ENVIRONMENTAL PRODUCT DECLARATION

As per /ISO 14025/ und /EN 15804/

Owner of the Declaration	Schilliger Holz AG
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-SLH-20200098-IBC1-DE
Issue date	23.06.2020
Valid to	22.06.2025

Schilliger cross laminated timber

Schilliger Holz AG

Institut Bauen und Umwelt e.V.

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

1. General Information

Schilliger Holz AG	Schilliger cross laminated timber
Programme holder IBU – Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the declaration** Schilliger Holz AG Haltikon 33 6403 Küssnacht Switzerland
Declaration number EPD-SLH-20200098-IBC1-EN	**Declared product / declared unit** 1 m³ Schilliger 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 declaration concerns cross laminated timber produced by Schilliger Holz AG in accordance with /ETA 19/0675/. The production site is the plant in Küssnacht, Switzerland.
Issue date 23.06.2020	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.
Valid to 22.06.2025	**Verification** The standard /EN 15804/ serves as the core PCR Independent verification of the declaration and data according to /ISO 14025:2010/ ☐ internally ☒ externally
Dipl. Ing. Hans Peters (Head of Board IBU)	
Dr. Alexander Röder (Executive Director IBU)	Prof. Dr. Birgit Grahl, (Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

Schilliger cross laminated timber (CLT) is a timber product industrially manufactured for load-bearing purposes. It is used as a panel or disk element, and is generally constructed symmetrically, consisting of at least three layers of solid coniferous wood which are glued perpendicular to one another. Details of the cross-sectional structures can be taken from the manufacturer-specific approvals (Declaration of performance /GFP / SHI / 03-01052020/). Further information on the cross-sectional structures and product properties can also be found in the technical data sheets which the company publishes for each product on its website.

Schilliger Holz AG offers cross laminated timber in various designs: as classic multi-layer panels, sandwich panels, box beam elements, rib panels, or as kits for factory assembly of prefabricated elements. Due to the perpendicular layering, CLT elements are very dimensionally stable, and can transfer loads both longitudinally and transversely to the main load-bearing direction. The panels are machined with state-of-the-art CNC machines and can be delivered ready for assembly, with surface treatment.

A comprehensive description of Schilliger CLT can be found on the company website at www.schilliger.ch

Regulation (EU) No. 305/2011 (CPR) applies to the marketing of the product in the EU/EFTA (with the exception of Switzerland). The product requires a Declaration of Performance, under consideration of /ETA-19/0675/ and the CE marking. Relevant national regulations apply where the product's use is concerned.

Schilliger cross laminated timber meets the technical requirements as per /ETA-19/0675/ (01.05.2020), which are further specified in the Declaration of Performance for CLT (/GFP / SHI / 03-01052020/).

2.2 Application

Schilliger cross laminated timber is manufactured to exact dimensions for wall and ceiling constructions, visible on one or two sides. They are suitable as either load-bearing or cladding elements both for timber engineering and for residential and office construction.

2.3 Technical data

Schilliger CLT fulfils the requirements of /ETA-19/0675/.

Schilliger cross laminated timber is made primarily of spruce and silver
Fir, but can be made of other wood types on request. Only single-component adhesives according to

Chapter 2.5 are used for the gluing. The CLT is produced with an average moisture content of 10 % to 12 % and with the structural properties of strength class C24 (/EN 338:2016/). The mechanical properties can be taken directly from /ETA 19/0675 Annex 2/ and apply to the calculation methods given in /ETA 19/0675 Annex 3/.
They are supplied in the dimensions stated in Chapter 2.4.

Technical Data

Name	Value	Unit
Wood types by trade names according to EN 1912	Spruce, silver fir, other wood types on request	-
Moisture content according to EN 13183-1	10 - 12	%
Compressive strength parallel to the grain according to EN 1995	21	N/mm²
Compressive strength perpendicular to the grain according to EN 1995	2.5	N/mm²
Use of wood preservatives (the test rating of the wood preservatives according to DIN 68800-3 must be stated)	-	-
Tensile strength parallel to the grain according to EN 1995	14.5	N/mm²
Tensile strength perpendicular to the grain according to EN 1995	0.4	N/mm²
Modulus of elasticity according to EN 1995	12000	N/mm²
Shear strength according to EN 1995	4	N/mm²
Shear modulus according to EN 1995	650	N/mm²
Dimensional deviation	+/- 3	mm
Gross density load-bearing components according to EN 338 or DIN 1052, non-load-bearing components according to DIN 68364	420	kg/m³
Surface quality (possible forms are to be named)	See below	-
Thermal conductivity according to EN 12664	0.1	W/(mK)
Specific heat capacity according to EN 12664	1.6	kJ/kgK
Calculation value for thermal conductivity	0.12	W/(mK)
Equivalent air layer thickness of water vapour diffusion	40 - 80	m
Water vapour diffusion resistance factor according to EN ISO 12572	20 - 50	-

Surface treatments:

Panels with D-quality are calibrated.
B or C-quality panels are sanded. For the B-quality panels, a finer sanding is possible on request.

Surface treatments are possible at the factory.

The mechanical properties and performance values of the cross laminated timber can be taken from the manufacturer-specific Declaration of Performance (/GFP / SHI / 03-01052020/).

2.4 Delivery status

The maximum product dimensions are 14,000 mm (l) x 3,400 mm (w) x 400 mm (h). The manufacturer-specific dimensional tolerance is ±1 mm for height and ±3 mm for length and width. For transport reasons, panels up to a thickness of 60 mm are only available with outer layers in the longitudinal direction of the panel.
Panel thicknesses: 27 mm - 400 mm
Standard format size: freely selectable between 2,000 mm x 7,000 mm and 3,400 mm x 14,000 mm.
Other formats are possible on request.

2.5 Base materials / Ancillary materials

Only single-component adhesives based on polyurethane (PUR) are used. No other additives are appended to the products. Finger-jointing and surface bonding is performed according to /EN 15425/ and as per the specifications of /ETA-19/0675/.
The average weight-proportions of the components per m³ of Schilliger CLT, for the purpose of this EPD, amount to:

- Softwood, mainly spruce: 90 %
- Water: approx. 9 %
- PUR adhesives: < 1 %.

The product has an average gross density of 424 kg/m³.

1) The product/at least one part of the product contains substances on the ECHA Candidate List (/ECHA-Kandidatenliste/, 14.04.2020**)** accounting for above 0.1 % of the mass: no

2) The product/at least one part of the product contains other CMR substances of category 1A or 1B not on the the ECHA Candidate List (/ECHA-Kandidatenliste/) accounting for above 0.1 % of the mass: no.

3) Biocidal products have been added to this construction product, or it has been treated with biocidal products (thereby a “treated product” as defined in /Regulation (EU) No 528/2012)/: no.

2.6 Manufacture

Only timber sawn and produced in-house is used, which is kiln-dried to a moisture content of 10 % to 12 % and left untreated.
The wood moisture of each board is measured, and following a visual pre-sorting, the boards are planed on all 4 sides. They then pass through the quality scanner, which marks flaws for trimming out, and sorts the boards according to their respective qualities. After the flaws have been cut out, the boards are finger-jointed into continuous lengths and thereafter shortened according to orders. After an additional planing process, the lamellas are edge-glued together to form a single layer; these layers are then rotated and glued at 90° from one another to create a CLT element. Finally, the end-product is planed once more, chamfered and proofed. The commissioned orders are then packaged and wrapped in Polyethylene (PE) film for delivery.
During the production process, the quality requirements of /ISO 9001/ are adhered to (certificate number 01 100 1300116 LGA-Intercert).

2.7 Environment and health during manufacturing

No exhaust air, no gases or any other harmful emissions for air, ground or water are generated during production. Wood-dust is produced during production; the plants are therefore equipped with filter systems for the dust in accordance with legal requirements. Working conditions in the production plant are subject to controls by the cantonal Labour Inspectorate and the Swiss National Accident Insurance Fund (SUVA).

2.8 Product processing/Installation

Schilliger CLT can be processed with the usual tools suitable for solid wood processing. Guidelines on occupational safety should also be observed during processing/assembly.

2.9 Packaging

Schilliger cross laminated timber may be wrapped in Polyethylene (PE) film for delivery. The foil can either be collected and recycled separately at the construction site or fed to waste incineration for energy recovery.

2.10 Condition of use

The composition for the period of use corresponds to the material composition in accordance with Section 2.5 "Raw materials".
During use, there are about 190 kg of carbon bound in the product. With complete oxidation, this equates to approximately 696 kg CO_2.

2.11 Environment and health during use

Environmental protection: According to present knowledge, using these products in the way they are intended will not pose any threat to water, air or soil

Health protection: According to present knowledge, no damage or impairment to health is to be expected. Glued wood bonded with PUR adhesives exhibits formaldehyde emission-values in the range of natural wood (around 0.004 ml/m³). The emissions of methylenediphenyl diisocyanate (MDI) for laminated wood bonded with PUR adhesives found to be below the detectability threshold of 0.05 µg/m³. Due to the high reactivity of MDI with water (air and wood moisture), it can therefore be assumed that shortly after production, the CLT emits levels of MDI in the nil-value-range.

2.12 Reference service life

No reference service life is specified, according to /ISO 15686/.

According to the /BBSR/ table on the service life of building products, a service life of more than 50 years can be assumed for the use of Schilliger cross laminated timber in load-bearing applications. The service life of Schilliger CLT generally coincides with the service life of a building.
When used as intended, no end to the durability is known or to be expected.

2.13 Extraordinary effects

Fire

Fire Protection

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

The toxicity of the combustion gases is equivalent to that of natural, untreated wood.

Water

No substances are washed out that could be hazardous to water.

Mechanical destruction

The fracture pattern of Schilliger cross laminated timber reflects the typical behaviour of solid wood.

2.14 Re-use phase

In the case of selective dismantling after the end of its service life, Schilliger cross laminated timber can be reused or repurposed without any issues.
If Schilliger cross laminated timber cannot be reused, it is thermally recycled in a waste-wood furnace or a waste incineration plant for the generation of process heat and electricity, due to its high calorific value of approximately 15 MJ/kg.

2.15 Disposal

Swiss (/VVEA/, Appendix 5) and German legislation (§9 /AltholzV/) do not permit the dumping or landfilling of wood.
Classification according to the European waste code (/EWC No./EAK Nummer/): 17 02 01 (treated CLT panels depending on the type of wood preservative used are assigned waste code 17 02 04)

2.16 Further information

Further information can be found at:
http://www.schilliger.ch

3. LCA: Calculation rules

3.1 Declared Unit

The declared environmental figures refer to 1 m³ of Schilliger cross laminated timber in accordance with /ETA-19/0675/.

Description of the declared unit

Name	Value	Unit
Declared unit	1	m³
Gross density	424	kg/m³
Mositure content upon delivery	10	%
Conversion factor to 1 kg	0,002358	-

Regarding the production of the dried lamellas, site data was weighted based on their respective production volumes; cross laminated timber panels are only produced at the one site.

3.2 System boundary

This EPD represents a 'cradle-to-gate' analysis, with options.

The manufacturing process of the cross laminated timber products **(modules A1-A3)** comprises the forestry processes, the transportation of the round timber to the sawmill, the production of the sawn timber and the related background processes (power generation, extraction of fossil fuels, etc.).

Furthermore, the production of the glue, as well as the packaging, is also reflected in the analysis. The infrastructure required for the sawmill and the glulam plant was drawn from the *ecoinvent* dataset (/KBOB 2016/).
According to the applicable PCR, the content of biogenic CO2 is accounted for as a negative input to the global warming potential (GWP).
Waste and secondary materials or secondary fuels are not used in production. Bark, wood -chips -shavings and other raw sawdust leave the product scope as coproducts.

In ***module A4*** an average transport distance of over 125km for the Schilliger cross laminated timber to reach the prospective construction site is accounted for.

Module A5 includes the disposal of PE packaging in a waste incineration plant (WIP).The heat and electricity generated in the WIP are offset as exported energy in module D. Installation material is not reflected in module A5, as the type and quantity of installation material varies depending on the use of the cross laminated timber; installation material must be considered accordingly when assessing a building.

Modul C2 comprises the transport of the reclaimed cross laminated timber to a biomass power plant.

Module C3 depicts the chopping of the reclaimed cross laminated timber; in accordance with /EN 16485/, it is assumed that non-pressure-treated waste wood reaches the end of its waste-state when it becomes available as wood chips. The chipped wood, including its content of biogenic C (as CO_2 equivalent) and its content of renewable primary energy, leaves the product system as secondary fuel.

Module C4 contains no processes/environmental impacts.

Module D calculates the energy recovery of the wood chips in a biomass power plant. It is assumed that the recovered energy will replace the electricity mix in Germany and heat from industrial natural gas firing. The exported energy recovered from the PE packaging (module A5) is calculated analogically.

3.3 Estimates and assumptions
No further assumptions and estimates that would be relevant to the result had to be made regarding the points discussed in this Chapter and in Chapter 4.

3.4 Cut-off criteria
No data available from the company survey has been neglected. Airborne emissions resulting from the heating system were modelled on a company-specific basis and supplemented by emission information drawn from the *ecoinvent* dataset (/KBOB 2016/). VOC emissions as a result of timber processing and drying were considered equivalent to natural emissions; there is no other corresponding data available The infrastructure requirements for the sawmill and gluing facility were derived from *ecoinvent* dataset (/KBOB 2016/).
This approach also accounted for mass and energy flows of < 1 %; it can further be assumed that no processes were neglected that would have been known to those responsible for the study to have had a significant effect on the indicators of the impact assessment.

3.5 Background data
The background database employed is an updated version of the *ecoinvent* 2.2 database (/KBOB 2016/; /Werner 29017/), which is used in Switzerland for the environmental performance indicators of construction products.

3.6 Data quality
The primary data is based on extensive and detailed data collection at both production sites for the dried lamellas, and at the Haltikon site for the production of the CLT out of the lamellas. The primary data could be completely matched to corresponding data records from an updated version of *ecoinvent* 2.2 (/KBOB 2016/).
The background data - for instance, with regard to electricity mix - was updated in 2016; some background data records however- such as for the production of MDI - are already older, but do not allow for an update, as they are only available in aggregated form. Subsequently, the quality of the foreground data is considered to be very good, and the quality of the background data is regarded as sufficient.

3.7 Period under review
The life cycle assessment data represents the production conditions for 2019.; the data for the manufacture of dried sawn timber used in the CLT production reflect the 2017 production year.

3.8 Allocation
The allocation of the forestry processes was adopted from *ecoinvent* data (/KBOB 2016/) - the forestry processes are allocated by real expenditure, i.e. based on mass. The sawmill processes at Schilliger Holz AG were allocated economically, according to the specific revenue generated by individual co-products; expenses that are directly attributable to one of the coproducts were only attributed to that co-product (chopping into chips, extraction of sawdust, etc.). To simplify matters, debarking was allocated to the bark or the debarked trunk - the bark is largely used to generate heat for drying, so this allocation is of secondary significance to the final result.

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 in accordance with /EN 15804/, and the building context and/or product-specific performance characteristics are considered.

The background database used is an updated version of the *ecoinvent* 2.2 database (/KBOB 2016/;/Werner 2017/). This database is being employed as source of ecological reference data for building materials in Switzerland.

4. LCA: Scenarios and additional technical information

Transport to the construction site

For transport to the construction site, it is assumed (A4):

- Transport distance and mode of transport: 125 km with the average truck fleet > 28 t in Switzerland
- Transport weight: product weight of 424 kg/m^3 plus 0.52 kg of PE packing per m^3

Disposal of packaging on site

For the modelling in module A5, the following is assumed:

- Transport distance and means of transport for the disposal of packaging: 30 km with the average truck fleet > 28 t in Switzerland
- Heat value of PE packaging: 22,8 MJ per m^3 of product
- Efficiency of waste incineration plants: 39 % based on the lower calorific value, of which 66 % is heat and 34 % is electricity.

Service life

No reference service life is specified per /ISO 15686/. According to the /BBSR/ table on the service life of building products, a service life of more than 50 years can be assumed for the use of Schilliger cross laminated timber in load-bearing applications. The service life of Schilliger cross laminated timber generally coincides with the service life of a building.

Reference service life

Name	Value	Unit
Life Span (according to BBSR)	> 50	a

End-of-life

A complete collection and subsequent utilisation as secondary fuel in a biomass power plant is assumed to be the disposal scenario for the cross laminated timber.

For transportation to a biomass power plant, it is assumed (C2):
- Transport distance and means of transport: 30 km with the average truck fleet > 28 t in Switzerland

For chopping of waste wood, it is assumed (C3):
- Chopping is done with a stationary electric woodchipper

The modelling in module D assumes:
- calorific value of glued wood with a water content of 20 %: 6091 MJ/m^3
- Efficiency of the biomass power plant: 68 % based on the lower calorific value, of which 54 % is heat and 46 % is electricity

Substituted processes are assumed to be: "Heat, natural gas, at boiler modulating>100kW/RER" and "electricity, medium voltage, at grid/kWh/CH".

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	MND	MND	MNR	MNR	MNR	MND	MND	MND	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m³ Schilliger cross laminated timber

Parameter	Unit	A1-A3	A4	A5	C2	C3	C4	D
GWP	[kg CO_2-Eq.]	-6,23E+2	7,22E+0	1,58E+0	1,65E+0	7,00E+2	0,00E+0	-2,00E+2
ODP	[kg CFC11-Eq.	9,40E-6	3,11E-7	1,58E-9	3,68E-8	1,99E-7	0,00E+0	-3,99E-5
AP	[kg SO_2-Eq.]	4,18E-1	3,75E-2	1,55E-4	9,48E-3	1,60E-2	0,00E+0	-2,16E-1
EP	[kg $(PO_4)^{3-}$-Eq.]	9,42E-2	8,23E-3	5,09E-5	2,02E-3	2,13E-3	0,00E+0	-1,75E-3
POCP	[kg ethene-Eq.]	1,05E-1	1,34E-3	2,60E-6	2,82E-4	7,19E-4	0,00E+0	-1,41E-2
ADPE	[kg Sb-Eq.]	1,49E-4	1,70E-5	1,67E-8	4,15E-6	1,48E-6	0,00E+0	-6,61E-5
ADPF	[MJ]	1,02E+3	1,09E+2	2,31E-1	2,48E+1	4,93E+1	0,00E+0	-2,90E+3

Legend	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 Schilliger cross laminated timber

Parameter	Einheit	A1-A3	A4	A5	C2	C3	C4	D
PERE	[MJ]	7,44E+2	1,70E+0	4,27E-3	4,08E-1	8,51E+0	0,00E+0	-8,27E+2
PERM	[MJ]	7,30E+3	0,00E+0	0,00E+0	0,00E+0	-7,30E+3	0,00E+0	0,00E+0
PERT	[MJ]	8,05E+3	1,70E+0	4,27E-3	4,08E-1	-7,29E+3	0,00E+0	-8,27E+2
PENRE	[MJ]	2,45E+3	1,15E+2	2,30E+1	2,63E+1	8,07E+1	0,00E+0	-6,58E+3
PENRM	[MJ]	1,05E+2	0,00E+0	-2,28E+1	0,00E+0	-8,20E+1	0,00E+0	0,00E+0
PENRT	[MJ]	2,55E+3	1,15E+2	2,45E-1	2,63E+1	-1,29E+0	0,00E+0	-6,58E+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]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	7,30E+3
NRSF	[MJ]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	8,20E+1
FW	[m³]	IND	IND	IND	IND	IND	IND	IND

Legend	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 Schilliger cross laminated timber

Parameter	Einheit	A1-A3	A4	A5	C2	C3	C4	D
HWD	[kg]	1,89E-3	1,31E-4	1,55E-6	3,12E-5	9,96E-5	0,00E+0	-2,37E-3
NHWD	[kg]	2,37E+1	1,02E+0	2,65E-2	2,03E-1	4,50E-1	0,00E+0	3,09E-1
RWD	[kg]	3,16E-2	1,29E-4	2,87E-7	3,10E-5	7,05E-4	0,00E+0	-7,74E-2
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	4,24E+2	0,00E+0	0,00E+0
EEE	[MJ]	0,00E+0	0,00E+0	5,80E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
EET	[MJ]	0,00E+0	0,00E+0	3,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0

Legende	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

The use of freshwater resources is not declared, since although the data set for MDI - a key driver of the results - does disclose the water input, it does not disclose the water output; thus an evaluation of this indicator is not meaningful.

6. LCA: Interpretation

6.1 Impact assessment indicators

Figure 6-1 illustrates the contribution of the individual stages of the life cycle to the overall result of the ecological assessment for Schilliger Holz AG's cross laminated timber, whereby the environmental impact of the production is set as 100 %.

Figure 6-1: Relative contributions of the individual stages of the life cycle (modules A1-A3 = 100 %)

Figure 6-1 illustrates that the benefit to GWP, ODP and the ADPF from the energy recovered from the cross laminated timber is about 2.5 to 4 times greater than the environmental impact of its production; for the remaining impact categories, the benefit of energy recovery lies between 2 % and 50 % of the environmental impact of production, depending on the impact category.

The greenhouse gas potential is dominated by the storage effect of biogenic carbon in the product, i.e. about 10 times as much biogenic carbon (in CO_2 equivalent) is stored in the product over its lifetime as is released during the production of the cross laminated timber (Figure 6-2).

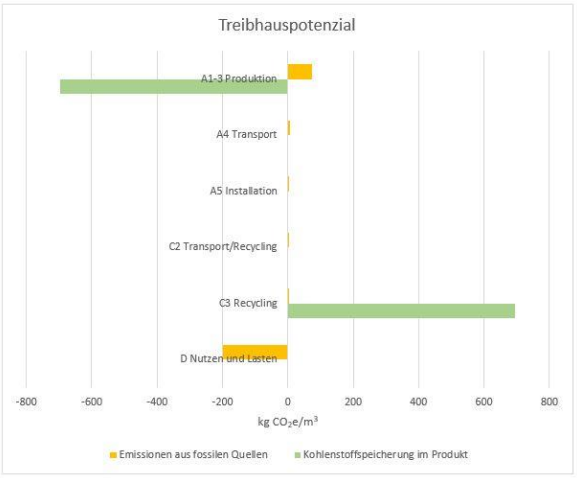

Figure 6-2: Contributions per module to the Global Warming Potential

If the laminated wood is used as a secondary fuel at the end of its service life, it can prevent around 2.5 times as much greenhouse gas emissions as is released during production. Since the environmental profile of the cross laminated timber over its life cycle is largely dictated by the production phase (ignoring module D), the following interpretation focuses on the production stage.

Global Warming Potential

The global warming potential (GWP) is an indicator of the contribution to climate change of a product and is calculated from the emissions of climate relevant gases. The use of fuel for forestry processes and for the transportation of the wood from the forest to the sawmill accounts for around 40 % of the GWP of production (excluding biogenic CO_2). The production of MDI as the basic material for bonding contributes about 20 % (without biogenic CO_2); from electricity generation (approx. 25 %).

Ozone Depletion Potential

The ozone depletion potential (ODP) is determined from emissions of gases that can deplete the stratospheric ozone layer. The main contributions to the ODP result from the emissions of halon 1211, halon 1301 and CFC114, which occur in the upstream chains of uranium and natural gas extraction.

Considering that the use of ozone-depleting substances has been prohibited under the Montreal Protocol for decades, the values of the ODP should be regarded as highly uncertain, as they are often based on outdated or incorrect background data; this impact category is no longer relevant from an environmental perspective.

Acidification Potential

Acidification potential (AP) regards the conversion of air pollutants into acids, which can possibly impair soil

fertility. About 30 % of the AP stems from the forestry processes and from the transportation of the wood from the forest to the sawmill. A further 30 % is caused by the combustion of the bark in order to generate heat for heating the gluing unit, and by the combustion of the bark for technical drying. The production of the MDI accounts for roughly another 30 % of this impact category.
The AP is caused in similar proportions by ammonia, nitrogen oxides and sulphur dioxide.

Eutrophication Potential
The eutrophication potential (EP) is calculated from the accumulation of nutrients in soil and water, which can lead to increased algae growth and undesirable shifts in the species composition. Approximately 40 % of the EP is caused by the combustion of the bark in order to generate heat for heating the gluing unit, and by the combustion of the bark for technical drying. The forestry processes and the transportation of the wood from the forest to the sawmill contribute another 35 %, and the production of the MDI an additional 5 %, to this impact category.
The AP is mainly caused by atmospheric emissions of ammonia and nitrogen oxides, as well as phosphorus/phosphate release into groundwater.

Photochemical Oxidant Formation Potential
The photochemical ozone creation potential (POCP) is calculated from emissions that can contribute to the formation of ozone in summer. Around 80 % of CO and VOC emissions (mainly toluene, formaldehyde and pentane) contributing to POCP originate from the exhaust gases from chainsaws in forestry processes; foaming of PE packaging is responsible for an additional 6 % of this environmental impact.

Abiotic Resource Consumption (fossil resources)
The abiotic depletion potential of fossil energy resources (ADPF) reflects the consumption of scarce fossil fuels such as crude oil or natural gas. The main contribution to ADPF here comes from the diesel consumption of forestry machines and the transportation of the wood from the forest to the sawmill (around 25 %), by the production of MDI (around 22 %) and through the production of PE packaging and power generation (approximately 3 % and 20 % respectively).

Abiotic Resource Consumption (mineral resources)
The abiotic depletion potential of mineral resource elements (ADPE) refers to the depletion of scarce, non-renewable mineral resources such as ores and other raw minerals. ADPE is almost entirely caused by infrastructure processes, such as the production of forestry machinery (around 15 %), the production of trucks (about 20 %), the construction of the sawmill and the planing and gluing units (around 30 %) and the infrastructure required for the generation and distribution of electricity (approximately 20 %). The main contributors to this environmental impact are the resource consumption of chromium, sulphur and lead.

6.2 Selected Life Cycle Inventory indicators

Primary Energy from Renewables (PERE)
The calorific value of the wood in the cross laminated timber is the main source of renewable primary energy; the amount of primary energy stored in the cross laminated timber is not consumed within the product system, but rather it leaves module C3 as secondary fuel, entering module D where it is used for energy purposes. Wood and water power are the main renewable energy sources used.

Primary Energy from Non-Renewables
As mentioned in regard to ADPF, about 40 % of non-renewable primary energy is derived from fossil fuels; the remaining 60 % of this indicator represents the consumption of uranium for nuclear energy.

Disposed Waste
The 3 waste indicators describe the quantities of waste that are disposed after any pre-treatment (e.g. in a WIP).
The largest component of disposed waste in the production of cross laminated timber is non-hazardous waste (NHWD), which is mainly generated through the disposal of infrastructure, e.g. the production halls or roads..
Hazardous waste (HWD) is unspecifically generated in the upstream chains of production, such as during the disposal of ash, as production waste from the chemical industry or during the production of aluminium, which is used in infrastructure processes.
The disposed radioactive waste (RWD) is associated with the use of nuclear energy.

Water Consumption
The net consumption of fresh water (FW) is not declared due to missing information in the data set for the production of MDI.

Secondary Materials
No secondary materials (SM) were utilised.

Other Life Cycle Inventory Indicators
The remaining indicators of the Life Cycle Inventory are individual values which are derived from the description of the system boundary in Chapter 3.2.

7. Requisite evidence

7.1 Formaldehyde
No adhesives containing formaldehyde were used.

VOC emission measurements were performed by the "Testing Institute for Construction and Environmental Chemistry", Zurich, on spruce and silver fir cross laminated timber (/Bau- und Umweltchemie 2011a/2011b/, 7 June 2011) as per /ISO 16000-6/:

Formaldehyde (28 days): 6 - 8 µg/m³

The formaldehyde emission of the tested product falls below the E1 value and requirements for low-emission building materials.

7.2 MDI
During the adhesion of the glulam, the MDI contained in the moisture curing single-component polyurethane adhesive reacts completely. An MDI emission test for

the finished cross laminated timber is not possible as no test standard/standardised test exists.
In tests based on the measurement methodology for determining formaldehyde emission from /DIN EN 7171/, no MDI emission was detected (detection threshold: 0.05 µg/m³; /Innenraum Mess- & Beratungsservice 2010/).

7.3 Toxicity of fumes

As optional, evidence regarding this was not provided.

7.4 VOC emissions

VOC emission measurements were performed by the "Testing Institute for Construction and Environmental Chemistry", Zurich, on spruce and silver fir cross laminated timber (/Bau- und Umweltchemie 2011a/2011b/, 7 June 2011). The emission analysis of the test cell was carried out in accordance with the AV FLEC work specification, which is based on ISO 16000-9 and ISO 16000-11. The measuring method is based on /ISO 160006/.

AgBB results overview (28 Days)

Name	Value	Unit
TVOC (C6 - C16)	55 - 75	µg/m³
Sum SVOC (C16 - C22)	unverifiable	µg/m³
R (dimensionless)	not specified	-
VOC without LCI	not specified	µg/m³
Carcinogenic substances	unverifiable	µg/m³

AgBB results overview (3 Days)

Name	Value	Unit
TVOC (C6 - C16)	not specified	µg/m³
Sum SVOC (C16 - C22)	not specified	µg/m³
R (dimensionless)	not specified	-
VOC without LCI	not specified	µg/m³
Carcinogenic substances	not specified	µg/m³

The tested cross laminated timber panels (silver fir or spruce) exhibit low levels of TVOC emissions. The products can be recommended for indoor use.

8. References

/EN 15804/
EN 15804:2012-04+A1 2013, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

/ISO 14025/
DIN EN ISO 14025:2011-10, Environmental labels and declarations — Type III environmental declarations — Principles and procedures.

/IBU 2016/
IBU (2016): General Programme Instructions for the Preparation of EPDs at the Institut Bauen und Umwelt e.V., Version 1.1 Institut Bauen und Umwelt e.V., Berlin.
www.ibuepd.de

/EN 15425/
DIN EN 15425:2017-05, Adhesives - One component polyurethane (PUR) for load-bearing timber structures - Classification and performance requirements; German version EN 15425:2017.

/EN 338/
DIN EN 338:2016-07, Structural timber - Strength classes; German version EN 338:2016.

/EN 717-1/
DIN EN 717-1:2005-01, Wood based panels - Determination of formaldehyde release - Part 1: Formaldehyde emission by the chamber method; German version EN 717-1:2004.

/EN 16485/
EN 16485:2014-07, Round and sawn timber Environmental Product Declarations - Product category rules for wood and wood-based products for use in construction; German version EN 16485:2014.

/EN 1912/
DIN EN 1912:2013-10, Structural timber - Strength classes - Assignment of visual grades and species; German version EN 1912:2012 + AC:2013.

/EN 1995/
DIN EN 1995-1-1/A2:2014-07, Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings; German version EN 1995-1-1:2004/A2:2014.

/EN 13183-1/
DIN EN 13183-1:2002-07, Moisture content of a piece of sawn timber - Part 1: Determination by oven dry method; German version EN 13183-1:2002.

/DIN 68800-3/
DIN 68800-3,
Wood preservation- Part 3: Preventive protection of wood with wood preservatives.

/DIN 68364:2003-05/
DIN 68364:2003-05, Properties of wood species - Density, modulus of elasticity and strength.

/EN 12664/
DIN EN 12664:2001-05, Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Dry and moist products with medium and low thermal resistance; German version EN 12664:2001.

/ISO 12572/
DIN EN ISO 12572:2017-05, Hygrothermal performance of building materials and products - Determination of water vapour transmission properties - Cup method (ISO 12572:2016); German version EN ISO 12572:2016.

/ISO 15686/
ISO 15686, Buildings and constructed assets — Service life planning (multiple parts).

/BBSR/
BBSR Tabelle, “Nutzungsdauern von Bauteilen”, online:
http://www.nachhaltigesbauen.de/fileadmin/pdf/baustof

f_gebauededaten/BNB_Nutzungsdauern_von_Bauteilen_2017-02-24.xls.

/Bau- und Umweltchemie 2011a/
Bau- und Umweltchemie (2011): Factsheet Grossformatplatte Fichte (FI), Schilliger Holz AG, Haltikon 33, CH-6403 Küssnacht. Bau- und Umweltchemie, Zürich.

/Bau- und Umweltchemie 2011b/
Bau- und Umweltchemie (2011): Factsheet Grossformatplatte Tanne (TA), Schilliger Holz AG, Haltikon 33, CH-6403 Küssnacht. Bau- und Umweltchemie, Zürich.

/ISO 16000-6/
ISO 16000-6:2011-12, Indoor air — Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS or MS-FID.

/ECHA-Kandidatenliste/
The Candidate List of substances of very high concern, available via https://echa.europa.eu/nl/-/four-newsubstances-added-to-the-candidate-list.

/EWC No./EAK-Nummer/
EWC – European Waste Catalogue, valid in Germany: Verordnung über das Europäische Abfallverzeichnis (Abfallverzeichnis-Verordnung – AVV) 2001, last updated 2012.

/GFP / SHI / 03-01052020/
GFP / SHI / 03-01052020 (01.05.2020), Schilliger Grossformatplatte GFP / crosslam according to ETA-19/0675 (31.03.2020), issued in accordance with Regulation (EU) No 305/2011.

/ISO 9001/
DIN EN ISO 9001:2015-11, Quality management systems – Requirements (ISO 9001:2015).

/IBU 2018/
IBU (2018): PCR Teil B: Anforderungen an die EPD für Vollholzprodukte. Version 2018/12, Institut Bauen und Umwelt, Berlin.

/IBU 2019/
IBU (2019): PCR Teil A: Rechenregeln für die Ökobilanz und Anforderungen an den Projektbericht. Version 1.8, Institut Bauen und Umwelt, Berlin.

/KBOB et al. 2016/
KBOB, eco-bau and IPB (2016): ecoinvent Datenbestand 2016 basierend auf Datenbestand ecoinvent 2.2; Grundlage für die KBOB Empfehlung 2009/1:2016: Ökobilanzdaten im Baubereich. Stand April 2016. Koordinationskonferenz der Bau- und Liegenschaftsor-gane der öffentlichen Bauherren c/o BBL Bundesamt für Bauten und Logistik.

/AltholzV/
Verordnung über Anforderungen an die Verwertung und Beseitigung von Altholz (Altholzverordnung - AltholzV) vom 15.08.2002. Zuletzt geändert durch Art. 5 Abs. 26 G v. 24.2.2012 I 212.

/VVEA/
Verordnung über die Vermeidung und die Entsorgung von Abfällen (Abfallverordnung, VVEA) vom 4. Dezember 2015 (Stand am 1. Januar 2018); SR 814.600.

/Werner 2017/
Werner F (2017): Background report for the life cycle inventories of wood and wood based products for updates of ecoinvent 2.2. Werner Umwelt & Entwicklung, Zürich.

/Innenraum Mess- & Beratungsservice 2010/
Innenraum Mess- & Beratungsservice (2010): UNTERSUCHUNGEN VON RAUMLUFT UND VON MATERIALPROBEN AUF FORMALDEHYD, FLÜCHTIGE ORGANISCHE VERBINDUNGEN UND ISOCYANATE; Prüfbericht vom 29.9.2010. Österreichisches Institut für Baubiologie und -ökologie GmbH, Wien.

Publisher
Institut Bauen und Umwelt e.V.
Panoramastr.1
10178 Berlin
Germany

Tel +49 (0)30 3087748- 0
Fax +49 (0)30 3087748- 29
Mail info@ibu-epd.com
Web **www.ibu-epd.com**

Programme holder
Institut Bauen und Umwelt e.V.
Panoramastr.1
10178 Berlin
Germany

Tel +49 (0)30 3087748- 0
Fax +49 (0)30 3087748- 29
Mail info@ibu-epd.com
Web **www.ibu-epd.com**

Author of the Life Cycle Assessment
Dr. Frank Werner - Umwelt & Entwicklung
Idaplatz 3
8003 Zürich
Switzerland

Tel + 41 (0)44 241 39 06
Fax + 41 (0)44 461 33 28
Mail frank@frankwerner.ch
Web **http://www.frankwerner.ch/**

Owner oft he Declaration
Schilliger Holz AG
Haltikon 33
6403 Küssnacht
Switzerland

Tel +41 41 854 08 00
Fax +41 41 854 0 801
Mail info@schilliger.ch
Web **http://www.schilliger.ch**