Environmental Product Declaration

XLam CLT Panel

Environmental Product Declaration (EPD) in accordance with ISO 14025 and EN 15804+A1
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Acknowledgements

An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules).

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

Environmental Product Declarations within the same product category from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

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Independent verification of the declaration and data, according to ISO 14025:
EPD verification (External)

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Procedure for follow-up of data

Procedure involves third party verifier	☑ Yes ☐ No
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Added GreenPower® energy use
Change to Life Cycle info-graphic on p19
Correction to the figures in the Life Cycle info-graphic on p19

Introduction

This EPD has been prepared in accordance with ISO 14025:2006, EN 15804:2012+A1:2013, PCR 2012:01 and EPD Australasia (2015). It covers XLam Cross-Laminated Timber (CLT) panels 85mm-315mm thick, treated or untreated, Natural & Industrial appearance grade manufactured at XLam's manufacturing facility in Australia for use in buildings in Australia and New Zealand.

This EPD update follows XLam decision to introduce in January 2022 use of 100% renewable energy to manufacture products in its Wodonga facility in Victoria, Australia. The renewable energy is provided by GreenPower Australia. XLam, by taking this action, reduced its production carbon footprint (Global Warming Potential (fossil)) by 45% from 447 kg CO_2e to 248 kg CO_2e per 1 m^3 of the product. No other changes to the underlying data were made apart from the electricity generation. The source of the inventory data for the generation of electricity was a specific electricity mix as demonstrated by a Guarantee of Origin; certified GreenPower® renewable energy certificates.

Manufacturer Information

This EPD covers cross-laminated timber panels produced at XLam Australia's factory located in Wodonga, Victoria. This EPD is based on a life cycle assessment study compiled in October 2020 with input and environmental output data gathered for the period 1st April 2019 – March 31st 2020 conducted by thinkstep-anz.

Product Description

XLam CLT panels 85-315mm are structural timber panels made by face gluing together layers of finger-jointed Radiata Pine boards ranging from 20mm to 45mm thick with a moisture curing polyurethane adhesive in alternating 90 degree angles. Three, five or seven layers are pressed together in a hydraulic press while the glue cures. Panels 6-16 metres long and 2.4-3.4 metres wide can be manufactured. Products included in this EPD are: 3, 5 or 7 layers and 85-315mm thick.

Representative Product

The representative product for this EPD is the CL5/205, which has been selected as it has an adhesive content similar to the production average. The environmental impacts of all other products fall within ±10% of this product, as required by the PCR. The variation between different products can be seen in Table 9.

Application

XLam CLT panels provide a structural building system particularly suited to single and multi-unit buildings, and for other subdivided buildings such as schools, health care facilities and commercial offices. CLT is applied as individual components for floors, internal and external walls and roofs, or as a complete structural system encompassing all of these.

Declared Unit

This EPD applies to 1m^3 of XLam CLT at an average moisture content of 13%, density 480kg/m^3 either treated or untreated, Natural or Industrial appearance grade. CLT products are used for flooring, roofing and stairs.

Table 1 shows the classification codes and class descriptions of the products included within this EPD according to the UN CPC (Version 2.1) and ANZSIC 2006 classification systems.

Table 1: Classifications codes of included products

Product type	Classification	Code	Category
XLam CLT	UN CPC Ver. 2.1	31421	Other plywood, veneered panels and similar laminated wood, of coniferous wood
	ANZSIC 2006	1493	Veneer and Plywood Manufacturing

Product Composition Content Declaration

All products within this EPD are of the species pinus radiata (Radiata Pine), grown within Australia in sustainably managed plantations certified to the forest management standard of PEFC-ST-2002:2013 (Responsible Wood, 2019).

The adhesive used for finger-jointing and lamination is polyurethane (PU) that is a formaldehyde-free, Type 1, exterior structural grade glue which meets the requirements of AS/NZS 4364.

No products declared within this EPD contain substances exceeding the limits for registration according to the European Chemicals Agency's "Candidate List of Substances of Very High Concern for Authorisation".

Materials

XLam CLT panels are manufactured from:

Outer Layers MGP8[1] Radiata Pine average 13% moisture Inner Layers XGP6 Radiata Pine average 13% moisture	99%
Moisture curing polyurethane adhesive	1%

XLam CLT panels are available as either untreated or treated for protection against mould and termite attack. The results in the main body of this EPD are for untreated CLT. Information on treatment can be found in the Durability and Preservation Treatment section. The optional treatment is Hyne T3 Plus. XLam CLT panels are available as either Natural or Industrial appearance grade.

Packaging

To protect XLam CLT panels from exposure to the elements they are covered with a low density polyethylene wrap, which is held in place with a polyester/polypropylene blend strapping. To support and protect XLam CLT panels during transportation and storage on site, panels are placed on to a combination of softwood timber gluts and bearers.

[1] Since the LCA on which this EPD is based upon was conducted, the outer lamella used in production has changed from MGP8 to MGP10. Based on previous data and modelling this change is not expected to have a significant impact on the outcomes. Once sufficient production data of the new grade has been accumulated the base data will be reviewed and this EPD updated accordingly.

Use of this EPD with Green Star, Homestar and IS® rated projects

Green Star Australia

This EPD complies with the requirements for a product specific EPD under the Green Building Council of Australia's Green Star sustainable building rating system:

- Conforms with ISO 14025 and EN 15804
- Verified by an independent third party
- Cradle-to-gate scope

Green Star & Homestar New Zealand

This EPD complies with the requirements for a product specific EPD under the Green Building Council of New Zealand's Green Star and Homestar sustainable building rating systems:

- Conforms with ISO 14025 and EN 15804
- Verified by an independent third party
- Cradle-to-gate scope

Further guidance on how using XLam CLT panels can earn points under Green Star in Australia and Green Star and Homestar in New Zealand are provided in the Other Environmental Information Section.

IS® Rating - Australia

This EPD complies with requirements under the Infrastructure Sustainability Council's IS® rating scheme:

- Compliant with ISO 14025 and EN15804
- Verified by a third party

This EPD may help your project achieve ISv2.0 Rso-7 or ISv1.2 Mat-2 credits under the IS® rating scheme.

XLam CLT Panels Australian Grown & Made

XLam CLT panels are manufactured in Wodonga, Australia using Australian grown, PEFC certified, plantation radiata pine timber milled to strict CO_2 specifications by Hyne at their Tumbarumba sawmill. XLam is committed to using responsibly grown timber, contributing to the local economy, providing jobs, and ensuring that as part of a vertically integrated operator, maximum use is made of our precious forest resources.

Maximised Resource Use

The CLT manufacturing process is based on the principle of utilising a large proportion of low structural and/or appearance grade timber and transforming it into high structural and/or appearance grade panel products, maximising the efficient use of our planet's resources. XLam CLT panels are made to precise dimensions by computer numerical control, and result in reduced construction site waste, increased efficiency of labour, scaffolds, cranes, and other site resources.

Local Expertise

XLam has extensive experience supplying structural timber elements into the Australian and New Zealand markets and provide comprehensive guides, design and construction services, local sales, technical support and advice.

System Boundaries

This EPD is of the 'cradle-to-gate with options' type which includes mandatory production stages (Modules A1-A3) with optional modules transportation to customer (Module A4) and end of life processing (Modules C3 and C4) included. Benefits and impacts beyond the system boundary from reuse, recycling and energy recovery within Australia are also included (Module D). Other life cycle stages (Modules A5, B1-B7 and C1-C2) are dependent on specific circumstances and are best modelled at the building level, therefore these have not been declared.

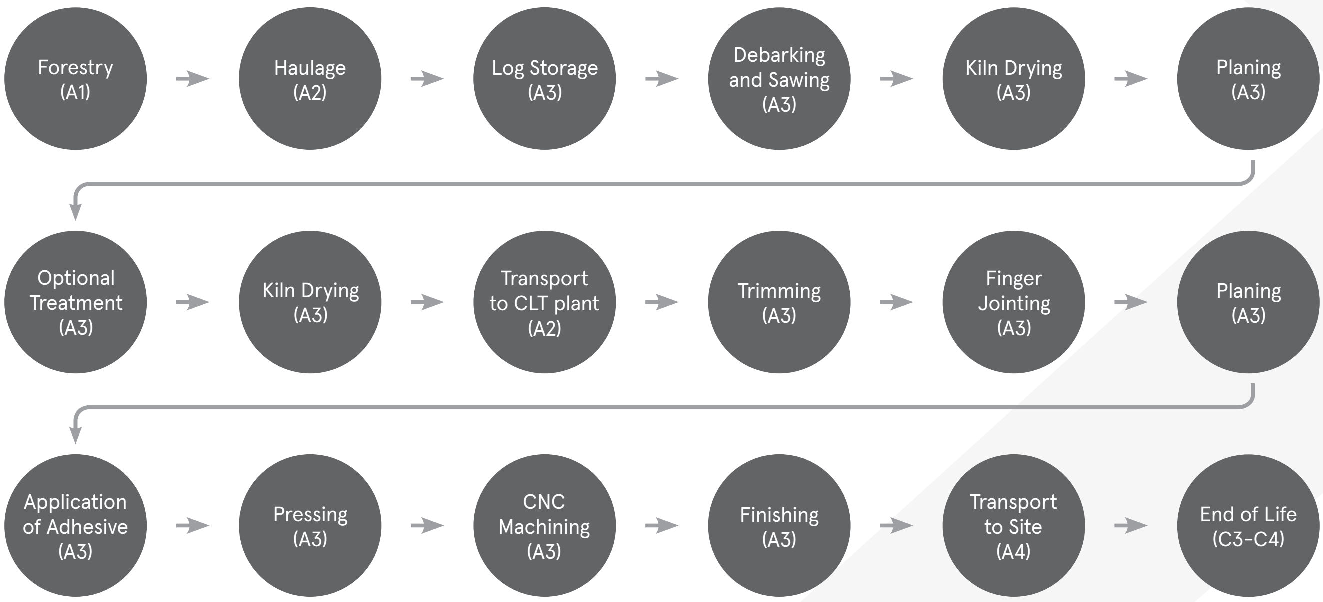
Table 2: Life cycle stages and modules included in the scope of this EPD

Product stage			Construction stage		Use stage							End of life stage				Beyond System Boundary
Raw Material supply	Transport of raw materials	Manufacturing	Transport to customer	Installation	Uses	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport to waste processing	Waste processing	Disposal	Re-use Recovery recycling
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X

X = Included in the EPD
MND = Module Not Declared (such a declaration shall not be regarded as an indicator result of zero)

Production (Modules A1-A3)

The production stage includes forestry processes, production of kiln-dried sawn softwood timber (treated and untreated) by Hyne at Tumbarumba, transport to XLam's Wodonga factory and the laminating process including trimming, finger-jointing, planning of lamellas, application of adhesive, pressing, CNC machining, finishing, packaging and transport to site.



Transport to Customer/Distribution (Module A4)

Data for transport module A4 is shown separately in Table 6 to allow for estimation of each individual project's location transport impacts.

End of Life (Module C)

Modules C1-C4 are optional for this EPD and include the waste processing and disposal stages, where applicable. Waste processing (Module C3) is applicable for the energy recovery, recycling and reuse scenarios and disposal (Module C4) is applicable for the landfill scenarios.

Recovery and Recycling Potential (Module D)

Module D accounts for the potential benefits of reuse and recycling at the end of its first use in a building. Energy credits for the recovery of energy embodied in CLT by combustion (energy recovery scenario) or the generation of electricity from combustion of natural gas from the very small volumes (if any) of methane generated by disposal in lined and sealed landfill (two landfill scenarios) are also included.

End of Life Scenarios

CLT is a relatively new building material so buildings constructed with CLT have not yet been deconstructed or demolished. Real life reference examples of the full range of end of life options are therefore not available. In general, when a wood product used in buildings reaches the end of its useful life, it may either be reused, recycled, combusted to recover energy, or landfilled. Landfill is currently the most common fate for end of life wood products in Australia. All other end of life scenarios, including reuse, are possible for CLT therefore data for each scenario has been included within this EPD.

Data for each EoL option in this EPD assumes that 100% of CLT is sent to that scenario.

Reuse of CLT panels can be expected in some cases due to the large dimensions, modular construction, and value of CLT. Previous work by Forsythe Consultants (2007) has shown that high value timber, particularly hardwoods in Australia are reused, with practices already in place. If a reuse scenario is selected, it is recommended to have 27% of the reuse amount still going to landfill. A recent study has shown this to be the amount of waste generated in adapting the recovered panels to the new system (Passarelli, R. 2018). However, given that landfill is currently the most common fate for end of life wood products in Australia the 'landfill (typical)' scenario should be used for 100% of the end of life CLT where no other data is available.

To calculate impacts for a mix of scenarios for a region (e.g. 50% reuse, 25% recycling, 25% landfill) based on the local availability of options, the user of this EPD should take a weighted sum of these scenarios.

Reuse

The CLT panels are assumed to be removed from a building manually and reused with no further processing (i.e. direct reuse). Transport and wastage are excluded and only one reuse cycle is considered. The second life is assumed to be the same to the first, meaning that a credit is given for production of 1 m^3 of CLT in Module D. The CO_2 sequestered and energy content of the wood are assumed to leave the system boundary at Module C3 so that future product systems can also claim these without double-counting in line with EN 16485:2014 (Section 6.3.4.2). Any further processing, waste or transport would need to be modelled and included separately.

Recycling

This scenario considers grinding or shredding CLT panels into woodchips. Woodchips may be utilised in many different products including in the manufacture of new particleboard, land applied products such as mulch or animal bedding or used in paper production. Wood waste is ground/shredded (Module C3) and assigned credits relative to the avoided production of woodchips from virgin softwood (Module D). The CO_2 sequestered and the energy content of the wood are assumed to leave the system boundary at C3 so that future product systems can also claim these without double-counting (CEN, 2014).

Energy Recovery

This scenario includes grinding/shredding and combustion (Module C3) to produce electricity with recovered energy offset against average electricity from the Australian grid and thermal energy from natural gas (Module D) in line with EN 16485:2014.

Landfill

This EPD includes two scenarios for landfill, each with a different value for the degradable organic carbon fraction (DOCF) of wood. The two values are based on bioreactor laboratory research. This experimental work involves the testing of a range of waste types in reactors operated to obtain maximum methane yields. As the laboratory work optimises the conditions for anaerobic decay and methane generation, the results can be considered as true estimates of the DOCF value that would apply over very long time horizons.

- **Landfill (best-practice):** DOCF = 0.1%. This is based on the latest peer-reviewed bioreactor laboratory research by Wang et al. on radiata pine timber, the dominant softwood species in Australia. This value is best-practice and should be used unless specific regulatory circumstances exist.
- **Landfill (NGA):** DOCF = 10%. This is the value from Australia's National Greenhouse Accounts (NGA) (Australian Government, 2019). It was derived from early peer-reviewed bioreactor laboratory research from the 1990s that investigated the degradability of wood tree branches (unknown species) ground to a fine powder and subjected to anaerobic conditions (Australian Government, 2014). This value can be considered as an upper limit for degradation of carbon in finely ground timber placed in a landfill. It should only be used in specific regulatory circumstances.

The impacts associated with the landfill are declared in Module C4. All landfill gas that is combusted for energy recovery (Module C4) is assumed to occur in a power plant with an electrical conversion efficiency of 36% (Australian Government, 2019b) and the resulting electricity receives a credit for offsetting average electricity from the Australian grid (Module D) in line with EN 16485:2014.

Both landfill scenarios assume the following for carbon emissions:

- Of the gases formed from any degradation of wood in landfill, 50% is methane and 50% is carbon dioxide (Australian Government, 2014).
- All carbon dioxide is released directly to the atmosphere.
- 36% of the methane is captured, based on forecasted average methane capture in Australian landfills by 2020 (Hyder Consulting, 2007). Of this, one quarter (9% of the total) is flared and three quarters (27% of the total) are used for energy recovery (Carre, 2011).
- Of the 64% of methane that is not captured, 10% (6.4% of the total) is oxidised (Australian Government, 2014) and 90% (57.6%) is released to the atmosphere.
- In summary, for every kilogram of carbon converted to landfill gas, 71.2% is released as carbon dioxide and 28.8% is released as methane.

Life Cycle Inventory (LCI) Data and Assumptions

Primary data was used for all manufacturing operations up to the factory gate, including the upstream data for the planed wood input into the XLam manufacturing facility. Primary data for the planed wood came from the Hyne facility and was sourced from the 2019/20 Australian financial year. Data from the XLam Wodonga manufacturing facility was sourced from the period 1st April 2019 to 31st March 2020. Background data was used for input materials sourced from other suppliers.

Electricity

The electricity supply grid mixes were based on GaBi's state and country-specific grid mix datasets for Victoria, New South Wales and Australia for the XLam Wodonga factory, Tumbarumba sawmill, and end of life respectively. The emission factor (given in g CO_2e/kWh) for each grid mix are given in Table 3 below.

Table 3: Electricity grid Global Warming Potential (GWP)

Grid	Carbon footprint (g CO_2e/kWh)
Australia average	891
Victoria	1,321
New South Wales	1,020
GreenPower (2021)	18

Cut-off Criteria

Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary as per the PCR (IEPDS, 2019). All other reported data were incorporated and modelled using the best available life cycle inventory data.

Allocation

Upstream data: For refinery products, allocation is done by mass and net calorific value. Inventories for electricity and thermal energy generation include allocation by economic value for some by-products (e.g. gypsum, boiler ash and fly ash). Allocation by energy is applied for co-generation of heat and power.

Co-products (e.g. sawn wood and sawdust from milling): As the difference in economic value of the co-products is high (>25% as per EN 15804 (CEN, 2013)), allocation has been done by economic value.

Background Data

Data for all energy inputs, transport processes and raw materials are from GaBi Databases 2020 (Sphera, 2020). Most datasets have a reference year between 2015 and 2019 and all fall within the 10-year limit allowable for generic data under EN 15804+A1.

Electricity used in the manufacturing of the product is modelled as the consumption mix of the State of Victoria electrical grid. Electricity credits generated in Module D are modelled as the national Australian electricity grid mix. Background forestry data came from previous work done by thinkstep-anz on behalf of FWPA (thinkstep-anz, 2018).

Representativeness

Market representativeness: The EPD is based on detailed data collected by survey from XLam Wodonga which is the sole producer of XLam CLT and Hyne Tumbarumba which is the sole source of feedstock.

Temporal representativeness: Primary data for the planed wood was sourced from the 2019/20 Australian financial year. Data from the XLam Wodonga manufacturing facility was sourced from the period 1st April 2019 to 31st March 2020.

Geographical and technological representativeness: The data is representative of the XLam Wodonga manufacturing facility and its suppliers.

Environmental Impact Indicators

An introduction to each environmental impact indicator is provided below. The best-known effect of each indicator is listed.

Global Warming Potential (GWP) > Climate Change

A measure of greenhouse gas emissions, such as carbon dioxide and methane. These emissions increase absorption of radiation emitted by the earth, intensifying the natural greenhouse effect. Contributions to GWP can come from either fossil or biogenic sources, e.g. burning fossil fuels or burning wood. GWP is reported as a total (GWP) as well as both for just fossil carbon (GWPF) and including biogenic carbon (GWPB).

Ozone Depletion Potential (ODP) > Ozone Hole

A measure of air emissions that contribute to the depletion of the stratospheric ozone layer, causing higher levels of ultraviolet B (UVB) to reach the earth's surface with detrimental effects on humans, animals, and plants.

Acidification Potential (AP) > Acid Rain

A measure of emissions that cause acidifying effects to the environment. Acidification potential is a measure of a molecule's capacity to increase the hydrogen ion (H+) concentration in the presence of water, thus decreasing the pH value. Potential effects include fish mortality, forest decline and the deterioration of building materials.

Eutrophication Potential (EP) > Algal Blooms

A measure of nutrient enrichment that may cause an undesirable shift in species composition and elevated biomass production in both aquatic and terrestrial ecosystems. It includes potential impacts of excessively high levels of macronutrients, the most important of which are nitrogen (N) and phosphorus (P).

Photochemical Ozone Creation Potential (POCP) > Smog

A measure of emissions of precursors that contribute to ground level smog formation (mainly ozone O_3), produced by the reaction of VOCs and carbon monoxide in the presence of nitrogen oxides under the influence of UV light. Ground level ozone may be harmful to human and ecosystem health and may also damage crops.

Abiotic Depletion Potential > Resource Consumption

The consumption of non-renewable resources leads to a decrease in the future availability of the functions supplied by these resources. Depletion of mineral resource elements (ADPE) and non-renewable fossil energy resources (ADPF) are reported separately.

EPD Results

Modules A1–A3, C3, C4: Production and End of Life

Impacts for the production of XLam CLT as well as various end of life scenarios are shown in Table 4. For information on different end of life scenarios and how to use them, see Module D. Please note that all values are to three significant figures and as such, some values appear to be slightly different to the sum of their parts.

Table 4: Environmental Impacts, 1m^3 of XLam CLT panels

	Acronym	Units	Production A1–A3	Landfill (typical) C4	Landfill (NGA) C4	Energy recovery C3	Recycling C3	Reuse C3
Environmental impact								
Global warming potential (total)	GWPT	kg CO_2-eq.	-492	57.3	346	784	784	779
Global warming potential (fossil)	GWPF	kg CO_2-eq.	248	56.2	56.3	4.86	4.86	0
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	-740	1.11	289	779	779	779
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	1.17E-11	1.98E-13	1.98E-13	8.60E-16	8.60E-16	0
Acidification potential of land and water	AP	kg SO_2-eq.	1.99	0.168	0.187	0.0307	0.0307	0
Eutrophication potential	EP	kg PO_4^{3-}- eq.	0.458	0.0198	0.0245	0.00713	0.00713	0
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	0.968	0.0103	0.0665	0.00267	0.00267	0
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	1.87E-04	4.67E-06	4.67E-06	5.98E-08	5.98E-08	0
Abiotic depletion potential – fossil fuels	ADPF	MJ	3,000	809	809	64.3	64.3	0
Resource use								
Renewable primary energy as energy carrier	PERE	MJ	5,790	56.8	56.8	0.426	0.426	0
Renewable primary energy resources as material utilization	PERM	MJ	8,090	0	0	-8,090	-8,090	-8,090
Total use of renewable primary energy resources	PERT	MJ	13,900	56.8	56.8	-8,090	-8,090	-8,090
Non-renewable primary energy as energy carrier	PENRE	MJ	2,940	821	821	64.4	64.4	0
Non-renewable primary energy as material utilization	PENRM	MJ	98.3	0	0	-98.3	-98.3	-98.3
Total use of non-renewable primary energy resources	PENRT	MJ	3,042	821	821	-33.9	-33.9	-98.3
Use of secondary material	SM	kg	0	0	0	0	0	0
Use of renewable secondary fuels	RSF	MJ	0	0	0	0	0	0
Use of non-renewable secondary fuels	NRSF	MJ	0	0	0	0	0	0
Use of net fresh water	FW	m^3	1.53	0.0112	0.0433	6.08E-04	6.08E-04	0
Waste categories and output flows								
Hazardous waste disposed	HWD	kg	3.47E-06	2.20E-06	2.20E-06	9.32E-08	9.32E-08	0
Non-hazardous waste disposed	NHWD	kg	289	481	396	0.00150	0.00150	0
Radioactive waste disposed	RWD	kg	0.0159	0.00457	0.00457	6.86E-06	6.86E-06	0
Components for re-use	CRU	kg	0	0	0	0	0	480
Materials for recycling	MFR	kg	0	0	0	0	480	0
Materials for energy recovery	MER	kg	0	0	0	480	0	0
Exported electrical energy	EEE	MJ	0	0.778	77.8	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0	0	0

Preservative Treatment of XLam CLT Panels

For T3 Plus preservative treated XLam CLT panels the values shown in Table 5 should be added to the A1–A3 values per m^3 of XLam CLT given in Table 4.

Table 5: Environmental data for T3 Plus preservative treatment of $1m^3$ of XLam CLT panels

Description	Acronym	Units	T3 Plus
Environmental impact			
Global warming potential (total)	GWPT	kg CO_2-eq.	11.4
Global warming potential (fossil)	GWPF	kg CO_2-eq.	11.4
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	0.0414
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	5.06E-14
Acidification potential of land and water	AP	kg SO_2-eq.	0.148
Eutrophication potential	EP	kg PO_4^{3-}- eq.	0.00555
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	0.00731
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	2.17E-04
Abiotic depletion potential – fossil fuels	ADPF	MJ	155
Resource use			
Renewable primary energy as energy carrier	PERE	MJ	35.6
Renewable primary energy resources as material utilization	PERM	MJ	0
Total use of renewable primary energy resources	PERT	MJ	35.6
Non-renewable primary energy as energy carrier	PENRE	MJ	159
Non-renewable primary energy as material utilization	PENRM	MJ	0
Total use of non-renewable primary energy resources	PENRT	MJ	159
Use of secondary material	SM	kg	0
Use of renewable secondary fuels	RSF	MJ	0
Use of non-renewable secondary fuels	NRSF	MJ	0
Use of net fresh water	FW	m^3	0.0738
Waste categories and output flows			
Hazardous waste disposed	HWD	kg	9.17E-08
Non-hazardous waste disposed	NHWD	kg	0.322
Radioactive waste disposed	RWD	kg	0.00133
Components for re-use	CRU	kg	0
Materials for recycling	MFR	kg	0
Materials for energy recovery	MER	kg	0
Exported electrical energy	EEE	MJ	0
Exported thermal energy	EET	MJ	0

Module A4: Transport to Customer/Distribution

The environmental impact of transport is dependent on the distance of the site location from the XLam manufacturing facility. 320km has been chosen as the baseline distance traveled by truck as this is the distance between the XLam facility in Wodonga and the Port of Melbourne. To calculate the impacts from traveling by truck for a custom distance, multiply the impacts in Table 6 by the custom distance and then divide that by 320. Examples of this are shown below. This method can also be used for shipping distances.

Transport to Christchurch New Zealand

Transport by truck to Port Melbourne	=	Read from Table 6	=	13.3 kg CO_2 - eq
Transport by boat to Christchurch (2800km)	=	11.9 x 2800/3100	=	10.7 kg CO_2 - eq
Transport by truck to Christchurch (12km)	=	13.3 x 12/320	=	0.5 kg CO_2 - eq
Total				**24.5 kg CO_2 - eq**

Transport to Sydney Australia

Transport by truck to Sydney (560km)	=	13.3 x560/320	=	23.3 kg CO_2 - eq
Total				**23.3 kg CO_2 - eq**

Transport to Port of Auckland New Zealand

Transport by truck to Port Melbourne	=	Read from Table 6	=	13.3 kg CO_2 - eq
Transport by boat to Auckland	=	Read from Table 6	=	11.9 kg CO_2 - eq
Total				**25.2 kg CO_2 - eq**

Table 6: Environmental impacts for transport of 1m³ of XLam CLT panels

Description	Acronym	Units	Boat from Port of Melbourne to Port of Auckland (3,100km)	Truck from XLam Wodonga to Port of Melbourne (320km)
Environmental impact				
Global warming potential (total)	GWPT	kg CO_2-eq.	11.9	13.3
Global warming potential (fossil)	GWPF	kg CO_2-eq.	11.9	12.7
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	3.41E-04	0.534
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	1.31E-15	2.40E-15
Acidification potential of land and water	AP	kg SO_2-eq.	0.365	0.0566
Eutrophication potential	EP	kg PO_4^{3-}- eq.	0.0407	0.0135
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	0.0194	-0.0226
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	1.43E-07	1.66E-07
Abiotic depletion potential – fossil fuels	ADPF	MJ	148	179
Resource use				
Renewable primary energy as energy carrier	PERE	MJ	0.379	1.17
Renewable primary energy resources as material utilization	PERM	MJ	0	0
Total use of renewable primary energy resources	PERT	MJ	0.379	1.17
Non-renewable primary energy as energy carrier	PENRE	MJ	148	180
Non-renewable primary energy as material utilization	PENRM	MJ	0	0
Total use of non-renewable primary energy resources	PENRT	MJ	148	180
Use of secondary material	SM	kg	0	0
Use of renewable secondary fuels	RSF	MJ	0	0
Use of non-renewable secondary fuels	NRSF	MJ	0	0
Use of net fresh water	FW	m^3	0.00129	0.00168
Waste categories and output flows				
Hazardous waste disposed	HWD	kg	9.16E-09	1.09E-08
Non-hazardous waste disposed	NHWD	kg	0.00183	0.00417
Radioactive waste disposed	RWD	kg	1.93E-06	1.90E-05
Components for re-use	CRU	kg	0	0
Materials for recycling	MFR	kg	0	0
Materials for energy recovery	MER	kg	0	0
Exported electrical energy	EEE	MJ	0	0
Exported thermal energy	EET	MJ	0	0

Module D: End of Life Credits

Reusing, recycling, energy recovery and landfilling of CLT panels at end of life can have some benefits beyond the defined system boundary. These benefits are avoided emissions. Table 7 summarises the impacts that potentially are avoided under each scenario. The modelling of these benefits (seen in Table 8) follows the guidance set by EN 16485:2014 (CEN, 2014).

Table 7: Benefits beyond the system boundary (taken from EN 16485, Table 1)

Reuse	Recycling	Energy Recovery	Landfill (best-practice & NGA)
Avoided impact of forestry, harvesting, wood production	Avoided impact of forestry, harvesting, wood chips preparation	Avoided impact of electricity generation and thermal energy recovery	Avoided impact of electricity production and/or thermal energy recovery from landfill gas recovery

Note: The data provided below should only be utilised by people experienced in conducting comparative analysis. It is provided for experienced environmental consultants to use in reviewing end of life options/ scenarios. Studies have shown that re-use of large format timber panels such as timber is a practical option.

Table 8: Module D, 1m^3 of XLam CLT panels

Description	Acronym	Units	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling	Reuse
Environmental impact							
Global warming potential (total)	GWPT	kg CO_2-eq.	-0.193	-19.3	-533	-54.5	-447
Global warming potential (fossil)	GWPF	kg CO_2-eq.	-0.193	-19.3	-534	-49.0	-447
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	-1.02E-04	-0.0102	1.12	-5.49	0
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	-1.19E-15	-1.19E-13	-1.00E-14	-6.88E-14	-7.90E-13
Acidification potential of land and water	AP	kg SO_2-eq.	-7.68E-04	-0.0768	-0.0287	-0.628	-2.47
Eutrophication potential	EP	kg PO_4^{3-}- eq.	-6.91E-05	-0.00691	-0.0394	-0.130	-0.494
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	-4.14E-05	-0.00414	0.0848	-0.354	-0.993
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	-1.31E-08	-1.31E-06	-4.58E-05	-1.73E-05	-1.06E-04
Abiotic depletion potential – fossil fuels	ADPF	MJ	-2.16	-216	-9,110	-458	-5,010
Resource use							
Renewable primary energy as energy carrier	PERE	MJ	-0.329	-32.9	8,090	-2,130	-3,860
Renewable primary energy resources as material utilization	PERM	MJ	0	0	0	0	0
Total use of renewable primary energy resources	PERT	MJ	-0.329	-32.9	8,090	-2,130	-3,860
Non-renewable primary energy as energy carrier	PENRE	MJ	-2.16	-216	-9,110	-459	-4,950
Non-renewable primary energy as material utilization	PENRM	MJ	0	0	0	0	0
Total use of non-renewable primary energy resources	PENRT	MJ	-2.16	-216	-9,110	-459	-4,950
Use of secondary material	SM	kg	0	0	0	480	480
Use of renewable secondary fuels	RSF	MJ	0	0	8,090	0	0
Use of non-renewable secondary fuels	NRSF	MJ	0	0	98.3	0	0
Use of net fresh water	FW	m^3	-0.00104	-0.104	0.00997	-0.356	-2.58
Waste categories and output flows							
Hazardous waste disposed	HWD	kg	-3.50E-10	-3.50E-08	-2.13E-06	-2.89E-07	-3.09E-06
Non-hazardous waste disposed	NHWD	kg	-5.58E-04	-0.0558	22.4	-16.9	-289
Radioactive waste disposed	RWD	kg	-3.70E-07	-3.70E-05	-5.47E-04	-4.68E-04	-0.0145
Components for re-use	CRU	kg	0	0	0	0	0
Materials for recycling	MFR	kg	0	0	0	0	0
Materials for energy recovery	MER	kg	0	0	0	0	0
Exported electrical energy	EEE	MJ	0	0	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0	0

Variation between products

The CL5/205 product has been used as the representative product, with all other products covered by this EPD having environmental impact within 10% of this product. Table 9 shows the range of variability of the environmental impacts between the CL5/205 and other products

Table 9: Inter-product variability for XLam CLT panels (modules A1-A3)

Description	Acronym	Units	Min	Max	CV
Environmental impact					
Global warming potential (total)	GWPT	kg CO_2-eq.	-0.6%	+1.0%	±0.4%
Global warming potential (fossil)	GWPF	kg CO_2-eq.	-1.2%	+2.0%	±0.8%
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	-0.2%	+0.0%	±0.0%
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	-0.3%	+0.4%	±0.2%
Acidification potential of land and water	AP	kg SO_2-eq.	-0.2%	+0.3%	±0.1%
Eutrophication potential	EP	kg PO_4^{3-}- eq.	-0.1%	+0.3%	±0.1%
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	-0.1%	+0.1%	±0.0%
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	-0.3%	+0.4%	±0.2%
Abiotic depletion potential – fossil fuels	ADPF	MJ	-2.1%	+3.6%	±1.5%

The Carbon Life Cycle of XLam CLT Panels

Sequestration of Carbon Dioxide

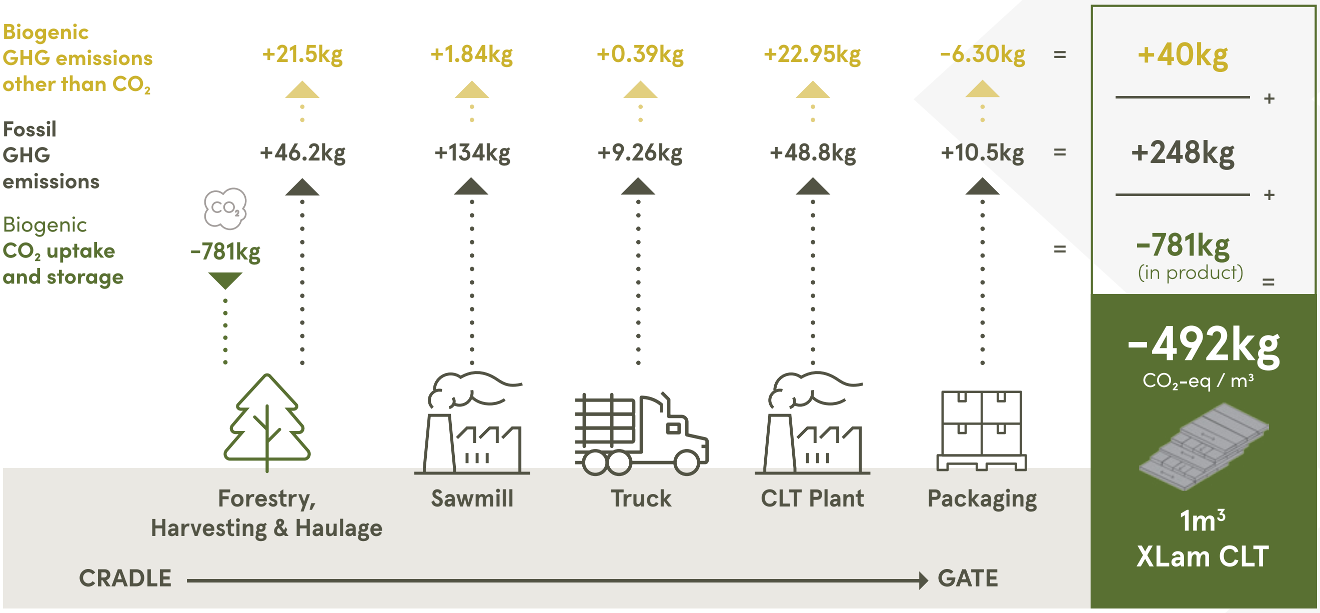
During growth, trees absorb carbon dioxide (CO_2) from the atmosphere through the process of photosynthesis and convert this into carbon-based compounds that constitute various components of a tree, including wood. On average, half the dry weight of all radiata pine is made up of the element carbon (Gifford, 2000).

The source of XLam CLT feedstock are plantations which are independently certified to the Australian Standard for Sustainable Forest Management (AS 4708), which is endorsed under the internationally recognised forest management certification system Programme for the Endorsement of Forest Certification (PEFC). It is therefore appropriate to include biogenic CO_2 sequestration in this EPD in line with EN 16485 (Section 6.3.4.2) (CEN, 2014).

Plantation management activities including harvesting, the manufacture and transport of timber, adhesives, CLT and packaging require energy which releases carbon dioxide into the atmosphere as per the schematic below. When the CLT panel reaches the end of life it may be re-used, recycled, used as fuel to make energy or sent to land fill. In some cases the carbon may be released back into the environment.

Life Cycle of XLam CLT Panels

Life cycle carbon footprint in kg CO_2- equivalent per m^3 XLam CLT panels (13% moisture content), including both biogenic and fossil carbon. "Cradle to Gate" A1 - A3.



*CO_2 biogenic emissions from production (e.g. from combustion and degradation of residues) are excluded as they are balanced by uptake during tree growth (i.e. balance to zero).

Other Environmental Information

Health & Safety

XLam operate a centralised, cloud-based environmental and safety management platform at all our workplaces. Health, safety, and wellbeing of our people and creating a positive safety culture across the XLam group is a fundamental business imperative and a core part of everything we do. Compliance with the law and recognised codes of practice is a given. XLam provides detailed guidelines on the handling and installation of CLT panels - see XLam Site Guide.

Quality Accreditations

XLam has a documented Quality Assurance Framework which includes a stringent set of QA procedures. Every single panel is subject to rigorous testing of both the timber and glue bond to ISO standards prior to dispatch. The XLam quality assurance process has been audited by the EWPAA to certification requirements.

Responsible Products: Forest & Timber Certification

XLam operations and sales offices are certified to the chain of custody (COC) standards of the global forest and wood product certification scheme PEFC by SCS Global Services. Multi-site certificate number SCS-PEFC/COC-05795.

XLam CLT panels are manufactured from radiata pine grown in sustainably managed plantations certified to the forest management standard of PEFC and other controlled sources located within Australia.

PEFC certified product with a claim of PEFC 70% is available on request. This meets the requirements of Green Star and numerous other sustainable procurement policies and schemes.

Indoor Environment Quality

XLam CLT panels are manufactured using polyurethane (PU) resin, which is formaldehyde-free. Formaldehyde is neither a component in the formulation, nor is it formed or liberated during curing, during use of the CLT or during disposal at the end of their life cycle. Product specific evidence is available on request.

XLam CLT panels untreated and treated with Hyne T3 Plus both have some naturally occurring formaldehyde emissions. In both cases the formaldehyde emissions rate is less than 0.1 mg/m^2/h (test method ASTM D5116:2017). This is less than the emission limit set for engineered wood products for two points under Credit 12.1 in Green Star Product – Interiors v1.3 and for one point under Credit 12.1 in Green Star – Design & As Built v1.3.

Specific laboratory test certificates for formaldehyde emissions for treated and untreated XLam CLT panels are available on request.

Declare Red List Free

XLam CLT panels are accredited as Declare Red List Free see Declare - International Living Future Institute (living-future.org)

XLam CLT and Green Star - Applicable Credits

Australia

The use of XLam CLT panels may assist projects in Australia seeking Green Star certification with the gaining of credits in these categories:

- Indoor Environment Quality / Indoor Pollutants
- Materials / Life Cycle Impacts
- Life Cycle Impacts:
  - Life Cycle Assessment
  - Life Cycle Impacts: Structural Timber
- Materials / Responsible Building Materials
- Materials / Sustainable Products

New Zealand

The use of XLam CLT panels may assist projects in New Zealand seeking Green Star or Homestar accreditation with the gaining of credits in these categories:

- Indoor Pollutants / Healthy Materials
- Life Cycle Impact / Embodied Carbon
- Responsible Building Materials
- Sustainable Products
- Construction Demolition Waste
- Earthquake Resilience

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