ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Rubner Holding AG - S.p.A.
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-RUB-20230231-IBC1-EN
Issue date	27.06.2023
Valid to	26.06.2028

Cross laminated timber

Rubner Holding AG - S.p.A

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RUBNER

1. General Information

Rubner Holding AG - S.p.A

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-RUB-20230231-IBC1-EN

This declaration is based on the product category rules:

Solid wood products, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

27.06.2023

Valid to

26.06.2028

Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Cross laminated timber

Owner of the declaration

Rubner Holding AG - S.p.A.
Handwerkerzone 2
39030 Kiens
Italy

Declared product / declared unit

1 m³ of RUBNER cross laminated timber [CLT, XLAM] with an average density of 461 kg/m³

Scope:

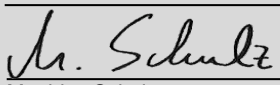
This EPD is based on a declared unit of 1 m³ of cross laminated timber (moisture of 11 % at a raw density of 461 kg/m³) produced at the RUBNER site in Brixen (Italy).

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.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally



Matthias Schulz,
(Independent verifier)

RUBNER

2. Product

2.1 Product description/Product definition

RUBNER cross laminated timber (RUBNER-XLAM, RUBNER-CLT) is a homogenized wood-based plate-like material that is used in engineered structural timber constructions, single family houses as well as in multistory buildings. RUBNER-XLAM consists of at least three layers made from kiln-dried coniferous wood according to *EN 1912* which are orthogonally glued together at their wide faces. Due to the multi-layer cross-sectional structure combined with the technically supported strength and stiffness classification of the raw materials, RUBNER-XLAM is characterized by a high product quality. As a result of the industrial manufacturing process, RUBNER-XLAM exhibits steady mechanical characteristics. In addition to flat standard plates, RUBNER-XLAM also includes architecturally sophisticated shell components which are curved in space. RUBNER-XLAM has a high dimensional stability and can be characterized as a largely crack-minimized building material.

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-18/0303* and the CE-marking. For the application and use, the respective national provisions apply.

2.2 Application

RUBNER-XLAM is mainly used as a structural component for buildings and bridges.

2.3 Technical Data

The performance data of the product are in accordance with the Declaration of Performance with respect to its essential characteristics according to *ETA-18/0303*.
RUBNER-XLAM is produced in different strength classes. For the strength class T14 the following applies:

Constructional data

Name	Value	Unit
Wood types by trade names acc. to EN 1912	spruce, pine, larch, Douglas fir	-
Wood moisture acc. to ETA-18/0303	< 15	%
Use of wood preservatives (the wood preservative test mark to DIN 68800-3 must be indicated)	Where other preservative means are insufficient	-
Bending strength acc. to ETA-18/0303	22.6	N/mm^2
Compressive strength parallel acc. to ETA-18/0303	21	N/mm^2
Compressive strength rectangular acc. to ETA-18/0303	2.5	N/mm^2
Tensile strength parallel acc. to ETA-18/0303	14	N/mm^2
Tensile strength rectangular acc. to ETA-18/0303	0.12	N/mm^2
Modulus of elasticity acc. to ETA-18/0303	11550	N/mm^2
Shear strength acc. to ETA-18/0303	1.2	N/mm^2
Shear modulus acc. to ETA-18/0303	690	N/mm^2
Dimensional deviation	depending on geometrical dimesions	mm
Length	< 17.5	m
Width	< 4.3	m
Height (min. - max.)	0.018 to 0.3	m
Gross density acc. to ETA-18/0303	420	kg/m^3
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 vapour diffusion resistance factor acc. to ISO 12572	20 - 50	-
Formaldehyde emissions acc. to EN 717-1	< E1	$\mu g/m^3$

RUBNER-XLAM is manufactured in accordance with *ETA-18/0303* from coniferous species, with priority being given to spruce, fir, pine, larch or Douglas fir. Other coniferous species are permissible but not typical.
RUBNER-XLAM is produced from kiln-dried coniferous wood with an average wood moisture content of around 11 % at delivery. For bonding, only approved modern low-emission adhesives according to chapter 2.5 are used.
The mechanical characteristics of RUBNER-XLAM are in accordance with strength classes specified in *ETA-18/0303*. For determination of the technical specifications, the declarations of performance (DOP) in the currently valid versions apply. The dimensional tolerances are defined in accordance with *ETA-18/0303* and to *Data Sheet XLAM*.
The products are manufactured in domestic visual quality, in

visual-industrial quality or industrial quality according to *Data Sheet XLAM*.
Use of preventive chemical wood preservatives in accordance with *DIN 68800-3* is unusual and permitted only if other preservative measures given in *DIN 68800-2* are not sufficient on their own.

2.4 Delivery status

RUBNER-XLAM is produced with the dimensions according to chapter 2.3 and is delivered in accordance with *Data Sheet XLAM* in domestic visual quality, in visual-industrial quality or industrial quality. The tolerances according to *ETA-18/0303* are met.

2.5 Base materials/Ancillary materials

RUBNER-XLAM comprises at least three orthogonally bonded kiln-dried coniferous single layers made from boards/laminations according to *hEN 14081*.

The following types of adhesive systems are used for bonding the individual components (finger jointing and surface bonding):

- Melamine-urea-formaldehyde adhesives (MUF)
- Polyurethane adhesives (PU)

RUBNER-XLAM contains the following proportions of ingredients per m³ on average:

- Coniferous wood (atro), mainly spruce approx. 88-90 %
- Water approx. 9-10 %,
- Adhesive about 1 - 2.5 %, The proportions of the adhesives used are based on about 85 % PU and about 15 % MUF

The product has an average density of 461 kg/m³.

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

This product/article/at least one partial article contains other carcinogenic, mutagenic, reprotoxic (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**.

2.6 Manufacture

RUBNER-XLAM is manufactured from sustainable sawn timber (PEFC) sourcing from sustainable forestry. Wet sawn timber is kiln dried to a moisture content of about 11 % and subsequently pre-planed. To ensure the characteristic values of the RUBNER-XLAM, all individual boards are visually- or machine-graded regarding strength and stiffness. Weak parts of planks, which reduce the strength and stiffness properties due to the natural growth characteristics of wood, are cut out depending on the grading class. The graded boards are subsequently bonded by finger jointing to endless laminations.
These laminations with infinite length and a thickness up to 45 mm are subsequently planed and cut to the required length for further production. After applying the adhesive to the wide faces of boards/laminations, RUBNER-XLAM is pressed in a straight or curved press to at least 3-layer plate like blanks. After curing the blanks are planed or grinded. If necessary, these single components are bonded together to composite plates with oversized final cross-section geometry also in combination with RUBNER glulam.
If necessary, the blanks are cut to their final complex shapes.

To ensure the product quality, a treatment with weathering or wood preservatives may be required for transport to the construction site, storage, and during assembly.

2.7 Environment and health during manufacturing

During production, there are no negative impacts on water and soil. The resulting process wastewater is fed into the local sewage system and cleaned according to legal regulations. The resulting exhaust air is cleaned according to the legal regulations.
Noise emissions from industrial plants are reduced by structural measures and comply with the legal requirements.
The production facility has an environmental management system *ISO 14001* and a quality management system *ISO 9001*.
The production facility has an occupational health and safety management system *OHSAS 18001*.
The employee protection in the manufacturing process complies with the respective country-specific requirements, employees are provided with personal protective equipment.

2.8 Product processing/Installation

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

2.9 Packaging

Polyethylene foils are used in small quantities during transportation. The use of polyethylene foils is less than 5 % depending on the necessity.

2.10 Condition of use

The composition of RUBNER-XLAM corresponds to the composition according to Section 2.5 for the entire period of use.

2.11 Environment and health during use

Environmental protection: According to current knowledge, the intended use of RUBNER-XLAM does not present any hazards or impairments to water, air and soil.
Health protection: Under normal conditions of use, RUBNER-XLAM is not expected to cause any damage or impairments to health.
RUBNER-XLAM subsequently releases formaldehyde during its life cycle.
RUBNER-XLAM 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, *Meyer, 1994*, Testreport PB_2117078_CT, 2021, by 0.01 ppm).
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.

2.12 Reference service life

XLAM has been used in structural timber construction for more than 25 years and is very similar to RUBNER glulam with more than 100 years of experience of use. In accordance with *ETA-18/303*, a service life of 50 years applies.
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 RUBNER-XLAM is equal to the duration of use of the building.

2.13 Extraordinary effects

Fire

RUBNER-XLAM is classified according to *ETA-18/0303* as follows:

Fire protection

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

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

Mechanical destruction
The fracture behavior of RUBNER-XLAM is appearance typical for solid wood.

2.14 Re-use phase
In the event of selective de-construction, RUBNER-XLAM can easily be re-used after the end of the structure's service life.

The preferred use of RUBNER-XLAM is in the form of reuse based on the applicable country-specific requirements.
If it is not re-used, it will be subjected to thermal utilization for the production of heat and electricity due to the high calorific value of approx. 16.5 MJ/kg (at a humidity of u = 12 %) in compliance with the applicable country-specific requirements.

2.15 Disposal
If the residues are not used for any other cascading use, waste wood is disposed according to the applicable country-specific requirements. Disposal represents a possible but unusual case. RUBNER-XLAM is assigned to waste code 17 02 01 in the European list of waste *2014/955/EU*. (Treated cross laminated timber is assigned to waste code 17 02 04).

2.16 Further information
More detailed information is available at: www.rubner.com

3. LCA: Calculation rules

3.1 Declared Unit
This EPD refers to a declared unit of 1 m³ of cross laminated timber produced by the RUBNER group. The declared unit refers to an average density of 461 kg/m³ and a wood moisture at delivery of 11 %.

Declared unit

Name	Value	Unit
Declared unit	1	m^3
Gross density	461	kg/m^3
Wood moisture at delivery	11	%

The analysed products represent average XLAM produced at the Rubner site in Brixen (IT).

The declared unit was calculated on a volume-weighted basis. This EPD refers to an average product manufactured at one site. All products undergo the same processing steps. A possible variability is only expected due to the use of different wood species. The upstream chain for spruce is considered representative. The robustness of the declared LCA values can thus be classified as high.

Brixen not only produces cross laminated timber but also glued laminated timber. The allocation of product-specific material and energy flows is based on physical relationships when possible. Where necessary, the allocation is based on the production volumes of each product line manufactured at Brixen.

3.2 System boundary
The life cycle assessment of average cross laminated timber produced by RUBNER refers to a cradle-to-gate analysis of the environmental impacts with modules C1–C4 and module D (A1–A3 + C + D). The following life cycle phases are part of the analysis:

Module A1–A3 | Production stage
The production stage includes upstream burdens of raw materials (lamellae, adhesive system, etc.) and the corresponding transports to the RUBNER production site in Brixen (Italy). As the production site in Rohrbach delivers lamellae to the other RUBNER sites, resulting environmental impacts refer to RUBNER's specific production process including drying. Direct emissions from drying are based on worst-case approximations and are included in the study. Upstream emissions from the use of adhesive systems rely on supplier-specific data.

Thermal energy is provided in Brixen by district heating, electricity is provided by the regional electricity grid (modelled with the Italian residual-mix) and RUBNER's photovoltaic system.

Module C1 | Deconstruction and demolition
After the removal of building components overlying the product, 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.

Module C2 | Transport to disposal
Module C2 includes the transport to waste treatment. In this case, transport by truck over a transport distance of 50 km is assumed.

Module C3 | Waste processing
In Module C3, the chipping after the removal of the products is considered. The wooden products and with them the material-inherent properties leave the product system as secondary combustibles in module C3.

Module C4 | Disposal
The applied scenario declares the energetic recovery of the wooden products, therefore no environmental impacts are to be expected from waste processing of the products in C4.

Module D | Benefits and loads beyond the system boundary
Applying an European average scenario, module D describes the energetic recovery of the product at the end of life including the corresponding energy substitution potentials.

3.3 Estimates and assumptions
All assumptions are verified through detailed documentation and correspond to the best possible representation of reality based on the available data.
Background data for wood logs refer to generic data for spruce logs in bark derived from *GaBi* database. Spruce represents the majority of wood processed at RUBNER. The used dataset represents an approximation for all other species.
Regional applicability of the used background data refers to average data under European or German conditions taken from the *GaBi* database. German data were used for the Italian market whenever European or regionalised average data were not available.

Emissions from wood drying were included in the calculations according to *Rüter & Diederichs 2012*.

3.4 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. Cutoff 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. Environmental impacts of machines, plant and infrastructure were not included.

3.5 Background data

This study uses generic background data for the evaluation of upstream environmental impacts from *GaBi* database 2022.2 as well as recognised literature such as *Rüter & Diederichs 2012*.

All lamellae processed for cross laminated timber at group level are delivered of the RUBNER RHI located in Rohrbach. Thus, the supply chain for lamellae input is based on primary data. The representation of adhesives used for XLAM production is based on primary data from RUBNER's suppliers. Where necessary, this information was complemented with estimates ensuring the completeness of the component's representation in the LCA.

3.6 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 the RUBNER group and Daxner & Merl result 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 (lamellae, 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 *GaBi* background datasets refer to the latest versions available and are carefully chosen.

The assessment of the robustness of the average can be found in Section 3.1.

3.7 Period under review

Foreground data were collected in the 2022 production year, and the data are based on the volumes produced on an annual basis.

3.8 Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Italy

3.9 Allocation

Carbon content and primary energy content of the products were assessed based on their material inherent properties according to underlying physical relationships.

3.10 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 *GaBi* background database was used to calculate the LCA (*GaBi* 10; 2022.2).

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

During tree growth, the wood assimilates carbon dioxide and stores biogenic carbon. The carbon stored in the product is declared in the following table.

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic carbon content in product	205	kg C

Installation into the building (A5)

The end of life of the product packaging is not declared in module A5.

Name	Value	Unit
Packaging (polyethylene)	0.145	kg

The end-of-life scenario used in this LCA study is based on the following assumptions:

End of life (C1-C4)

Name	Value	Unit
Energy recovery	461	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
Processing rate	100	%
Efficiency of power plant	68	%

The product reaches the end-of-waste status after removal from the building, transport to processing and chipping of the product. For the end of life of the cross laminated timber product, energy recovery as secondary fuel in a biomass power plant is assumed. As the main sales market for the solid wood products is concentrated in the European region, plant-specific characteristic values correspond to a European average scenario (EU). The scenario considers a reprocessing rate of 100 % for the solid wood products after removal from the building. This assumption has to be adjusted accordingly when applying the results in the building context. 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.

RUBNER

5. LCA: Results

The following table contains the LCA results for a declared unit of 1 m³ of cross laminated timber produced by the RUBNER group (461 kg/m³).

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

Product stage			Construction process stage		Use stage							End-of-life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m³ cross laminated timber (461 kg/m³)

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Global Warming Potential total (GWP-total)	kg CO_2 eq	-6.24E+02	0	1.46E+00	7.62E+02	0	-4.1E+02
Global Warming Potential fossil fuels (GWP-fossil)	kg CO_2 eq	1.32E+02	0	1.39E+00	3.4E+00	0	-3.83E+02
Global Warming Potential biogenic (GWP-biogenic)	kg CO_2 eq	-7.56E+02	0	6.05E-02	7.59E+02	0	-2.73E+01
Global Warming Potential luluc (GWP-luluc)	kg CO_2 eq	2.75E-01	0	9.32E-03	7.19E-04	0	-4.58E-02
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC11 eq	5.49E-09	0	1.36E-13	4.98E-11	0	-2.96E-09
Acidification potential of land and water (AP)	mol H^+ eq	5.74E-01	0	4.62E-03	7.47E-03	0	3.17E-01
Eutrophication potential aquatic freshwater (EP-freshwater)	kg P eq	2.96E-03	0	4.94E-06	9.92E-06	0	-5.98E-04
Eutrophication potential aquatic marine (EP-marine)	kg N eq	2.22E-01	0	2.11E-03	1.68E-03	0	6.88E-02
Eutrophication potential terrestrial (EP-terrestrial)	mol N eq	2.1E+00	0	2.37E-02	1.76E-02	0	8.15E-01
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg NMVOC eq	6.98E-01	0	4.15E-03	4.53E-03	0	2.92E-01
Abiotic depletion potential for non fossil resources (ADPE)	kg Sb eq	7.26E-05	0	1.39E-07	9.27E-07	0	-6.36E-05
Abiotic depletion potential for fossil resources (ADPF)	MJ	1.98E+03	0	1.82E+01	6.17E+01	0	-6.62E+03
Water use (WDP)	m^3 world eq deprived	2.38E+01	0	1.55E-02	7.76E-01	0	-2.18E+01

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m³ cross laminated timber (461 kg/m³)

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Renewable primary energy as energy carrier (PERE)	MJ	3.52E+03	0	1.26E+00	7.63E+03	0	-2.04E+03
Renewable primary energy resources as material utilization (PERM)	MJ	7.59E+03	0	0	-7.59E+03	0	0
Total use of renewable primary energy resources (PERT)	MJ	1.11E+04	0	1.26E+00	3.43E+01	0	-2.04E+03
Non renewable primary energy as energy carrier (PENRE)	MJ	1.89E+03	0	1.82E+01	1.49E+02	0	-6.62E+03
Non renewable primary energy as material utilization (PENRM)	MJ	9.31E+01	0	0	-8.68E+01	0	0
Total use of non renewable primary energy resources (PENRT)	MJ	1.98E+03	0	1.82E+01	6.18E+01	0	-6.62E+03
Use of secondary material (SM)	kg	0	0	0	0	0	0
Use of renewable secondary fuels (RSF)	MJ	0	0	0	0	0	7.59E+03
Use of non renewable secondary fuels (NRSF)	MJ	0	0	0	0	0	8.68E+01
Use of net fresh water (FW)	m^3	9.4E-01	0	1.45E-03	3.27E-02	0	-1.39E+00

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m³ cross laminated timber (461 kg/m³)

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed (HWD)	kg	7.08E-07	0	9.65E-11	5.34E-09	0	-8.2E-07
Non hazardous waste disposed (NHWD)	kg	3.09E+00	0	2.97E-03	4.65E-02	0	2.29E-01
Radioactive waste disposed (RWD)	kg	5.4E-02	0	3.39E-05	9.86E-03	0	-5.86E-01
Components for re-use (CRU)	kg	0	0	0	0	0	0
Materials for recycling (MFR)	kg	0	0	0	0	0	0
Materials for energy recovery (MER)	kg	0	0	0	4.61E+02	0	0
Exported electrical energy (EEE)	MJ	0	0	0	0	0	0
Exported thermal energy (EET)	MJ	0	0	0	0	0	0

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m³ cross laminated timber (461 kg/m³)

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Incidence of disease due to PM emissions (PM)	Disease	ND	ND	ND	ND	ND	ND

	incidence						
Human exposure efficiency relative to U235 (IR)	kBq U235 eq	ND	ND	ND	ND	ND	ND
Comparative toxic unit for ecosystems (ETP-fw)	CTUe	ND	ND	ND	ND	ND	ND
Comparative toxic unit for humans (carcinogenic) (HTP-c)	CTUh	ND	ND	ND	ND	ND	ND
Comparative toxic unit for humans (noncarcinogenic) (HTP-nc)	CTUh	ND	ND	ND	ND	ND	ND
Soil quality index (SQP)	SQP	ND	ND	ND	ND	ND	ND

The additional and optional impact categories according to *EN 15804*+A2 are not declared, as the uncertainty of these indicators is to be classified as high.

Disclaimer 1 – for the indicator 'Potential Human exposure efficiency relative to U235'.
This impact category deals mainly with the eventual impact of lowdose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators 'abiotic depletion potential for non-fossil resources', 'abiotic depletion potential for fossil resources', 'water (user) deprivation potential, deprivation-weighted water consumption', 'potential comparative toxic unit for ecosystems', 'potential comparative toxic unit for humans – cancerogenic', 'Potential comparative toxic unit for humans - not cancerogenic', 'potential soil quality index'.
The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator.

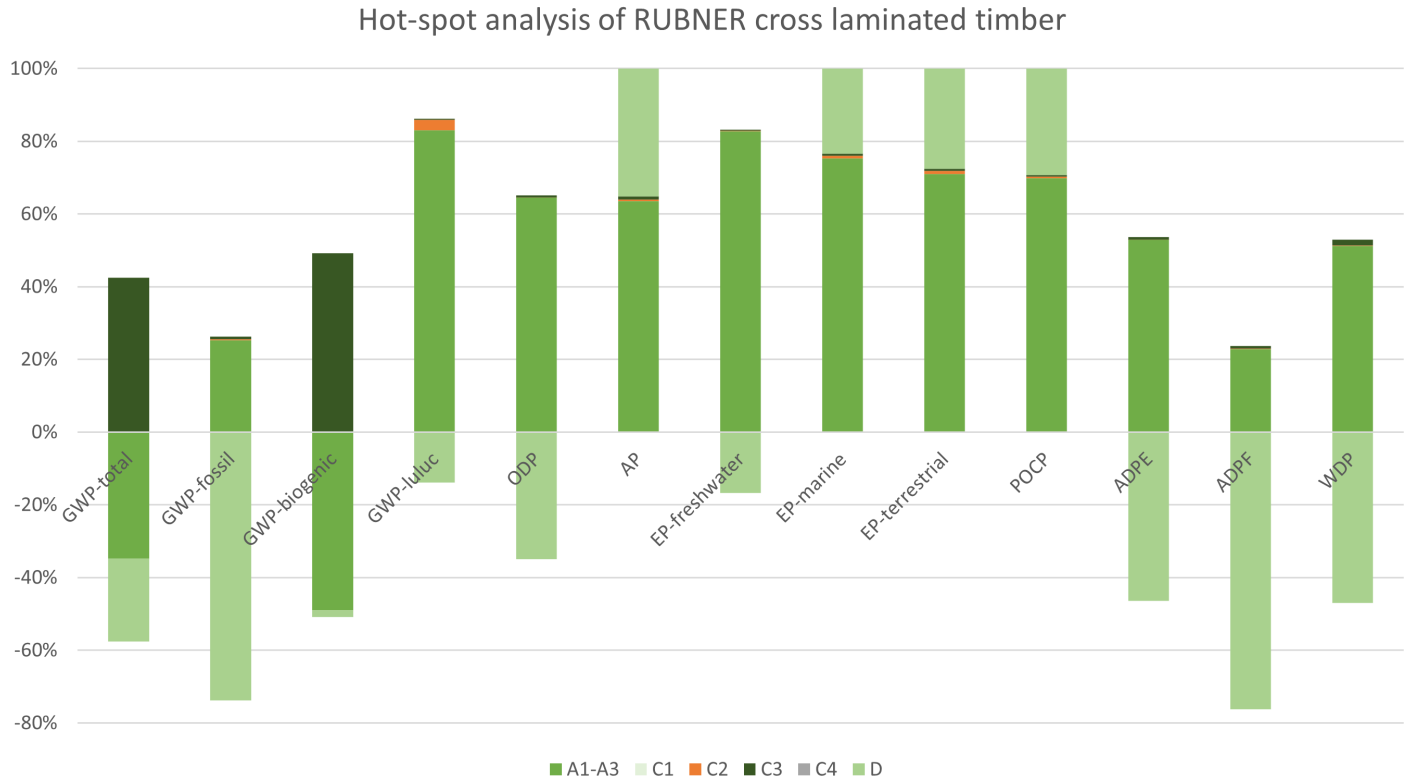
6. LCA: Interpretation

The following interpretation contains a summary of the LCA results referenced to a declared unit of 1 m³ of cross laminated timber.

The global warming potential (**GWP**) of cross laminated timber shows negative values in the production phase (modules A1–A3). These negative impacts result from the use of wood as raw material. Wood sequesters biogenic carbon during tree growth. The sequestered carbon does not contribute to global warming as long as it is stored in the biomass.

After its use in the building, the product is assumed to be incinerated in a biomass power plant. As a result, the incorporated carbon is emitted again to the atmosphere representing biogenic carbon dioxide emissions (module C3).

The negative values in the end-of-life (module D) result from the energetic treatment of the product. As the energy produced at the biomass power plant can substitute (mainly fossil) fuels, an environmental net benefit is generated.



Potential global warming (**GWP**) due to the production of RUBNER XLAM mainly stems from the provision of round wood and associated impacts from forestry.

What's more, the electricity demand at the production site (Italian residual-mix) represents a further driver of the environmental impact, especially with regard to fossil greenhouse gas emissions.

The results of the previous EPD (EPD-RUB-20180060-IBB1-EN) are not directly comparable with the present updated version due to the update of the underlying methodology according to *EN 15804*+A2.

7. Requisite evidence

The following evidence of environmental and health relevance was provided.

7.1 Formaldehyde

The emissions listed in section 2.11 are based on test results of emission measurements in accordance with *EN 717-1* at a temperature of 23 °C, a relative humidity of 45 % and an air change rate of 1.0 per hour. The test results all meet the requirements of emission class E1 according to *EN 16351* of 0.124 mg/m³.

For RUBNER-XLAM glued with PU adhesives, according to the information of the manufacturer of the glue, no formaldehyde is added to the PU-glue during production of surface gluing; thus, the emissions are in the range of natural wood. According to 2.11 a MUF adhesive is only used (if necessary) for the manufacture of finger joints; the low mass proportion is not relevant for the overall assessment. RUBNER-XLAM bonded with PU-based adhesives for the surface gluing has formaldehyde emission values in the range of of 0.01 ppm (Testreport PB_2117078_CT, 2021). The test specimens were taken at random from production.

There is a test report for proof of occupational exposure (according to *EN 689* (date 8. 8 2022), the maximum allowed workplace concentration of 0.369 mg/m³ is significantly higher than the measured with concentration of 0.12 mg/m³ have shown.

7.2 MDI

When gluing RUBNER-XLAM with MDI-based adhesive, the contained MDI will react completely. Thus, a MDI emission from the finished RUBNER-XLAM is not possible. As there is no standardised measurement process defined in test standards, no test reports are available.

For the verification of the workplace concentration of MDI (according to *EN 689*), a test report is available (date 02. 5. 2016), the maximum allowed workplace concentration of 0.005 mg/m³ is significantly higher than a measurement with < 0.0005 mg/m³ has shown.
For the verification of the workplace concentration of MDI (acc. to *EN 689*), a test report is available (date 8.8 2022), the maximum allowed workplace concentration of 0.005 mg/m³ is significantly higher than a measurement with < 0.0005 mg/m³ has shown.

7.3 Fire gas toxicity

Due to the heterogeneous structure of cross laminated timber, combined with the non-applicability of the test standard *DIN 53436*, no relevant measurement results are available, the test specimen geometry is not able to represent the real gas composition for a representative cross-section.

7.4 VOC emissions

For the verification of VOC emissions, a test report (51005-002 III B, 2016) of an emission analysis according to *AgBB-Scheme 2015* for pure timber is available. Due to the adhesive system used, based on supplier information, the VOC values are within the range of the natural wood. Analysis was performed in accordance with *ISO 16000-3* and *ISO 16000-6*.

VOC emissions

Name	Value	Unit
TVOC (C6 - C16) acc. to AgBB 2015	10	µg/m^3
Sum SVOC (C16 - C22) acc. to AgBB 2015	< 5	µg/m^3
R (dimensionless) acc. to AgBB 2015	0.086	-
VOC without NIK acc. to AgBB 2015	<5	µg/m^3
Carcinogenic Substances	<1	µg/m^3

8. References

Standards

DIN 53436
DIN 53436:2015, Generation of thermal decomposition products from materials for their analytic-toxicological testing.

DIN 68800-2
DIN 68800-2:2012-02, Wood preservation – Part 2: Preventive constructional measures in buildings.

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

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

EN 689
EN 689:1995, Workplace atmospheres - Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy.

EN 717-1
DIN EN 717-1:2005-01, Wood-based panels – Determination of Formaldehyde release – Part 1: Formaldehyde emission by the chamber method.

EN 1912
EN 1912:2013-10-15, Structural timber - Strength classes - Assignment of visual grades and species.

EN 12664
EN 12664:2001, 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.

EN 15804
DIN EN 15804:2012+A2:2019+AC:2021, Sustainability of construction works Environmental product declarations Core rules for the product category of construction products.

EN 16351
ÖNORM EN 16351:2015-11-15, Timber structures - Cross laminated timber – Requirements (not harmonized in EU).

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ETA-18/0303-2022, Rubner XLAM , Rubner Holding AG.

hEN 14081
hEN 14081-1:2016-06-01, Timber structures - Strength graded structural timber with rectangular cross section - Part 1: General requirements.

ISO 9001
EN ISO 9001:2015, Quality management systems - Requirements.

ISO 12572
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ISO 14001
EN ISO 14001:2015, Environmental management systems - Requirements with guidance for use.

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ISO 14044
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ISO 16000-3
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ISO 16000-6
ISO 16000-6:2011, 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.

OHSAS 18001
OHSAS 18001:2018, Occupational Health- and Safety Assessment Series.

Further references

AgBB-Scheme 2015
German Committee for HealthRelated Evaluation of Building Products (AgBB): Approach to health assessment of emissions of volatile organic compounds (VOCs and SVOCs) from building products.

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Institut Bauen und Umwelt e.V.: General Programme Instructions for the Preparation of EPDs at the Institut Bauen und Umwelt e.V. (IBU). Version 2.0, Berlin: Institut Bauen und Umwelt e.V., 2021. www.ibuepd.com

Meyer, 1994
Meyer, B, Boehme, C: 1994, Formaldeyhdabgabe von natürlich gewachsenem Holz, Holzzentralblatt 122 (Formaldeyhd release of naturally grown wood), S. 1969-1972.

Ordinance on Biocide Products
Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products.

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Product category rules for building-related products and services. Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report according to EN 15804+A2:2019. Version 1.3. Berlin: Institut Bauen und Umwelt e.V., 2022.

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Product category rules for building-related products and services. Part B: EPD requirements for solid wood products. Version v2, Berlin: Institut Bauen und Umwelt e.V., 31.05.2023.

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2005/610/EG, COMMISSION DECISION of 9 August 2005 establishing the classes of reaction-to-fire performance for certain construction products.

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