Environmental Product Declaration

For Solid, Finger-Jointed and Laminated Timber Products including timber preservation options

Environmental Product Declaration
In accordance with ISO 14025 and EN 15804

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AUSTRALASIA EPD®
ENVIRONMENTAL PRODUCT DECLARATION








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Wood Processors' and Manufacturers' Association of New Zealand (Inc.) (WPMA)

WPMA is a membership body for companies which manufacture a wide range of wood products throughout New Zealand.

The activities of the WPMA include:

- Representation of the views and requirements of the wood processing industries to Government and lobbying on their behalves.
- Organisation and promotion of high profile events which showcase the wood processing and manufacturing sector to special interest groups and the public.
- Development of technical representations through multiple technical committees of WPMA members, for submission to Standards New Zealand, Standards Australia, and Ministry for Business, Innovation and Employment (MBIE), especially with regard to Standards for wood products and the references to timber products in the NZ Building Code.
- Encouraging and aiding members to undertake various multi-party projects to increase and improve the uses of wood products, usually by developing information targeted to specifiers and users of wood products. This, the WPMA Environmental Product Declaration Project, is one such example.

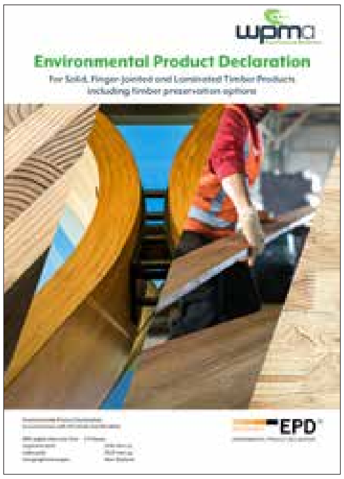
The environmental impact figures shown in this EPD are average figures for the companies which are shown in ***Table 1***. They do not represent and cannot be taken to represent environmental impacts of products made by other companies. To see the individual sustainability policies of each company please refer to their relevant websites.

Table 1: WPMA member companies who contributed data and finance to the WPMA Environmental Product Declaration.

Company	Financial Contributor	Data Contributor
Abodo Wood Ltd. (www.abodo.co.nz)	X	X
NorthPine Ltd. (www.northpine.co.nz)	X	X
OTC Timber Co Ltd.(www.otctimber.co.nz)	X	X
Red Stag Timber (www.redstagtimber.co.nz)	X	X
Rosvall Sawmill Ltd (www.rosvall.co.nz)	X	X
Taranakipine (www.taranakipine.co.nz)	X	X
Techlam (www.techlam.nz)	X	X
Tenon Clearwood LP (www.tenonmanufacturing.co.nz)	X	X
Timberlab Solutions Ltd (www.timberlab.co.nz)	X	X
Xlam NZ Ltd (www.xlam.co.nz)	X	X

The WPMA EPD project highlights the environmental credentials of the products made by the included companies. And in a competitive construction and development marketplace, provision of credible figures for the environmental properties of these products will help property owners, developers, and specifiers to select the best solutions for these needs.

HOW TO USE THIS EPD



The project contributors have developed this EPD to help to showcase the environmental credentials of their wood products. The EPD also provides life cycle data for calculating the impacts of wood products at a building level. This data may be used by specifiers and developers to calculate and present the environmental impacts of particular construction projects.

New Zealand Green Building Council states "An EPD does not imply environmental superiority; it is solely a transparent declaration of the life-cycle environmental impact. The detailed, transparent environmental data that EPDs provide is an important step towards enabling whole-of-building life cycle assessment"

NZGBC currently allows up to two points to be awarded for use of EPDs in Greenstar projects. To get up to date information on use of EPDs in Greenstar please go to

https://www.nzgbc.org.nz/Attachment?Action=Download&Attachment_id=351

Please note: The remainder of this EPD comprises 2 parts.

Part 1 is the explanation of the Technical Information:

Declared Unit
Product Descriptions
Product Compositions
System Boundaries
End-of-Life
Key Assumptions
Environmental Impact Indicators
Environmental Impacts
Variation in Results
References
Acknowledgments

Part 2 is the description of the different product types and their modelled environmental impacts:

Sawn Kiln Dried Timber
Surfaced Kiln Dried Timber
Finger-Jointed Timber
Glue Laminated Timber (GLULAM)
Cross Laminated Timber (CLT)

PART 1: TECHNICAL INFORMATION

DECLARED UNIT

This EPD is valid for a declared unit of 1 m^3 Radiata Pine timber as specified in the table below, packaged and ready for dispatch to a customer.

Table 2: Timber products included in this EPD.

PRODUCT TYPE	TIMBER PROPERTIES (DENSITY)	USES
Sawn, kiln dried	Density: 488 kg/m^3 Moisture content (dry-basis): 11.6%	Non- structural indoor uses not requiring smooth finish eg workshop shelving. Packaging and pallet uses.
Surfaced, kiln dried	Density: 486 kg/m^3 Moisture content (dry-basis): 11.6%	Structural uses when preservative treated. Decorative and aesthetic finishes for indoor uses, treated and untreated.
Finger-jointed	Density: 475 kg/m^3 Moisture Content (dry-basis) 10.5%	Mouldings, window reveals, exterior cladding (used where the presence of knots is not acceptable). Treated or untreated as required. May also be used as a structural component.
Glulam	Density: 491 kg/m^3 Moisture content (dry-basis): 11.4%	Usually larger size beams, comprising boards (sometimes finger-jointed), which are face-glued with all the grain running parallel to the length of the beam. May be used in interior and exterior situations, depending on choices of adhesive, treatment type and coating.
Cross-laminated timber (CLT)	Density: 500 kg/m^3 Moisture content (dry-basis): 12.0%	Usually larger size panels, comprising boards (sometimes finger-jointed) laid up edge to edge with grain running parallel to the length of the boards, then additional layers of boards are laid on them, each layer with grain running at right angles to the layer beneath. Used as structural walls and floors in protected from weather situations, and preservative treated as required.

The products listed above present an average based on all participants producing the specific product type.

Additionally, the products listed in ***Table 2*** may be supplied in an untreated or treated form. The treatment types shown in ***Table 3*** are used by the participating facilities; they have therefore been modelled. Instructions for calculating the total environmental impacts of treated products are given in the Preservative Treatments section.

Table 3: Timber preservative treatments included in this EPD.

Treatment class	Treatment type	Use
H1.2	Boron	House framing
H3.1	LOSP	Outdoor products (paint coating required), not in ground contact, non-structural
H3.1	Copper Azole	Outdoor products (paint coating required), not in ground contact, non-structural
H3.2	CCA	Outdoor products not in ground contact, structural
H4	CCA	Outdoor products in ground contact, non-structural

PRODUCT DESCRIPTIONS

Table 4 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 4: Classification codes of included products.

Product type	Classification	Code	Category
Sawn, kiln dried, Surfaced, kiln dried	UN CPC Ver.2.1	31101	Wood, sawn or chipped lengthwise, sliced or peeled, of a thickness exceeding 6 mm, of coniferous wood
	ANZSIC 2006	1411 1413	Log Sawmilling Timber re-sawing and dressing
Finger-jointed	UN CPC Ver. 2.1	31211	Wood, continuously shaped along any of its edges or faces (including strips and friezes for parquet flooring, not assembled, and beadings and mouldings) of coniferous wood Radiata Pine
	ANZSIC 2006	1413	Timber re-sawing and dressing
Glulam, Cross-laminated timber (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 COMPOSITIONS

All timber products included in this EPD are of the species *Pinus radiata* (Radiata Pine), grown within New Zealand in sustainably managed plantations and processed locally by the members listed in ***Table 1***. Radiata Pine is the dominant species logged in New Zealand and represents over 95% of all harvested timber in the 2016/17 financial year (April 2016-March 2017) (MPI, 2017).

Resins used in the production of finger-jointed timber and glulam include Melamine-Urea-Formaldehyde (MUF), Phenol-Resorcinol-Formaldehyde (PRF) or Polyurethane (PU). The CLT product uses PU resin.

Treated timber products declared within this EPD include those treated with Boron, LOSP, Copper Azole or Copper-chrome-arsenate (CCA).

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".

SYSTEM BOUNDARIES

As shown in ***Table 5*** this EPD is of the 'cradle-to-gate' type with options. The options include end-of-life processing (Modules C3-C4) and recycling potential (Module D).

Other life cycle stages (Modules A4-A5, B1-B7 and C1-C2) are dependent on particular scenarios and best modelled at the building level, therefore these modules have not been declared.

Table 5: Modules included in the scope of the EPD.

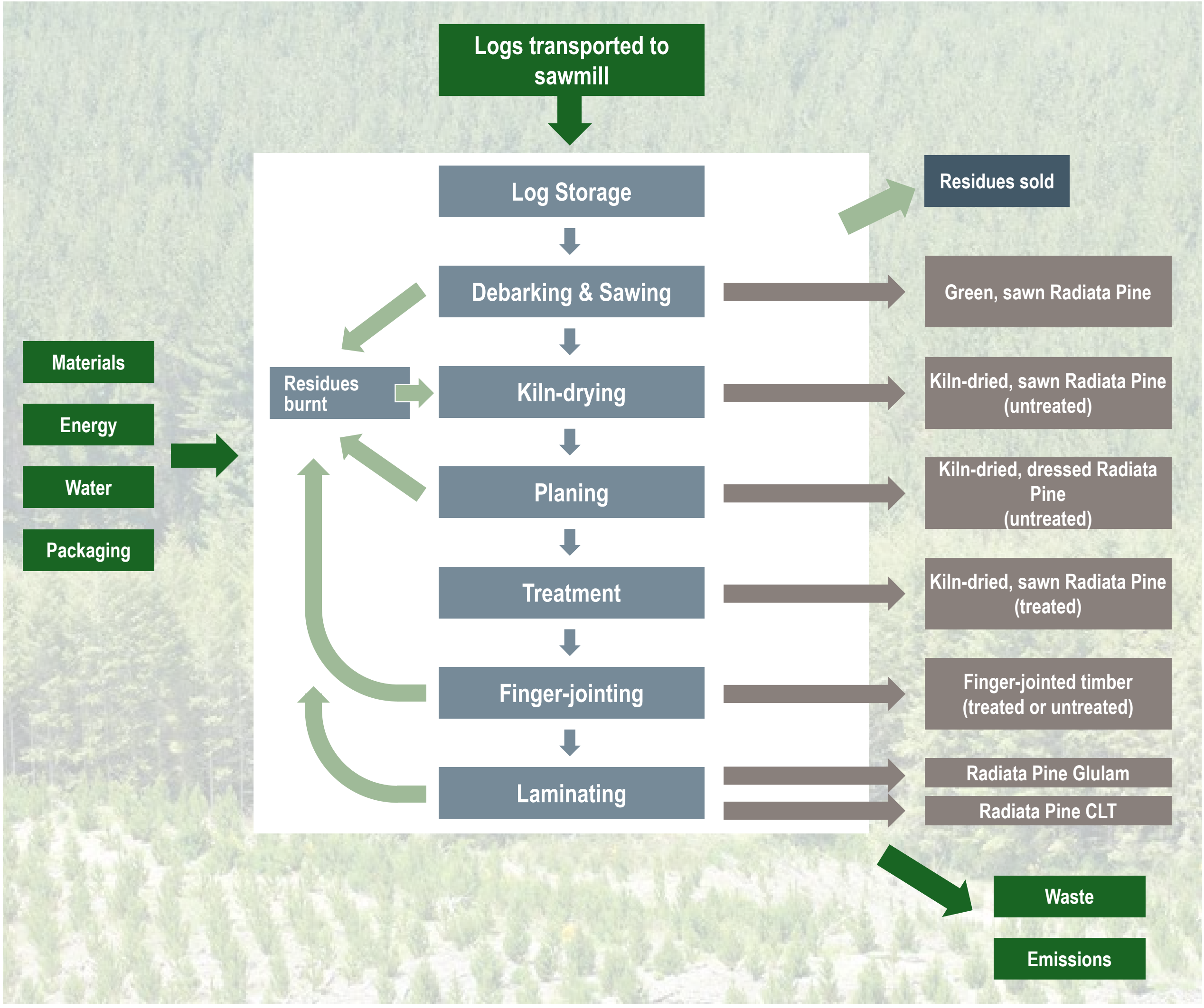
Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport of raw materials	Manufacturing	Transport to customer	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to waste processing	Waste processing	Disposal	Reuse Recovery Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X

X = included in the EPD
MND = not declared (such a declaration shall not be regarded as an indicator result of zero)

Production (modules A1-A3)

Figure 1: Shows the basic manufacturing processes for the products included within this EPD. Each product type represents an output from a different point in the production process.

Figure 1: Manufacturing (A1-A3) process flowchart.



END-OF-LIFE

At the end of its useful life, a timber product is removed from the building and may end up recycled, reused, combusted to produce energy, or landfilled. In New Zealand, the most common end-of-life method is landfill, especially for treated products, which have limitations for recycling and incinerating.

The landfill scenario and three other possible end of life scenarios are described below. Each scenario assumes that 100% of the wood is sent to that scenario. To create an end-of-life mix for a given region or end use, the reader should take a weighted sum of these scenarios. Where no specific data are available, the 'landfill' scenario should be used.

LANDFILL

Emissions from landfill are dependent on the Degradable Organic Carbon fraction (DOCf).

The DOCf = 0.1% for Radiata Pine. This is based on bioreactor laboratory research by Wang et al. (2011) for Pinus radiata. 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 2014c, p. 189) and the resulting electricity receives a credit for offsetting average electricity from the New Zealand grid (module D) in line with EN 16485:2014 (Section 6.3.4.5).

The landfill scenario assumes 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 2016, Table 43).
- All carbon dioxide is released directly to the atmosphere.
- 40% of the methane is captured (New Zealand Government, 2015, p. 299).
- Of the 40% captured, one quarter (10% of the total) is flared and three quarters (30% of the total) are used for energy recovery (Carre 2011). Methane is combusted in both processes, resulting in all carbon being released as carbon dioxide.
- Of the 60% of methane that is not captured, 10% (6% of the total) is oxidised (released as carbon dioxide) (Australian Government 2016, Table 43) and 90% (54% of the total)) is released to the atmosphere as methane.
- In summary, for every kilogram of carbon converted to landfill gas, 73% is released as carbon dioxide and 27% is released as methane.

ENERGY RECOVERY

This scenario includes shredding (module C3) and combustion with the recovered thermal energy assumed to replace thermal energy from natural gas (module D) in line with EN 16485:2014 (Section 6.3.4.5). Note that other options may also be in use within New Zealand, including replacement of coal, replacement of electricity, and replacement of both electricity and thermal energy (via co-generation).

REUSE

The product is 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 (or very similar) to the first, meaning that a credit is given for production of 1 m^3 of timber in module D. The CO2 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

Timber may be recycled in many different ways. This scenario considers shredding and effectively downcycling into wood chips. Wood waste is chipped (module C3) and assigned credits relative to the avoided production of virgin Radiata Pine woodchips as a co-product from sawmilling (module D). In line with the reuse scenario, the CO_2 sequestered, and 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 (EN 16485:2014, Section 6.3.4.2).

KEY ASSUMPTIONS

Energy: Thermal energy and transport fuels have been modelled using the Australian average as no New Zealand-specific datasets are available (see thinkstep 2018 for documentation). Electricity for timber production (modules A1-A3) has been modelled with the New Zealand-specific grid mix.

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 2017, Section 7.5.4). All other reported data were incorporated and modelled using the best available life cycle inventory data.

ALLOCATION

Upstream data: For refinery products, allocation is applied 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. For materials and chemicals, the allocation rule most suitable for the product is applied (see thinkstep 2018).

Co-products (e.g. sawdust): As the difference in economic value of the co-products is high (>25% as per EN 15804, Section 6.4.3.2), allocation by economic value has been applied. Economic data were provided by the facilities represented in this EPD.

BACKGROUND DATA

Wood manufacturing data have been provided by each facility. Upstream data for the forestry stage have been taken from literature data (Sandilands, et al., 2006), and have been updated by Scion (Evanson, 2018) for the most significant items within the forestry inventory, based on the results of a sensitivity analysis

Data for all energy inputs, transport processes and raw materials are from GaBi Databases 2017 (thinkstep 2018). Most datasets have a reference year between 2013 and 2015 and all fall within the 10-year limit allowable for generic data under EN 15804 (Section 6.3.7).

PRIMARY DATA

Primary data were collected from each of the New Zealand wood product manufacturers listed in ***Table 1***, for all products which (a) each facility produced and (b) is included within this study. Each product group declared represents a production-weighted average of the included facilities. Note that the product represents an average and cannot be purchased from any single manufacturer.

REPRESENTATIVENESS

Market representativeness: The EPD is based on detailed data collected by survey from the facilities listed in ***Table 1***. The EPD is representative of an average timber product produced by those contributors.

Temporal representativeness: Primary data were collected from participating sites for the 2016/2017 year (12 consecutive months of data for each facility, primarily July 2016 – June 2017).

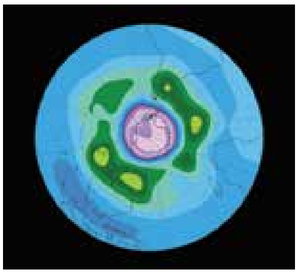
Geographical and technological representativeness: The data are representative of the sites surveyed, and the production technologies used by those facilities. More detailed information can be found in the 'Variation in Results' section later in this EPD.

ENVIRONMENTAL IMPACT INDICATORS

An introduction to each environmental impact indicator is provided below.
he best-known effect of each indicator is listed to the right of its name.
The abbreviation in Red corresponds to the labels in the following tables.

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 as well as being separated into biogenic carbon (GWPB) and fossil carbon (GWPF).



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 (ADPE and ADPF) → 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.

EXPLANATION OF ACRONYMS

ENVIRONMENTAL IMPACT

GWP [kg CO_2-eq.]	Global Warming Potential, measured as kg of CO_2 equivalent
GWPF [kg CO_2-eq.]	Global Warming Potential, measured as kg of CO_2 equivalent from burning of fossil fuels
GWPB [kg CO_2-eq.]	Global Warming Potential, measured as kg of CO_2 equivalent from burning of plants and trees
ODP [kg CFC11-eq.]	Ozone Depletion Potential, measured as kg of chlorofluorocarbon equivalent
AP [kg SO_2-eq.]	Acidification Potential, measured as kg SO_2 equivalent
EP [kg $PO4^{3}$--eq.]	Eutrophication Potential, measured as kg PO_4^{3-}
POCP [kg C_2H_4-eq.]	Photochemical Ozone creation potential measured as kg C_2H_4 (ethene)
ADPE [kg Sb-eq.]	Abiotic Depletion Potential (depletion of mineral resources) measured as kg Sb equivalent. Sb is the symbol for Antimony
ADPF [MJ]	Abiotic Depletion Potential (depletion of non-renewable fossil energy) measured as MJ. (Mega Joules)

RESOURCE USE

PERE [MJ]	Use of renewable primary energy excluding renewable primary energy resources used as raw materials, measured in MJ
PERM [MJ]	Use of renewable primary energy resources used as raw materials, measured in MJ
PERT [MJ]	Total use of renewable primary energy resources, measured in MJ
PENRE [MJ]	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials, measured in MJ
PENRM [MJ]	Use of non-renewable primary energy resources used as raw materials, measured in MJ
PENRT [MJ]	Total use of non-renewable primary energy resources, measured in MJ
SM [kg]	Use of secondary material, measured in kg
RSF [MJ]	Use of renewable secondary fuels, measured in MJ
NRSF [MJ]	Use of non-renewable secondary fuels, measured in MJ
FW [m^3]	Net use of fresh water, measured in cubic metres

WASTE AND OUTPUTS

HWD [kg]	Hazardous waste disposed measured in kg
NHWD [kg]	Non-hazardous waste disposed measured in kg
RWD [kg] *	Radioactive waste disposed measured in kg
CRU [kg]	Components for re-use measured in kg
MFR [kg]	Materials for recycling measured in kg
MER [kg]	Materials for energy recovery measured in kg
EEE [MJ]	= Exported electrical energy measured in MJ
EET [MJ]	Exported thermal energy measured in MJ

* As a nuclear-free country, no radioactive waste is disposed of within New Zealand. The RWD (Radioactive Waste Disposed) results are due to the use of European life cycle inventory datasets for the production of resins, fuels and packaging materials due to a lack of NZ-specific data.

ENVIRONMENTAL IMPACTS

The reported impact categories represent impact potentials, i.e., they are approximations of environmental impacts that could occur if the emissions would (a) follow the underlying impact pathway and (b) meet certain conditions in the receiving environment while doing so. The environmental impact results are therefore relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks.

Long-term emissions (>100 years) are not taken into consideration in the impact estimate.

Note that each end-of-life scenario (C3 & C4) assumes that 100% of the wood is sent to that scenario. To create an end-of-life mix for a given region or end use, the reader should take a weighted sum of these scenarios. Where no specific data are available, the 'landfill' scenario should be used (see the section 'End-of-life').

Note: Carbon dioxide sequestration: 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. On average, half the dry weight of all timber is made up of the element carbon (Gifford 2000). This is the reason for a negative GWP. More gases contributing to global warming are removed during tree growth, than emitted during the production phase.

VARIATION IN RESULTS

The variation between sites used to create the average shown in this EPD are given in ***Table 6*** below for the environmental impact indicators in modules A1-A3. Note: no inter-site variability exists for CLT, as the production data covers a single manufacturing site.

Table 6: Inter-site variability of impact assessment results (modules A1-A3).

	Sawn Radiata Pine			Surfaced Radiata Pine		
Parameter [Unit]	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**
GWP [kg CO_2-eq.]	-12.1%	+2.1%	±5.0%	-9.5%	+9.4%	±5.4%
GWPF [kg CO_2-eq.]	-30.9%	+67.3%	±35.0%	-30.7%	+59.8%	±31.0%
GWPB [kg CO_2-eq.]	-12.0%	+2.0%	±4.6%	-10.4%	+6.1%	±4.7%
ODP [kg CFC11-eq.]	-7.7%	+25.6%	±11.4%	-10.3%	+25.4%	±11.5%
AP [kg SO_2-eq.]	-30.8%	+34.4%	±24.7%	-30.2%	+32.7%	±22.6%
EP [kg $PO4^{3-}$-eq.]	-39.5%	+50.3%	±30.7%	-38.7%	+49.0%	±29.3%
POCP [kg C_2H_4-eq.]	-18.0%	+17.5%	±12.2%	-21.4%	+19.4%	±12.6%
ADPE [kg Sb-eq.]	-55.8%	+123.0%	±55.7%	-57.0%	+113.2%	±48.1%
ADPF [MJ]	-22.1%	+96.4%	±35.9%	-22.7%	+90.2%	±33.0%

	Finger-jointed Radiata Pine			Radiata Pine glulam		
Parameter [Unit]	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**
GWP [kg CO_2-eq.]	-1.8%	+8.0%	±3.8%	-3.3%	+16.2%	±5.3%
GWPF [kg CO_2-eq.]	-27.9%	+29.2%	±20.8%	-15.7%	+45.7%	±25.1%
GWPB [kg CO_2-eq.]	-3.7%	+4.9%	±3.8%	0.0%	+8.9%	±3.7%
ODP [kg CFC11-eq.]	-15.8%	+43.8%	±23.9%	-20.8%	+256.7%	±123.5%
AP [kg SO_2-eq.]	-3.8%	+18.0%	±5.3%	-9.7%	+33.0%	±17.7%
EP [kg $PO4^{3-}$-eq.]	-7.8%	+32.8%	±8.9%	-10.6%	+33.7%	±20.1%
POCP [kg C_2H_4-eq.]	-9.6%	+22.2%	±11.4%	-0.4%	+14.4%	±6.4%
ADPE [kg Sb-eq.]	-52.1%	+51.9%	±35.4%	-11.2%	+23.7%	±16.4%
ADPF [MJ]	-21.0%	+56.3%	±26.6%	-20.4%	+68.7%	±36.4%

Min = (minimum - average) / average **Max** = (maximum - average) / average
CV = coefficient of variation = standard deviation / average

RESOURCE USE

The resource use indicators describe the use of renewable and non-renewable material resources, renewable and non-renewable primary energy and water.

Note: Water consumption: The FW indicator in the EPD results tables reports consumption (i.e. net use) of 'blue water' (which includes river water, lake water and ground water). This indicator deliberately excludes consumption of 'green water' (rain water), as net loss should be interpreted as any additional water loss beyond what would occur in the original, natural system. For plantation Radiata Pine forestry, the natural system might be a native forest or a grassland (Quinteiro et al. 2015).

WASTE AND OUTPUT FLOWS

Waste indicators describe waste generated within the life cycle of the product. Waste is categorised by hazard class, end of life fate and exported energy content.

PRESERVATIVE TREATMENTS

Timber products produced in New Zealand can be treated to help resist insect attack and/or fungal decay. Products to be used in outdoor applications such as decking, cladding, fencing and landscaping are usually treated to the appropriate hazard class.

The values shown in ***Table 7*** and ***Table 8*** may be used to add the associated treatment impacts to the A1-A3 values per m^3 of Radiata Pine product given in ***Tables 9-11, 14-16, 19-21, 24-26, 29-31.*** This allows the associated A1-A3 impacts per m^3 of treated Radiata Pine to be calculated for each treatment type.

How to calculate the impacts of a treated product:

1. Select the scaling factor from ***Table 7*** for the corresponding product
2. Multiply all values in ***Table 8*** by this factor for the chosen treatment type
3. Add the calculated values to the A1-A3 values from ***Tables 9-11, 14-16, 19-21, 24-26, 29-31*** for the product

Table 7: Preservative treatment product scaling factor.

Sawn Radiata Pine	**1**
Surfaced Radiata Pine	**1**
Finger-jointed Radiata Pine	**1.34**
Radiata Pine glulam	**1.43**
Radiata Pine CLT	**1.37**

Table 8: Environmental data for preservative treatment of radiata pine per m^3 of untreated timber product.

Treatment type:	H1.2 Boron	H1.2 Boron re-dried	H3.1 LOSP	H3.1 Copper Azole	H3 CCA	H3 CCA Re-dried	H4 CCA	H4 CCA Re-dried
ENVIRONMENTAL IMPACT								
GWP [kg CO_2-eq.]	2.0	5.7	50.2	10.1	16.3	20.0	23.8	27.5
GWPF [kg CO_2-eq.]	2.0	5.6	50.1	10.0	15.9	19.6	23.2	26.9
GWPB [kg CO_2-eq.]	0.0	0.1	0.1	0.1	0.4	0.4	0.5	0.6
ODP [kg CFC11-eq.]	6.81E-12	6.99E-12	1.51E-10	5.73E-11	5.53E-10	5.53E-10	8.34E-10	8.34E-10
AP [kg SO_2-eq.]	0.0115	0.0502	0.118	0.229	0.226	0.265	0.337	0.376
EP [kg $PO4^{3-}$-eq.]	0.00187	0.0107	0.0117	0.0118	0.00605	0.0149	0.00844	0.0173
POCP [kg C_2H_4-eq.]	0.000973	0.159	6.74	0.167	0.0109	0.169	0.0161	0.174
ADPE [kg Sb-eq.]	5.03E-07	1.18E-06	1.75E-04	4.95E-04	2.36E-03	2.36E-03	3.56E-03	3.56E-03
ADPF [MJ]	26.2	51.0	1960	144	200	225	292	316
RESOURCE USE								
PERE [MJ]	29.0	661	49.4	665	35.7	668	39.2	671
PERM [MJ]	0	0	0	0	0	0	0	0
PERT [MJ]	29.0	661	49.4	665	35.7	668	39.2	671
PENRE [MJ]	26.4	51.2	1980	148	207	232	302	326
PENRM [MJ]	0	0	0	0	0	0	0	0
PENRT [MJ]	26.4	51.2	1980	148	207	232	302	326
SM [kg]	0	0	0	0	0	0	0	0
RSF [MJ]	5.48E-24	3.98E-10	5.48E-24	3.98E-10	5.48E-24	3.98E-10	5.48E-24	3.98E-10
NRSF [MJ]	6.43E-23	5.05E-09	6.43E-23	5.05E-09	6.43E-23	5.05E-09	6.43E-23	5.05E-09
FW [m^3]	247	340	401	361	281	374	303	396
WASTE AND OUTPUTS								
HWD [kg]	1.56E-08	2.66E-08	3.40E-07	3.12E-04	1.42E-07	1.54E-07	2.10E-07	2.21E-07
NHWD [kg]	0.0323	0.988	0.298	1.06	1.14	2.10	1.72	2.67
RWD [kg]	5.67E-05	7.51E-05	7.61E-03	1.42E-03	2.63E-03	2.65E-03	3.97E-03	3.98E-03
CRU [kg]	0	0	0	0	0	0	0	0
MFR [kg]	0	0	0	0	0	0	0	0
MER [kg]	0	0	0	0	0	0	0	0
EEE [MJ]	0	0	0	0	0	0	0	0
EET [MJ]	0	0	0	0	0	0	0	0

To aid the users of this EPD, these values have been calculated for each product type, and are shown in ***Tables** 13*, ***18***, ***23***, ***28***, and ***33***.

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ACKNOWLEDGMENTS

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

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

Declaration owner:

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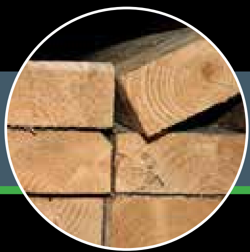
CEN standard EN 15804 served as the core PCR

PCR:	PCR 2012:01 Construction products and Construction services, 2.3 (2018-11-15)
PCR review was conducted by:	The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com.
Independent verification of the declaration and data, according to ISO 14025:	☐ EPD process certification (Internal) ☑ EPD verification (External)
Third party verifier	Andrew D Moore, Life Cycle Logic Pty Ltd Web: www.lifecyclelogic.com.au Email: andrew@lifecyclelogic.com.au Post: PO Box 571 Fremantle 6959 Western Australia
Approved by:	EPD Australasia Ltd

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

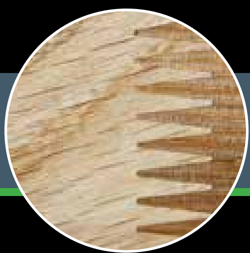
PART 2: PRODUCT TYPES AND THEIR ENVIRONMENTAL IMPACTS

Page



SAWN, KILN DRIED TIMBER 18

SURFACED, KILN DRIED TIMBER 22



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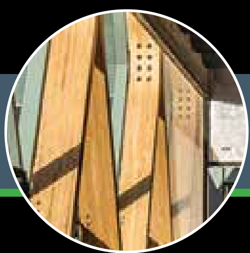
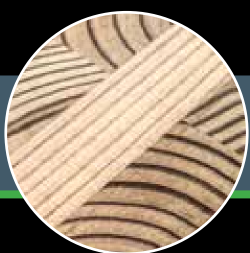
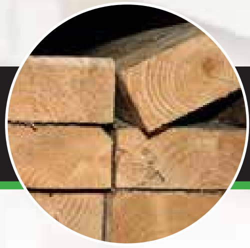


GLUE LAMINATED TIMBER (GLULAM) 30



CROSS LAMINATED TIMBER (CLT) 34



SAWN, KILN DRIED TIMBER

When timber is sawn from a Radiata Pine log it may have a moisture content (oven dry basis) of between 40 to 200%. For most purposes, the timber must be dried to a moisture content of between 12 to 20%. To do this, the timber is usually stacked in kilns, with small timber fillets laid between the layers. Heated air is forced through the fillet spaces between the layers to evaporate moisture from the surface of the timber. Temperature, humidity and airflow must be tightly controlled to get the most efficient drying without damaging the timber.

The energy required for drying, heat and electrical, is often supplied by burning residues of the timber manufacturing process, which makes timber more sustainable as the requirement for use of fossil fuels in the process is much reduced.

Sawn, kiln dried timber is often the starting point for a lot of further processed timber products, however it can be an end product saleable in its own right. Timber in the sawn kiln dried condition will likely have size variation and surface roughness which makes it unsuitable for many uses, but it is often used for pallets, packaging and internal applications such as industrial shelving. It can be preservative treated and then used for applications such as exposed to weather rustic elements, e.g. posts, pergolas, fencing.

Table 9: Environmental impacts, 1 m^3 of sawn kiln dried Radiata Pine.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
GWP [kg CO_2-eq.]	-747	57.3	805	805	801
GWPF [kg CO_2-eq.]	51.3	54.3	4.90	4.90	0
GWPB [kg CO_2-eq.]	-798	2.96	801	801	801
ODP [kg CFC11-eq.]	1.22E-10	7.25E-12	5.44E-15	5.44E-15	0
AP [kg SO_2-eq.]	0.387	0.160	0.0308	0.0308	0
EP [kg PO4^{3-}-eq.]	0.0922	0.0213	0.00715	0.00715	0
POCP [kg C_2H_4-eq.]	0.187	0.0101	0.00268	0.00268	0
ADPE [kg Sb-eq.]	8.44E-06	6.15E-06	6.70E-08	6.70E-08	0
ADPF [MJ]	548	796	61.6	61.6	0

Table 10: Resource use, 1 m^3 of sawn kiln dried Radiata Pine.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
PERE [MJ]	4,200	76.5	3.13	3.13	0
PERM [MJ]	8,260	0	-8,260	-8,260	-8,260
PERT [MJ]	12,500	76.5	-8,260	-8,260	-8,260
PENRE [MJ]	552	812	61.6	61.6	0
PENRM [MJ]	0	0	0	0	0
PENRT [MJ]	552	812	61.6	61.6	0
SM [kg]	0	0	0	0	0
RSF [MJ]	2.92E-07	4.88E-21	7.60E-21	7.60E-21	0
NRSF [MJ]	3.70E-06	5.73E-20	8.92E-20	8.92E-20	0
FW [m^3]	1.000	0.0506	6.64E-04	6.64E-04	-1.000

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;
PENRE = Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials;
PENRM = Use of non renewable primary energy resources used as raw materials;
PENRT = Total use of non renewable primary energy resources;
SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non renewable secondary fuels;
FW = Net use of fresh water

Table 11: Waste categories, 1 m^3 of sawn kiln dried Radiata Pine.

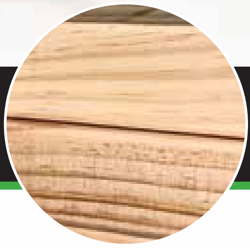
	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
HWD [kg]	2.20E-05	2.80E-06	9.61E-08	9.61E-08	0
NHWD [kg]	14.0	489	4.46E-04	4.46E-04	0
RWD [kg]	0.00153	0.00635	3.64E-06	3.64E-06	0
CRU [kg]	0	0	0	0	488
MFR [kg]	0	0	0	488	0
MER [kg]	0	0	488	0	0
EEE [MJ]	0	0.878	0	0	0
EET [MJ]	0	0	0	0	0

Table 12: Recycling, reuse and recovery potentials (Module D), 1 m^3 of sawn Radiata Pine.

Parameter [Unit]	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
ENVIRONMENTAL IMPACT				
GWP [kg CO_2-eq.]	-0.0402	-537	-18.1	747
GWPF [kg CO_2-eq.]	-0.0402	-538	-17.6	-51.3
GWPB [kg CO_2-eq.]	-8.52E-05	1.26	-0.557	798
ODP [kg CFC11-eq.]	-9.87E-17	7.26E-14	-1.27E-13	-1.22E-10
AP [kg SO_2-eq.]	-1.28E-04	-0.0180	-0.209	-0.387
EP [kg $PO4^{3-}$-eq.]	-1.65E-05	-0.0372	-0.0477	-0.0922
POCP [kg C_2H_4-eq.]	-9.11E-06	0.0889	-0.189	-0.187
ADPE [kg Sb-eq.]	-2.18E-08	-4.08E-05	-4.13E-06	-8.44E-06
ADPF [MJ]	-0.497	-9,280	-87.5	-548
RESOURCE USE				
PERE [MJ]	-1.51	-2.83	-3,920	-4,200
PERM [MJ]	0	0	0	-8,260
PERT [MJ]	-1.51	-2.83	-3,920	-12,500
PENRE [MJ]	-0.497	-9,280	-87.8	-552
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.497	-9,280	-87.8	-552
SM [kg]	0	0	488	488
RSF [MJ]	0	8,260	-5.01E-10	-2.92E-07
NRSF [MJ]	0	9.51E-22	-6.36E-09	-3.70E-06
FW [m^3]	-0.00393	-0.0102	-0.578	-1.000
WASTES AND OUTPUTS				
HWD [kg]	-4.25E-10	-1.79E-06	-5.13E-08	-2.20E-05
NHWD [kg]	-2.92E-04	23.2	-5.76	-14.0
RWD [kg]	-1.53E-07	-6.34E-04	-1.02E-04	-0.00153
CRU [kg]	0	0	0	0
MFR [kg]	0	0	0	0
MER [kg]	0	0	0	0
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

Table 13: Environmental data for preservative treatment of 1m³ of sawn Radiata Pine.

SAWN	PRODUCTION							
Treatment type:	H1.2 Boron	H1.2 Boron re-dried	H3.1 LOSP	H3.1 Copper Azole	H3 CCA	H3 CCA Re-dried	H4 CCA	H4 CCA Re-dried
ENVIRONMENTAL IMPACT								
Parameter [Unit]	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP [kg CO_2-eq.]	-745.0	-741.3	-696.8	-736.9	-730.7	-727.0	-723.2	-719.5
GWPF [kg CO_2-eq.]	53.3	56.9	101.4	61.3	67.2	70.9	74.5	78.2
GWPB [kg CO_2-eq.]	-798.0	-797.9	-797.9	-797.9	-797.6	-797.6	-797.5	-797.4
ODP [kg CFC11-eq.]	1.29E-10	1.29E-10	2.73E-10	1.79E-10	6.75E-10	6.75E-10	9.56E-10	9.56E-10
AP [kg SO_2-eq.]	0.3985	0.4372	0.5050	0.6160	0.6130	0.6520	0.7240	0.7630
EP [kg $PO4^{3-}$-eq.]	0.09407	0.10290	0.10390	0.10400	0.09825	0.10710	0.10064	0.10950
POCP [kg C_2H_4-eq.]	0.1880	0.3460	6.9270	0.3540	0.1979	0.3560	0.2031	0.3610
ADPE [kg Sb-eq.]	8.94E-06	9.62E-06	1.83E-04	5.03E-04	2.37E-03	2.37E-03	3.57E-03	3.57E-03
ADPF [MJ]	574	599	2508	692	748	773	840	864
RESOURCE USE								
PERE [MJ]	4229	4861	4249	4865	4236	4868	4239	4871
PERM [MJ]	8260	8260	8260	8260	8260	8260	8260	8260
PERT [MJ]	12529	13161	12549	13165	12536	13168	12539	13171
PENRE [MJ]	578	603	2532	700	759	784	854	878
PENRM [MJ]	0	0	0	0	0	0	0	0
PENRT [MJ]	578	603	2532	700	759	784	854	878
SM [kg]	0	0	0	0	0	0	0	0
RSF [MJ]	2.920E-07	2.924E-07	2.920E-07	2.924E-07	2.920E-07	2.924E-07	2.920E-07	2.924E-07
NRSF [MJ]	3.70E-06	3.71E-06	3.70E-06	3.71E-06	3.70E-06	3.71E-06	3.70E-06	3.71E-06
FW [m^3]	248	341	402	362	282	375	304	397
WASTE CATEGORIES								
HWD [kg]	2.20E-05	2.20E-05	2.23E-05	3.34E-04	2.21E-05	2.22E-05	2.22E-05	2.22E-05
NHWD [kg]	14	15	14	15	15	16	16	17
RWD [kg]	0.00159	0.00161	0.00914	0.00295	0.00416	0.00418	0.00550	0.00551
CRU [kg]	0	0	0	0	0	0	0	0
MFR [kg]	0	0	0	0	0	0	0	0
MER [kg]	0	0	0	0	0	0	0	0
EEE [MJ]	0	0	0	0	0	0	0	0
EET [MJ]	0	0	0	0	0	0	0	0



SURFACED, KILN DRIED TIMBER

Surfaced, kiln dried timber is sawn, kiln dried timber which has been passed through a planer or moulding machine.

These machines have either flat or profiled rotating knives which are set to remove the required outer layer of the timber surface so as to leave a smoother surface and reduce the size variation of the timber. It will also reduce the overall cross section of the piece. Depending on the planer or moulder used, the finished shape can have four or more flat faces, or some or all of the surfaces may be curved. The untreated shavings are used as boiler fuel (reducing requirement for gas or other fossil fuels for heating requirements for kiln drying and preservative treatment).

(top) Abodo Processing, (bottom) Abodo, Lara Lane.

Table 14: Environmental impacts, 1 m^3 of surfaced Radiata Pine.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
GWP [kg CO_2-eq.]	-728	57.2	803	803	798
GWPF [kg CO_2-eq.]	66.9	54.3	4.89	4.89	0
GWPB [kg CO_2-eq.]	-795	2.95	798	798	798
ODP [kg CFC11-eq.]	1.49E-10	7.25E-12	5.42E-15	5.42E-15	0
AP [kg SO_2-eq.]	0.500	0.159	0.0307	0.0307	0
EP [kg $PO4^{3-}$-eq.]	0.118	0.0213	0.00713	0.00713	0
POCP [kg C_2H_4-eq.]	0.234	0.0101	0.00267	0.00267	0
ADPE [kg Sb-eq.]	1.16E-05	6.15E-06	6.68E-08	6.68E-08	0
ADPF [MJ]	716	796	61.4	61.4	0

Table 15: Resource use, 1 m^3 of surfaced Radiata Pine.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
PERE [MJ]	5,330	76.5	3.12	3.12	0
PERM [MJ]	8,240	0	-8,240	-8,240	-8,240
PERT [MJ]	13,600	76.5	-8,230	-8,230	-8,240
PENRE [MJ]	720	812	61.4	61.4	0
PENRM [MJ]	0	0	0	0	0
PENRT [MJ]	720	812	61.4	61.4	0
SM [kg]	0	0	0	0	0
RSF [MJ]	3.60E-07	4.88E-21	7.57E-21	7.57E-21	0
NRSF [MJ]	4.56E-06	5.73E-20	8.89E-20	8.89E-20	0
FW [m^3]	1.46	0.0506	6.62E-04	6.62E-04	0

Table 16: Waste categories, 1 m^3 of surfaced Radiata Pine.

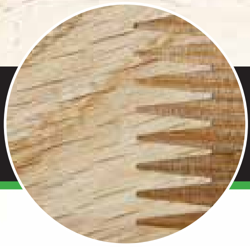
	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
HWD [kg]	2.25E-05	2.80E-06	9.57E-08	9.57E-08	0
NHWD [kg]	17.6	488	4.45E-04	4.45E-04	0
RWD [kg]	0.00168	0.00635	3.63E-06	3.63E-06	0
CRU [kg]	0	0	0	0	486
MFR [kg]	0	0	0	486	0
MER [kg]	0	0	486	0	0
EEE [MJ]	0	0.875	0	0	0
EET [MJ]	0	0	0	0	0

Table 17: Recycling, reuse and recovery potentials (Module D), 1 m^3 of surfaced Radiata Pine.

Parameter [Unit]	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
ENVIRONMENTAL IMPACT				
GWP [kg CO_2-eq.]	-0.0401	-535	-18.1	728
GWPF [kg CO_2-eq.]	-0.0400	-536	-17.6	-66.9
GWPB [kg CO_2-eq.]	-8.49E-05	1.25	-0.557	795
ODP [kg CFC11-eq.]	-9.83E-17	7.24E-14	-1.27E-13	-1.49E-10
AP [kg SO_2-eq.]	-1.28E-04	-0.0180	-0.209	-0.500
EP [kg $PO4^{3-}$-eq.]	-1.64E-05	-0.0371	-0.0477	-0.118
POCP [kg C_2H_4-eq.]	-9.08E-06	0.0886	-0.189	-0.234
ADPE [kg Sb-eq.]	-2.17E-08	-4.06E-05	-4.13E-06	-1.16E-05
ADPF [MJ]	-0.495	-9,250	-87.5	-716
RESOURCE USE				
PERE [MJ]	-1.50	-2.82	-3,920	-5,330
PERM [MJ]	0	0	0	-8,240
PERT [MJ]	-1.50	-2.82	-3,920	-13,600
PENRE [MJ]	-0.496	-9,250	-87.8	-720
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.496	-9,250	-87.8	-720
SM [kg]	0	0	486	486
RSF [MJ]	0	8,240	-5.01E-10	-3.60E-07
NRSF [MJ]	0	9.48E-22	-6.36E-09	-4.56E-06
FW [m^3]	-0.00391	-0.0102	-0.578	-1.46
WASTES AND OUTPUTS				
HWD [kg]	-4.24E-10	-1.78E-06	-5.13E-08	-2.25E-05
NHWD [kg]	-2.91E-04	23.1	-5.76	-17.6
RWD [kg]	-1.52E-07	-6.32E-04	-1.02E-04	-0.00168
CRU [kg]	0	0	0	0
MFR [kg]	0	0	0	0
MER [kg]	0	0	0	0
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

Table 18: Environmental data for preservative treatment of 1m³ of surfaced Radiata Pine.

SURFACED	PRODUCTION							
Treatment type:	H1.2 Boron	H1.2 Boron re-dried	H3.1 LOSP	H3.1 Copper Azole	H3 CCA	H3 CCA Re-dried	H4 CCA	H4 CCA Re-dried
ENVIRONMENTAL IMPACT								
Parameter [Unit]	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP [kg CO_2-eq.]	-726.0	-722.3	-677.8	-717.9	-711.7	-708.0	-704.2	-700.5
GWPF [kg CO_2-eq.]	68.9	72.5	117.0	76.9	82.8	86.5	90.1	93.8
GWPB [kg CO_2-eq.]	-795.0	-794.9	-794.9	-794.9	-794.6	-794.6	-794.5	-794.4
ODP [kg CFC11-eq.]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AP [kg SO_2-eq.]	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9
EP [kg $PO4^{3-}$-eq.]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
POCP [kg C_2H_4-eq.]	0.2	0.4	7.0	0.4	0.2	0.4	0.3	0.4
ADPE [kg Sb-eq.]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADPF [MJ]	742.2	767.0	2676.0	860.0	916.0	941.0	1008.0	1032.0
RESOURCE USE								
PERE [MJ]	5359	5991	5379	5995	5366	5998	5369	6001
PERM [MJ]	8240	8240	8240	8240	8240	8240	8240	8240
PERT [MJ]	13629	14261	13649	14265	13636	14268	13639	14271
PENRE [MJ]	746	771	2700	868	927	952	1022	1046
PENRM [MJ]	0	0	0	0	0	0	0	0
PENRT [MJ]	746	771	2700	868	927	952	1022	1046
SM [kg]	0	0	0	0	0	0	0	0
RSF [MJ]	0	0	0	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0	0	0	0
FW [m³]	248	341	402	362	282	375	304	397
WASTE CATEGORIES								
HWD [kg]	2.25E-05	2.25E-05	2.28E-05	3.35E-04	2.26E-05	2.27E-05	2.27E-05	2.27E-05
NHWD [kg]	18	19	18	19	19	20	19	20
RWD [kg]	0.0017	0.0018	0.0093	0.0031	0.0043	0.0043	0.0057	0.0057
CRU [kg]	0	0	0	0	0	0	0	0
MFR [kg]	0	0	0	0	0	0	0	0
MER [kg]	0	0	0	0	0	0	0	0
EEE [MJ]	0	0	0	0	0	0	0	0
EET [MJ]	0	0	0	0	0	0	0	0



FINGER-JOINTED TIMBER

Finger-jointing is used to remove knots and other characteristics from boards, and thus produce a "clear" product which commands a higher price. Finger-jointed timber is usually manufactured from kiln dried timber, although some gluing processes allow it to be finger-jointed before drying, and then dried afterward.

Firstly the raw timber lengths are graded, and unacceptable (in the final product) defects are identified. This can be done by human or robotic graders. High speed "chop" saws then make cuts each side of each defect, and the defect is removed, leaving shorter lengths of timber of the required properties and appearance.

Finger-joints are made by passing the end grain of a piece of wood across a set of profiled rotating knives which cut a series of V-profiles in the timber.

Adhesive is spread on these profiles in the timber, the piece is then mated with a similarly profiled second piece of timber and end pressure is applied to force the joints to close up, and the adhesive is allowed to cure.

There are two orientations for finger-joints, face to face (where the finger profiles shows on the wide face of the timber, and edge to edge, where the profile shows on the narrow face. Finger lengths can range from short (4 mm fingers) to long (>25 mm fingers).

Finger-joints commonly reach strengths of 50-60% of the strength of straight-grained, defect free timber, and therefore finger-jointed timber can be suitable for a variety of load-bearing applications. Selection of suitable adhesive and timber treatment means the joints are durable outdoors.

Finger-jointed timber is used in the manufacture of mouldings and weatherboards (non-structural) and in production of glulam and CLT (structural finger-joints).

Table 19: Environmental impacts, 1 m³ of finger-jointed Radiata Pine.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
GWP [kg CO_2-eq.]	-697	57.1	793	793	788
GWPF [kg CO_2-eq.]	86.7	54.3	4.78	4.78	0
GWPB [kg CO_2-eq.]	-784	2.88	788	788	788
ODP [kg CFC11-eq.]	2.04E-10	7.25E-12	5.30E-15	5.30E-15	0
AP [kg SO_2-eq.]	0.627	0.159	0.0301	0.0301	0
EP [kg $PO4^{3-}$-eq.]	0.146	0.0213	0.00697	0.00697	0
POCP [kg C_2H_4-eq.]	0.280	0.0101	0.00261	0.00261	0
ADPE [kg Sb-eq.]	1.58E-05	6.14E-06	6.53E-08	6.53E-08	0
ADPF [MJ]	983	795	60.0	60.0	0

Table 20: Resource use, 1 m³ of finger-jointed Radiata Pine.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
PERE [MJ]	6,530	76.5	3.05	3.05	0
PERM [MJ]	8,140	0	-8,140	-8,140	-8,140
PERT [MJ]	14,700	76.5	-8,140	-8,140	-8,140
PENRE [MJ]	991	812	60.1	60.1	0
PENRM [MJ]	0	0	0	0	0
PENRT [MJ]	991	812	60.1	60.1	0
SM [kg]	0	0	0	0	0
RSF [MJ]	4.19E-07	4.88E-21	7.40E-21	7.40E-21	0
NRSF [MJ]	5.31E-06	5.73E-20	8.69E-20	8.69E-20	0
FW [m³]	2.02	0.0505	6.47E-04	6.47E-04	0

Table 21: Waste categories, 1 m³ of finger-jointed Radiata Pine.

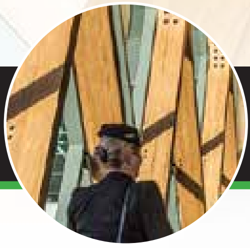
	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
HWD [kg]	2.30E-05	2.77E-06	9.36E-08	9.36E-08	0
NHWD [kg]	31.6	477	4.35E-04	4.35E-04	0
RWD [kg]	0.00300	0.00635	3.55E-06	3.55E-06	0
CRU [kg]	0	0	0	0	475
MFR [kg]	0	0	0	475	0
MER [kg]	0	0	475	0	0
EEE [MJ]	0	0.856	0	0	0
EET [MJ]	0	0	0	0	0

Table 22: Recycling, reuse and recovery potentials (Module D), 1 m³ of finger-jointed Radiata Pine.

Parameter [Unit]	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
ENVIRONMENTAL IMPACT				
GWP [kg CO_2-eq.]	-0.0392	-529	-18.1	697
GWPF [kg CO_2-eq.]	-0.0391	-530	-17.6	-86.7
GWPB [kg CO_2-eq.]	-8.30E-05	1.24	-0.557	784
ODP [kg CFC11-eq.]	-9.61E-17	7.15E-14	-1.27E-13	-2.04E-10
AP [kg SO_2-eq.]	-1.25E-04	-0.0189	-0.209	-0.627
EP [kg $PO4^{3-}$-eq.]	-1.61E-05	-0.0369	-0.0477	-0.146
POCP [kg C_2H_2-eq.]	-8.87E-06	0.0873	-0.189	-0.280
ADPE [kg Sb-eq.]	-2.12E-08	-4.02E-05	-4.13E-06	-1.58E-05
ADPF [MJ]	-0.484	-9,150	-87.5	-983
RESOURCE USE				
PERE [MJ]	-1.47	-2.79	-3,920	-6,530
PERM [MJ]	0	0	0	-8,140
PERT [MJ]	-1.47	-2.79	-3,920	-14,700
PENRE [MJ]	-0.485	-9,150	-87.8	-991
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.485	-9,150	-87.8	-991
SM [kg]	0	0	475	475
RSF [MJ]	0	8,140	-5.01E-10	-4.19E-07
NRSF [MJ]	0	9.36E-22	-6.36E-09	-5.31E-06
FW [m³]	-0.00383	-0.0101	-0.578	-2.02
WASTES AND OUTPUTS				
HWD [kg]	-4.14E-10	-1.76E-06	-5.13E-08	-2.30E-05
NHWD [kg]	-2.84E-04	22.8	-5.76	-31.6
RWD [kg]	-1.49E-07	-6.25E-04	-1.02E-04	-0.00300
CRU [kg]	0	0	0	0
MFR [kg]	0	0	0	0
MER [kg]	0	0	0	0
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

Table 23: Environmental data for preservative treatment of 1m³ of finger-jointed Radiata Pine.

F/J	PRODUCTION							
Treatment type:	H1.2 Boron	H1.2 Boron re-dried	H3.1 LOSP	H3.1 Copper Azole	H3 CCA	H3 CCA Re-dried	H4 CCA	H4 CCA Re-dried
ENVIRONMENTAL IMPACT								
Parameter [Unit]	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP [kg CO_2-eq.]	-694.3	-689.3	-629.7	-683.5	-675.2	-670.2	-665.1	-660.2
GWPF [kg CO_2-eq.]	89.4	94.2	153.8	100.1	108.0	113.0	117.8	122.7
GWPB [kg CO_2-eq.]	-784.0	-783.9	-783.9	-783.8	-783.5	-783.4	-783.3	-783.2
ODP [kg CFC11-eq.]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AP [kg SO_2-eq.]	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.1
EP [kg $PO4^{3-}$-eq.]	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
POCP [kg C_2H_4-eq.]	0.3	0.5	9.3	0.5	0.3	0.5	0.3	0.5
ADPE [kg Sb-eq.]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADPF [MJ]	1018.1	1051.3	3609.4	1176.0	1251.0	1284.5	1374.3	1406.4
RESOURCE USE								
PERE [MJ]	6569	7416	6596	7421	6578	7425	6583	7429
PERM [MJ]	8140	8140	8140	8140	8140	8140	8140	8140
PERT [MJ]	14739	15586	14766	15591	14748	15595	14753	15599
PENRE [MJ]	1026	1060	3644	1189	1268	1302	1396	1428
PENRM [MJ]	0	0	0	0	0	0	0	0
PENRT [MJ]	1026	1060	3644	1189	1268	1302	1396	1428
SM [kg]	0	0	0	0	0	0	0	0
RSF [MJ]	0	0	0	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0	0	0	0
FW [m^3]	333	458	539	486	379	503	408	533
WASTE CATEGORIES								
HWD [kg]	2.30E-05	2.30E-05	2.35E-05	4.41E-04	2.32E-05	2.32E-05	2.33E-05	2.33E-05
NHWD [kg]	32	33	32	33	33	34	34	35
RWD [kg]	0.0031	0.0031	0.0132	0.0049	0.0065	0.0066	0.0083	0.0083
CRU [kg]	0	0	0	0	0	0	0	0
MFR [kg]	0	0	0	0	0	0	0	0
MER [kg]	0	0	0	0	0	0	0	0
EEE [MJ]	0	0	0	0	0	0	0	0
EET [MJ]	0	0	0	0	0	0	0	0



GLUE LAMINATED TIMBER (GLULAM)

Glulam is made of pieces of planed timber aligned so all the longitudinal grains of the pieces are parallel. For structural uses the timber used is preservative treated to the required Hazard Class. To get the long lengths (can be in excess of 30 m) which are often required for the products made using this technology, the timber lengths are finger-jointed together. The faces of the lengths of timber are planed smooth after the joints have cured, then adhesive is spread on the face of the timber and the timber is stacked one on the other until the desired depth of product is attained. A clamping pressure is applied, and the adhesive is left to cure. After this the glulam is planed and / or sanded smooth, and may be given a protective coating of oil, stain or a full paint coating.

One of the big advantages of glulam is that curved structural products can be made which offer architects the opportunity to produce some visually stunning buildings (as in these pictures).

Table 24: Environmental impacts, 1 m^3 of Radiata Pine glulam.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
GWP [kg CO_2-eq.]	-668	57.3	814	814	809
GWPF [kg CO_2-eq.]	136	54.3	4.94	4.94	0
GWPB [kg CO_2-eq.]	-804	2.98	809	809	809
ODP [kg CFC11-eq.]	3.10E-10	7.25E-12	5.48E-15	5.48E-15	0
AP [kg SO_2-eq.]	0.713	0.160	0.0311	0.0311	0
EP [kg $PO4^{3-}$-eq.]	0.164	0.0214	0.00721	0.00721	0
POCP [kg C_2H_4-eq.]	0.292	0.0102	0.00270	0.00270	0
ADPE [kg Sb-eq.]	2.53E-05	6.15E-06	6.75E-08	6.75E-08	0
ADPF [MJ]	1,980	796	62.1	62.1	0

Table 25: Resource use, 1 m^3 of Radiata Pine glulam.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
PERE [MJ]	6,730	76.5	3.16	3.16	0
PERM [MJ]	8,350	0	-8,350	-8,350	-8,350
PERT [MJ]	15,100	76.5	-8,350	-8,350	-8,350
PENRE [MJ]	2,020	812	62.1	62.1	0
PENRM [MJ]	0	0	0	0	0
PENRT [MJ]	2,020	812	62.1	62.1	0
SM [kg]	0	0	0	0	0
RSF [MJ]	4.43E-07	4.88E-21	7.65E-21	7.65E-21	0
NRSF [MJ]	5.60E-06	5.73E-20	8.99E-20	8.99E-20	0
FW [m^3]	2.57	0.0506	6.69E-04	6.69E-04	0

Table 26: Waste categories, 1 m^3 of Radiata Pine glulam.

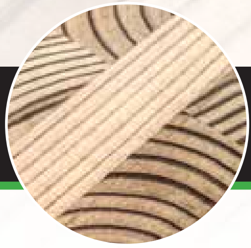
	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
HWD [kg]	1.79E-05	2.81E-06	9.68E-08	9.68E-08	0
NHWD [kg]	57.6	493	4.50E-04	4.50E-04	0
RWD [kg]	0.0174	0.00635	3.67E-06	3.67E-06	0
CRU [kg]	0	0	0	0	491
MFR [kg]	0	0	0	491	0
MER [kg]	0	0	491	0	0
EEE [MJ]	0	0.885	0	0	0
EET [MJ]	0	0	0	0	0

Table 27: Recycling, reuse and recovery potentials (Module D), 1 m^3 of Radiata Pine glulam.

Parameter [Unit]	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
ENVIRONMENTAL IMPACT				
GWP [kg CO_2-eq.]	-0.0405	-542	-18.1	668
GWPF [kg CO_2-eq.]	-0.0405	-544	-17.6	-136
GWPB [kg CO_2-eq.]	-8.58E-05	1.27	-0.557	804
ODP [kg CFC11-eq.]	-9.94E-17	7.34E-14	-1.27E-13	-3.10E-10
AP [kg SO_2-eq.]	-1.29E-04	-0.0185	-0.209	-0.713
EP [kg $PO4^{3-}$-eq.]	-1.66E-05	-0.0377	-0.0477	-0.164
POCP [kg C_2H_4-eq.]	-9.18E-06	0.0897	-0.189	-0.292
ADPE [kg Sb-eq.]	-2.19E-08	-4.12E-05	-4.13E-06	-2.53E-05
ADPF [MJ]	-0.501	-9,380	-87.5	-1,980
RESOURCE USE				
PERE [MJ]	-1.52	-2.86	-3,920	-6,730
PERM [MJ]	0	0	0	-8,350
PERT [MJ]	-1.52	-2.86	-3,920	-15,100
PENRE [MJ]	-0.501	-9,380	-87.8	-2,020
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.501	-9,380	-87.8	-2,020
SM [kg]	0	0	491	491
RSF [MJ]	0	8,350	-5.01E-10	-4.43E-07
NRSF [MJ]	0	9.61E-22	-6.36E-09	-5.60E-06
FW [m^3]	-0.00396	-0.0103	-0.578	-2.57
WASTES AND OUTPUTS				
HWD [kg]	-4.28E-10	-1.80E-06	-5.13E-08	-1.79E-05
NHWD [kg]	-2.94E-04	23.4	-5.76	-57.6
RWD [kg]	-1.54E-07	-6.41E-04	-1.02E-04	-0.0174
CRU [kg]	0	0	0	0
MFR [kg]	0	0	0	0
MER [kg]	0	0	0	0
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

Table 28: Environmental data for preservative treatment of 1m³ of Radiata Pine glulam.

GLULAM	PRODUCTION							
Treatment type:	H1.2 Boron	H1.2 Boron re-dried	H3.1 LOSP	H3.1 Copper Azole	H3 CCA	H3 CCA Re-dried	H4 CCA	H4 CCA Re-dried
ENVIRONMENTAL IMPACT								
Parameter [Unit]	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP [kg CO_2-eq.]	-665.1	-659.8	-596.2	-653.6	-644.7	-639.4	-634.0	-628.7
GWPF [kg CO_2-eq.]	138.8	144.0	207.6	150.3	158.7	164.0	169.2	174.5
GWPB [kg CO_2-eq.]	-804.0	-803.9	-803.9	-803.8	-803.5	-803.4	-803.2	-803.1
ODP [kg CFC11-eq.]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AP [kg SO_2-eq.]	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3
EP [kg $PO4^{3-}$-eq.]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
POCP [kg C_2H_4-eq.]	0.3	0.5	9.9	0.5	0.3	0.5	0.3	0.5
ADPE [kg Sb-eq.]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADPF [MJ]	2017.5	2052.9	4782.8	2185.9	2266.0	2301.8	2397.6	2431.9
RESOURCE USE								
PERE [MJ]	6771	7675	6801	7681	6781	7685	6786	7690
PERM [MJ]	8350	8350	8350	8350	8350	8350	8350	8350
PERT [MJ]	15141	16045	15171	16051	15151	16055	15156	16060
PENRE [MJ]	2058	2093	4851	2232	2316	2352	2452	2486
PENRM [MJ]	0	0	0	0	0	0	0	0
PENRT [MJ]	2058	2093	4851	2232	2316	2352	2452	2486
SM [kg]	0	0	0	0	0	0	0	0
RSF [MJ]	0	0	0	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0	0	0	0
FW [m^3]	356	489	576	519	404	537	436	569
WASTE CATEGORIES								
HWD [kg]	1.79E-05	1.79E-05	1.84E-05	4.64E-04	1.81E-05	1.81E-05	1.82E-05	1.82E-05
NHWD [kg]	58	59	58	59	59	61	60	61
RWD [kg]	0.0175	0.0175	0.0283	0.0194	0.0212	0.0212	0.0231	0.0231
CRU [kg]	0	0	0	0	0	0	0	0
MFR [kg]	0	0	0	0	0	0	0	0
MER [kg]	0	0	0	0	0	0	0	0
EEE [MJ]	0	0	0	0	0	0	0	0
EET [MJ]	0	0	0	0	0	0	0	0



CROSS LAMINATED TIMBER (CLT)

Cross laminated timber is a relatively new development on the global engineered wood products stage. CLT is most often used to make large structural panels. The advent of these panels has made great advances possible in the type and number of buildings constructed mostly of wood.

CLT is manufactured by forming layers of kiln dried, surfaced (preservative treated when required) boards 25-50 mm thick, laid up edge to edge. Adhesive is spread over the top face. On top of this layer is laid another layer, but with the boards oriented at right angles to the first layer. Again adhesive is spread over the top face. On top of this layer is laid yet another layer, but with the boards oriented at right angles to the layer below, and parallel to the first layer. And so on until the desired number of layers is reached.

CLT usually comprises three or five layers but thicker ones can be made if required.

Once the layup has been completed the panel is subjected to a clamping force until the adhesive has cured.

CLT can be made in very large panels, e.g. 3 m wide by 15 + m long. These panels can then be manufactured into ready to use building components by machining on a CNC machine. This transforms the raw wood panel into a prefabricated component ready for lifting into place in a building, as a floor, roof or wall.

Table 29: Environmental impacts, 1 m³ of Radiata Pine CLT.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
GWP [kg CO_2-eq.]	-678	57.4	823	823	818
GWPF [kg CO_2-eq.]	128	54.3	5.03	5.03	0
GWPB [kg CO_2-eq.]	-805	3.04	818	818	818
ODP [kg CFC11-eq.]	2.30E-10	7.25E-12	5.58E-15	5.58E-15	0
AP [kg SO_2-eq.]	0.786	0.160	0.0316	0.0316	0
EP [kg $PO4^{3}$--eq.]	0.192	0.0214	0.00733	0.00733	0
POCP [kg C_2H_4-eq.]	0.338	0.0102	0.00274	0.00274	0
ADPE [kg Sb-eq.]	2.63E-05	6.15E-06	6.87E-08	6.87E-08	0
ADPF [MJ]	1,550	796	63.2	63.2	0

Table 30: Resource use, 1 m³ of Radiata Pine CLT.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
PERE [MJ]	7,950	76.6	3.21	3.21	0
PERM [MJ]	8,440	0	-8,440	-8,440	-8,440
PERT [MJ]	16,400	76.6	-8,440	-8,440	-8,440
PENRE [MJ]	1,570	813	63.2	63.2	0
PENRM [MJ]	0	0	0	0	0
PENRT [MJ]	1,570	813	63.2	63.2	0
SM [kg]	0	0	0	0	0
RSF [MJ]	5.00E-07	4.88E-21	7.79E-21	7.79E-21	0
NRSF [MJ]	6.33E-06	5.73E-20	9.15E-20	9.15E-20	0
FW [m^3]	3.32	0.0507	6.81E-04	6.81E-04	0

Table 31: Waste categories, 1 m³ of Radiata Pine CLT.

	PRODUCTION	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
Parameter [Unit]	**A1-A3**	**C4**	**C3**	**C3**	**C3**
HWD [kg]	4.23E-06	2.83E-06	9.85E-08	9.85E-08	0
NHWD [kg]	208	502	4.57E-04	4.57E-04	0
RWD [kg]	0.00819	0.00635	3.73E-06	3.73E-06	0
CRU [kg]	0	0	0	0	500
MFR [kg]	0	0	0	500	0
MER [kg]	0	0	500	0	0
EEE [MJ]	0	0.901	0	0	0
EET [MJ]	0	0	0	0	0

Table 32: Recycling, reuse and recovery potentials (Module D), 1 m^3 of Radiata Pine CLT.

Parameter [Unit]	LANDFILL	ENERGY RECOVERY	RECYCLING	REUSE
ENVIRONMENTAL IMPACT				
GWP [kg CO2-eq.]	-0.0413	-548	-18.1	678
GWPF [kg CO2-eq.]	-0.0412	-549	-17.6	-128
GWPB [kg CO2-eq.]	-8.74E-05	1.29	-0.557	805
ODP [kg CFC11-eq.]	-1.01E-16	7.43E-14	-1.27E-13	-2.30E-10
AP [kg SO2-eq.]	-1.31E-04	-0.0180	-0.209	-0.786
EP [kg PO43--eq.]	-1.69E-05	-0.0380	-0.0477	-0.192
POCP [kg C2H4-eq.]	-9.34E-06	0.0909	-0.189	-0.338
ADPE [kg Sb-eq.]	-2.23E-08	-4.17E-05	-4.13E-06	-2.63E-05
ADPF [MJ]	-0.510	-9,480	-87.5	-1,550
RESOURCE USE				
PERE [MJ]	-1.55	-2.89	-3,920	-7,950
PERM [MJ]	0	0	0	-8,440
PERT [MJ]	-1.55	-2.89	-3,920	-16,400
PENRE [MJ]	-0.510	-9,480	-87.8	-1,570
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.510	-9,480	-87.8	-1,570
SM [kg]	0	0	500	500
RSF [MJ]	0	8,440	-5.01E-10	-5.00E-07
NRSF [MJ]	0	9.72E-22	-6.36E-09	-6.33E-06
FW [m^3]	-0.00403	-0.0104	-0.578	-3.32
WASTES AND OUTPUTS				
HWD [kg]	-4.36E-10	-1.82E-06	-5.13E-08	-4.23E-06
NHWD [kg]	-2.99E-04	23.7	-5.76	-208
RWD [kg]	-1.57E-07	-6.48E-04	-1.02E-04	-0.00819
CRU [kg]	0	0	0	0
MFR [kg]	0	0	0	0
MER [kg]	0	0	0	0
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

Table 33: Environmental data for preservative treatment of 1m³ of Radiata Pine CLT.

CLT	PRODUCTION							
Treatment type:	H1.2 Boron	H1.2 Boron re-dried	H3.1 LOSP	H3.1 Copper Azole	H3 CCA	H3 CCA Re-dried	H4 CCA	H4 CCA Re-dried
ENVIRONMENTAL IMPACT								
GWP [kg CO_2-eq.]	-675.3	-670.2	-609.2	-664.2	-655.7	-650.6	-645.4	-640.3
GWPF [kg CO_2-eq.]	130.7	135.7	196.6	141.7	149.8	154.9	159.8	164.9
GWPB [kg CO_2-eq.]	-805.0	-804.9	-804.9	-804.8	-804.5	-804.4	-804.3	-804.1
ODP [kg CFC11-eq.]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AP [kg SO_2-eq.]	0.8	0.9	0.9	1.1	1.1	1.1	1.2	1.3
EP [kg $PO4^{3-}$-eq.]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
POCP [kg C_2H_4-eq.]	0.3	0.6	9.6	0.6	0.4	0.6	0.4	0.6
ADPE [kg Sb-eq.]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADPF [MJ]	1585.9	1619.9	4235.2	1747.3	1824.0	1858.3	1950.0	1982.9
RESOURCE USE								
PERE [MJ]	7990	8856	8018	8861	7999	8865	8004	8869
PERM [MJ]	8440	8440	8440	8440	8440	8440	8440	8440
PERT [MJ]	16440	17306	16468	17311	16449	17315	16454	17319
PENRE [MJ]	1606	1640	4283	1773	1854	1888	1984	2017
PENRM [MJ]	0	0	0	0	0	0	0	0
PENRT [MJ]	1606	1640	4283	1773	1854	1888	1984	2017
SM [kg]	0	0	0	0	0	0	0	0
RSF [MJ]	0	0	0	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0	0	0	0
FW [m^3]	342	469	553	498	388	516	418	546
WASTE CATEGORIES								
HWD [kg]	4.25E-06	4.27E-06	4.70E-06	4.32E-04	4.42E-06	4.44E-06	4.52E-06	4.53E-06
NHWD [kg]	208	209	208	209	210	211	210	212
RWD [kg]	0.0083	0.0083	0.0186	0.0101	0.0118	0.0118	0.0136	0.0136
CRU [kg]	0	0	0	0	0	0	0	0
MFR [kg]	0	0	0	0	0	0	0	0
MER [kg]	0	0	0	0	0	0	0	0
EEE [MJ]	0	0	0	0	0	0	0	0
EET [MJ]	0	0	0	0	0	0	0	0

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