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Environmental Product Declaration
Softwood Timber

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

EPD Registration No. S-P-00560 | Version 1.2
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Geographical Scope: Australia

AUSTRALASIA EPD®
ENVIRONMENTAL PRODUCT DECLARATION

Environmental Product Declarations

WoodSolutions has developed a suite of EPDs for industry-average, Australian-produced timber products.

These EPDs help to showcase the environmental credentials of Australian wood products. They also provide life cycle data for calculating the impacts of wood products at a building level.

EPDs include:

#01 Softwood Timber

#02 Hardwood Timber

#03 Particleboard

#04 Medium Density Fibreboard (MDF)

#05 Plywood

#06 Glued Laminated Timber (Glulam)

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WoodSolutions is an industry initiative designed to provide independent, non-proprietary information about timber and wood products to professionals and companies involved in building design and construction.

WoodSolutions is resourced by Forest and Wood Products Australia (FWPA). It is a collaborative effort between FWPA members and levy payers, supported by industry peak bodies and technical associations.

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Version history

V1.0 Initial version based on 2005/06 data from CSIRO and produced by thinkstep Pty Ltd and the Timber Development Association (NSW) Ltd.

V1.1 Minor corrections to text and images in V1.0.

V1.2 Revised version incorporating 2015/16 data from a new industry survey, as well as updates to Global Warming Potential (GWP) and fresh water indicators.

Produced: December 2017

EPD Details

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

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

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CEN standard EN 15804 served as the core PCR

PCR:
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☐ EPD process certification (Internal)
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Introduction

This Environmental Product Declaration presents the average performance of sawn timber from Australian grown softwood processed in Australia by members of Forest and Wood Products Australia (FWPA). It recognises the importance of transparency by providing information on the raw materials, production and environmental impacts of Australian softwood.

This EPD has been prepared in accordance with ISO 14025:2006, EN 15804:2013 and PCR 2012:01 (IEPDS 2017). It covers Australian seasoned softwood products produced in accordance with the following standards:

- AS/NZS 1748 Timber – Mechanically stress-graded for structural purposes
- AS 2858 Timber – Softwood – Visually stress-graded for structural purposes
- AS 4785 Timber – Softwood – Sawn and milled products.

The environmental data presented in this document are primarily derived from a survey of industry members covering the 2015/16 financial year conducted by thinkstep and Stephen Mitchell Associates on behalf of FWPA. This updates an earlier survey conducted by CSIRO (2009) based on the 2005/06 financial year, which was used in the first version of this EPD. The current survey covers one third of total sawn softwood production in Australia.

Production of this EPD has been facilitated by FWPA with participation of its current sawn softwood timber producer members listed in Table 1. All members have contributed financially through levies paid to FWPA and some have also contributed data (as shown in Table 1).

Table 1: FWPA members contributing to this EPD.

Company	Financial contributor	Data contributor
Allied Timber Products Pty Ltd	X	
Associated Kiln Driers Pty Ltd trading as A.K.D. Softwoods	X	
Australian United Timbers Pty Ltd	X	
Auswest Timbers Pty Ltd	X	
Boral Timber	X	
Carter Holt Harvey Woodproducts Australia	X	X
D&R Henderson Pty Ltd	X	
Highland Pine Products Pty Ltd	X	
Hyne Timber	X	X
KSI Sawmills Pty Ltd	X	
LM Hayter & Sons Pty Ltd	X	
Lorimer Timber Pty Ltd trading as Davids Timber	X	
McDonnell Industries Pty Ltd trading as NF McDonnell & Sons	X	
Penrose Pine Products Pty Ltd	X	
Rodpak Pty Ltd	X	
SA Sawmilling Pty Ltd	X	
Tarmac Sawmilling Pty Ltd	X	
TASCO trading as Dongwha Timbers Pty Ltd	X	X
Timberlink Australia	X	X
Wespine Industries Pty Ltd	X	X
Whiteheads Timber Sales Pty Ltd	X	

Description of the Australian Sawn Softwood Industry

The Australian softwood manufacturing industry is an important contributor to the Australian economy – particularly to the regional economies where many producers are based. In 2015-16 it is estimated that 64,300 people were employed in forestry, logging and wood manufacturing, with forestry and forest product manufacturing contributing 0.5% of Australia's GDP (ABARES 2017b).

In 2015-16, the industry produced 3.8 million cubic metres of sawn softwood timber products across 60 different sawmills (ABARES 2017b). The distribution of softwood sawmills by state is included in Table 2. Production is dominated by large sawmills, 20 of which have a log input capacity greater than 100,000 m^3 per year.

Table 2: Softwood sawmills by Australian state

NSW[a]	Vic.	Qld	SA	WA[b]	Tas.	Aust.
13	10	17	14	3	3	60

a Includes ACT
b includes Northern Territory.
Source: ABARES 2017b

Description of Sawn Softwood Products

Seasoned sawn softwood is widely used in residential and multi-residential frame construction (wall frames: studs, plates, headers; floor and roof truss components) and other internal fit-out elements (see Table 3).

Structural grade seasoned softwood is usually sold with a dressed surface finish (planer gauged). It may also be rougher headed, which is a reeded finish. Structural softwood is also available preservative treated (see Other Environmental Information section) for a variety of internal (termite protected) and external (termite and decay protected) applications. Factory manufactured finger-jointed and metal plate connector joined products are also available.

Appearance grade seasoned softwood is usually sold for internal fit-out elements such as mouldings, wall and ceiling linings, furniture, cladding and flooring.

Table 3: Proportion of Australian softwood by product group (2016-17).
Source: FWPA Softwood Timber Survey 2017.

Softwood product	% of total
Outdoor domestic	8.7%
Fencing	3.2%
Appearance	0.5%
Structural < 120mm	24.2%
Structural > 120mm	1.8%
Treated structural < 120mm	22.6%
Treated structural > 120mm	2.3%
Landscaping	4.8%
Poles	1.0%
Packaging	15.7%
Ungraded / non-structural	8.4%
Export	6.9%
Total	**100%**

Image courtesy of Hyne Timber

Image courtesy of FWPA

Image courtesy of Timberlink Australia

Image courtesy of Timberlink Australia

Seasoned sawn softwood timber is sold by grades for strength or appearance and the quantity specified by cross section and lineal metres. Although it is possible to cut timber to a large range of cross sections, there are a number of common dimensions for the dominant building products such as timber studs for floor, wall and roof framing (see Table 4 and Table 5).

Table 4: Structural grades of seasoned sawn softwood and availability. Source: WPV 2009

Typical species	Stress grade	Supply
Radiata Pine, Hoop Pine, Slash Pine, Maritime Pine, Caribbean Pine	F5	Readily available
	F7	Available from selected suppliers
	MGP10	Readily available
	MGP12	Available from selected suppliers
	MGP15	Available from selected suppliers

Table 5: Structural seasoned softwood - available sizes. Source: WPV 2009.

Breadth (mm)	Depth (mm)							
	42	70	90	120	140	190	240	290
35	X	Y	Y	Y	Y	Y	X	X
45		Y	Y	Y	Y	Y	Y	Y
90			X					

Key: X = Available from selected suppliers; Y = Readily available

Use of EPDs in Sustainable Building and Infrastructure Rating Systems

This document complies with the requirements for an industry-wide EPD under the Green Building Council of Australia's Green Star rating system given that:

1. It conforms with ISO 14025 and EN 15804.
2. It has been verified by an independent third party.
3. It has at least a cradle-to-gate scope.
4. The participants in the EPD are listed (see Table 1).

It may be used by project teams using the *Design & As Built* and *Interiors* rating tools to obtain Green Star points under the following credits:

- Materials > Product Transparency and Sustainability.
- Materials > Life Cycle Assessment: By providing data for an EN 15978 compliant whole-of-building whole-of-life assessment.
- Innovation Challenge > Responsible Carbon Impact: By providing embodied carbon impacts (i.e. data on Global Warming Potential) which can be used in the calculation and reduction of the total embodied carbon impacts of a project.

This EPD is also recognised for credits in the Infrastructure Sustainability (IS) rating scheme of the Infrastructure Sustainability Council of Australia (ISCA).

Scope

Products

This Sector EPD describes the following average products (declared units) manufactured in Australia by the FWPA members listed in Table 1:

- *1 m^3 of sawn kiln-dried softwood*
  12% moisture content (dry basis), density of 551 kg/m^3
- *1 m^3 of dressed kiln-dried softwood*
  12% moisture content (dry basis), density of 551 kg/m^3

The declared units above represent an entire product category rather than a specific product from a specific manufacturer. The values represent a production volume weighted average. As such, a specific product purchased on the market may have a lesser or greater environmental impact than the average presented in this EPD. Some products may also undergo further processing (e.g. fabrication into frames and trusses) before being used in a building.

All wood used in these products is from Australian native and exotic (non-native) softwood species grown in plantations. The dominant softwood species used to produce sawn timber in Australia is *Pinus radiata* (radiata pine). Other softwood species used are *Araucaria cunninghami* (hoop pine), *Pinus pinaster* (maritime pine) and the Southern Pines: *Pinus elliottii* (slash pine), *Pinus caribaea* (Caribbean pine) and hybrids thereof.

The results in the main body of this EPD are for untreated timber. Information on treatment can be found in the Additional Environmental Information section. The results for the specific treatment type used can be added to the results for untreated timber to calculate the environment profile for treated timber.

Table 6 indicates the availability of softwood by hazard class (a bold **X** indicates a common product).

Table 6: Availability of softwood by hazard class

Products	Untreated	H1	H2	H3	H4	H5	H6
Softwood, rough sawn, kiln-dried	**X**			**X**	**X**	X	
Softwood, dressed, kiln-dried	**X**		**X**	X	X		

End Uses

Sawn kiln-dried softwood	Packaging, outdoor domestic and fencing (after appropriate treatment)
Dressed sawn kiln-dried softwood	Structural framing, utility, H2F structural framing, mouldings, architraves, joinery, furniture, flooring grades

Representativeness

Market coverage: The data in this EPD are from detailed surveys of six of the 29 softwood mills in Australia who are FWPA members. These six mills collectively produced 1,229,419 m^3 of of sawn softwood in 2015/16, equating to 32.5% of total Australian production of approximately 3,784,000 m^3 (based on the 2015/16 total from ABARES 2017a, as adjusted to saleable volume following Houghton 2015) and approximately 36% of total production by FWPA members (assuming FWPA members account for 90% of Australian production).

Temporal representativeness: Primary data were collected from participating sites for the 2015/16 Australian financial year (1st July 2015 to 30th June 2016). Following EN 15804, site-specific data are valid for 5 years (to 30th June 2021), meaning that these datasets are valid until the end of this EPD's validity period.

Geographical and technological representativeness: The data are representative of the six sites surveyed, which collectively produce a third of all Australian-produced sawn softwood. More detailed information can be found in the Variation in Results section later in this EPD.

Industry Classifications

Product	Classification	Code	Category
All	UN CPC Ver.2	31100	Wood, sawn or chipped lengthwise, sliced or peeled, of a thickness exceeding 6 mm
All	ANZSIC 2006	1413	Timber resawing and dressing

LCA Calculation Rules

System Boundary

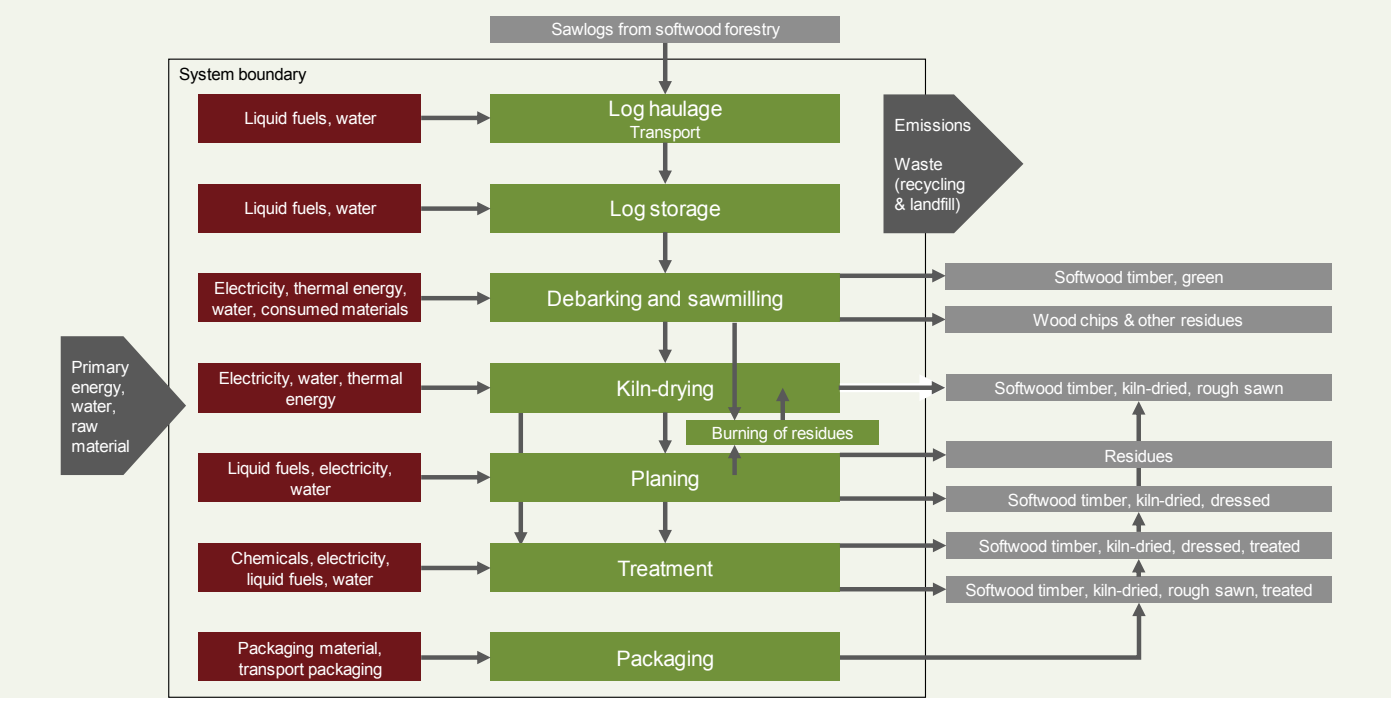
This EPD is of the 'cradle-to-gate' type with options. The options include the end-of-life stage, which is modelled through the use of scenarios.

Product stage			Con-struction 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	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X

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

Production

The production stage includes the forestry, sawmilling and kiln drying stages for all products and planing for dressed timber. Preservative treatment has been included separately to timber production within this EPD. Environmental profiles for a range of common treatment options are included in the Durability and Preservative Treatment section within this EPD.



End-of-Life

When a wood product reaches the end of its useful life, it may either be reused, recycled, landfilled or combusted to produce energy. Landfill is currently the most common end-of-life route for wood products in Australia. With the exception of reuse, which is not common for softwood, all other scenarios are in use in certain regions (Forsythe Consultants 2007; National Timber Product Stewardship Group) and have been included within this EPD.

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 data are available, the 'landfill (typical)' scenario should be used for 100% of the waste.

Landfill

This EPD includes two scenarios for landfill, each with a different value for the degradable organic carbon fraction (DOCf) of wood. The two values are based on bioreactor laboratory research. This experimental work involves the testing of a range of waste types in reactors operated to obtain maximum methane yields. As the laboratory work optimises the conditions for anaerobic decay, the results can be considered as estimates of the DOCf value that would apply over very long time horizons (Australian Government 2014a, p.17).

- **Landfill (typical):** DOC_f = 0.1%. This is based on bioreactor laboratory research by Wang *et al.* (2011) on radiata pine timber, the dominant softwood species in Australia.
- **Landfill (NGA)**: DOC_f = 10%. This is the value chosen for Australia's National Greenhouse Accounts (NGA) (Australian Government 2017). This is a reduction from the previous value of 23% (Australian Government 2014b) that was derived from early bioreactor laboratory research from the 1990s (e.g. Barlaz 1998) that investigated the degradability of wood tree branches ground to a fine powder under anaerobic conditions (Australian Government 2014a, p.17). This DOCf value can be considered extremely conservative when compared to values from later research (as used in the typical scenario above) and effectively assumes that at least part of the wood waste is ground into a powder to accelerate degradation.

The impacts associated with the landfill are declared in module C4. All landfill gas that is combusted for energy recovery (module C4) is assumed to occur in a power plant with an electrical conversion efficiency of 36% (Australian Government 2014c, p.189) and the resulting electricity receives a credit for offsetting average electricity from the Australian grid (module D) in line with EN 16485:2014 (Section 6.3.4.5).

Both landfill scenarios assume the following for carbon emissions:

- Of the gases formed from any degradation of wood in landfill, 50% is methane and 50% is carbon dioxide (Australian Government 2016, Table 43).
- All carbon dioxide is released directly to the atmosphere.
- 36% of the methane is captured, based on forecasted average methane capture in Australian landfills by 2020 (Hyder Consulting 2007). The year 2020 was chosen as landfill will take place in the future and this was the last year for which forecasts were available.
- Of this 36% captured, one-quarter (9% of the total) is flared and three-quarters (27% of the total) are used for energy recovery (Carre 2011).
- Of the 64% of methane that is not captured, 10% (6.4% of the total) is oxidised (Australian Government 2016, Table 43) and 90% (57.6%) is released to the atmosphere.
- In summary, for every kilogram of carbon converted to landfill gas, 71.2% is released as carbon dioxide and 28.8% is released as methane.

Energy recovery

This scenario includes shredding (module C3) and combustion with recovered energy offset against average thermal energy from natural gas (module D) in line with EN 16485:2014 (Section 6.3.4.5). Note that other options are also in use within Australia, including replacement of coal, replacement of electricity, and replacement of both electricity and thermal energy (via co-generation).

Recycling

Softwood 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 woodchips from virgin softwood (module D). The CO_2 sequestered and the energy content of the wood are assumed to leave the system boundary at C3 so that future product systems can also claim these without double-counting (EN 16485:2014, Section 6.3.4.2).

Key Assumptions

Energy: Thermal energy and transport fuels have been modelled as the Australian average (see thinkstep 2017 for documentation). Electricity for production (modules A1-A3) has been modelled as a state-specific split based upon the volume of production in each state for the 2012-13 financial year (the most recent year split by state in ABARES, 2017a): 50% NSW, 40% Vic, 5% WA, 4% Tas. Electricity at end-of-life (module C) has been modelled using an average Australian electricity mix as the location where the product reaches end-of-life is unknown.

Cut-off Criteria

Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary as per the PCR (IEPDS 2017, Section 7.5.4). All other reported data were incorporated and modelled using the best available life cycle inventory data.

Allocation

Upstream data: For refinery products, allocation is done by mass and net calorific value. Inventories for electricity and thermal energy generation include allocation by economic value for some by-products (e.g. gypsum, boiler ash and fly ash). Allocation by energy is applied for co-generation of heat and power. For materials and chemicals, the allocation rule most suitable for the product is applied (see thinkstep 2017).

Co-products (e.g. sawn wood and sawdust from milling): As the difference in economic value of the co-products is high (>25% as per EN 15804, Section 6.4.3.2), allocation has been done by economic value.

Background Data

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

EPD Results

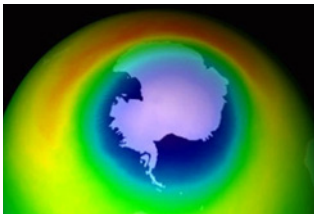
Note: these tables show the impacts associated with production and end-of-life. Any potential credits to future products from recycling or energy recovery are presented in the Other Environmental Information section.

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.

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 (ADP)→ 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.

Table 7: Environmental impacts, 1 m³ of sawn, kiln-dried softwood.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-760	61.2	392	906	906
GWPF [kg CO_2-eq.]	128	57.8	58.0	5.59	5.59
GWPB [kg CO_2-eq.]	-887	3.34	334	900	900
ODP [kg CFC11-eq.]	3.93E-11	2.79E-11	2.79E-11	2.41E-13	2.41E-13
AP [kg SO_2-eq.]	0.799	0.181	0.203	0.0352	0.0352
EP [kg PO_4^3-eq.]	0.216	0.0233	0.0287	0.00823	0.00823
POCP [kg C_2H_4-eq.]	0.551	0.0115	0.0760	0.00305	0.00305
ADPE [kg Sb-eq.]	6.39E-05	1.16E-05	1.16E-05	6.97E-08	6.97E-08
ADPF [MJ]	1,610	838	838	72.9	72.9

Table 8: Environmental impacts, 1 m³ of dressed, kiln-dried softwood.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-699	61.2	392	906	906
GWPF [kg CO_2-eq.]	183	57.8	58.0	5.59	5.59
GWPB [kg CO_2-eq.]	-882	3.34	334	900	900
ODP [kg CFC11-eq.]	4.72E-11	2.79E-11	2.79E-11	2.41E-13	2.41E-13
AP [kg SO_2-eq.]	1.10	0.181	0.203	0.0352	0.0352
EP [kg PO_4^3--eq.]	0.275	0.0233	0.0287	0.00823	0.00823
POCP [kg C_2H_4-eq.]	0.680	0.0115	0.0760	0.00305	0.00305
ADPE [kg Sb-eq.]	7.86E-05	1.16E-05	1.16E-05	6.97E-08	6.97E-08
ADPF [MJ]	2,250	838	838	72.9	72.9

Resource Use

Table 9: Resource use, 1 m³ of sawn, kiln-dried softwood.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	2,480	52.9	52.9	1.32	1.32
PERM [MJ]	9,290	0	0	-9,290	-9,290
PERT [MJ]	11,800	52.9	52.9	-9,290	-9,290
PENRE [MJ]	1,610	854	854	72.9	72.9
PENRM [MJ]	0	0	0	0	0
PENRT [MJ]	1,610	854	854	72.9	72.9
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m³]	0.955	0.00549	0.0423	7.99E-04	7.99E-04

***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 10: Resource use, 1 m³ of dressed, kiln-dried softwood.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	3,050	52.9	52.9	1.32	1.32
PERM [MJ]	9,290	0	0	-9,290	-9,290
PERT [MJ]	12,300	52.9	52.9	-9,290	-9,290
PENRE [MJ]	2,260	854	854	72.9	72.9
PENRM [MJ]	0	0	0	0	0
PENRT [MJ]	2,260	854	854	72.9	72.9
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m³]	1.36	0.00549	0.0423	7.99E-04	7.99E-04

Waste and Output Flows

Table 11: Waste categories, 1 m³ of sawn, kiln-dried softwood.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	1.06E-06	2.71E-06	2.71E-06	1.21E-07	1.21E-07
NHWD [kg]	17.7	553	456	5.02E-04	5.02E-04
RWD [kg]	0.00216	0.00608	0.00608	4.38E-06	4.38E-06
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	551
MER [kg]	0	0	0	551	0
EEE [MJ]	0	0.893	89.3	0	0
EET [MJ]	0	0	0	0	0

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

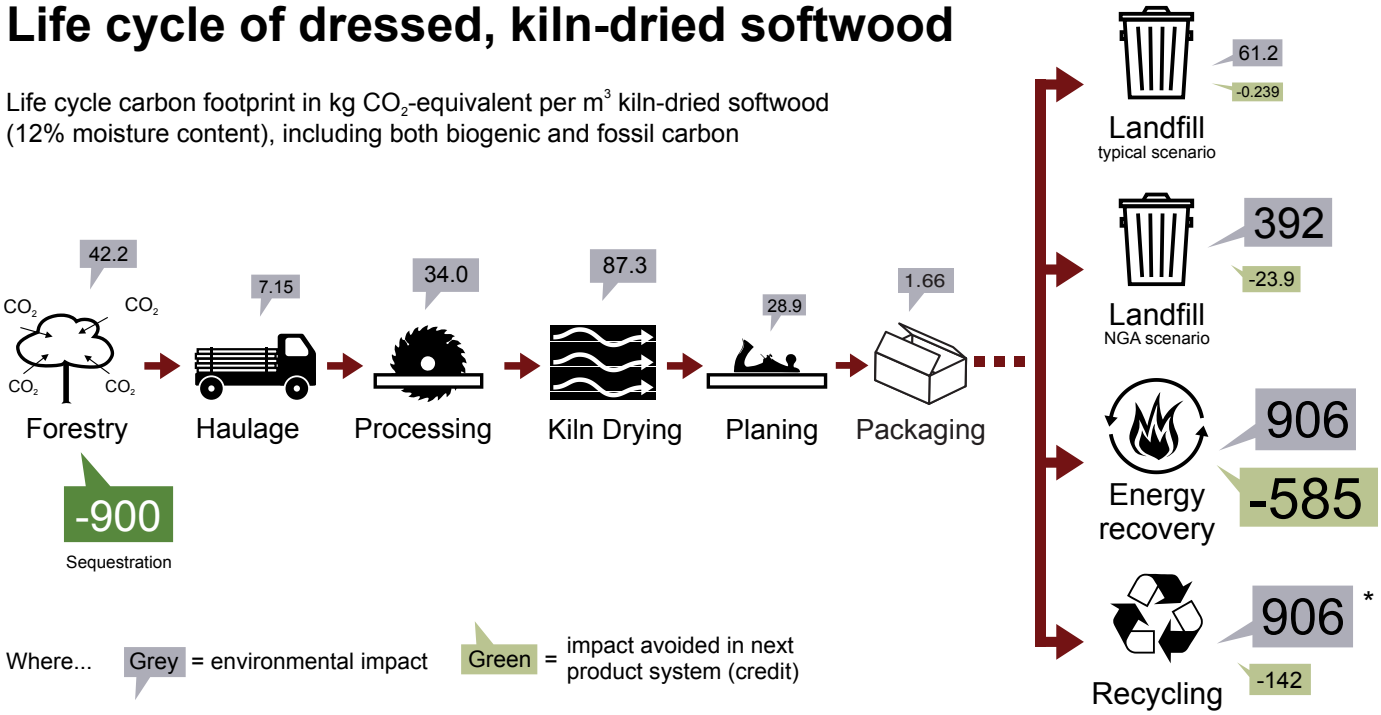
Table 12: Waste categories, 1 m³ of dressed, kiln-dried softwood.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	1.33E-06	2.71E-06	2.71E-06	1.21E-07	1.21E-07
NHWD [kg]	23.1	553	456	5.02E-04	5.02E-04
RWD [kg]	0.00253	0.00608	0.00608	4.38E-06	4.38E-06
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	551
MER [kg]	0	0	0	551	0
EEE [MJ]	0	0.893	89.3	0	0
EET [MJ]	0	0	0	0	0

Understanding the Life Cycle of Softwood Timber

Life cycle of dressed, kiln-dried softwood

Life cycle carbon footprint in kg CO_2-equivalent per m^3 kiln-dried softwood (12% moisture content), including both biogenic and fossil carbon



* While carbon is not released directly through recycling, it is passed to another product system and is therefore counted as being released

Variation in Results

The variation between sites used to create the average shown in this EPD are given in Table 13 for the environmental impact indicators in modules A1-A3.

Table 13: Inter-site variability for softwood (modules A1-A3).

	Sawn, kiln-dried softwood			Dressed, kiln-dried softwood		
Parameter [Unit]	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**
GWP [kg CO_2-eq.]	-10.7%	+15.8%	±9.2%	-17.1%	+19.6%	±11.6%
GWPF [kg CO_2-eq.]	-63.7%	+94.3%	±54.8%	-65.3%	+74.8%	±44.5%
GWPB [kg CO_2-eq.]	-0.3%	+0.3%	±0.2%	-0.5%	+0.8%	±0.4%
ODP [kg CFC11-eq.]	-8.6%	+5.8%	±5.4%	-7.5%	+10.8%	±6.7%
AP [kg SO_2-eq.]	-14.1%	+19.3%	±11.0%	-17.3%	+11.6%	±11.3%
EP [kg PO_4^3-eq.]	-11.6%	+12.3%	±7.3%	-11.6%	+9.4%	±8.8%
POCP [kg C_2H_4-eq.]	-9.8%	+8.3%	±7.1%	-10.7%	+11.7%	±9.4%
ADPE [kg Sb-eq.]	-18.6%	+12.4%	±10.1%	-20.3%	+18.6%	±11.9%
ADPF [MJ]	-69.2%	+143.1%	±75.5%	-69.3%	+120.4%	±63.4%

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

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, including wood. On average, half the dry weight of all wood is made up of the element carbon (Gifford 2000).

All major Australian production forests and plantations are independently certified to one, or both, of the internationally recognised forest management certification systems: the Australian Standard for Sustainable Forest Management (AS 4708), which is recognised under the Programme for the Endorsement of Forest Certification (PEFC), and/or one of the Forest Stewardship Council's (FSC®) interim forest management standards. It is therefore appropriate to include biogenic CO2 sequestration in this EPD in line with EN 16485 (Section 6.3.4.2).

For more information on certification by forest owner or manager please see www.forestrystandard.org.au/find-certified/certified-forest-managers and info.fsc.org/certificate.php.

Other Environmental Information

Module D: Recycling, Reuse and Recovery Potentials

Table 14: Module D, 1 m³ of sawn, kiln-dried softwood.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.239	-23.9	-585	-142
GWPF [kg CO_2-eq.]	-0.239	-23.9	-586	-135
GWPB [kg CO_2-eq.]	-4.88E-06	-4.88E-04	1.41	-6.25
ODP [kg CFC11-eq.]	-6.82E-15	-6.82E-13	-5.92E-12	-1.18E-11
AP [kg SO_2-eq.]	-0.00105	-0.105	-0.0131	-1.04
EP [kg PO_4^3--eq.]	-8.89E-05	-0.00889	-0.0242	-0.241
POCP [kg C_2H_4-eq.]	-5.49E-05	-0.00549	0.103	-0.429
ADPE [kg Sb-eq.]	-1.78E-08	-1.78E-06	-3.55E-05	-2.57E-05
ADPF [MJ]	-2.72	-272	-10,300	-1,730
Resource Use				
PERE [MJ]	-0.306	-30.6	-1.73	-2,510
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.306	-30.6	-1.73	-2,510
PENRE [MJ]	-2.72	-272	-10,300	-1,740
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-2.72	-272	-10,300	-1,740
SM [kg]	0	0	0	551
RSF [MJ]	0	0	9,290	0
NRSF [MJ]	0	0	0	0
FW [m^3]	-0.00141	-0.141	-0.00651	-0.533
Wastes and Outputs				
HWD [kg]	-3.59E-10	-3.59E-08	-7.81E-07	-5.09E-07
NHWD [kg]	-6.95E-04	-0.0695	26.4	-17.8
RWD [kg]	-3.36E-07	-3.36E-05	-2.54E-04	-6.26E-04
CRU [kg]	0	0	0	0
MFR [kg]	0	0	0	0
MER [kg]	0	0	0	0
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

Table 15: Module D, 1 m^3 of dressed, kiln-dried softwood.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.239	-23.9	-585	-142
GWPF [kg CO_2-eq.]	-0.239	-23.9	-586	-135
GWPB [kg CO_2-eq.]	-4.88E-06	-4.88E-04	1.41	-6.25
ODP [kg CFC11-eq.]	-6.82E-15	-6.82E-13	-5.92E-12	-1.18E-11
AP [kg SO_2-eq.]	-0.00105	-0.105	-0.0131	-1.04
EP [kg PO_4^3--eq.]	-8.89E-05	-0.00889	-0.0242	-0.241
POCP [kg C_2H_4-eq.]	-5.49E-05	-0.00549	0.103	-0.429
ADPE [kg Sb-eq.]	-1.78E-08	-1.78E-06	-3.55E-05	-2.57E-05
ADPF [MJ]	-2.72	-272	-10,300	-1,730
Resource Use				
PERE [MJ]	-0.306	-30.6	-1.73	-2,510
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.306	-30.6	-1.73	-2,510
PENRE [MJ]	-2.72	-272	-10,300	-1,740
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-2.72	-272	-10,300	-1,740
SM [kg]	0	0	0	551
RSF [MJ]	0	0	9,290	0
NRSF [MJ]	0	0	0	0
FW [m^3]	-0.00141	-0.141	-0.00651	-0.533
Wastes and Outputs				
HWD [kg]	-3.59E-10	-3.59E-08	-7.81E-07	-5.09E-07
NHWD [kg]	-6.95E-04	-0.0695	26.4	-17.8
RWD [kg]	-3.36E-07	-3.36E-05	-2.54E-04	-6.26E-04
CRU [kg]	0	0	0	0
MFR [kg]	0	0	0	0
MER [kg]	0	0	0	0
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

Durability and Preservative Treatment

As described in the Scope section, the body of the EPD covers untreated seasoned sawn softwood products. These products will deliver a long service life in most building, joinery and furniture applications when they are protected from termite attack and used inside a building envelope.

While the majority of seasoned sawn softwood produced in Australia for structural applications is untreated, a significant proportion is treated in the factory for termite and/or decay protection. Products to be used in outdoor applications such as decking, cladding, fencing and landscaping are usually treated to the appropriate hazard class. The following treatment types were used by the softwood producers participating in the survey and thus have been modelled:

Treatment	Hazard class
Bifenthrin	H2, H2F
Low organic solvent preservative (LOSP) (permethrin)	H2, H2F
Low organic solvent preservative (LOSP) (azole + permethrin)	H3
Copper chrome arsenic (CCA)	H3 & H4
Copper with didecyl dimethyl ammonium chloride or carbonate/bicarbonate (DDAX)	H3
Copper azole	H3 & H4

The values shown in Table 14 and Table 15 may be added to the A1-A3 values per m^3 of seasoned softwood given in Tables 7 to 12. This allows the associated A1-A3 impacts per m^3 of treated softwood to be calculated for each treatment type.

Table 16: Environmental data for preservative treatment of softwood (non-copper treatments), per m^3 of treated wood

Parameter [Unit]	Bifenthrin [H2]	Bifenthrin [H2F]	LOSP (permethrin) [H2]	LOSP (permethrin) [H2F]	LOSP (azole + permethrin) [H3]
Environmental Impact					
GWP [kg CO_2-eq.]	11.2	10.9	12.1	11.4	59.0
GWPF [kg CO_2-eq.]	11.2	10.9	12.1	11.4	58.9
GWPB [kg CO_2-eq.]	0.00527	0.00307	0.0114	0.00679	0.0892
ODP [kg CFC11-eq.]	1.77E-12	1.14E-12	3.59E-12	2.25E-12	1.51E-10
AP [kg SO_2-eq.]	0.0478	0.0470	0.0504	0.0486	0.158
EP [kg PO_4^3--eq.]	0.00409	0.00400	0.00439	0.00418	0.0149
POCP [kg C_2H_4-eq.]	0.0386	0.0230	0.0191	0.0123	6.74
ADPE [kg Sb-eq.]	3.14E-05	1.82E-05	1.02E-04	6.09E-05	2.02E-04
ADPF [MJ]	151	141	165	151	2,070
Resource Use					
PERE [MJ]	14.2	22.0	19.9	16.3	17.6
PERM [MJ]	0	0	0	0	0
PERT [MJ]	14.2	22.0	19.9	16.3	17.6
PENRE [MJ]	151	366	286	167	232
PENRM [MJ]	0	0	0	0	0
PENRT [MJ]	151	366	286	167	232
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m^3]	0.0701	0.114	0.106	0.0699	0.0902
Wastes and Outputs					
HWD [kg]	2.88E-08	1.86E-07	4.76E-04	5.24E-08	3.12E-04
NHWD [kg]	0.0384	1.46	0.165	0.0528	0.118
RWD [kg]	2.62E-04	0.00335	0.00214	7.16E-04	0.00141
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	0
MER [kg]	0	0	0	0	0
EEE [MJ]	0	0	0	0	0
EET [MJ]	0	0	0	0	0

Table 17: Environmental data for preservative treatment of softwood (copper treatments), per m^3 of treated wood.

Parameter [Unit]	Copper + DDAX [H3]	Copper azole [H3]	Copper azole [H4]	CCA [H3]	CCA [H4]
Environmental Impact					
GWP [kg CO_2-eq.]	17.8	15.3	19.2	32.5	25.1
GWPF [kg CO_2-eq.]	17.8	15.2	19.2	32.0	24.7
GWPB [kg CO_2-eq.]	0.0478	0.0314	0.0570	0.527	0.350
ODP [kg CFC11-eq.]	8.75E-11	5.74E-11	1.04E-10	8.56E-10	5.68E-10
AP [kg SO_2-eq.]	0.326	0.229	0.379	0.378	0.266
EP [kg PO_4^3--eq.]	0.00678	0.00578	0.00734	0.0120	0.00925
POCP [kg C_2H_4-eq.]	0.0146	0.0104	0.0170	0.0179	0.0127
ADPE [kg Sb-eq.]	2.90E-04	1.90E-04	3.46E-04	0.00361	0.00239
ADPF [MJ]	281	228	310	395	306
Resource Use					
PERE [MJ]	33.8	21.1	13.2	13.2	13.2
PERM [MJ]	0	0	0	0	0
PERT [MJ]	33.8	21.1	13.2	13.2	13.2
PENRE [MJ]	2,090	316	129	129	129
PENRM [MJ]	0	0	0	0	0
PENRT [MJ]	2,090	316	129	129	129
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m^3]	0.223	0.114	0.0610	0.0610	0.0610
Wastes and Outputs					
HWD [kg]	3.47E-07	5.67E-04	1.63E-08	1.63E-08	1.63E-08
NHWD [kg]	0.313	0.190	0.0300	0.0300	0.0300
RWD [kg]	0.00762	0.00255	1.47E-05	1.47E-05	1.47E-05
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	0
MER [kg]	0	0	0	0	0
EEE [MJ]	0	0	0	0	0
EET [MJ]	0	0	0	0	0

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).

PCR 2012:01 (Section 16.1) states that all water loss from a drainage basin is considered consumption, including any net loss of rain water. According to the PCR, 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).

The initial versions of this EPD (v1.0 and v1.1) included estimated losses of rain water in the main results tables, labelled as green water consumption. These values were based on calculated differences in water flow between plantation forests and a base case land use (pasture) from the original CSIRO LCI study (CSIRO 2009).

Table 18 reports green water consumption calculated by CSIRO using 2005-08 data. These values have not been updated and are now reported here rather than in the main results tables to reflect their uncertainty. At the time of writing, there is no internationally agreed method for calculating green water consumption due to evapotranspiration relative to a hypothetical natural state (Manzardo et al. 2016). As such, different calculation methods may yield significantly different results, introducing a high level of uncertainty.

The reader should also be aware that water consumption does not account for relative water stress in the catchment(s) where the forest is located, meaning that it provides no information about the potential impacts of any water consumption that does occur.

Table 18: Green water consumption estimates for modules A1-A3 from CSIRO (2009).

	Sawn, kiln-dried softwood	**Dressed, kiln-dried softwood**
Parameter [Unit]	A1-A3	A1-A3
Green water consumption in forest [m^3]	291	356

Timber & Forest Certification

Many Australian timber and reconstituted wood products are certified to a forest certification scheme. This certification is an independent auditing process which provides:

- Assurance that the timber is from well-managed forests certified to internationally and nationally accepted forest management standards
- Assurance that the timber is from legally harvested sources
- Chain of custody (CoC) certification extending from the forest to the end user, which is traceable throughout the supply chain.

Two schemes apply to Australian wood production forests. One is administered by the Australian Forestry Standard Ltd (AFS). The AFS scheme is also endorsed by the international Programme for Endorsement of Forest Certification (PEFC). The other scheme is administered by the Forest Stewardship Council (FSC®) Australia.

If a Green Star project elects to use the timber credit as part of their Green Star submission, the Green Building Council of Australia recognises PEFC-endorsed forest certification schemes (such as the Australian Forest Certification Scheme, AFCS) as well as FSC®. Compliance with the chain of custody certification rules of either forest certification scheme for at least 95% by value of timber products used in the project will meet the requirements for this credit point (GBCA 2014).

As of 2017, there are more than 26.7 million hectares of native and plantation forests certified under AFS (AFS 2017) and 1.2 million hectares certified under FSC® interim national standards (FSC 2017). In addition, many Australian softwood manufacturers' premises listed in this EPD are chain of custody certified so they can supply certified products.

Land Use and Biodiversity

Like other land uses, forestry operations for timber and wood production can have both positive and negative effects on biodiversity. However, as biodiversity varies considerably by region and as data are often limited, assessing potential biodiversity impacts within LCA is challenging.

An Australian study completed shortly before initial publication of this EPD (Turner et al. 2014) demonstrated a new method – BioImpact – to discern the biodiversity impacts of different land uses. A trial of this method was conducted using case studies in three different regions and four production systems in New South Wales: native hardwood forestry, plantation softwood forestry, mixed cropping and rangeland grazing. Managed forestry resulted in biodiversity impacts equivalent to or better than those of cropping/grazing systems.

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