (if instructed by the manufacturer), including the references to the appropriate practices and application codes	-	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	-	-
Outdoor environment, (for outdoor applications), e.g. weathering, pollutants, UV and wind exposure, building orientation, shading, temperature	-	-
Indoor environment (for indoor applications), e.g. temperature, moisture, chemical exposure	-	-
Usage conditions, e.g. frequency of use, mechanical exposure	-	-

Maintenance e.g. required frequency, type and quality and replacement of components	0	-

The service life as given by the manufacturer is achieved on appropriate use in accordance specifications: not for use in external areas, for use with a typical indoor climate, no mechanical stresses over and above the specified mechanical load.

Operational energy and water requirements

Name	Value	Unit
Water consumption	0	m^3
Electricity consumption	0	kWh
Other energy carriers	0	MJ
Equipment output	-	kW

End of the service life

Name	Value	Unit
Collected separately waste type metal	2.58	kg
Collected as mixed construction waste	0	kg
Reuse	0	kg
Recycling brackets, screws	2.58	kg
Energy recovery cross laminated timber	480	kg
Landfilling	0	kg

A waste collection rate for the KLH cross-laminated timber panels of 100 % is assumed for the recycling of brackets and screws.

Re-use, recovery and recycling potentials (D), relevant scenario details

The furnace facilities for recovery exploitation of used panels (calorific value 17.3 MJ/kg) consist of an incineration line, which is provided with a grate and a steam generator. Energy from waste incineration plants in Austria is converted to approx. one third electricity and two thirds district heating. An efficiency rate of 17% for conversion into electricity ad 75% boiler efficiency for district heating is assumed as a worst-case-scenario from the /UBA 2007/ report.

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	X	X	X	X	MNR	MNR	MNR	X	X	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m³ Kreuzlagenholz

Parameter	Unit	A1-A3	A4	A5	B1	B2	B6	B7	C1	C2	C3	C4	D
GWP	[kg CO_2-Eq.]	-601.29	70.38	20.69	0.00	0.00	0.00	0.00	9.28	4.02	808.39	0.00	-203.39
ODP	[kg CFC11-Eq.]	1.93E-5	1.28E-5	2.46E-6	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.67E-6	7.31E-7	5.66E-7	0.00E+0	-3.77E-5
AP	[kg SO_2-Eq.]	0.98	0.23	0.11	0.00	0.00	0.00	0.00	0.07	0.01	0.11	0.00	-0.38
EP	[kg $(PO_4)^{3-}$-Eq.]	0.33	0.05	0.03	0.00	0.00	0.00	0.00	0.02	0.00	0.14	0.00	-0.21
POCP	[kg ethene-Eq.]	0.15	0.03	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00	-0.06
ADPE	[kg Sb-Eq.]	6.19E-4	2.09E-4	1.12E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.16E-6	1.20E-5	9.68E-6	0.00E+0	-1.40E-4
ADPF	[MJ]	2491.52	1051.82	234.78	0.00	0.00	0.00	0.00	133.97	60.08	45.41	0.00	-3170.34

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 Kreuzlagenholz

Parameter	Unit	A1-A3	A4	A5	B1	B2	B6	B7	C1	C2	C3	C4	D
PERE	[MJ]	1058.09	12.84	5.39	0.00	0.00	0.00	0.00	1.03	0.73	1.77	0.00	-367.61
PERM	[MJ]	8210.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERT	[MJ]	9268.54	12.84	5.39	0.00	0.00	0.00	0.00	1.03	0.73	1.77	0.00	-367.61
PENRE	[MJ]	2594.67	1068.35	243.13	0.00	0.00	0.00	0.00	135.16	61.03	47.77	0.00	-3347.48
PENRM	[MJ]	163.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENRT	[MJ]	2756.80	1068.35	243.13	0.00	0.00	0.00	0.00	135.16	61.03	47.77	0.00	-3347.48
SM	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	[m³]	1.85E-2	2.60E-3	1.18E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.54E-4	1.48E-4	2.42E-4	0.00E+0	-8.47E-3

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 Kreuzlagenholz

Parameter	Unit	A1-A3	A4	A5	B1	B2	B6	B7	C1	C2	C3	C4	D
HWD	[kg]	6.21E-3	6.57E-4	1.08E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	6.11E-5	3.75E-5	1.40E-4	0.00E+0	-6.12E-3
NHWD	[kg]	60.27	50.51	2.24	0.00	0.00	0.00	0.00	0.15	2.89	4.83	0.00	-7.65
RWD	[kg]	2.35E-2	1.44E-2	2.66E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.87E-3	8.22E-4	2.84E-4	0.00E+0	-5.19E-3
CRU	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.58	0.00	0.00
MER	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	[MJ]	0.00	0.00	1.57	0.00	0.00	0.00	0.00	0.00	0.00	471.20	0.00	0.00
EET	[MJ]	0.00	0.00	13.81	0.00	0.00	0.00	0.00	0.00	0.00	4157.66	0.00	0.00

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 assessments of effects are relative statements only, which do not attempt to make a statement on the “final state” of the properties categories, the exceeding of threshold values, safety margins or about risks. The ecological life cycle assessment and the assessment of effects are based on the provisions of the European standard and there is no data-related or method-related limitation to the interpretation extending beyond this.

Global warming potential
The greenhouse potential is dominated in the manufacturing process by carbon dioxide. For each m³ of KLH there results from the calculation of bound

carbon dioxide during the wood formation phase on the one hand and fossil and biogenic carbon dioxide emissions from the production on the other, a greenhouse potential of -601.3 kg CO2 equivalent per m³ in the modules A1 to A3. Outside of the system under review there is an accumulated credit (substitution effects in the electricity mix and also in the average thermic energy for the energy use of 1 m3 KLH) 192.9 kg CO2 equivalents per m³ KLH panel.
The greenhouse potential in the production is influenced above all by the CO2 absorption of the wood during its growth in the forest (-794.2 kg CO2 equivalent). Outside of the system under review all the GWP-relevant emissions are produced in combustion (794.2 kg of CO2 equivalent). As a result of the credit 202.7 kg of CO2 equivalent is substituted.
The greenhouse potential from the delivery process (70.4 kg of CO2 equivalent) is about equal to 1/3 of that from production, during the erecting phase (A5) the potential is only 20.7 kg.

Ozone depletion potential

Per m³ KLH 1.93E-05 kg of R11 equivalent are emitted in the product phase (timber). The transport of the finished product also results in almost the same emission quantity (1.28E-05). The erecting process and the disposal module are below this by two powers of ten.
Substitution (D) through the energy use of the KLH panel in the end-of-life phase amounts to -3.75E-05 kg R11 equivalent.

Acidification potential

Per m³ KLH 0.975 kg of SO2 equivalent are emitted in the product phase. The transport of the product results in 0.23 kg. The emissions from combustion are at 0.11 kg and the substitution through energy use results in a credit of 0.37 kg SO2 equivalent.
The acidification potential results above all from the timber requirement for the production of KLH panels and from the emissions from combustion outside of the systems under review. Nitrogen oxide here has the greatest share in the acidification potential.

Eutrophication potential

In the product phase the eutrophication potential is 0.33 kg of phosphate equivalent. The combustion increases the eutrophication potential by 0.145 kg.
The eutrophication potential results above all from the timber requirement for the production of KLH panels and from the emissions from the combustion outside the system under review.

Photochemical ozone creation potential

In the product phase the POCP is 0.149 kg ethylene equivalent. The combustion results in a POCP of 0.0179 kg ethylene equivalent. The photochemical ozone creation potential results above all from the timber required for the production of KLH panels and from the emissions from the combustion outside the system under review. In this nitrogen oxide and VOC emissions have the highest share in the photochemical ozone creation potential.

Abiotic depletion potential of resources (fossil and non-fossil)

In the product phase the ADP fossil is 2856 MJ. An important issue in this context is also the transport of the product to the building site (A4). The contribution in A4 is 1059.97 MJ. On account of the otherwise very low use of fossil energy for the product, transport has an especially strong position for this indicator. On the one hand this is the transport of the product itself, and on the other hand the more intensive transport of the raw materials and timber.
In the product phase the ADP primary is 6.2E-04 kg antimony equivalent.
The gluing in the product phase is mainly responsible for the ADP in the product phase.

Life cycle inventory

Water consumption

The water consumption for 1 m³ KLH is 0.0185 m³ of water in the product phase.
The water consumption in A5 is the result of the high water requirement (rinsing baths) in the galvanizing process for the brackets and screws.

Primary energy renewable and non-renewable

In the A1-A3 phases a total of 9268 MJ renewable primary energy is used, whereby 8210 MJ of this is actually in the material itself. In the D phase there is a 368 MJ renewable primary energy credit through substitution in generating energy.
The total primary energy requirement consists of the primary energy and the renewable primary energy carrier together used as a raw material (energy and material use).
In the A1-A3 phases a total of 2757 MJ non-renewable primary energy is used. In the D phase there is a credit of -3347 MJ non-renewable primary energy through energy generation substitution. The high proportion of non-renewable energy is on account of the transport requirements for both the product (A4) and also of the timber. The wood drying is largely fuelled with wood remnants from the production process.

Wastes

All wastes occurring in A1-A3 are either thermally utilised or recycled. There is no landfill dumping: Plastic wastes and also paint and varnish remnants are incinerated. Metal and paper are recycled.
Radioactive waste results exclusively from participation in the generation of electricity production and does not occur in the plant. The quantity of this is a long way below 1 % of the entire waste volume.

Overview of the ecological impacts of the different processes in the production phases A1-A3 on the basis of selected indicators

As can be recognised in Fig. 1. the timber that is used is the cause of the biggest impact by far. Transport from the sawmill to the KLH production plant is responsible for on average around 10 % of the effect. An important point here is the eutrophication potential requiring some 17 % of the electrical energy in production. Since thermal energy is used solely for heating the production works, it relevance for the production itself is very low.

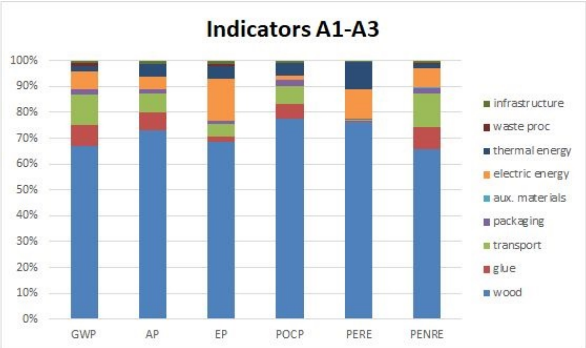

Fig. 1: The results for selected indicators A1-A3

Overview of the ecological impacts of the various life phases A1-A5 and C1-C3 on the basis of selected indicators

As can be seen in Fig. 2 production is the cause of the biggest impact in virtually all the indicators that are examined. As a consequence of the very long average transport distances for the finished product the deliveries (A4) account on average for virtually 20 % of the total impact. Not taken into account in the graph are the CO2 storage of the wood in the forest (negative GWP in A1 and the biogenic GWP emissions in C3). This is exclusively a consequence of the presentation in %.

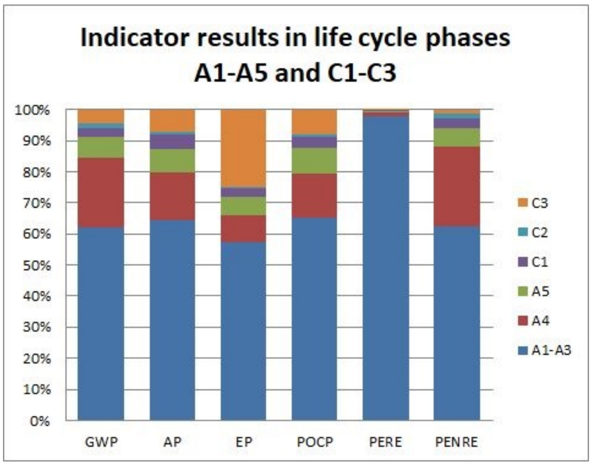

Fig. 2: The results for selected indicators A1-A5 and C1-C3

GWP overview of the various life cycle phases

In general, the calculation of the GWP (sum) is divided into GWP and GWP C content. GWP designates the greenhouse gas emissions that are generated in the course of the production process, while GWPC content refers to the CO2 bound in the wood in the form of carbon (C) on the one hand and the fossil CO2 contained in the packaging on the other. This separation makes possible a more readily understood tracing of the CO2 flows. As a tree grows it absorbs CO2. This is presented as a negative emission in A1 for example. In production (A3) it is largely process emissions that are released, while by contrast in A5 it is largely greenhouse gas emissions (fossil) that are released in the combustion of packaging. In C3 the product is thermally recycled and in D substituted from C3. taking efficiency levels into account (Fig.3).

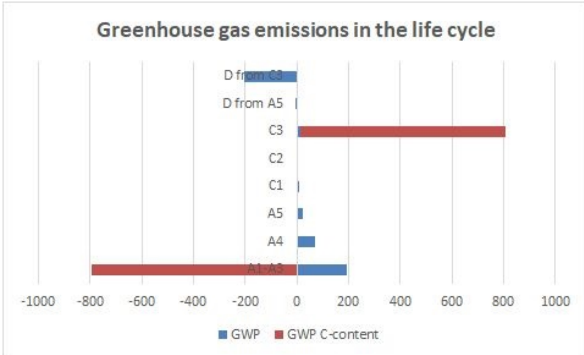

Fig. 3: GWP in the various life cycles in reference to the annual average energy and material input.

For 1m³ of KLH cross-laminated timber panels, no variable can be computed from using the annual input and output data from production for the calculation. In reality the environmental effects of the product vary with the thickness of the panels (60 to 500 mm) and also with the thickness of the wood lamella and with the ratio of adhesive to wood in this context.

7. Requisite evidence

7.1 Formaldehyde

Issuing agency: Fraunhofer IBP

Test report, date: HoE-005/2018 of 24.5.2018

The investigation of formaldehyde emissions was carried out in accordance with /EN 16516/.

The identification and quantification work was made using HPLC-DAD with reference substances.

Name	Value	Unit
Formaldehyd	8	[µg/m³]

7.2. MDI

On the gluing of the BSP the MDI in the cross-linked wet single component polyurethane glue reacts completely. An MDI emission from the hardened BSP is thus not possible; a test standard for this does not exist.

For testing based on the measurement method for determining the formaldehyde emission to /DIN EN 717-2/ an MDI emission is not detectable (detection limit : 0.05 µg/m³).

7.3 Fire gas toxicity

The toxicity of fire gases from the combustion of laminated timber is in compliance with the toxicity of the fire gases that arise on the combustion of natural wood.

7.4 VOC emissions

Issuing agency: Holzforschung Austria

Test report, date: 871/2014-HC, 6.5.2014

The investigation of the VOC emissions was carried out in accordance with /ISO 16000/.

AgBB performance summary (28 days)

Name	Value	Unit
TVOC (C6 - C16)	142	µg/m³
Sum SVOC (C16 - C22)	46	µg/m³
Carcinogenic Substances	<1	µg/m³

8. References

The literature referred to in the Environmental Product Declaration must be listed in full.

Standards already fully quoted in the EPD do not need to be listed here again.
The current version of PCR Part A and PCR Part B of the PCR document on which they are based must be referenced
.

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ISO 15686-8:20080615: Buildings and constructed assets -- Service-life planning -- Part 8: Reference service life and service-life estimation

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