Environmental Product Declaration (EPD)

In accordance with ISO 14025 and EN 15804+A1 for:
Vulcan Thermally Modified Radiata Pine from Abodo Wood Ltd.

Programme operator:	EPD Australasia Limited
EPD registration number:	S-P-01543
Eco Platform EPD reference number:	00001258
Publication date:	2020-08-12
Revised:	2023-03-20 (version 1.3)
Valid until:	2025-08-12
Geographical scope of EPD:	New Zealand manufacture with European distribution and end of life

How to use this EPD

Abodo Wood has developed this EPD to help to showcase the environmental credentials of their wood products. The EPD also provides lifecycle 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 lifecycle environmental impact. The detailed, transparent environmental data that EPDs provide is an important step towards enabling whole-of-building lifecycle assessment”.

NZGBC currently allows up to three points to be awarded for use of EPDs in Greenstar projects, as of the ’Green Star Design and As Built New Zealand v1.0 Submission Guidelines’. Other green building certification frameworks such as LEED, Green Building Council of Australia and Living Building Certification also have points available for products with an EPD

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

Contents

Part 1 Abodo Wood and Technical Information:

Abodo Wood

Our Craft

Abodo® crafts timbers with lasting beauty that are safe for people and the environment. Many exterior timbers are harvested from unsustainable old growth forests or are treated with harmful chemicals.

Our timbers stand the test of time, they are beautiful, durable and rapidly renewable.

Formed in 2001 by the Gudsell family, Abodo remains a New Zealand-owned, family business with a purpose.

Our Philosophy

Our design ethos has two core components:

Lifetime beauty

Abodo timbers are crafted to be enjoyed for years to come. Designed to age with grace, our timbers have exceptional weatherability and maintain their durability and beauty for a lifetime.

With tomorrow in mind

Our timbers are harvested from New Zealand's FSC® certified rapidly renewable plantation forests. They are ethically crafted with respect from beginning to end – allowing us to meet today's increasing needs without disadvantaging future generations.

All products are manufactured in New Zealand's central North Island to local and international standards.

Abodo third party audited certifications:

- Forest Stewardship Council® (FSC®) SGS-COC004944
- Ministry of Primary Industries – export certification
- CodeMark – quality system
- Declare Certification – Living Futures Institute

Third party site certifications:

- AS/NZS1328 Glue laminated structural timber
- AS5068 Finger- joints in structural timber
- AS5609 Finger- joints in non-structural timber
- AS1604/ NZS3640 Specifications for preservative treatment

Vulcan Thermally Modified Timbers

Below are examples of case studies that showcase the versatility of Vulcan Thermally Modified Timbers.

Project: Rivercove Home – Hamilton, New Zealand
Architect: Urban Homes
Product: Vulcan Cladding in Sioo:x Coating, Vulcan Screening in Protector – Ebony

Project: Black Box Luxury Home – Western Australia
Architect: Valento Homes
Product: Vulcan Cladding in Protector – Ebony

Project: The Grounds – Hobsonville Point, New Zealand
Architect: Peddle Thorp Architects
Product: Vulcan Screening in Sioo:x Coating

Project: Cardrona Cabin – Queenstown, New Zealand
Architect: Assembly Architects
Product: Vulcan Screening in Sioo:x Coating

Project: Lake Tarawera Holiday Home – Rotorua, New Zealand
Product: Vulcan Decking (Uncoated)

Project: Mahoe Ave Remuera House– Auckland, New Zealand
Product: Vulcan Primed in Paint Finish

Business Values

The future of wood

Abodo's thermally modified timbers stand the test of time, they are beautiful, durable and sustainable. Even better, they're safe for people and the environment.

Growing more for less

Our timbers are sustainably grown in New Zealand forests that we know and respect, whose rich soils and high annual rainfall ensure rapid growth. With a total forested area of 1.8 million hectares (Forest Owners Assn, 2018/19), New Zealand's high yielding Radiata Pine plantations are the perfect source for raw material. New Zealand is the ultimate base for sustainable forestry. Consistently ranked in the top two for the world's least corrupt country (Transparency International, 2020), New Zealand is not adversely affected by the corruption that affects wood producers in other parts of the world (International Criminal Police Organization, 2016).

Minimising our impact

We choose only the highest quality logs, which are then sawn in close proximity to the plantation. This means that transport related emissions are minimised and operational efficiencies are maximised. Our strong partnerships with forest owners in New Zealand's North Island ensure a consistent supply of high quality FSC® certified logs.

Transforming Radiata Pine

Our timbers are precision modified for durability and stability at the sawmill site. Most companies that use wood modification technology source their timber from around the world, mainly shipping the timbers to Europe to process. Our localised process reduces transport related emissions and increases speed and flexibility.

Design by nature

We take a leaf out of nature's book to design timbers that look better for longer. Grown trees experience resistance (like wind) perpendicular to the grain – so we cut some of our timber vertically for greater stability and less surface cracking. This means they age with grace.

Finishing touches

Wood coatings are typically produced to work over a broad range of timber, rather than work very well with specific timbers. Abodo has developed a tested system of wood finishes that are designed to work synergistically with our timbers, ensuring high performance and simple maintenance.

Built to last

We work with architects, designers and builders to create beautiful natural structures with lifetime beauty. At Abodo, we provide detailed specifications and direct support to ensure design and installation is done right, with pride.

Enjoy for years

Our timbers help create beautiful spaces for people to live and work, safely and sustainably. Timber spaces feel better, because they are. Abodo timbers are crafted to be durable and long lasting. With simple yearly maintenance, their beauty evolves slowly with time. Their exceptional weatherability means our timbers are enjoyed for decades.

Sources

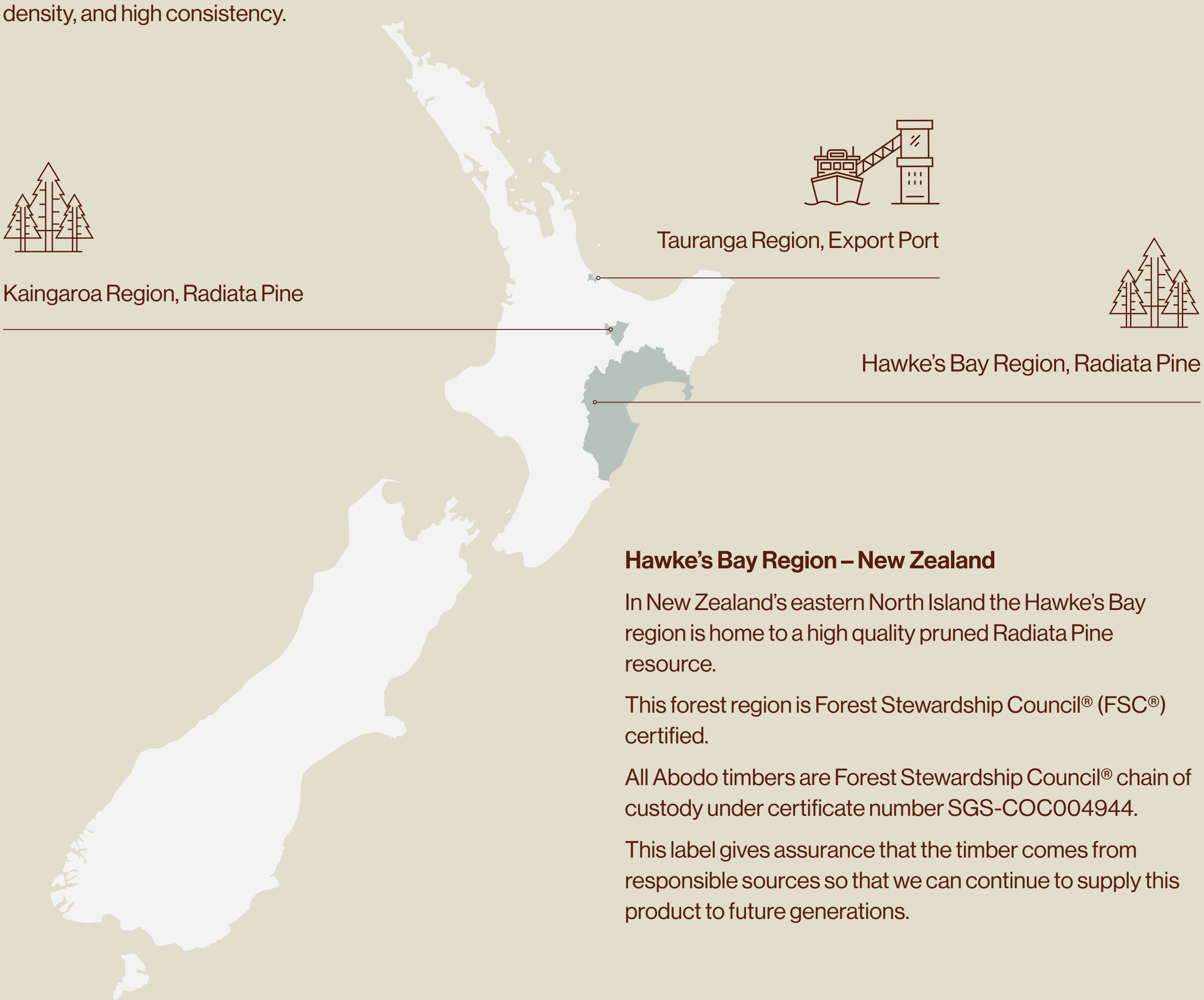
Kaingaroa Region - New Zealand

Much of Abodo's Radiata Pine is sourced from the Kaingaroa region, in New Zealand's central North Island.

The Kaingaroa Forest, is one of the largest man-made plantation forests in the southern hemisphere.

Today the Kaingaroa Forest is managed by Timberlands, a global forest manager, on behalf or investors. It is a world class forest, which is Forest Stewardship Council® (FSC®) certified.

Wood fibre from the Kaingaroa region is prized for its medium density, and high consistency.



Hawke's Bay Region – New Zealand

In New Zealand's eastern North Island the Hawke's Bay region is home to a high quality pruned Radiata Pine resource.

This forest region is Forest Stewardship Council® (FSC®) certified.

All Abodo timbers are Forest Stewardship Council® chain of custody under certificate number SGS-COC004944.

This label gives assurance that the timber comes from responsible sources so that we can continue to supply this product to future generations.

Product Information

Declared/functional Unit

The declared unit for the EPD is 1m^3 of thermally modified Radiata Pine timber as specified in the table below, packaged and distributed to a customer in Europe.

Table 1: Abodo timber products included in this EPD

Product type	Timber properties (density)	Uses
Vulcan – Thermally Modified, Sawn	Density: 420 kg/m^3 Moisture content (dry-basis): 7%	Generally non structural appearance grade uses interior and exterior where further machining or processing is required.
Vulcan – Thermally Modified, Surfaced	Density: 420 kg/m^3 Moisture content (dry-basis): 7%	Generally non structural appearance grade uses interior and exterior such as mouldings, window reveals, joinery, interior panelling, exterior cladding.
Vulcan – Thermally Modified, Finger-jointed	Density: 420 kg/m^3 Moisture content (dry-basis): 7%	Used where the presence of knots is not acceptable and/or a specific length is desired. End products include mouldings, window reveals, joinery, interior panelling, exterior cladding. Often supplied factory coated with an opaque primer ready for paint finish. (The factory coating of primer is outside of the scope of the current study).
Vulcan – Thermally Modified, Glulam	Density: 420 kg/m^3 Moisture content (dry-basis): 7%	Usually larger size structurally rated beams, comprising boards (sometimes finger-jointed), which are face-glued with the grain running parallel to the length of the beam. The beams may be resawn to produce smaller section sizes or boards for manufacture into products including cladding, panelling screening and joinery with vertical grain orientation. Maybe used in interior and exterior situations depending on choices of adhesive and coating.

Table 2 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 2: Classification codes of included products

Product	Classification	Code	Category
Sawn, kiln dried, Surfaced, kiln dried	UN CPC Ver.2	31101	Wood, sawn or chipped lengthwise, sliced or surfaced, kiln dried 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	UN CPC Ver.2.1	31421	Other plywood, veneered panels and similar laminated wood, of coniferous wood
	ANZSIC 2006	1493	Veneer and Plywood Manufacturing

Product Composition Content Declaration

All products within this EPD are of the species Pinus Radiata (Radiata Pine), grown within New Zealand in sustainably managed plantations and processed locally. Radiata Pine is the dominant species logged in New Zealand and represents 90% of the exotic plantation area in New Zealand (Ministry for Primary Industries, 2020)

The resource used for Vulcan products is certified by the Forest Stewardship Council® (FSC®).The product itself carries FSC® chain of custody certification.

Adhesive used for finger-jointed timber and glulam include Polyurethane (PU) that is a formaldehyde free Type 1 exterior structural grade glue to AS/NZS4364.

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".

Abodo Vulcan is Declare Certified 'Red List Free' by the Living Futures Institute.

Net calorific value of Vulcan timber is 18.00 MJ/kg.

Packaging

The timber products are strapped on ISPM-15 Radiata Pine gluts with recyclable/ biodegradeable cardboard protective sheets on sides/top for impact protection, covered in recyclable plastic wrap to protect the product from moisture and dirt.

The packaging for finger-jointed and Glulam products are based on industry averages from the WPMA EPD.

Thermal Modification Process – Vulcan Thermally Modified Timber

Vulcan products are made from thermally modified (TMT) clears grade FSC® certified New Zealand Radiata Pine. Thermal modification is achieved by using steam and high temperatures in excess of 190 degrees Celsius. The modification process requires a purpose-built computer-controlled kiln to ensure every piece of timber is modified to the correct specification and quality.

The modification process occurs in three stages:

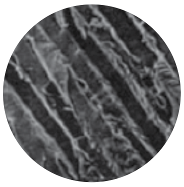
Phase 1 The kiln is slowly elevated in temperature until the moisture content of the wood is essentially 0%. The wood in the kiln is then heated further until it reaches the desired modification temperature - 230 degrees Celsius for outdoor end use applications.

Phase 2 The kiln is held at the modification temperature for a prescribed time to achieve full modification. This time is the critical point in the process.

Phase 3 The kiln is allowed to cool, and the wood is reconditioned with steam (we bring the moisture content back to around 7%). Once cool enough the wood can be extracted from the kiln.

Abodo Vulcan

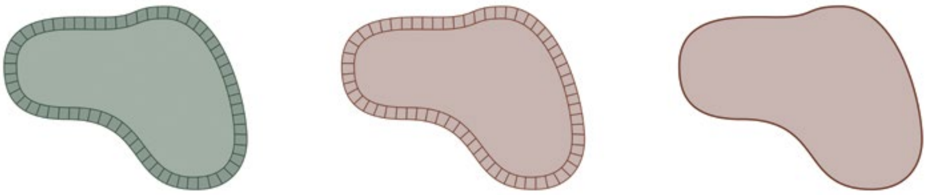
Cell structure – normal kiln dried timber



Cell structure – thermally modified timber

What is Thermal Modification?

Thermal modification permanently alters the cells of timber, effectively reducing the moisture that is held inside the cells.



Before Kiln Drying
Water is held in the cell walls along with the cell itself.

After Kiln Drying
Some water is still held in the cell walls.

After Thermal Modification
The cell walls collapse and fuse together, permanently reducing the ability of the cell wall to store water.

At the end of the process the moisture content of the timber is around 7% moisture content and the chemical and physical properties have been permanently changed. Thermal modification dramatically increases the durability and stability of wood – and results in a beautiful brown colouration. The result: a new, sustainable, environmentally friendly timber species.

During the thermal modification process, many of the extractives are 'cooked' out of the wood so that there is little chance of 'resin bleed' in service. This, combined with a degrading of the hemicellulose (sugar compound) in the wood, means that the conditions for fungal growth are almost eliminated.

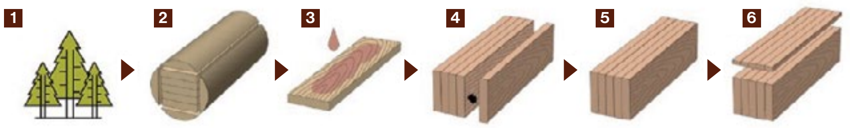
The energy required for drying is supplemented by burning residues of the modification process, which makes the timber more sustainable as the requirement for use of fossil fuels in the process is reduced.

As a result, the durability of Radiata Pine is increased to Class 2 above ground (AS5604) and Class 1 (EN350-1)– providing a 30 year expected service life in above ground vertical (cladding) applications. As an added advantage, thermal insulation properties are improved by around 20%.

All this is achieved without the use of wood preservatives or chemicals of any type. Thermally modified wood is perfect for eco decking, cladding and weatherboard applications, especially where 'healthy' building materials are desired.

By laminating boards of predominantly flat sawn timber together and then cutting the laminated block perpendicular to the glue line, it is possible to create boards with vertical or quarter sawn grain orientation on the end section. This process further adds to the exterior weathering performance and stability of the end product and is a feature of Abodo's patented Vulcan oil / stain finish products. The finished product is normally given a protective coating of oil, stain or a full paint coating.

Lamination process



1. Sourcing from pruned FSC® certified Radiata Pine plantation forest
2. Timber lamina from Radiata Pine log
3. Glue spreading with Type 1 exterior polyurethane adhesive
4. Lamination of lamina with vertical grain orientation
5. Slice to size required
6. Slice to any size

System Boundaries

As shown in the table below, this EPD is of the 'cradle-to-gate with options' type with transportation to customer and end of life options. The options include end-of-life processing (Modules C1-C4) and recycling potential (Module D) with Europe. Transportation to customer includes a base case scenario of transporting the finished product to the Port of Rotterdam in the Netherlands (21,000km distance). Other lifecycle stages (Modules A5 and B1-B7) are dependent on particular scenarios and best modelled at the building level.

Table 3: Modules included in the scope of the EPD

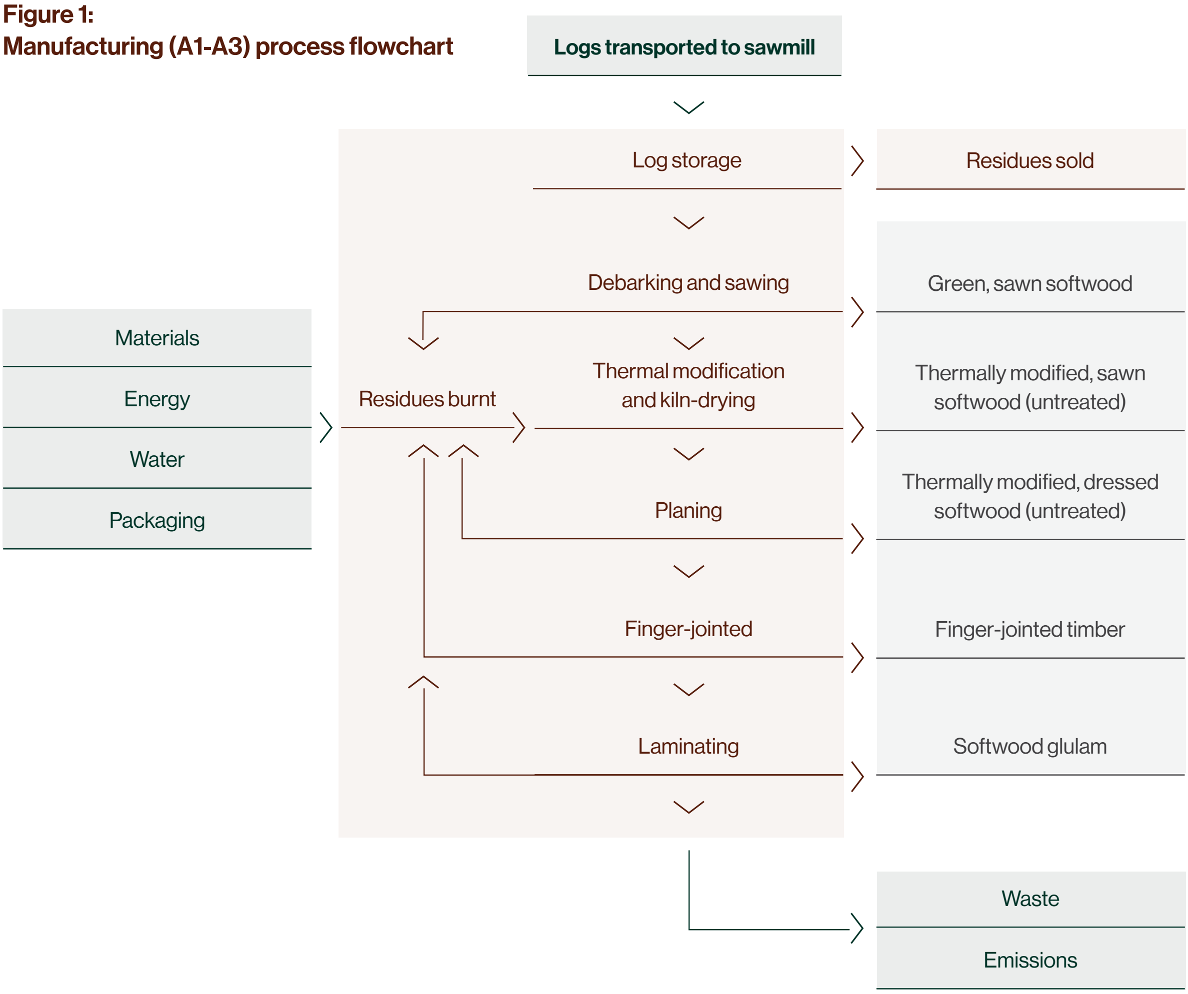
Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport of raw materials	Manufacturing	Transport to customer	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy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

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

Production (Modules A1-A3)

The production stage includes the environmental impacts associated with raw materials extraction and processing of inputs, transport to, between and within the manufacturing site, manufacturing of average product at the exit gate of the manufacturing site and transport of product to customer.

Figure 1:
Manufacturing (A1-A3) process flowchart



Distribution (Module A4)

This EPD includes distribution of the final product to customer. The default scenario that has been assumed is the transportation of the product from the sawmill to the Port of Rotterdam in the Netherlands, via the Port of Tauranga with a total distance of 21,000km.

End of Life (Modules C & D)

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. These end of life scenarios are described below, Europe has been assumed as the location of end of life. 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. The deconstruction of the building is assumed to be done by a 100 kW construction excavator. The transport of demolished timber to landfill is assumed to be 50km by truck.

End-of-Life Scenarios

Landfill

Emissions from landfill are dependent on the Degradable Organic Carbon fraction (DOCf). The DOCf = 0.1% for softwood. This a conservative value for softwood 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 28% (Sphera, 2020) and the resulting electricity receives a credit for offsetting average electricity from the European grid (module D) in line with (EN 16485:2014, 2014).

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, Department of Environment, 2016).
- All carbon dioxide is released directly to the atmosphere.
- 50% of the methane is captured (Sphera, 2020).
- Of the 50% captured, 56% (28% of the total) is flared and 44% (22% of the total) are used for energy recovery (Sphera, 2020). Methane is combusted in both processes, resulting in all carbon being released as carbon dioxide.
- Of the 50% of methane that is not captured, 10% (5% of the total) is oxidised (released as carbon dioxide) (Australian Government, Department of Environment, 2016).and 90% (45% of the total)) is released to the atmosphere as methane.
- In summary, for every kilogram of carbon converted to landfill gas, 77.5% is released as carbon dioxide and 22.5% 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, 2014). Note that other options may also be in use within Europe, 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 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, 2014). 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 softwood 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, 2014).

Lifecycle Inventory (LCI) Data and Assumptions

Primary data was used for all manufacturing operations up to the factory gate, including upstream data for wood. Primary data for the Donelley Sawmill was sourced from the period 1st December 2018 to 30th November 2019. Background data was used for input materials sourced from other suppliers. Industry average data from the WPMA EPD was used for finger-jointed and glulamination processes and packaging (WPMA, 2019).

All data in the background system were from the GaBi Lifecycle Inventory Database 2020 (Sphera, 2020). Most datasets have a reference year between 2016 and 2019 and all fall within the 10 year limit allowable for generic data under EN 15804.

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.

Upstream Data

Upstream data for the forestry stage has been taken from literature data (Sandilands, Nebel, Hodgson, & Hall, 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.

Cut off criteria

Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary as per the PCR (IEPDS, 2019) (EPD Australasia, 2018). All other reported data was incorporated and modelled using the best available lifecycle 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 (Sphera, 2020).

Co-products (e.g. sawdust): As the difference in economic value of the co-products is high (>25% as per EN 15804 A1 (EN15804:2012+A1:2013, 2013)), allocation by economic value has been applied. Economic data were provided by the facilities represented in this EPD.

Representativeness

Market representativeness: The EPD is based on detailed data collected by survey from the Donelley Sawmill who is the sole provider of thermally modified wood to Abodo Wood. Industry average data is used for glulam and finger-jointing processes as well as glulam and finger-jointed wood product packaging.

Temporal representativeness: Primary data from the Donelley Sawmill was collected for the 12 month period of December 2018 to November 2019.

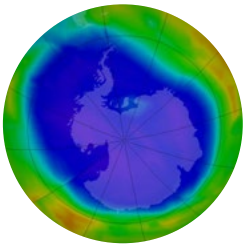
Geographical and technological representativeness: The data is representative of the Donelley Sawmill and sites surveyed for the WPMA EPD.

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 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 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.

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 is 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, R., 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.

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 flows

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

Thermally Modified Timber, Sawn

When timber is sawn from a Radiata Pine log it may have a moisture content (oven dry basis) of between 40 to 200%. Prior to thermal modification the timber is dried to a moisture content of between 12 to 20%. After being kiln dried the timber is thermally modified using a three step schedule at to 230 degrees celsius. To do this, the timber is stacked in a special modification kiln, 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 is tightly controlled with a computer to impart enhanced properties without damaging the timber.

Sawn timber is often the starting point for a lot of further processed timber products. Timber which has just been rough sawn will likely have size variation and surface roughness which makes it unsuitable for many uses however it can be an end product saleable in its own right.

Table 4: Environmental impacts, 1 m^3 of sawn softwood

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Environmental impact	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Global warming potential (total)	GWPT	kg CO_2-eq.	-535	73.4	0.264	1.61	57.2	762	762	758	-0.0755	-493	-6.31	-224
Global warming potential (fossil)	GWPF	kg CO_2-eq.	224	73.3	0.265	1.54	55.7	4.29	4.29	0	-0.0759	-493	-6.34	-224
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	-758	0.105	-8.99E-04	0.0638	1.47	758	758	758	3.74E-04	-0.0199	0.0283	0
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	1.68E-10	8.27E-15	4.76E-17	2.88E-16	2.24E-13	1.01E-15	1.01E-15	0	-2.26E-15	-3.17E-14	-7.91E-14	-1.68E-10
Acidification potential of land and water	AP	kg SO_2-eq.	0.782	2.17	9.66E-04	0.00385	0.154	0.0262	0.0262	0	-1.38E-04	0.452	-0.0274	-0.782
Eutrophication potential	EP	kg PO_4^{3-}- eq.	0.156	0.242	2.15E-04	8.42E-04	0.0184	0.00625	0.00625	0	-1.69E-05	0.101	-0.00613	-0.156
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	0.33	0.114	8.88E-05	-0.00121	0.00951	0.00235	0.00235	0	-1.13E-05	0.104	-8.58E-04	-3.30E-01
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	9.06E-06	8.81E-07	3.30E-09	1.99E-08	4.91E-06	3.32E-07	3.32E-07	0	-2.36E-08	-2.68E-05	-1.10E-06	-9.06E-06
Abiotic depletion potential – fossil fuels	ADPF	MJ	2,970	914	3.56	21.5	781	54.8	54.8	0	-0.836	-8,530	-77.8	-2970

GWPT= Global warming potential (total); GWPF= Global warming potential (fossil); GWPB= Global warming potential (biotic); ODP= Depletion potential of the stratospheric ozone layer; AP= Acidification potential of land and water; EP= Eutrophication potential; POCP= Photochemical ozone creation potential.

Table 5: Resource use, 1 m³ of sawn softwood

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Resource use	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Renewable primary energy as energy carrier	PERE	MJ	4,200	2.49	0.0233	0.141	63.2	3.17	3.17	0	-0.599	-16.1	-8,120	-4,200
Renewable primary energy resources as material utilization	PERM	MJ	7,560	0	0	0	0	-7,560	-7,560	-7,560	0	0	0	0
Total use of renewable primary energy resources	PERT	MJ	11,800	2.49	0.0233	0.141	63.2	-7,560	-7,560	-7,560	-0.599	-16.1	-8,120	-4,200
Non-renewable primary energy as energy carrier	PENRE	MJ	2,970	914	3.57	21.5	804	55.1	55.1	0	-1.35	-8,540	-94.1	-2,970
Non-renewable primary energy as material utilization	PENRM	MJ	0	0	0	0	0	0	0	0	0	0	0	0
Total use of non-renewable primary energy resources	PENRT	MJ	2,970	914	3.57	21.5	804	55.1	55.1	0	-1.35	-8,540	-94.1	-2,970
Use of secondary material	SM	kg	0	0	0	0	0	0	0	0	0	0	420	420
Use of renewable secondary fuels	RSF	MJ	0	0	0	0	0	0	0	0	0	7,560	0	0
Use of non-renewable secondary fuels	NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0
Use of net fresh water	FW	m³	1.91	0.00797	0.00505	0.00372	0.00505	0.00372	0.00372	0	-6.90E-04	-0.0247	-0.0254	-1.91

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 6: Waste categories, 1 m³ of sawn softwood

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Waste categories and output flows	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Hazardous waste disposed	HWD	kg	3.96E-05	5.65E-08	2.17E-10	1.31E-09	2.08E-06	3.44E-06	3.44E-06	0	-5.62E-10	-3.21E-06	-3.41E-06	-3.96E-05
Non-hazardous waste disposed	NHWD	kg	16.6	0.0117	8.28E-05	5.01E-04	421	0.00876	0.00876	0	-9.61E-04	20.6	-0.044	-16.6
Radioactive waste disposed	RWD	kg	0.00128	1.53E-05	3.78E-07	2.28E-06	0.00911	1.02E-04	1.02E-04	0	-2.05E-04	-0.00233	-0.00647	-0.00128
Components for re-use	CRU	kg	0	0	0	0	0	0	0	420	0	0	0	0
Materials for recycling	MFR	kg	0	0	0	0	0	0	420	0	0	0	0	0
Materials for energy recovery	MER	kg	0	0	0	0	0	420	0	0	0	0	0	0
Exported electrical energy	EEE	MJ	0	0	0	0	0.718	0	0	0	0	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0	0	0	0	0	0	0	0	0

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy.

Thermally Modified Timber, Surfaced

Surfaced, thermally modified timber is sawn 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). Generally the flat sawn timber has a paint finished applied for exterior use. It is also suitable for charring with Japanese 'Yakisugi' burnt wood technique as featured on Vulcan Charred.

Table 7: Environmental impacts, 1 m³ of surfaced softwood

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Environmental impact	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Global warming potential (total)	GWPT	kg CO_2-eq.	-516	73.4	0.264	1.61	57.2	762	762	758	-0.0755	-493	-6.31	-243
Global warming potential (fossil)	GWPF	kg CO_2-eq.	243	73.3	0.265	1.54	55.7	4.29	4.29	0	-0.0759	-493	-6.34	-243
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	-758	0.105	-8.99E-04	0.0638	1.47	758	758	758	3.74E-04	-0.0199	0.0283	0
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	1.81E-10	8.27E-15	4.76E-17	2.88E-16	2.24E-13	1.01E-15	1.01E-15	0	-2.26E-15	-3.17E-14	-7.91E-14	-1.81E-10
Acidification potential of land and water	AP	kg SO_2-eq.	0.81	2.17	9.66E-04	0.00385	0.154	0.0262	0.0262	0	-1.38E-04	0.452	-0.0274	-0.81
Eutrophication potential	EP	kg PO_4^{3-}- eq.	0.161	0.242	2.15E-04	8.42E-04	0.0184	0.00625	0.00625	0	-1.69E-05	0.101	-0.00613	-0.161
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	0.36	0.114	8.88E-05	-0.00121	0.00951	0.00235	0.00235	0	-1.13E-05	0.104	-8.58E-04	-3.60E-01
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	1.09E-05	8.81E-07	3.30E-09	1.99E-08	4.91E-06	3.32E-07	3.32E-07	0	-2.36E-08	-2.68E-05	-1.10E-06	-1.09E-05
Abiotic depletion potential – fossil fuels	ADPF	MJ	3,230	914	3.56	21.5	781	54.8	54.8	0	-0.836	-8,530	-77.8	-3230

GWPT = Global warming potential (total); GWPF = Global warming potential (fossil); GWPB = Global warming potential (biotic); ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Photochemical ozone creation potential.

Table 8: Resource use, 1 m³ of surfaced softwood

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Resource use	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Renewable primary energy as energy carrier	PERE	MJ	4,740	2.49	0.0233	0.141	63.2	3.17	3.17	0	-0.599	-16.1	-8,120	-4,740
Renewable primary energy resources as material utilization	PERM	MJ	7,560	0	0	0	0	-7,560	-7,560	-7,560	0	0	0	0
Total use of renewable primary energy resources	PERT	MJ	12,300	2.49	0.0233	0.141	63.2	-7,560	-7,560	-7,560	-0.599	-16.1	-8,120	-4,740
Non-renewable primary energy as energy carrier	PENRE	MJ	3,230	914	3.57	21.5	804	55.1	55.1	0	-1.35	-8,540	-94.1	-3,230
Non-renewable primary energy as material utilization	PENRM	MJ	0	0	0	0	0	0	0	0	0	0	0	0
Total use of non-renewable primary energy resources	PENRT	MJ	3,230	914	3.57	21.5	804	55.1	55.1	0	-1.35	-8,540	-94.1	-3,230
Use of secondary material	SM	kg	0	0	0	0	0	0	0	0	0	0	420	420
Use of renewable secondary fuels	RSF	MJ	0	0	0	0	0	0	0	0	0	7,560	0	0
Use of non-renewable secondary fuels	NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0
Use of net fresh water	FW	m³	2.61	0.00797	3.33E-05	2.01E-04	0.00505	0.00372	0.00372	0	-6.90E-04	-0.0247	-0.0254	-2.61

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 9: Waste categories, 1 m³ of surfaced softwood

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Waste categories and output flows	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Hazardous waste disposed	HWD	kg	4.17E-05	5.65E-08	2.17E-10	1.31E-09	2.08E-06	3.44E-06	3.44E-06	0	-5.62E-10	-3.21E-06	-3.41E-06	-4.17E-05
Non-hazardous waste disposed	NHWD	kg	16.9	0.0117	8.28E-05	5.01E-04	421	0.00876	0.00876	0	-9.61E-04	20.6	-0.044	-16.9
Radioactive waste disposed	RWD	kg	0.00143	1.53E-05	3.78E-07	2.28E-06	0.00911	1.02E-04	1.02E-04	0	-2.05E-04	-0.00233	-0.00647	-0.00143
Components for re-use	CRU	kg	0	0	0	0	0	0	0	420	0	0	0	0
Materials for recycling	MFR	kg	0	0	0	0	0	0	420	0	0	0	0	0
Materials for energy recovery	MER	kg	0	0	0	0	0	420	0	0	0	0	0	0
Exported electrical energy	EEE	MJ	0	0	0	0	0.718	0	0	0	0	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0	0	0	0	0	0	0	0	0

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy.

Thermally Modified Timber, Finger-Jointed

Finger-jointed is used to remove knots and other characteristics from boards, and thus produce a 'clear' product in long lengths.

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.

The adhesive used is PUR (polyurethane) which is formaldehyde free and classified Type 1 exterior structural according to AS/NZS 4364.

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.

Finger-jointed timber is used in the manufacture of mouldings and weatherboards such as Vulcan Primed Cladding and in production of glulam (structural finger-joints). Generally, the finger-jointed timber has a paint finish applied.

Table 10: Environmental impacts, 1 m³ of finger-jointed softwood

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Environmental impact	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Global warming potential (total)	GWPT	kg CO_2-eq.	-469	73.4	0.264	1.61	57.2	762	762	758	-0.0755	-493	-6.31	-290
Global warming potential (fossil)	GWPF	kg CO_2-eq.	290	73.3	0.265	1.54	55.7	4.29	4.29	0	-0.0759	-493	-6.34	-290
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	-758	0.105	-8.99E-04	0.0638	1.47	758	758	758	3.74E-04	-0.0199	0.0283	0
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	2.08E-10	8.27E-15	4.76E-17	2.88E-16	2.24E-13	1.01E-15	1.01E-15	0	-2.26E-15	-3.17E-14	-7.91E-14	-2.08E-10
Acidification potential of land and water	AP	kg SO_2-eq.	0.958	2.17	9.66E-04	0.00385	0.154	0.0262	0.0262	0	-1.38E-04	0.452	-0.0274	-0.958
Eutrophication potential	EP	kg PO_4^{3-}- eq.	0.191	0.242	2.15E-04	8.42E-04	0.0184	0.00625	0.00625	0	-1.69E-05	0.101	-0.00613	-0.191
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	0.418	0.114	8.88E-05	-0.00121	0.00951	0.00235	0.00235	0	-1.13E-05	0.104	-8.58E-04	-4.18E-01
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	1.45E-05	8.81E-07	3.30E-09	1.99E-08	4.91E-06	3.32E-07	3.32E-07	0	-2.36E-08	-2.68E-05	-1.10E-06	-1.45E-05
Abiotic depletion potential – fossil fuels	ADPF	MJ	3,870	914	3.56	21.5	781	54.8	54.8	0	-0.836	-8,530	-77.8	-3870

GWPT = Global warming potential (total); GWPF= Global warming potential (fossil); GWPB = Global warming potential (biotic); ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Photochemical ozone creation potential.

Table 11: Resource use, 1 m³ of finger-jointed softwood

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Resource use	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Renewable primary energy as energy carrier	PERE	MJ	5,680	2.49	0.0233	0.141	63.2	3.17	3.17	0	-0.599	-16.1	-8,120	-5,680
Renewable primary energy resources as material utilization	PERM	MJ	7,560	0	0	0	0	-7,560	-7,560	-7,560	0	0	0	0
Total use of renewable primary energy resources	PERT	MJ	13,200	2.49	0.0233	0.141	63.2	-7,560	-7,560	-7,560	-0.599	-16.1	-8,120	-5,680
Non-renewable primary energy as energy carrier	PENRE	MJ	3,850	914	3.57	21.5	804	55.1	55.1	0	-1.35	-8,540	-94.1	-3,850
Non-renewable primary energy as material utilization	PENRM	MJ	25.8	0	0	0	0	0	0	0	0	0	0	-25.8
Total use of non-renewable primary energy resources	PENRT	MJ	3,880	914	3.57	21.5	804	55.1	55.1	0	-1.35	-8,540	-94.1	-3,880
Use of secondary material	SM	kg	0	0	0	0	0	0	0	0	0	0	420	420
Use of renewable secondary fuels	RSF	MJ	0	0	0	0	0	0	0	0	0	7,560	0	0
Use of non-renewable secondary fuels	NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0
Use of net fresh water	FW	m³	3.58	0.00797	3.33E-05	2.01E-04	0.00505	0.00372	0.00372	0	-6.90E-04	-0.0247	-0.0254	-3.58

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 12: Waste categories, 1 m³ of finger-jointed softwood

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Waste categories and output flows	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Hazardous waste disposed	HWD	kg	4.22E-05	5.65E-08	2.17E-10	1.31E-09	2.08E-06	3.44E-06	3.44E-06	0	-5.62E-10	-3.21E-06	-3.41E-06	-4.22E-05
Non-hazardous waste disposed	NHWD	kg	35.1	0.0117	8.28E-05	5.01E-04	421	0.00876	0.00876	0	-9.61E-04	20.6	-0.044	-35.1
Radioactive waste disposed	RWD	kg	0.0026	1.53E-05	3.78E-07	2.28E-06	0.00911	1.02E-04	1.02E-04	0	-2.05E-04	-0.00233	-0.00647	-0.0026
Components for re-use	CRU	kg	0	0	0	0	0	0	0	420	0	0	0	0
Materials for recycling	MFR	kg	0	0	0	0	0	0	420	0	0	0	0	0
Materials for energy recovery	MER	kg	0	0	0	0	0	420	0	0	0	0	0	0
Exported electrical energy	EEE	MJ	0	0	0	0	0.718	0	0	0	0	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0	0	0	0	0	0	0	0	0

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy.

Thermally Modified Timber , Glulaminated

Glulam is made of pieces of planed timber aligned so all the longitudinal grains of the pieces are parallel.

To achieve the long lengths which are often required for the products made using this technology, the timber lengths are sometimes 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. The adhesive used is PUR (polyurethane) which is formaldehyde free and classified Type 1 exterior structural according to AS/NZS 4364. A clamping pressure is applied, and the adhesive is left to cure. After this, the glulam is cut and machined into different section sizes or profiles.

Table 13: Environmental impacts, 1 m³ of softwood glulam

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Environmental impact	**Parameter**	**Unit**	**A1-A3**	**C1**	**C2**	**A4**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Global warming potential (total)	GWPT	kg CO_2-eq.	-420	0.264	1.61	73.4	57.2	762	762	758	-0.0755	-493	-6.31	-339
Global warming potential (fossil)	GWPF	kg CO_2-eq.	339	0.265	1.54	73.3	55.7	4.29	4.29	0	-0.0759	-493	-6.34	-339
Global warming potential (biogenic)	GWPB	kg CO_2-eq.	-758	-8.99E-04	0.0638	0.105	1.47	758	758	758	3.74E-04	-0.0199	0.0283	0
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11-eq.	2.09E-10	4.76E-17	2.88E-16	8.27E-15	2.24E-13	1.01E-15	1.01E-15	0	-2.26E-15	-3.17E-14	-7.91E-14	-2.09E-10
Acidification potential of land and water	AP	kg SO_2-eq.	1.05	9.66E-04	0.00385	2.17	0.154	0.0262	0.0262	0	-1.38E-04	0.452	-0.0274	-1.05
Eutrophication potential	EP	kg PO_4^{3-}- eq.	0.211	2.15E-04	8.42E-04	0.242	0.0184	0.00625	0.00625	0	-1.69E-05	0.101	-0.00613	-0.211
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.	0.416	8.88E-05	-0.00121	0.114	0.00951	0.00235	0.00235	0	-1.13E-05	0.104	-8.58E-04	-4.16E-01
Abiotic depletion potential – elements	ADPE	kg Sb-eq.	2.15E-05	3.30E-09	1.99E-08	8.81E-07	4.91E-06	3.32E-07	3.32E-07	0	-2.36E-08	-2.68E-05	-1.10E-06	-2.15E-05
Abiotic depletion potential – fossil fuels	ADPF	MJ	4,880	3.56	21.5	914	781	54.8	54.8	0	-0.836	-8,530	-77.8	-4880

GWPT = Global warming potential (total); GWPF = Global warming potential (fossil); GWPB = Global warming potential (biotic); ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Photochemical ozone creation potential.

Table 14: Resource use, 1 m³ of softwood glulam

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Resource use	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Renewable primary energy as energy carrier	PERE	MJ	5,880	2.49	0.0233	0.141	63.2	3.17	3.17	0	-0.599	-16.1	-8,120	-5,880
Renewable primary energy resources as material utilization	PERM	MJ	7,560	0	0	0	0	-7,560	-7,140	-7,560	0	0	0	0
Total use of renewable primary energy resources	PERT	MJ	13,400	2.49	0.0233	0.141	63.2	-7,560	-7,140	-7,560	-0.599	-16.1	-8,120	-5,880
Non-renewable primary energy as energy carrier	PENRE	MJ	4,260	914	3.57	21.5	804	55.1	55.1	0	-1.35	-8,540	-94.1	-4260
Non-renewable primary energy as material utilization	PENRM	MJ	650	0	0	0	0	0	0	0	0	0	0	-650
Total use of non-renewable primary energy resources	PENRT	MJ	4,910	914	3.57	21.5	804	55.1	55.1	0	-1.35	-8,540	-94.1	-4910
Use of secondary material	SM	kg	0	0	0	0	0	0	0	0	0	0	420	420
Use of renewable secondary fuels	RSF	MJ	0	0	0	0	0	0	0	0	0	7,560	0	0
Use of non-renewable secondary fuels	NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0
Use of net fresh water	FW	m³	4.05	0.00797	3.33E-05	2.01E-04	0.00505	0.00372	0.00372	0	-6.90E-04	-0.0247	-0.0254	-4.05

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 15: Waste categories, 1 m³ of softwood glulam

			Production	Distribution	Demolition	Transport to End of Life	Landfill (typical)	Energy recovery	Recycling	Reuse	Landfill (typical)	Energy recovery	Recycling	Reuse
Waste categories and output flows	**Parameter**	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C4**	**C3**	**C3**	**C3**	**D**	**D**	**D**	**D**
Hazardous waste disposed	HWD	kg	1.84E-05	5.65E-08	2.17E-10	1.31E-09	2.08E-06	3.44E-06	3.44E-06	0	-5.62E-10	-3.21E-06	-3.41E-06	-1.84E-05
Non-hazardous waste disposed	NHWD	kg	54.6	0.0117	8.28E-05	5.01E-04	421	0.00876	0.00876	0	-9.61E-04	20.6	-0.044	-54.6
Radioactive waste disposed	RWD	kg	0.0139	1.53E-05	3.78E-07	2.28E-06	0.00911	1.02E-04	1.02E-04	0	-2.05E-04	-0.00233	-0.00647	-0.0139
Components for re-use	CRU	kg	0	0	0	0	0	0	0	420	0	0	0	0
Materials for recycling	MFR	kg	0	0	0	0	0	0	420	0	0	0	0	0
Materials for energy recovery	MER	kg	0	0	0	0	0	420	0	0	0	0	0	0
Exported electrical energy	EEE	MJ	0	0	0	0	0.718	0	0	0	0	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0	0	0	0	0	0	0	0	0

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy.

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Acknowledgements

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

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