Environmental Product Declaration

Cross-Laminated Timber (CLT)

In accordance with ISO 14025 and EN 15804+A1

AUSTRALASIA EPD®
ENVIRONMENTAL PRODUCT DECLARATION

ECO PLATFORM EPD VERIFIED

Programme:	The International EPD® System www.environdec.com
Programme operator:	EPD Australasia www.epd-australasia.com
EPD registration number:	S-P-03711
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Geographical scope:	New Zealand

RED STAG®
WOOD SOLUTIONS

Introduction

Red Stag recognizes the importance of providing transparent and independently verified environmental impact information about our products.

An Environmental Product Declaration (EPD) is a robust, science based, independently verified and standardized method for communicating the environmental impacts of products.

This EPD covers the environmental impacts of Red Stag Timber softwood cross laminated timber (CLT) for application both within and outside the building envelope subject to treatment level. The products are manufactured within the Red Stag Sawmill and processing plants located in Waipa Valley, Rotorua, New Zealand.

This EPD is based on a cradle-to-gate Life Cycle Assessment (LCA), with end-of-life options included. 'Cradle' refers to the raw material extraction and 'the gate' is the gate of the Waipa Mill as the product is ready to go out to customers.

Red Stag timber, as the EPD owner has the sole ownership, liability, and responsibility for the EPD.

This EPD has been produced in accordance with a consistent set of rules known as product category rules (PCR). EPDs 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+A1 or if they are produced using different product category rules.

Red Stag Timber

The Red Stag Group's long-standing vision is to be an industry leader, aiming to achieve 'the best' in everything we do. This focus is applied to our workplace culture, environmental and safety standards, product manufacturing processes and use of technology. Our focus is on a positive contribution to the communities and world we share.

'Make it better'

Red Stag Timber has developed an environmental policy that is given equal status to other business objectives.

The company maintains certification for its ISO 14001 Environmental Management System as an active programme for environmental improvement.

Initiatives include the sourcing of wood from sustainable forestry which is backed by Forest Stewardship Council (FSC) Certification. This certification is recognised by US, Australian, and New Zealand Green Building Councils.

The following EPD builds upon this approach for continual improvement and certification of performance: Red Stag participated in industry the industry-wide EPD in 2019 and has since implemented a number of environmental initiatives as well as new product lines. The following EPD quantifies these changes as Red Stag continues to 'make it better'.

Quality Accreditations

Red Stag Timber has a stringent internal framework of documented quality processes and procedures. It covers our primary breakdown, drying, processing and preservation processes. This quality assurance programme is aimed at ensuring that every piece of structural and/or treated timber leaving the Red Stag Timber site complies with and exceeds the applicable New Zealand and Australian standards.

We mechanically test every piece of structural timber to ensure it complies with and exceed the requirements of AS/NZS 1748. We also sample test to further ensure system accuracy. On top of this we have an independent audit system in place with external auditors "Grade Right".

Our Preservation process undergoes similar scrutiny to ensure every piece of chemically preserved timber conforms to NZS3640 and AS/NZS1604 in Australia. This process is independently 3rd party audited by IVS.

FSC Certification

Red Stag Timber has the internationally recognised Forest Stewardship Council (FSC) Certification that provides timber users with confidence that our products are sourced from responsibly managed and sustainable forests. FSC is the only forest certification system that is supported by all major environmental groups.

A number of certification assessments such as the US, Australian, and New Zealand Green Building Councils accept only FSC certification as proof of sustainability.

Scope of certificate

Certificate type: Single Chain of Custody and Controlled Wood

Certificate registration code

NC-COC-003967 NC-CW-003967
RA-COC-003967 RA-CW-003967

FSC License Code

FSC-C008413

Responsible operations

Red Stag Timber has become a market leader in terms of product innovation and manufacturing capacity. The company has been recognised as a leader in New Zealand for contribution to Energy Efficiency and Conservation in New Zealand by receiving the 2018 EECA award for Large Energy User of the Year.

Over the past 15 years Red Stag has taken measures to improve the local and greater environment through various conservation and sustainability measures.
The latest achievement relates to establishment of a new on-site energy centre that generates electricity and thermal energy.

On-site energy centre

Bio-Fuel Energy

Red Stag Timber utilises offcuts from sawing and planing as a bio-fuel to generate electricity and provide thermal energy to dry timber. Red Stag Timber is also a net exporter of electricity to the national grid to help power New Zealand's growing energy needs.

Thermal Energy

Wood waste is used as the energy source for the kiln drying of timber. The thermal energy required to kiln dry timber can exceed 85% of the energy usage for a modern sawmill. Utilising its own wood offcuts as an energy source ensures that both CO_2 emissions and landfill disposal requirements are minimised.

Red Stag Sawmill and processing plants located in Waipa Valley, Rotorua, New Zealand

Products in this EPD

This EPD covers Softwood cross laminated timber (CLT) used in the building and construction industry.

CLT is an engineered wood panel made up of planed timber layers glued and pressed together in alternating directions. The alternate layering gives CLT panels dimensional stability. CLT is mainly used for large structural elements, including walls, roofs, and floors.

Finished timber products undergo a preservation process where environmentally stable chemicals, all of which meet applicable safety guidelines are applied to meet and exceed all applicable standards and to ensure a long and useful life in their intended application.

Product Application

Red Stag CLT is typically used in construction of residential houses, multi-storey buildings, commercial fit-outs, home renovations, and in landscaping settings. They are specified by architects and designers and used by qualified tradesmen and home handypersons.

The choice of specific product from the Red Stag range will depend on the design of the structure and on the setting – whether inside the construction envelope, exposed to the weather or in contact with the soil.

Manufacturing Process
(abridged)

Sourcing

Logs are sourced from geographically adjacent sustainable plantation grown forests and transported to Red Stag Timber by road.

On site the bark is removed by mechanical process and the logs are sorted by species, size, and grade.

Breakdown

Smart cutting extracts the best part of the log to make structural timber.

Kiln drying

Advanced drying technology is gentler on timber, providing better stability and accurate moisture levels.

The energy to power the kilns is provided from the Energy Centre which converts bio-fuel from the various processes into steam and electricity.

Planing (optional)

Planing reduces the individual piece of timber from the sawn "call size" to a nominal size which is typically 5-10mm smaller and provides a smoother finish than rough sawn wood.

Preservation (optional)

Intelligent preservation with either Boron (for inside the building envelope) or CCA (for timber exposed to the elements) ensures maximum durability.

The chemicals used are all "not hazardous" under the Hazardous substances and new organisms (HSNO Minimum degrees of Hazard) regulations 2001.

Cross laminating

Polyurethane (PU) resin is applied to joining faces of individual laminations, which are then layered with the number of laminations required to create the desired dimensions and strength. The glued laminations are placed in a jig and kept under high pressure until the resin is cured. Once fully cured, the CLT panels are finished by planing and cutting to the final dimensions.

Packaging

Finally the timber is wrapped in low density polyethylene to maintain the moisture content and protection during storage and/or transportation.

Strapping is also used to keep the timber secure during transport.

This EPP covers 'cradle to gate' and excludes the transport to customers.

Some end-of-life options are also included. (See End-of-life scenarios section)

Transport

Timber is transported to merchants within New Zealand by a mix of road transport and coastal shipping. Product bound for overseas markets is transported by seafreight.

How to use this EPD

Red Stag has 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.

This EPD can allow the represented products to qualify for points under green rating tools, such as the Green Star rating tool of the New Zealand Green Building Council (NZGBC).

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"

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

Part 01 is the Technical Information for the method, assumptions, description of environmental indicators.

Part 02 contains the results from modelling the life cycle assessment of the different products.

How to use this EPD
Environmental Product Declaration

Declared Unit

The declared unit is the unit on which EPD results are based.
For this EPD, the declared unit is:

1m³ of timber, as specified in the table below, packaged and

Table 1: Timber products included in this

Product type	Timber properties (densities)	Uses
Cross Laminated Timber	Density: 480kg/m3 Moisture content (dry-basis): 12%	Larger size boards with each layer (laminate) glued at right angles to build the depth and strength of the board. Each laminate uses finger-jointed treated timber. The product may be used in interior and exterior for structural wall and floors depending on choices of adhesive, treatment type and coating.

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.

Cross Laminated Timber is currently produced using treated timber. The treatment types shown in Table 2 are used by Red Stag.

Table 2: Treatment class Treatment type Use

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

Classification

Table 3 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 3: Timber products included in this EPD

Product type	Classification	Code	Category
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 composition

All timber products included in this EPD are of the species **Pinus radiata (Radiata Pine)**, grown within New Zealand in independent sustainably managed plantations and processed by Red Stag.

Resins used in the production of Cross Laminate Timber include Polyurethane (PU).

Treated timber products declared within this EPD include those treated with Boron, Light Organic Solvent Preservatives (LOSP) and Copperchrome-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

In Life Cycle Assessments (LCA), the system boundary is a line that divides the processes which are included from those which are excluded.

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 the 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 4: Modules included in the scope of the EPD (X = included in the EPD | MND = module not declared)

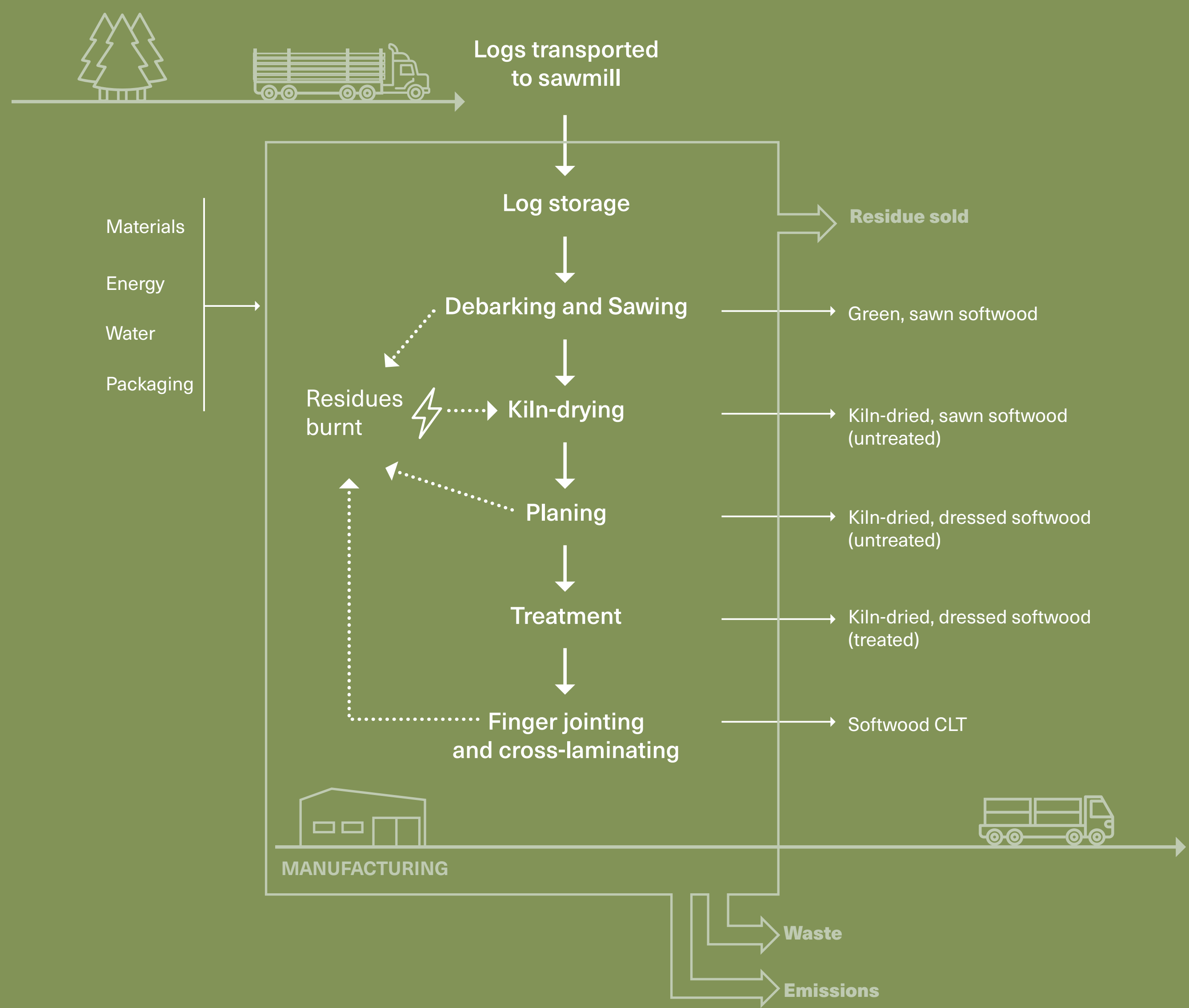
	Product stage			Construction process stage		Use stage							End-of-life				Recovery
	Raw material supply	Transport of raw materials	Manufacturing	Transport to customer	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to waste processing	Waste processing	Disposal	Future reuse, recycling or energy recovery potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Module declared	x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	x	x	x

Production (modules A1-A3)

For all timber products in this EPD, the production stage includes the forestry, sawmilling and kiln drying stages. It also includes treatment, planing, finger-jointing and laminating for the applicable products.

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 2014, 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 carbon in the wood that breaks down 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 (MfE, 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 m³ of timber 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

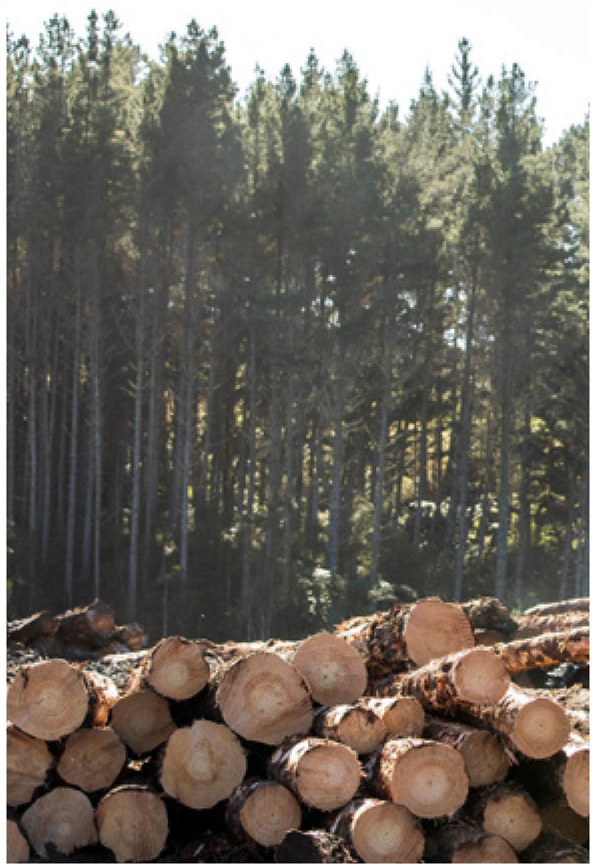
Timber may be recycled in many different ways. This scenario considers shredding and effectively downcycling into wood chips. Wood waste is chipped (module C3) and assigned credits relative to the avoided production of virgin woodchips as a co-product from sawmilling (module D). In line with the reuse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

Life Cycle Inventory (LCI) and assumptions

Energy

Thermal energy and transport fuels have been modelled using the Australian average as no New Zealand specific datasets are available (see Sphera, 2021 for documentation).

Electricity for timber production (modules A1-A3) has been modelled with the New Zealand-specific grid mix.



Forestry

Modelling of carbon flows in the forest has been performed in line with New Zealand's Greenhouse Gas Inventory (MfE, 2021).

Forestry is modelled as being in a steady-state, meaning that – on average – all harvested trees are replanted and that soil carbon stocks remain constant over time at the national level (MfE, 2021).

Biodegradation of forest litter and forest residues are modelled as being aerobic (MfE, 2021) and therefore carbon neutral as carbon dioxide sequestered from the air during tree growth is later released back to the air as carbon dioxide.

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.

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.

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 (EPD International, 2019, Section 7.5.4). All other reported data were incorporated and modelled using the best available life cycle inventory data.

Primary Data

Primary data was used for all manufacturing processes. Planed wood data was collected from the Red Stag Timber sawmill in Rotorua, New Zealand.

CLT manufacturing data has been collected from the Red Stag Wood Solution manufacturing facility in Rotorua, New Zealand.

Background data

Secondary data has been used for forestry. Specifically, Sandilands, et al., (2006), as updated by Scion (Evanson, 2018). Data for all energy inputs, transport processes and raw materials are from GaBi Databases 2021 (Sphera 2021). Most datasets have a reference year between 2017 and 2020 and all fall within the 10-year limit allowable for generic data under EN 15804 (Section 6.3.7).

Representativeness

Temporal
Primary data for the sawmill was collected for the 12 month period from January 2019 to December 2019. Primary data for the CLT facility was collected for the 3 month period from the 1st of June 2021 to the 31st of August 2021. The Cross Laminated Timber facility has only been recently commissioned and a full year of data is not available. This data was checked for typical operation and should be revisited when a full year of data is available. All secondary data come from the GaBi 2021 databases and are representative of the years 2017-2021.

Geographical
All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data were used. Geographical representativeness is considered to be high.

Technological
All primary and secondary data were modelled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used. Technological

PART 01 Technical information
Environmental Product Declaration

Environmental impact indicators

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

Global Warming Potential (GWP) a.k.a. Carbon footprint | 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 O3), 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.

Results

The following tables show the results grouped in 3 categories, each looking at different types of indicators. The headings below provide descriptions for each of these categories.

Each column of numbers represents one declared unit: 1m³ of timber, packaged and ready for dispatch to the consumer.

The first row of the Environmental impact indicators, the Global Warming Potential (total) (GWPT) represents the total carbon footprint of the product. This is the sum of the biogenic carbon footprint (GWPB), mostly from the sequestration of carbon in wood, and the fossil carbon footprint (GWPF), which is mostly from the fossil fuels combusted during the production of the product. It should be noted that the GWPB is largely dependent on the density of the wood, which can vary by a large degree due to a range of factors.

For timber products, the most common value used for the carbon footprint in ratings tools like GreenStar and eTool is the fossil carbon footprint (GWPF).

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.

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 softwood forestry, the natural system might be a native forest or a grassland (Quinteiro et al. 2015).

Waste and Output Flow

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.

Cross-Laminated Timber results | A1 - A3

Production cradle-to-gate

Below are the results from the life cycle assessment for production of Cross-Laminated Timber. Each column represents one product type in the declared unit.

For timber products, the most common value used for the carbon footprint in ratings tools like Green Star and eTool is the fossil carbon footprint (GWPF).

Environmental impact indicators

Table 5: Environmental impact results covering modules A1-A3

			A1 -A3								
INDICATOR	ABB.	UNIT	No Treatment	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
Global warming potential (total)	GWPT	kg CO_2-eq.	-714	-711	-706	-645	-700	-692	-687	-681	-676
Global warming potential (fossil)	GWPF	kg CO_2-eq.	65.9	68.7	73.6	135	79.6	87.8	92.7	97.8	103
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	-780	-780	-780	-780	-780	-779	-779	-779	-779
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	1.64E-10	1.74E-10	1.74E-10	3.71E-10	2.43E-10	9.22E-10	9.22E-10	1.31E-09	1.31E-09
Acidification potential of land and water	AP	kg SO_2-eq.	0.609	0.625	0.678	0.770	0.922	0.919	0.972	1.07	1.12
Eutrophication potential	EP	kg PO_4^{3-}- eq.	0.137	0.140	0.152	0.153	0.153	0.145	0.157	0.149	0.161
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	0.271	0.273	0.490	9.51	0.500	0.286	0.503	0.293	0.510
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	7.17E-06	7.86E-06	8.78E-06	2.47E-04	6.85E-04	0.00324	0.00324	0.00488	0.00488
Abiotic depletion potential – fossil fuels	ADPF	MJ	943	979	1,010	3,630	1,140	1,220	1,250	1,340	1,380

Resource use indicators

Table 6: Resource use indicators results covering modules A1-A3

			A1 -A3								
INDICATOR	ABB.	UNIT	No Treatment	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
Renewable primary energy as energy carrier	PERE	MJ	3,420	3,460	4,330	3,490	4,330	3,470	4,340	3,480	4,340
Renewable primary energy resources as material utilization	PERM	MJ	8,110	8,110	8,110	8,110	8,110	8,110	8,110	8,110	8,110
Total use of renewable primary energy resources	PERT	MJ	11,500	11,600	12,400	11,600	12,400	11,600	12,400	11,600	12,400
Non-renewable primary energy as energy carrier	PENRE	MJ	868	904	938	3,580	1,070	1,150	1,180	1,280	1,310
Non-renewable primary energy as material utilization	PENRM	MJ	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5
Total use of non-renewable primary energy resources	PENRT	MJ	962	998	1,030	3,670	1,160	1,250	1,280	1,380	1,410
Use of secondary material	SM	kg	0	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	RSF	MJ	0	7.51E-24	5.46E-10	7.51E-24	5.46E-10	7.51E-24	5.46E-10	7.51E-24	5.46E-10
Use of non-renewable secondary fuels	NRSF	MJ	0	8.82E-23	6.92E-09	8.82E-23	6.92E-09	8.82E-23	6.92E-09	8.82E-23	6.92E-09
Use of net fresh water	FW	m^3	3.85E-04	338	465	550	495	386	513	415	542

Waste material and output flow indicators

Table 7: Waste categories and output flow indicators covering modules A1-A3

			A1 -A3								
INDICATOR	ABB.	UNIT	No Treatment	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
Hazardous waste disposed	HWD	kg	3.92E-06	3.95E-06	3.96E-06	4.39E-06	4.31E-04	4.12E-06	4.13E-06	4.21E-06	4.23E-06
Non-hazardous waste disposed	NHWD	kg	61.2	61.2	62.5	61.6	62.6	62.7	64.1	63.5	64.8
Radioactive waste disposed	RWD	kg	0.00674	0.00682	0.00684	0.0172	0.00868	0.0103	0.0104	0.0122	0.0122
Components for re-use	CRU	kg	0	0	0	0	0	0	0	0	0
Materials for recycling	MFR	kg	0	0	0	0	0	0	0	0	0
Materials for energy recovery	MER	kg	0	0	0	0	0	0	0	0	0
Exported electrical energy	EEE	MJ	0	0	0	0	0	0	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0	0	0	0	0	0

Cross-Laminated Timber results | C3, C4, D

End-of-life scenarios

Below are the results from the life cycle assessment for the different end-of-life scenarios of Cross-Laminated Timber. The results are the same for all treatment types.* The landfill option is the default option and is applicable for all treatment types. See the End-of-life section for more details.

*Please note: some scenarios are not applicable for treated timber (e.g. energy recovery).

Environmental impact indicators

Table 8: Environmental impact results covering modules C3, C4, D

			LANDFILL		ENERGY RECOVERY		RECYCLING		REUSE	
INDICATOR	ABB.	UNIT	C4	D	C3	D	C3	D	C3	D
Global warming potential (total)	GWPT	kg CO_2-eq.	55.2	-0.0321	791	-537	791	-23.9	786	-65.9
Global warming potential (fossil)	GWPF	kg CO_2-eq.	52.9	-0.0320	4.89	-538	4.89	-23.4	0	-65.9
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	2.26	-1.68E-04	786	1.08	786	-0.524	786	0
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq	1.85E-13	-1.79E-16	9.59E-16	-1.60E-14	9.59E-16	-2.11E-11	0	-1.64E-10
Acidification potential of land and water	AP	kg SO_2-eq.	0.152	-6.17E-05	0.0304	-0.0168	0.0304	-0.235	0	-0.609
Eutrophication potential	EP	kg PO_4^{3-}- eq.	0.0187	-1.29E-05	0.00714	-0.0381	0.00714	-0.0498	0	-0.137
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	0.00963	-5.28E-06	0.00268	0.0870	0.00268	-0.187	0	-0.271
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	5.44E-06	-5.72E-09	7.59E-08	-6.44E-05	7.59E-08	-2.71E-06	0	-7.17E-06
Abiotic depletion potential – fossil fuels	ADPF	MJ	791	-0.397	64.7	-9,380	64.7	-168	0	-943

Resource use indicators

Table 9: Resource use indicators results covering modules C3, C4, D

			LANDFILL		ENERGY RECOVERY		RECYCLING		REUSE	
INDICATOR	ABB.	UNIT	C4	D	C3	D	C3	D	C3	D
Renewable primary energy as energy carrier	PERE	MJ	81.5	-1.41	0.322	-3.72	0.322	-3,990	0	-3,420
Renewable primary energy resources as material utilization	PERM	MJ	0	0	-8,110	0	-8,110	0	-8,110	0
Total use of renewable primary energy resources	PERT	MJ	81.5	-1.41	-8,110	-3.72	-8,110	-3,990	-8,110	-3,420
Non-renewable primary energy as energy carrier	PENRE	MJ	802	-0.399	64.8	-9,380	64.8	-169	0	-868
Non-renewable primary energy as material utilization	PENRM	MJ	0	0	-94.5	0	-94.5	0	-94.5	0
Total use of non-renewable primary energy resources	PENRT	MJ	802	-0.399	-29.7	-9,380	-29.7	-169	-94.5	-868
Use of secondary material	SM	kg	0	0	0	0	0	480	0	480
Use of renewable secondary fuels	RSF	MJ	0	0	0	8,110	0	0	0	0
Use of non-renewable secondary fuels	NRSF	MJ	0	0	0	0	0	0	0	0
Use of net fresh water	FW	m^3	6.21E-05	-3.57E-06	6.34E-07	-1.37E-05	6.34E-07	-6.69E-04	0	-3.85E-04

Waste material and output flow indicators

Table 10: Waste categories and output flow indicators covering modules C3, C4, D

			LANDFILL		ENERGY RECOVERY		RECYCLING		REUSE	
INDICATOR	ABB.	UNIT	C4	D	C3	D	C3	D	C3	D
Hazardous waste disposed	HWD	kg	8.04E-08	-1.06E-10	5.79E-08	-6.97E-07	5.79E-08	-2.10E-07	0	-3.92E-06
Non-hazardous waste disposed	NHWD	kg	481	-2.22E-04	0.00156	22.3	0.00156	-6.27	0	-61.2
Radioactive waste disposed	RWD	kg	0.00421	-1.67E-07	8.98E-06	-6.59E-04	8.98E-06	-1.25E-04	0	-0.00674
Components for re-use	CRU	kg	0	0	0	0	0	0	480	0
Materials for recycling	MFR	kg	0	0	0	0	480	0	0	0
Materials for energy recovery	MER	kg	0	0	480	0	0	0	0	0
Exported electrical energy	EEE	MJ	0.778	0	0	0	0	0	0	-0.0610
Exported thermal energy	EET	MJ	0	0	0	0	0	0	0	0

PART 02 The Results
Environmental Product Declaration

References

Australian Government. (2014). **Technical Guidelines for the Estimation of Greenhouse Gas Emissions** by Facilities in Australia. Department of Environment.

Australian Government. (2016). **Technical Guidelines for the Estimation of Greenhouse Gas Emissions** by Facilities in Australia. Department of Environment and Energy.

Carre, A. (2011). **A Comparative Life Cycle Assessment of Alternative Constructions of a Typical Australian House Design**. Melbourne: Forest & Wood Products Australia. Retrieved from https://www.fwpa.com.au/images/marketaccess/PNA147-0809_Research_Report_Comparative-LCA_0.pdf

EN 15804:2012+A1:2013. (2013). **Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products.** Brussels: European Committee for Standardization.

EN 16485:2014. (2014). **Round and sawn timber. Environmental Product Declarations. Product category rules for wood and wood-based products for use in construction.** Brussels: European Committee for Standardization.

Evanson, T. (2018). **Greenhouse Gas emissions of the Forestry Sector in New Zealand (harvesting update).** Scion.

Gifford, R. (2000). **Carbon Contents of Above-Ground Tissues of Forest and Woodland Trees.** Technical report No. 22. National Carbon Accounting Scheme. Australian Greenhouse Office. Retrieved from: http://pandora.nla.gov.au/pan/23322/20020220-0000/www.greenhouse.gov.au/ncas/files/pdfs/tr22final.pdf

EPD International. (2019). **PCR 2012:01 Construction products and Construction services, Version 2.33** (2019-12-20). The International EPD® System.

ISO 14025:2006. **Environmental labels and declarations — Type III environmental declarations - Principles and procedures.** Geneva: International Organization for Standardization.

MfE. (2015). **New Zealand's Greenhouse Gas Inventory 1990-2013.** Ministry for the Environment, New Zealand Government

MfE. (2021). **New Zealand's Greenhouse Gas Inventory 1990–2019.** Ministry for the Environment, New Zealand Government

Quinteiro, P., Dias, A. C., Silva, M., Ridoutt, B. G., & Arroja, L. (2015). A contribution to the environmental impact assessment of green water flows. **Journal of Cleaner Production, 93**, 318-329.

Sandilands, J., Nebel, B., Hodgson, C., & Hall, P. (2006). **Greenhouse Gas emissions of the Forestry Sector in New Zealand.** Scion.

Sphera. (2021). **GaBi Life Cycle Inventory Database 2021 Documentation.** Chicago, United States. Retrieved from Sphera https://gabi.sphera.com/international/support/gabi

Wang, W., Padgett, J., De La Cruz, F., & Barlaz, M. (2011). Wood biodegradation in laboratory-scale landfills. **Environmental Science & Technology**, 45(16), pp. 6864-6871.

Programme-related Information and Verification

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Procedure for follow-up of data during EPD validity involved third-party verifier	☑	yes	
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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. EPDs within the same product category but 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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