Environmental
Product
Declaration
According to EN15804+A2 (+indicators A1)

This declaration is for:
Cross-laminated timber

Provided by:
Mayr-Melnhof Holz Holding AG

program operator
Stichting MRPI®
publisher
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www.mrpi.nl

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COMPANY INFORMATION

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MRPI® REGISTRATION

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28-8-2024

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28-08-2029

SCOPE OF DECLARATION

This MRPI®-EPD certificate is verified by Martijn van Hövell, SGS Search Consultancy. The LCA study has been done by Therese Daxner and Susanne Lehner, Daxner & Merl GmbH. The certificate is based on an LCA-dossier according to EN15804+A2 (+indicators A1). It is verified according to the 'MRPI®-EPD verification protocol November 2020.v4.0'. EPD's of construction products may not be comparable if they do not comply with EN15804+A2. Declaration of SVHC that are listed on the 'Candidate list of Substances of Very High Concern for authorisation' when content exceeds the limits for registration with ECHA.

PROGRAM OPERATOR

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PRODUCT

Cross-laminated timber

DECLARED UNIT/FUNCTIONAL UNIT

1 m³ of cross-laminated timber with an average density of 470 kg/m³ (moisture at delivery = 11.5 %)

DESCRIPTION OF PRODUCT

MM crosslam (cross-laminated timber, abbreviated as CLT or X-lam) is an industrially manufactured plane timber product for structural applications.

VISUAL PRODUCT

MORE INFORMATION

https://www.mm-holz.com/en/products/clt-cross-laminated-timber

DEMONSTRATION OF VERIFICATION
CEN standard EN15804 serves as the core PCR(a)
Independent verification of the declaration an data according to EN15804+A2 (+indicators A1) internal: external: x
Third party verifier: Martijn van Hövell, SGS Search Consultancy
[a] PCR = Product Category Rules

DETAILED PRODUCT DESCRIPTION

MM-crosslam (cross-laminated timber, abbreviated as CLT or X-lam) is an industrially manufactured plane timber product for structural applications. It is used as panel or diaphragm elements and more seldomly as beams.
MM-crosslam generally displays a symmetrical design and comprises at least three layers glued at right angles. MM-crosslam is supplied in various manufacturer-specific surface qualities.
MM-crosslam elements are very dimensionally stable on the one hand and can also transfer loads both lengthwise and transverse to the main load-bearing direction.
MM-crosslam is manufactured from spruce, fir, pine. Other coniferous species are permissible but not typical. Adhesives in accordance with "Base materials/Ancillary materials" are used for gluing. MM-crosslam is manufactured with a maximum wood moisture of 15 %. MM-crosslam is manufactured in dimensions as per "Delivery status".

For the placing of the product on the market in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) the Regulation (EU) No. 305/2011 PCR applies. The product needs a Declaration of Performance taking into consideration ETA-09/0036 and the CE-marking. For the application and use, the respective national provisions apply.

Application

Application of the products is subject to the respective national specifications.
Cross-laminated timber is used in service classes 1 and 2 in accordance with EN 1995-1-1 in members with primarily static dead loads.
Member resistance at normal temperature and resistance to fire are dependent on the properties of the layers, cross-sectional layup, static system and load position.
Member resistance and resistance to fire must be established for the respective building in accordance with the applicable design rules.
Use of wood preservatives in accordance with DIN 68800-3 is not typical and only permissible if other preservative means as per DIN 68800-2 are not sufficient on their own.
Where wood preservative is used in exceptional cases, it must be regulated in the form of a national technical approval or an approval in accordance with the Biocides Directive.

Manufacture

To produce MM-crosslam, softwood boards are first dried to less than 15 % wood moisture, preplaned and sorted visually or mechanically according to strength. Identified board sections with areas that reduce strength are cut out depending on the desired strength class and the resulting board sections are joined to endlessly long lamellas using finger-jointed connections. In the following pre-planning process, the lamellas are planed on four sides to thicknesses between 19 mm and 45 mm. In some cases, the lamellas are glued together using narrow side gluing to form a single-layer panel.
Wood-based panels in accordance with EN 13986 can also be used during production for surface qualities. After pressing and hardening, the raw element is planed, chamfered, tied and packaged.
To ensure product quality during transport to the construction site, storage or assembly, the application of a weatherproofing or wood preservative may be necessary.

Delivery status

Length up to 16.50 m
Width up to 3.5 m
Thickness up to 0.36 m

The tolerances acc. to ETA-09/0036 are met.
MM-crosslam is available in the following surface qualities:
• Non-visible (NVI)
• Industrial-visible (IVI)
• Residential-visible (RVI)

Packaging

Polyethylene foils and small amounts of other plastics are used.

Product processing/Installation

MM-crosslam can be processed with commercially available tools. The instructions for occupational safety/assembly are to be observed.

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: Under normal conditions of use, MM-crosslam is not expected to cause any damage or impairments to health. With regard to formaldehyde, MM-crosslam is low-emission thanks to its adhesive content, structure and form of use (formaldehyde emission class E1).

MM-crosslam bonded with PU-based adhesives has formaldehyde emission values in the range of the untreated raw material wood (sawn timber, by 0.004 ml/m³).
Measured against the limit value of 0.1 ml/m³ (0.124 mg/m³) of the Reach Regulation 1907/2006/EG, the measured values in accordance with EN 717-1 can be classified as low.

MM-crosslam 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 low after testing EN 717-1.

Reference service life
Cross-laminated timber has been used in structural timber construction for more than 25 years and is very similar to glulam with more than 100 years of experience of use. When used as designated, no end of durability must be expected due to its natural durability (protection against moisture). When used as designated, lifetime of MM-crosslam is equal to the duration of use of the building. Thus, 100 years can acc. to a manufacturer declaration be regarded as reference service life.

Re-use phase
MM-crosslam 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.

Disposal
MM-crosslam 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 code numbers according to the European Waste Catalogue (EAK): 170201
Landfill dumping is not permissible.

Technical Data
Performance data of the product MM-crosslam in accordance with the declaration of performance with respect to its essential characteristics according to ETA-09/0036, (not part of CE-marking).

Structural data	Value	Unit
Wood types by trade names acc. to EN 1912	Coniferous wood in accordance with ETA-09/0036	
Wood moisture acc. to ETA-09/0036	< 15	%
Use of wood preservatives (the test description as per DIN 68800-3 must be indicated)*	Iv, P and W	
Compressive strength parallel acc. to ETA-09/0036	21	N/mm²
Compressive strength rectangular acc. to ETA-09/0036	21	N/mm²
Tensile strength parallel acc. to ETA-09/0036	14.5	N/mm²
Tensile strength rectangular acc. to ETA-09/0036	0.12	N/mm²
Modulus of elasticity acc. to ETA-09/0036	12000	N/mm²
Shear strength acc. to ETA-09/0036	1.1	N/mm²
Shear modulus acc. to ETA-09/0036	690	N/mm²
Dimensional deviation	depending on geometrical dimensions	mm
Length max. acc. to ETA-09/0036	< 18.0	m
Width max. acc. to ETA-09/0036	< 4.0	m
Height (min. - max.) acc. to ETA-09/0036	0.036 0.36	m
Gross density acc. to EN 338**	420	kg/m³
Surface quality	n.r.	
Risk class acc. to DIN 68800-3	4	
Thermal conductivity acc. to EN 12664	0.12	W/(mK)
Specific heat capacity acc. to EN 12664	1.6	kJ/kgK
Water vapor diffusion equivalent air layer thickness acc. to ISO 12572	n.r.	m
Water vapor diffusion resistance factor acc. to ISO 12572	20 - 50	
Formaldehyde emissions acc. To EN 717-1	< E1	µg/m3

* Use of preventive chemical wood preservatives in accordance with DIN 68800-1 is unusual and permitted only if other preservative measures are not sufficient on their own.
** The declared density values may deviate from these average values due to different densities of the wood species used.

Base materials/Ancillary materials
MM-crosslam is mainly made from spruce wood (PEFC certified), which has a wood moisture content of m.c. = 12 % (+/2 %) (pine, fir, and other types of wood on request).

Either polyurethane (PUR) adhesives according to EN 15425 or melamine-urea-formaldehyde adhesives (MUF) according to EN 301 are used for bonding. The average proportions of ingredients per m³ MM-crosslam for the environmental product declaration are:

Component (> 1%)	(kg / %)
Softwood, mainly spruce approx.	88% to 90%
Water approx.	9% to 10%
Adhesives approx.	0.5% to 1.2%

SCOPE AND TYPE

The EPD was created according to the specifications of EN 15804:2012+A1:2013 and EN 15804:2012+A2:2019

The life cycle assessment of average cross-laminated timber produced by Mayr-Melnhof Holz Holding AG refers to a cradle-to-gate analysis of the environmental impacts (A1–A3, A4, A5, B1-B5, C1-C4, D). This EPD is based on a declared unit of 1 m³ of cross-laminated timber (moisture of 11.5 % at a raw density of 470 kg/m³), produced by Mayr-Melnhof Holz Holding AG in Gaishorn am See (Austria). The present study includes a declaration of average products from a manufacturer's factory. The production conditions are comparable for all products included in the average. Differences in energy consumption for different formats cannot be quantified and can be considered negligible due to their small share of the overall result.

Scenarios and standard values are acc. to the "Environmental Performance Assessment Method for Construction Works Calculation method to determine environmental performance of construction works throughout their service life, based on EN 15804" and the "Forfaitaire waarden voor verwerking-scenario's einde leven behorende bij: Bepalingsmethode Milieuprestatie Bouwwerken" of the Nationale Milieudatabase.

The ecoinvent 3.6 background database in the openLCA software version 2.0.3 was used to calculate the LCA.

The following life cycle phases are part of the analysis:

Module A1–A3 | production stage
The production stage includes the upstream burdens of raw material supply, their transports, and the manufacturing plant of Mayr-Melnhof Holz in Gaishorn am See (Austria). Main raw material inputs therefore refer to sawn timber and the production of the adhesive system. Within the plant boundaries the sorting, drying, finger jointing, pressing and framing as well as the packaging of the product are considered. The production site is supplied with thermal energy from a biomass power plant. Furthermore, electricity is purchased as 100 % green electricity from the external grid. Direct emissions from drying are based on worst-case assumptions and are included in the study. Primary data from adhesive production was used as far as possible. The packaging of the products is considered in module A1–A3 as well.

Module A4 - A5 | construction stage
A4 transport to construction site: The transport covers 1020 km distance by truck between Utrecht (Netherlands) and the production site in Gaishorn am See (Austria).
A5 assembly at construction site: Cross-laminated timber can be processed using the standard tools suitable for timber construction. The energy required for small machines as well as a crane and a work platform are considered in the study (0,12 kWh electricity and 12,8 kWh diesel). The actual energy demand depends on the installation of the products and can therefore vary greatly in the building context. Additionally, module A5 covers the transport to waste treatment and the disposal of product packaging as well as of off-cuts at the construction site (3%). The waste treatment scenarios acc. to the Dutch requirements are considered. Potentials from energy recovery and recycling are considered in Module D.

Module B1-B5 | use stage
B1 use: Cross-laminated timber has been used in structural timber construction for more than 25 years and is very similar to glulam with more than 100 years of experience of use. When used as designated, no end of durability must be expected due to its natural durability (protection against moisture). When used as designated, lifetime of MM-crosslam is equal to the duration of use of the building. No changes of the product are to be expected during its use. As a result, no environmental impacts can be asserted to module B1.

B2-B5 maintenance, repair, replacement, renovation: Cross-laminated timber is installed permanently in the structure and does not require maintenance, repair, replacement or refurbishment under normal use conditions. As a result, no environmental impacts can be asserted to modules B2-B5.

Module C | end of life stage

C1 deconstruction and demolition: After the removal of other building components, the joints can simply be loosened by screwing or sawing and lifted by cranes to the place of removal. Required energy demand can be neglected. The actual energy demand depends on the installation of the products and can therefore vary greatly in the building context. Therefore, no environmental burdens are declared in module C1.

C2 transport to end of life: Module C2 includes the transport to waste treatment. In this case, transport by truck over a transport distance of 100 km to incineration and 50 km to landfill is considered.

C3 waste processing: In Module C3, the chipping after the removal of the products is considered. Acc. to the Dutch requirements, 90% of the wooden products are incinerated in a municipal waste treatment plant and used for energy recovery. Emissions from incineration are declared in module C3. Plant-specific values are considered acc. to the Dutch requirements.

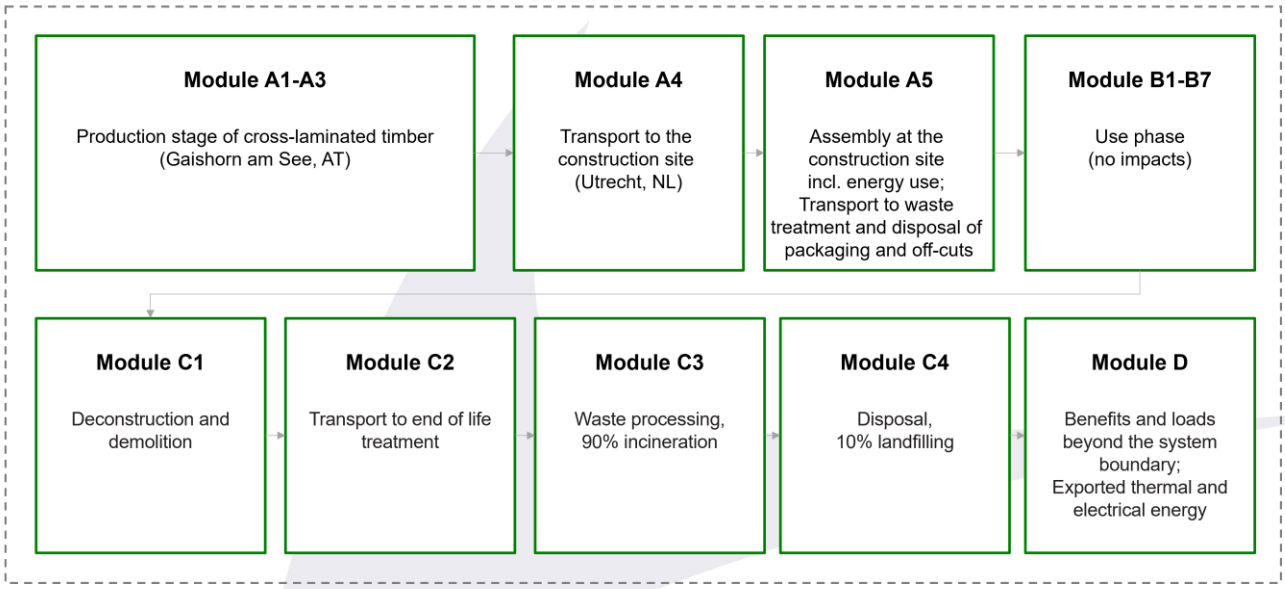
C4 disposal: The applied scenario declares 90% energetic recovery of the wooden products, and 10% landfilling. From the share that is incinerated, no environmental impacts are to be expected from waste processing of the products in C4. C4 includes the environmental burdens of landfilling 10% of the product.

Module D | benefits and loads beyond the system boundary

Applying a Dutch scenario, module D describes the energetic recovery of 90% of the product at the end of life including the corresponding energy substitution potentials. Furthermore, energetic recovery of off-cuts and packaging (both from module A5) as well as recycling of packaging are considered acc. to the Dutch scenario.

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USER STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport gate to 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	X	X	X	ND	ND	X	X	X	X	X
X= Modules Assessed ND= Not Declared																

System boundary



REPRESENTATIVENESS

This EPD is based on a declared unit of 1 m³ of average cross-laminated timber (moisture of 11.5 % at a raw density of 470 kg/m³). The present study includes a declaration of average products from a manufacturer's factory. The production conditions are comparable for all products included in the average. Differences in energy consumption for different formats cannot be quantified and can be considered negligible due to their small share of the overall result.

A possible variability is to be expected due to the use of different types of wood. The upstream supply chain for spruce wood is assumed to be representative. This applies to the majority of the wood used. The robustness of the declared LCA values can therefore be categorised as good.

ENVIRONMENT IMPACT per functional unit or declared unit (core indicators A1)

	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
ADPE	kg Sb eq.				2,01 E-04	8,14 E-05	9,60 E-06	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	7,35 E-06	7,13 E-06	5,52 E-07	-3,65 E-05
ADPF	MJ				1,41 E+03	9,97 E+02	1,34 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	9,00 E+01	8,07 E+01	1,08 E+01	-3,75 E+02
GWP	kg CO2 eq.				9,40 E+01	6,61 E+01	1,28 E+01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	5,97 E+00	1,87 E+01	2,91 E+01	-3,06 E+01
ODP	Kg CFC11 eq.				1,48 E-05	1,18 E-05	1,56 E-06	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,06 E-06	9,08 E-07	1,33 E-07	-8,79 E-06
POCP	Kg ethene eq.				1,73 E-01	1,94 E-02	8,22 E-03	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,75 E-03	8,98 E-03	6,37 E-03	-6,21 E-02
AP	kg SO2 eq.				5,38 E-01	2,91 E-01	5,98 E-02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	2,63 E-02	1,07 E-01	4,82 E-03	-6,26 E-01
EP	kg (PO4) 3- eq.				2,85 E-01	7,13 E-02	2,70 E-02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	6,43 E-03	1,38 E-01	1,40 E-01	-2,16 E-01
Toxicity indicators for Dutch market																			
HTP	kg DCB-Eq				1,63 E+02	3,82 E+01	1,12 E+01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	3,45 E+00	1,98 E+01	7,56 E+00	-1,01 E+02
FAETP	kg DCB-Eq				3,15 E+01	5,04 E+00	4,84 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	4,55 E-01	5,03 E+00	8,94 E+00	-5,33 E+00
MAETP	kg DCB-Eq				1,37 E+05	1,59 E+04	8,88 E+03	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,43 E+03	1,10 E+04	8,61 E+03	-1,44 E+04
TETP	kg DCB-Eq				1,64 E+00	1,79 E-01	6,89 E-02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,61 E-02	1,01 E-01	6,99 E-02	-7,66 E-01
ECI	euro				3,92 E+01	1,04 E+01	3,19 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	9,40 E-01	5,66 E+00	4,56 E+00	-1,68 E+01
ADPF	kg Sb eq.				6,78 E-01	4,80 E-01	6,46 E-02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	4,33 E-02	3,88 E-02	5,21 E-03	-1,80 E-01

ADPE = Abiotic Depletion Potential for non-fossil resources
ADPF = Abiotic Depletion Potential for fossil resources
GWP = Global Warming Potential
ODP = Depletion potential of the stratospheric ozone layer
POCP = Formation potential of tropospheric ozone photochemical oxidants
AP = Acidification Potential of land and water
EP = Eutrophication Potential
HTP = Human Toxicity Potential
FAETP = Fresh water aquatic ecotoxicity potential
MAETP = Marine aquatic ecotoxicity potential
TETP = Terrestrial ecotoxicity potential
ECI = Environmental Cost Indicator
ADPF = Abiotic Depletion Potential for fossil resources expressed in [kg Sb-eq.]

ENVIRONMENT IMPACT per functional unit or declared unit (core indicators A2)

	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-total	kg CO2 eq.				-6,63 E+02	6,68 E+01	1,32 E+01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	6,03 E+00	7,82 E+02	3,54 E+01	-3,19 E+01
GWP-fossil	kg CO2 eq.				9,63 E+01	6,68 E+01	1,21 E+01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	6,03 E+00	1,88 E+01	2,42 E+00	-3,12 E+01
GWP-biogenic	kg CO2 eq.				-7,62 E+02	2,49 E-02	1,01 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	2,25 E-03	6,87 E+02	1,09 E+02	-3,77 E-01
GWP-luluc)	kg CO2 eq.				2,85 E+00	2,45 E-02	8,45 E-02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	2,21 E-03	9,47 E-03	2,05 E-04	-3,48 E-01
ODP	kg CFC11 eq.				1,70 E-05	1,47 E-05	1,91 E-06	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,33 E-06	8,56 E-07	1,57 E-07	-8,95 E-06
AP	mol H+ eq.				7,25 E-01	3,87 E-01	8,24 E-02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	3,49 E-02	1,54 E-01	6,17 E-03	-9,84 E-01
EP-freshwater	kg PO4 eq.				3,67 E-02	6,12 E-03	1,65 E-03	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	5,52 E-04	6,22 E-03	6,16 E-04	-5,94 E-03
EP-marine	kg N eq.				2,59 E-01	1,38 E-01	3,61 E-02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,24 E-02	6,95 E-02	8,36 E-02	-2,88 E-01
EP-terrestrial	mol N eq.				2,74 E+00	1,50 E+00	3,64 E-01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,36 E-01	7,43 E-01	1,85 E-02	-4,74 E+00
POCP	kg NMVOC eq.				1,36 E+00	4,29 E-01	1,18 E-01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	3,87 E-02	1,94 E-01	1,52 E-02	-8,30 E-01
ADP-minerals & metals	kg Sb eq.				2,04 E-04	8,25 E-05	9,78 E-06	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	7,44 E-06	8,52 E-06	5,99 E-07	-3,69 E-05
ADP-fossil	MJ, net calorific value				1,64 E+03	1,01 E+03	1,43 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	9,14 E+01	1,17 E+02	1,28 E+01	-3,84 E+02
WDP	m3 world eq. Deprived				2,37 E+02	4,68 E+00	7,51 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	4,22 E-01	1,05 E+01	2,56 E-01	-2,25 E+01

GWP-total = Global Warming Potential total
GWP-fossil = Global Warming Potential fossil fuels
GWP-biogenic = Global Warming Potential biogenic
GWP-luluc = Global Warming Potential land use and land use change
ODP = Depletion potential of the stratospheric ozone layer
AP = Acidification Potential, Accumulated Exceedence
EP-freshwater = Eutrophication Potential, fraction of nutrients reaching freshwater end compartment
EP-marine = Eutrophication Potential, fraction of nutrients reaching marine end compartment
EP-terrestrial = Eutrophication Potential, Accumulated Exceedence
POCP = Formation potential of tropospheric ozone photochemical oxidants
ADP-minerals&metals = Abiotic Depletion Potential for non-fossil resources [2]
ADP-fossil = Abiotic Depletion for fossil resources potential [2]
WDP = Water (user) deprivation potential, deprivation-weighted water consumption [2]

Disclaimer [2]
- The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

ENVIRONMENT IMPACT per functional unit or declared unit (additional indicators A2)

	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	Disease incidence				2,97 E-05	6,04 E-06	2,26 E-06	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	5,45 E-07	1,17 E-06	7,99 E-08	-1,33 E-05
IRP	kBq U235 eq.				1,72 E+01	4,84 E+00	9,95 E-01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	4,37 E-01	2,14 E+00	1,61 E-01	-1,87 E+00
ETP-fw	CTUe				4,33 E+03	9,17 E+02	2,04 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	8,28 E+01	1,77 E+02	2,34 E+02	-9,56 E+03
HTP-c	CTUh				2,69 E-07	2,61 E-08	1,34 E-08	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	2,36 E-09	1,25 E-07	1,29 E-09	-8,21 E-08
HTP-nc	CTUh				4,89 E-06	8,92 E-07	2,17 E-07	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	8,05 E-08	4,43 E-07	6,78 E-08	-3,32 E-06
SQP	----				4,49 E+04	8,52 E+02	1,34 E+03	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	7,69 E+01	2,45 E+01	1,06 E+01	-3,75 E+04

PM = Potential incidence of disease due to PM emissions
IRP = Potential Human exposure efficiency relative to U235 [1]
ETP-fw = Potential Comparative Toxic Unit for ecosystems [2]
HTP-c = Potential Comparative Toxic Unit for humans [2]
HTP-nc = Potential Comparative Toxic Unit for humans, non-cancer [2]
SQP = Potential soil quality index [2]

Disclaimer [1]
- This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste.

Disclaimer [2]
- The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

OUTPUT FLOWS AND WASTE CATEGORIES per functional unit or declared unit (A1 / A2)

	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	kg				5,68 E-03	2,55 E-03	4,12 E-04	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	2,30 E-04	1,49 E-04	4,69 E-05	-1,31 E-03
NHWD	kg				2,98 E+01	6,38 E+01	1,55 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	5,76 E+00	3,12 E+00	-4,69 E+01	-1,09 E+01
RWD	kg				9,13 E-03	6,61 E-03	9,04 E-04	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	5,97 E-04	6,48 E-04	9,19 E-05	-2,34 E-03
CRU	kg				0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
MFR	kg				0,00 E+00	0,00 E+00	1,66 E-01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
MER	kg				0,00 E+00	0,00 E+00	1,22 E+01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	4,23 E+02	0,00 E+00	0,00 E+00
EEE	MJ				0,00 E+00	0,00 E+00	5,88 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,30 E+03	0,00 E+00	0,00 E+00
ETE	MJ				0,00 E+00	0,00 E+00	1,01 E+01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	2,24 E+03	0,00 E+00	0,00 E+00

HWD = Hazardous Waste Disposed
NHWD = Non Hazardous Waste Disposed
RWD = Radioactive Waste Disposed
CRU = Components for reuse
MFR = Materials for recycling
MER = Materials for energy recovery
EEE = Exported Electrical Energy
ETE = Exported Thermal Energy

RESOURCE USE per functional unit or declared unit (A1 / A2)

	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ				1,40 E+04	1,26 E+01	4,26 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,14 E+00	6,94 E+03	1,62 E+00	-7,85 E+03
PERM	MJ				7,70 E+03	0,00 E+00	2,08 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	-6,93 E+03	0,00 E+00	0,00 E+00
PERT	MJ				2,17 E+04	1,26 E+01	6,33 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	1,14 E+00	1,44 E+01	1,62 E+00	-7,85 E+03
PENRE	MJ				1,60 E+03	1,08 E+03	1,48 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	9,71 E+01	2,51 E+02	1,35 E+01	-4,10 E+02
PENRM	MJ				1,42 E+02	0,00 E+00	3,85 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	-1,28 E+02	0,00 E+00	0,00 E+00
PENRT	MJ				1,74 E+03	1,08 E+03	1,52 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	9,71 E+01	1,23 E+02	1,35 E+01	-4,10 E+02
SM	kg				0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
RSF	MJ				0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
NRSF	MJ				0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
FW	m3				5,51 E+00	1,09 E-01	1,75 E-01	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	9,83 E-03	2,45 E-01	5,95 E-03	-5,23 E-01

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

BIOGENIC CARBON CONTENT per functional unit or declared unit (A1 / A2)

	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
BBCpr	Kg C				2,08 E+02	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	-1,87 E+02	-2,08 E+01	0E +00
BCCpa	kg C				0,00 E+00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00	0E +00

BCCpr = Biogenic carbon content in product
BCCpa = Biogenic carbon content in packaging

CALCULATION RULES

Estimates and assumptions

All assumptions are verified through detailed documentation and correspond to the best possible representation of reality based on the available data. Regional applicability of the used background data refers to average data under European conditions taken from the ecoinvent-database. Swiss data were used for the Austrian and Dutch market whenever European or regionalised average data were not available. Emissions from wood drying were included in the calculations according to Rüter & Diederichs 2012.

Cut-off criteria

The LCA model covers all available input and output flows, which can be represented based on robust data and from which a significant contribution can be expected. Data gaps are filled with conservative assumptions of average data or generic data if available and are documented accordingly. Only data with a contribution of less than 1 % were cut off. Thus, no data were neglected, of which a substantial impact is to be expected. All relevant data were collected comprehensively. Cut-off material and energy flows were chosen carefully based on their expected quantitative contribution as well as potential environmental impacts. Thus, it can be assumed that the sum of all neglected input flows does not account for more than 5 % of the total material, water and energy flows.

Background data

This study uses generic background data for the evaluation of upstream environmental impacts from ecoinvent 3.6 database in the open LCA software version version 2.0.3, as well as recognised literature such as Rüter & Diederichs 2012.
The analysis of the major amount of adhesives used for cross-laminated timber production is based on primary data from Mayr-Melnhof Holz's suppliers.

Data quality

Data collection is based on product-specific questionnaires. It follows an iterative process of clarifying questions via e-mail, telephone calls or in personal/web meetings. Intensive discussions between Mayr-Melnhof Holz Holding AG and Daxner & Merl results in an accurate mapping of product-related material and energy flows. This leads to a high quality of foreground data collected. Data collection relies on a consistent process according to ISO 14044.
The representation of the main raw materials used for the production of cross-laminated timber is based on supplier specific primary data (adhesive systems) leading to a high data quality.

The technological, geographical and time-related representativeness of the database was kept in mind when selecting background data. Whenever specific data were missing, either generic datasets or representative average data were used instead. The implemented ecoinvent-background datasets refer to ecoinvent versions 3.6 as required acc. to the Assessment Method. As a result, some datasets are more than 10 years old.

Period under review

Foreground data were collected in the 2021 production year and the data are based on the volumes produced on an annual basis.

Allocation

Cross-laminated timber as well as glued laminated timber are produced at the Mayr-Melnhof Holz production site. Where possible, the allocation of product-specific material and energy flows was based on physical relationships. Where necessary, the allocation is based on the production volumes of the individual product lines manufactured in Gaishorn.
Wooden residues are collected on site and utilised for energy recovery. As no co-products are sold externally for material use, no co-product allocation was applied.
Carbon content and primary energy content of the products were assessed based on their material inherent properties according to underlying physical relationships.

SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

Module A4 - A5 | construction stage

At the construction stage scenarios for transportation to the construction site and losses at construction site acc. to the Dutch requirements are used.

Name	Value	Unit
Transport to Utrecht (NL) by truck (module A4)	1020	km
Generated off-cuts during construction (module A5)	3	%
Electricity used at construction site (module A5)	0,12	kWh
Diesel used at construction site (module A5)	12,8	kWh

Module C | end of life stage
At the end-of-life stage scenarios in line with the Dutch requirements are used for waste processing.

Name	Value	Unit
Transport distance to incineration by truck (module C2)	100	km
Transport distance to landfill by truck (module C2)	50	km
Incineration (module C3)	90	%
Waste wood for energy recovery (module C3)	423	kg
Landfill (module C4)	10	%
Waste wood for landfill (module C4)	47	kg

Module D | benefits and loads beyond the system boundary
For the end-of-life of the cross-laminated timber produced by Mayr-Melnhof Holz Holding AG, the Dutch scenario with 90% energy recovery from waste incineration in a waste treatment plant is assumed. As the scenario covers the Dutch conditions, the main sales market for the solid wood products is located in the Netherlands, plant-specific characteristic values such as efficiency of power plant (49%) correspond to the Dutch scenario. The scenario considers a reprocessing rate of 90 % for the solid wood products after removal from the building. At the end of life of the product, the equilibrium moisture is comparable to the moisture content at delivery. This value can vary depending on the storage of the product before energy recovery.
Furthermore, substitution potentials from energy recovery of off-cuts (90% incinerated) and packaging, both from module A5, are considered in module D.

The waste incineration plant generates thermal and electrical energy. Resulting potentials from the substitution of thermal energy and electricity mix are taken into account in Module D. It is assumed that the thermal energy generated by energy recovery can potentially replace thermal energy or electrical energy. When incinerating waste based on fossil raw materials, electricity from natural gas (NL) and heat from natural gas (Europe without Switzerland). When incinerating waste based on renewable raw materials, electricity from wood chips (NL) and heat from wood chips (NL).

Furthermore, substitution potentials of recycling of the packaging, are considered in module D. It is assumed that the recycled material can replace the production of primary polyethylene and primary polypropylene.

Name	Value	Unit
Processing rate (energy recovery wood)	90	%
Processing rate (energy recovery PE- and PP-packaging)	85	%
Processing rate (energy recovery PET-packaging)	80	%
Processing rate (energy recovery steel-packaging, with residual waste)	5	%
Efficiency of power plant (electrical)	18	%
Efficiency of power plant (thermal)	31	%
Processing rate (recycling PE- and PP-packaging)	5	%
Processing rate (recycling steel-packaging)	90	%

DECLARATION OF SVHC
This product/article/at least one partial article contains substances listed in the candidate list (17.01.2023) exceeding 0.1 percentage by mass: no.

This product/article/at least one partial article contains other carcinogenic, mutagenic, reproductively harmful (CMR) substances in categories 1A or 1B which are not on the candidate list, exceeding 0.1 percentage by mass: no.

Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products No. 528/2012): no.

REFERENCES

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DIN 68800-3: DIN 68800-3:2012-02, Wood protection – Part 3: Preventive protection of wood with wood preservatives.

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EN 338: ÖNORM EN 338:2016-07, Structural timber Strength classes.

EN 717-1: ÖNORM EN 717-1:2005-01, Woodbased panels – Determination of formaldehyde release – Part 1: Formaldehyde emission by the chamber method.

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EN 13986: ÖNORM EN 13986:2015-06-01, Woodbased panels for use in construction Characteristics, evaluation of conformity and marking.

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REMARKS

None.