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Environmental Product Declaration
Plywood

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

EPD Registration No. S-P-00564 | Version 1.2
Issued 14 October 2015 | Revised 8 December 2017 | Valid until 8 December 2022

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.

This work is supported by funding provided to FWPA by the Commonwealth Government.

978-1-925213-18-8

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

V1.2 - Revised version for correction of the validity period, documentation of the forestry carbon modelling assumptions, correction of minor typographical errors. Fixed the double counting of the artificial release of biogenic carbon that occurred in Module C and D of the Reuse EOL scenario (now the release is only included in Module C).

Produced: December 2020

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:
PCR 2012:01 Construction products and Construction services, Version 2.2, 2017-05-30

PCR review was conducted by:
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Introduction

This Environmental Product Declaration presents the average performance of plywood manufactured in Australia from Australian grown wood 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 plywood.

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

- AS/NZS 2269: 2012 Plywood – Structural – Specifications
- AS/NZS 2270: 2006 Plywood and Blockboard for Interior Use
- AS/NZS 2271: 2004 Plywood and Blockboard for Exterior Use
- AS/NZS 2272: 2006 Plywood – Marine
- AS 6669: 2007 Plywood Formwork

The environmental data presented in this document were 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 100% of plywood production in Australia.

Production of this EPD has been facilitated by FWPA with the participation of its current plywood producer members (listed below) and the Engineered Wood Products Association of Australasia (EWPAA).

Company	Financial contributor	Data contributor
Ausply Pty Ltd	X	X
Austral Plywoods Pty Ltd	X	X
Big River Group Pty Ltd	X	X
Carter Holt Harvey Woodproducts Australia	X	X
Ta Ann Tasmania Pty Ltd	X	X

Description of the Australian Plywood Industry

The Australian plywood manufacturing industry is an important contributor to the Australian economy – particularly in the regional areas where many plywood mills are based. The overall contribution of the wood products industries to the Australian GDP in 2015-16 was 0.5% [ABARES 2017). In 2015-2016, Australian plywood manufacturers produced 142,000 cubic metres of plywood products in five different facilities.

Description of Plywood Products

Plywood is a panel product made of thin veneers of wood peeled from softwood and hardwood logs and bonded by resin. Plywood products are either engineered wood panels (such as structural plywood and formwork plywood) or non-structural panels (such as interior and exterior plywood). The difference between the engineered products and the non-structural products is that engineered products have standardised structural properties, such as strength, stiffness and dimensional stability.

Plywood is used in many application areas, such as structural bracing, concrete formwork, cladding, flooring, webbed beams, boats, aircraft, door skins, furniture, wall panels and architectural joinery in exterior and interior environments.

Use of EPDs within Green Star

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 Introduction).

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 the Introduction:

- 1 m^2 of exterior plywood, A-bond, 7 mm (bracing)
- 1 m^2 of exterior plywood, A-bond, 9 mm (structural)
- 1 m^2 of formply, A-bond, 17 mm (formwork)
- 1 m^2 of formply, B-bond, 17 mm (formwork)
- 1 m^2 of plywood flooring, tongue and groove, A-bond, 15 mm (residential)
- 1 m^2 of plywood flooring, tongue and groove, A-bond, 25 mm (commercial)

Wood used in these products is from Australian grown native and exotic (non-native) softwood species grown in plantations as well as hardwood species grown in native forests. The dominant softwood species used to produce plywood 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. Hardwood species are a variety of species harvested in NSW, Queensland, Victoria and Tasmania.

The properties and material composition of these products are defined in Table 1 and Table 2 below.

Table 1: Properties of plywood products included in this EPD.

Properties	Ext 7 mm	Ext 9 mm	Form A-Bond 17 mm	Form B-Bond 17 mm	Floor 15 mm	Floor 25 mm
Area density (kg per m^2)	3.45	4.44	8.75	9.28	7.40	12.3
Density (kg per m^3)	493	493	514	546	493	493
Moisture content (dry basis)	8%	8%	8%	8%	8%	8%
Gross calorific value (MJ/kg)	21.1	21.1	21.2	20.5	21.2	21.2
Net calorific value (MJ/kg)	18.1	18.0	18.2	17.5	18.1	18.1
CO_2 sequestered (kg CO_2e)	5.61	7.24	14.0	14.6	12.0	20.0

Table 2: Composition of plywood products included in this EPD.

Materials	Ext 7 mm	Ext 9 mm	Form A-Bond 17 mm	Form B-Bond 17 mm	Floor 15 mm	Floor 25 mm
Softwood veneer (dry)	88.6%	89.0%	72.4%	55.6%	88.8%	88.5%
Hardwood veneer (dry)	0.0%	0.0%	12.9%	28.7%	0.0%	0.0%
Paper (dry)	0.0%	0.0%	2.3%	1.7%	0.0%	0.0%
Phenol formaldehyde	3.5%	3.2%	5.2%	1.1%	3.2%	3.9%
Melamine urea formaldehyde	0.0%	0.0%	0.0%	5.6%	0.0%	0.0%
Acrylic putty	0.6%	0.5%	0.0%	0.0%	0.3%	0.1%
Polypropylene (tongue)	0.0%	0.0%	0.0%	0.0%	0.3%	0.2%
Water	7.4%	7.3%	7.2%	7.4%	7.3%	7.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The data in Table 1 and Table 2 exclude packaging and any markings applied to the surface of the board. On average, packaging comprises 0.0065 m^3 softwood gluts and less than 1 kg in total of other packaging materials product (plastic strapping, steel strapping, paper labels, etc.) per cubic metre of product.

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. sawing) before being used in a building.

Representativeness

Market coverage: The data in this EPD are from detailed surveys of three of the five plywood plants in Australia. These plants collectively produced 142,391 m3 of plywood in 2015/16, which is 100% of total 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 five sites surveyed, which collectively produce all Australian-produced plywood, thus the EPD is valid for all plywood produced in Australia. 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	31410	Plywood consisting solely of sheets of wood, except of bamboo
All	ANZSIC 2006	1493	Veneer and Plywood Manufacturing

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)

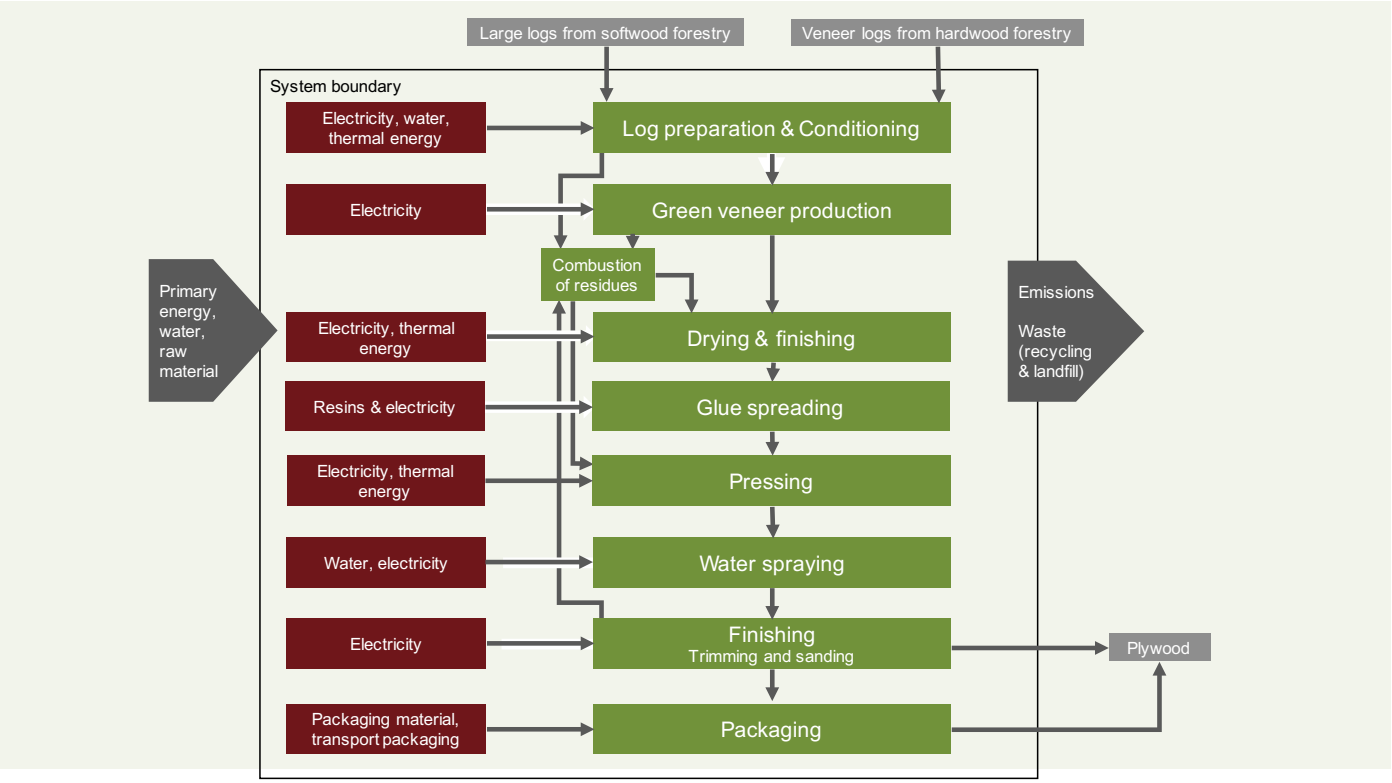
Production

Australian plywood can be produced from softwood or hardwood, with softwood plywood being the most common. This EPD represents average conditions, which includes a mixture of softwood veneer and hardwood veneer depending on the product type.

The manufacturing process starts by debarking and softening logs. Logs are then cut into billets and rotary peeled to produce veneers approximately 1.5 to 3 mm in thickness. The veneers are clipped, dried and then graded by appearance. Defects are repaired using putty.

Finished veneers are resin-bonded with the grain direction of each layer perpendicular to that of the previous layer and then hot pressed into a panel. A-bond (phenol formaldehyde) resin is most common, with B-bond (melamine urea formaldehyde) resin, used for formwork made from some hardwood species. The final board is cut to size, sanded, finished (e.g. with added grooves and polypropylene tongue for flooring) and then labelled/branded using ink or paint.

Plywood sheets are stacked in packs, held together with strapping. Some packs are also wrapped in plastic. A weighted average of all options is considered 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. Reuse is also common for plywood formwork. 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 true estimates of the DOCf value that would apply over very long time horizons (Australian Government 2014a, p. 17).

- **Landfill (typical):** DOCf = 1.4%. This is based on bioreactor laboratory research by Wang et al. (2011). This value can be considered as an upper limit for degradation of carbon in solid wood placed in a landfill.
- **Landfill (NGA)**: DOCf = 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). The modelling assumes that the product waste has value after it has been sorted.

Recycling

Plywood 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, the primary material used for the veneers (module D). The sequestered CO_2 and energy content of the wood are assumed to leave the system boundary at C3 so that future product systems can also claim these without double-counting (EN 16485:2014, Section 6.3.4.2).

Reuse (for plywood formwork only)

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^2 of primary plywood formwork in module D. The sequestered CO_2 and energy content of the wood are assumed to leave the system boundary at module C3 so that future product systems can also claim these without double-counting in line with EN 16485:2014 (Section 6.3.4.2). Any further processing, waste or transport would need to be modelled and included separately.

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 electricity consumption of the manufacturers who contributed data to this study. 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.

Forestry: All breakdown of forest matter after harvest is modelled as aerobic and therefore carbon neutral as carbon sequestered is released as carbon dioxide. Any burning of forestry material left behind after logging is modelled as being carbon neutral, aside from the trace emissions of various organic gases (Commonwealth of Australia, 2016). All forestry is assumed to be sustainably managed and as such there are no carbon emissions associated with land use change. Loss of carbon from the soil is assumed to be zero (i.e. no significant erosion). It is assumed that all timber will be replanted (plantation forest) or will regrow (native forest) after bushfires.

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. veneer, clippings and sawdust): 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. Economic data were supplied by the plywood manufacturers.

Background Data

Data for primary wood inputs use the same forestry data as FWPA EPD #01 for Softwood Timber and EPD #02 for Hardwood Timber, but with different economic allocation factors.

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

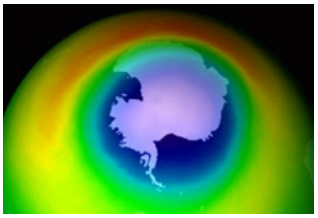
Note: these tables show the impacts associated with production and end-of-life.
Any potential credits to future products from recycling or energy recovery are presented in the Other Environmental Information section.

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 O_3), produced by the reaction of VOCs and carbon monoxide in the presence of nitrogen oxides under the influence of UV light. Ground level ozone may be harmful to human and ecosystem health and may also damage crops.

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

Table 3: Environmental impacts, 1 m² of exterior plywood, A-bond, 7 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-2.32	0.682	2.39	6.04	6.04
GWPF [kg CO_2-eq.]	3.08	0.407	0.430	0.437	0.437
GWPB [kg CO_2-eq.]	-5.40	0.275	1.96	5.61	5.61
ODP [kg CFC11-eq.]	9.74E-12	1.95E-13	1.95E-13	1.51E-15	1.51E-15
AP [kg SO_2-eq.]	0.0143	0.00128	0.00139	2.20E-04	2.20E-04
EP [kg PO_4^3-eq.]	0.00368	1.64E-04	1.93E-04	5.16E-05	5.16E-05
POCP [kg C_2H_4-eq.]	0.00679	1.29E-04	4.62E-04	1.91E-05	1.91E-05
ADPE [kg Sb-eq.]	1.60E-06	8.09E-08	8.09E-08	4.37E-10	4.37E-10
ADPF [MJ]	50.9	5.85	5.85	0.457	0.457

Table 4: Environmental impacts, 1 m² of exterior plywood, A-bond, 9 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-3.18	0.876	3.07	7.75	7.75
GWPF [kg CO_2-eq.]	3.80	0.523	0.549	0.508	0.508
GWPB [kg CO_2-eq.]	-6.98	0.353	2.52	7.24	7.24
ODP [kg CFC11-eq.]	1.10E-11	2.50E-13	2.50E-13	1.94E-15	1.94E-15
AP [kg SO_2-eq.]	0.0182	0.00164	0.00178	2.83E-04	2.83E-04
EP [kg PO_4^3-eq.]	0.00464	2.11E-04	2.48E-04	6.63E-05	6.63E-05
POCP [kg C_2H_4-eq.]	0.00852	1.66E-04	5.93E-04	2.46E-05	2.46E-05
ADPE [kg Sb-eq.]	1.94E-06	1.04E-07	1.04E-07	5.61E-10	5.61E-10
ADPF [MJ]	61.0	7.52	7.52	0.587	0.587

Table 5: Environmental impacts, 1 m² of formply, A-bond, 17 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling	Reuse
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**	**C3**
GWP [kg CO_2-eq.]	-4.22	1.69	6.06	15.4	15.4	14.0
GWPF [kg CO_2-eq.]	8.95	0.993	1.07	1.43	1.43	0
GWPB [kg CO_2-eq.]	-13.2	0.699	5.00	14.0	14.0	14.0
ODP [kg CFC11-eq.]	3.83E-11	4.73E-13	4.73E-13	3.82E-15	3.82E-15	0
AP [kg SO_2-eq.]	0.0414	0.00311	0.00339	5.58E-04	5.58E-04	0
EP [kg PO_4^3-eq.]	0.0107	4.04E-04	4.89E-04	1.31E-04	1.31E-04	0
POCP [kg C_2H_4-eq.]	0.0258	3.22E-04	0.00117	4.84E-05	4.84E-05	0
ADPE [kg Sb-eq.]	4.81E-06	1.97E-07	1.97E-07	1.11E-09	1.11E-09	0
ADPF [MJ]	160	14.2	14.2	1.16	1.16	0

Table 6: Environmental impacts, 1 m² of formply, B-bond, 17 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling	Reuse
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**	**C3**
GWP [kg CO_2-eq.]	-5.06	1.71	6.15	15.7	15.7	14.6
GWPF [kg CO_2-eq.]	8.49	0.992	1.05	1.10	1.10	0
GWPB [kg CO_2-eq.]	-13.5	0.714	5.10	14.6	14.6	14.6
ODP [kg CFC11-eq.]	3.44E-11	4.74E-13	4.74E-13	4.06E-15	4.06E-15	0
AP [kg SO_2-eq.]	0.0439	0.00312	0.00341	5.93E-04	5.93E-04	0
EP [kg PO_4^3-eq.]	0.0128	0.00124	0.00646	1.39E-04	1.39E-04	0
POCP [kg C_2H_4-eq.]	0.0311	3.25E-04	0.00119	5.14E-05	5.14E-05	0
ADPE [kg Sb-eq.]	4.36E-06	1.97E-07	1.97E-07	1.17E-09	1.17E-09	0
ADPF [MJ]	120	14.2	14.2	1.23	1.23	0

Table 7: Environmental impacts, 1 m² of plywood flooring, A-bond, 15 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-5.45	1.46	5.12	12.9	12.9
GWPF [kg CO_2-eq.]	6.16	0.872	0.918	0.896	0.896
GWPB [kg CO_2-eq.]	-11.6	0.589	4.20	12.0	12.0
ODP [kg CFC11-eq.]	1.74E-11	4.17E-13	4.17E-13	3.23E-15	3.23E-15
AP [kg SO_2-eq.]	0.0293	0.00273	0.00297	4.72E-04	4.72E-04
EP [kg PO_4^3-eq.]	0.00762	3.52E-04	4.13E-04	1.10E-04	1.10E-04
POCP [kg C_2H_4-eq.]	0.0141	2.77E-04	9.90E-04	4.10E-05	4.10E-05
ADPE [kg Sb-eq.]	4.22E-06	1.73E-07	1.73E-07	9.35E-10	9.35E-10
ADPF [MJ]	100.0	12.5	12.5	0.978	0.978

Table 8: Environmental impacts, 1 m² of plywood flooring, A-bond, 25 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-8.41	2.44	8.56	21.6	21.6
GWPF [kg CO_2-eq.]	10.8	1.46	1.54	1.63	1.63
GWPB [kg CO_2-eq.]	-19.3	0.982	7.02	20.0	20.0
ODP [kg CFC11-eq.]	3.39E-11	6.96E-13	6.96E-13	5.39E-15	5.39E-15
AP [kg SO_2-eq.]	0.0494	0.00455	0.00495	7.87E-04	7.87E-04
EP [kg PO_4^3-eq.]	0.0129	5.87E-04	6.89E-04	1.84E-04	1.84E-04
POCP [kg C_2H_4-eq.]	0.0241	4.62E-04	0.00165	6.83E-05	6.83E-05
ADPE [kg Sb-eq.]	6.59E-06	2.89E-07	2.89E-07	1.56E-09	1.56E-09
ADPF [MJ]	182	20.9	20.9	1.63	1.63

Resource Use

Table 9: Resource use, 1 m² of exterior plywood, A-bond, 7 mm

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	40.8	0.369	0.369	0.00829	0.00829
PERM [MJ]	58.7	0	0	-58.7	-58.7
PERT [MJ]	99.5	0.369	0.369	-58.7	-58.7
PENRE [MJ]	51.3	5.96	5.96	0.457	0.457
PENRM [MJ]	4.36	0	0	-4.36	-4.36
PENRT [MJ]	55.7	5.96	5.96	-3.90	-3.90
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m³]	0.0314	6.52E-05	2.56E-04	5.01E-06	5.01E-06

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 m² of exterior plywood, A-bond, 9 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	51.4	0.475	0.475	0.0107	0.0107
PERM [MJ]	75.9	0	0	-75.9	-75.9
PERT [MJ]	127	0.475	0.475	-75.9	-75.9
PENRE [MJ]	61.5	7.66	7.66	0.587	0.587
PENRM [MJ]	5.01	0	0	-5.01	-5.01
PENRT [MJ]	66.5	7.66	7.66	-4.42	-4.42
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m³]	0.0398	8.37E-05	3.28E-04	6.44E-06	6.44E-06

Table 11: Resource use, 1 m² of exterior plywood, A-bond, 17 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling	Reuse
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**	**C3**
PERE [MJ]	117	0.897	0.897	0.0210	0.0210	0
PERM [MJ]	146	0	0	-146	-146	-146
PERT [MJ]	264	0.897	0.897	-146	-146	-146
PENRE [MJ]	162	14.5	14.5	1.16	1.16	0
PENRM [MJ]	14.4	0	0	-14.4	-14.4	-14.4
PENRT [MJ]	176	14.5	14.5	-13.2	-13.2	-14.4
SM [kg]	0	0	0	0	0	0
RSF [MJ]	0	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0	0
FW [m³]	0.0904	1.64E-04	6.50E-04	1.27E-05	1.27E-05	0

Table 12: Resource use, 1 m² of formply, B-bond, 17 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling	Reuse
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**	**C3**
PERE [MJ]	97.9	0.898	0.898	0.0223	0.0223	0
PERM [MJ]	152	0	0	-152	-152	-152
PERT [MJ]	249	0.898	0.898	-152	-152	-152
PENRE [MJ]	121	14.5	14.5	1.23	1.23	0
PENRM [MJ]	12.9	0	0	-12.9	-12.9	-12.9
PENRT [MJ]	134	14.5	14.5	-11.7	-11.7	-12.9
SM [kg]	0	0	0	0	0	0
RSF [MJ]	0	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0	0
FW [m³]	0.0935	1.67E-04	6.61E-04	1.35E-05	1.35E-05	0

Table 13: Resource use, 1 m² of plywood flooring, A-bond, 15 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	85.4	0.791	0.791	0.0177	0.0177
PERM [MJ]	132	0	0	-132	-132
PERT [MJ]	218	0.791	0.791	-132	-132
PENRE [MJ]	101	12.8	12.8	0.978	0.978
PENRM [MJ]	9.53	0	0	-9.53	-9.53
PENRT [MJ]	111	12.8	12.8	-8.56	-8.56
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m³]	0.0638	1.40E-04	5.47E-04	1.07E-05	1.07E-05

Table 14: Resource use, 1 m² of plywood flooring, A-bond, 25 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	146	1.32	1.32	0.0296	0.0296
PERM [MJ]	210	0	0	-210	-210
PERT [MJ]	356	1.32	1.32	-210	-210
PENRE [MJ]	184	21.3	21.3	1.63	1.63
PENRM [MJ]	16.5	0	0	-16.5	-16.5
PENRT [MJ]	200	21.3	21.3	-14.8	-14.8
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m³]	0.109	2.33E-04	9.14E-04	1.79E-05	1.79E-05

Table 15: Waste categories, 1 m² of interior plywood, A-bond, 7 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	2.60E-08	1.80E-08	1.80E-08	7.57E-10	7.57E-10
NHWD [kg]	0.305	3.39	2.89	3.15E-06	3.15E-06
RWD [kg]	1.55E-04	4.25E-05	4.25E-05	2.74E-08	2.74E-08
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	3.45
MER [kg]	0	0	0	3.45	0
EEE [MJ]	0	0.0744	0.531	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 16: Waste categories, 1 m2 of exterior plywood, A-bond, 9 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	3.15E-08	2.32E-08	2.32E-08	9.73E-10	9.73E-10
NHWD [kg]	0.386	4.36	3.72	4.04E-06	4.04E-06
RWD [kg]	1.78E-04	5.47E-05	5.47E-05	3.53E-08	3.53E-08
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	4.44
MER [kg]	0	0	0	4.44	0
EEE [MJ]	0	0.0954	0.681	0	0
EET [MJ]	0	0	0	0	0

Table 17: Waste categories, 1 m² of formply, A-bond, 17 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling	Reuse
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**	**C3**
HWD [kg]	1.96E-07	4.46E-08	4.46E-08	1.92E-09	1.92E-09	0
NHWD [kg]	0.804	8.58	7.30	7.97E-06	7.97E-06	0
RWD [kg]	6.19E-04	1.03E-04	1.03E-04	6.95E-08	6.95E-08	0
CRU [kg]	0	0	0	0	0	8.75
MFR [kg]	0	0	0	0	8.75	0
MER [kg]	0	0	0	8.75	0	0
EEE [MJ]	0	0.190	1.36	0	0	0
EET [MJ]	0	0	0	0	0	0

Table 18: Waste categories, 1 m² of formply, B-bond, 17 mm.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling	Reuse
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**	**C3**
HWD [kg]	1.29E-07	4.59E-08	4.59E-08	2.04E-09	2.04E-09	0
NHWD [kg]	0.765	9.11	7.79	8.46E-06	8.46E-06	0
RWD [kg]	6.93E-04	1.03E-04	1.03E-04	7.38E-08	7.38E-08	0
CRU [kg]	0	0	0	0	0	9.28
MFR [kg]	0	0	0	0	9.28	0
MER [kg]	0	0	0	9.28	0	0
EEE [MJ]	0	0.193	1.38	0	0	0
EET [MJ]	0	0	0	0	0	0

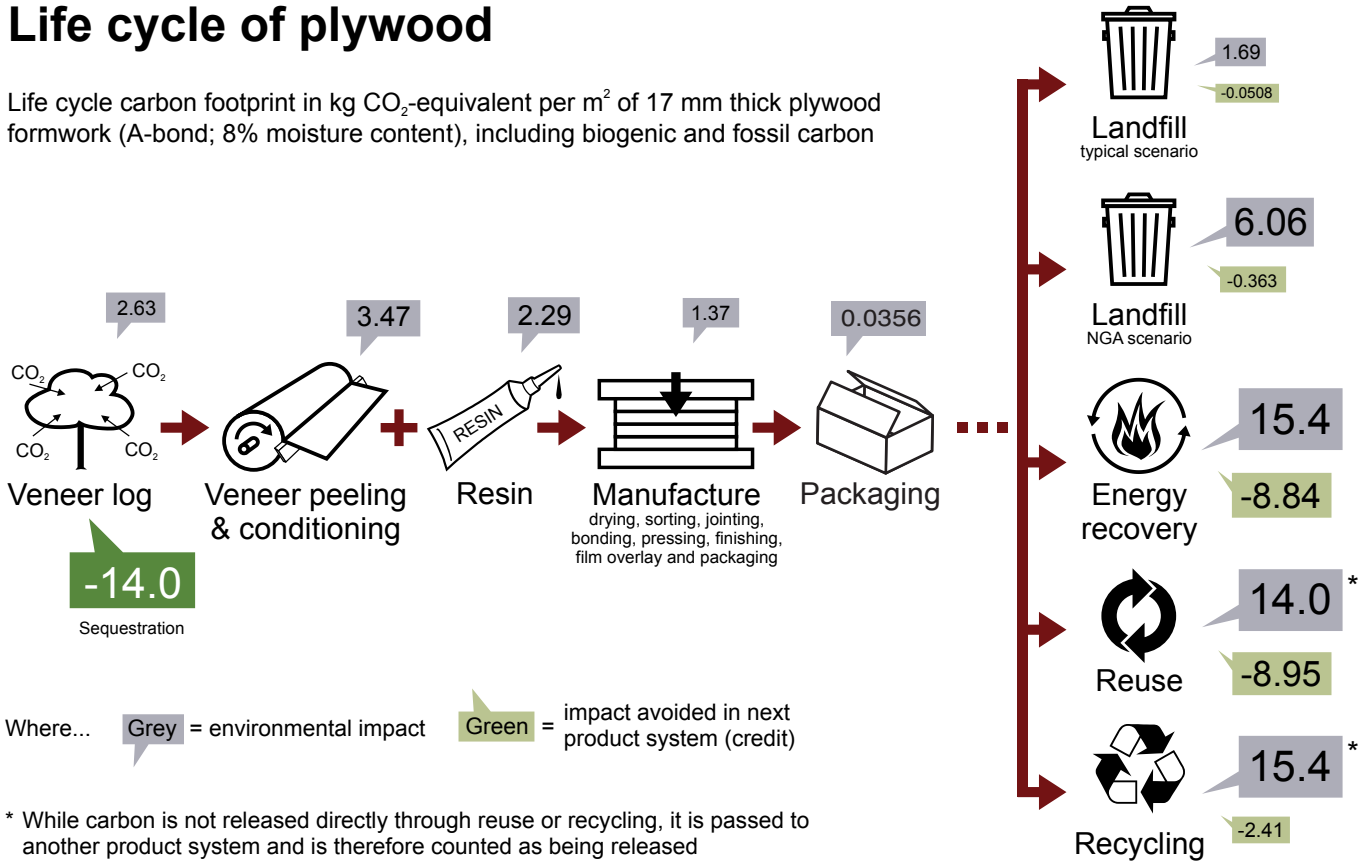
Table 19: Waste categories, 1 m² of plywood flooring, A-bond, 15 mm

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	5.24E-08	3.86E-08	3.86E-08	1.62E-09	1.62E-09
NHWD [kg]	0.634	7.26	6.19	6.74E-06	6.74E-06
RWD [kg]	3.19E-04	9.11E-05	9.11E-05	5.88E-08	5.88E-08
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	7.40
MER [kg]	0	0	0	7.40	0
EEE [MJ]	0	0.159	1.14	0	0
EET [MJ]	0	0	0	0	0

Table 20: Waste categories, 1 m² of plywood flooring, A-bond, 25 mm

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	9.39E-08	6.44E-08	6.44E-08	2.70E-09	2.70E-09
NHWD [kg]	1.06	12.1	10.3	1.12E-05	1.12E-05
RWD [kg]	5.73E-04	1.52E-04	1.52E-04	9.79E-08	9.79E-08
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	12.3
MER [kg]	0	0	0	12.3	0
EEE [MJ]	0	0.266	1.90	0	0
EET [MJ]	0	0	0	0	0

Understanding the Life Cycle of Plywood



Variation in Results

The data in this EPD are an average from multiple producers; however, there can be considerable variation between producers. Please contact your timber supplier if you require data on a specific product from that supplier.

Table 21: Inter-site variability for exterior plywood (modules A1-A3).

	Ext 7 mm			Ext 9 mm		
Parameter [Unit]	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**
GWP [kg CO_2-eq.]	-16.3%	+80.5%	±28.1%	-8.3%	+91.3%	±40.7%
GWPF [kg CO_2-eq.]	-2.0%	+48.2%	±22.1%	-7.8%	+76.1%	±34.3%
GWPB [kg CO_2-eq.]	-6.8%	+8.1%	±0.6%	-0.9%	+0.4%	±0.6%
ODP [kg CFC11-eq.]	-6.1%	+96.1%	±47.6%	-15.5%	+159.9%	±82.1%
AP [kg SO_2-eq.]	-17.5%	+28.6%	±19.2%	-20.4%	+47.5%	±27.8%
EP [kg PO_4^3-eq.]	-15.3%	+11.2%	±11.5%	-16.6%	+22.0%	±16.0%
POCP [kg C_2H_4-eq.]	-22.6%	+13.2%	±14.6%	-23.5%	+11.5%	±16.0%
ADPE [kg Sb-eq.]	-1.1%	+30.2%	±14.5%	-4.9%	+56.1%	±28.3%
ADPF [MJ]	-12.7%	+62.8%	±34.7%	-18.5%	+99.0%	±48.5%

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

Table 22: Inter-site variability for formply (modules A1-A3).

	Form A-Bond 17 mm			Form B-Bond 17 mm		
Parameter [Unit]	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**
GWP [kg CO_2-eq.]	-134.3%	+109.3%	±99.5%	-40.4%	+40.4%	±0.0%
GWPF [kg CO_2-eq.]	-43.3%	+47.8%	±37.2%	-22.8%	+22.8%	±0.0%
GWPB [kg CO_2-eq.]	-13.6%	+2.5%	±7.0%	-0.8%	+0.8%	±0.0%
ODP [kg CFC11-eq.]	-42.1%	+13.5%	±23.3%	-1.0%	+1.0%	±0.0%
AP [kg SO_2-eq.]	-13.9%	+8.3%	±9.7%	-17.4%	+17.4%	±0.0%
EP [kg PO_4^3-eq.]	-13.1%	+18.1%	±12.9%	-19.2%	+19.2%	±0.0%
POCP [kg C_2H_4-eq.]	-39.9%	+121.6%	±71.5%	-17.6%	+17.6%	±0.0%
ADPE [kg Sb-eq.]	-25.2%	+4.5%	±13.2%	-8.2%	+8.2%	±0.0%
ADPF [MJ]	-46.0%	+59.1%	±43.4%	-19.3%	+19.3%	±0.0%

Table 23: Inter-site variability for plywood flooring (modules A1-A3).

	Floor 15 mm			Floor 25 mm		
Parameter [Unit]	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**
GWP [kg CO_2-eq.]	-0.5%	+49.4%	±24.5%	-14.6%	+81.6%	±33.5%
GWPF [kg CO_2-eq.]	-0.5%	+45.3%	±22.9%	-2.3%	+51.3%	±26.8%
GWPB [kg CO_2-eq.]	-0.9%	+0.5%	±0.7%	-6.7%	+7.7%	±0.5%
ODP [kg CFC11-eq.]	-5.0%	+8.3%	±6.6%	-9.9%	+10.1%	±10.0%
AP [kg SO_2-eq.]	-16.5%	+14.4%	±15.4%	-9.8%	+13.5%	±11.7%
EP [kg PO_4^3-eq.]	-14.8%	+10.8%	±12.8%	-9.4%	+8.7%	±9.0%
POCP [kg C_2H_4-eq.]	-22.5%	+12.8%	±17.7%	-18.2%	+9.9%	±14.0%
ADPE [kg Sb-eq.]	-22.9%	+8.5%	±15.7%	-8.1%	+5.7%	±6.9%
ADPF [MJ]	-11.0%	+66.1%	±38.6%	-14.1%	+69.7%	±41.9%

Carbon Dioxide Sequestration

During growth, trees absorb carbon dioxide (CO2) 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).

Module D: Recycling, Reuse and Recovery Potentials

Table 24: Module D, 1 m² of exterior plywood, A-bond, 7 mm.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0199	-0.142	-3.63	-0.991
GWPF [kg CO_2-eq.]	-0.0199	-0.142	-3.64	-0.947
GWPB [kg CO_2-eq.]	-4.06E-07	-2.90E-06	0.00886	-0.0438
ODP [kg CFC11-eq.]	-5.68E-16	-4.06E-15	7.26E-15	-8.26E-14
AP [kg SO_2-eq.]	-8.77E-05	-6.26E-04	-5.35E-04	-0.00730
EP [kg PO_4^3-eq.]	-7.40E-06	-5.29E-05	-2.63E-04	-0.00169
POCP [kg C_2H_4-eq.]	-4.57E-06	-3.27E-05	6.06E-04	-0.00300
ADPE [kg Sb-eq.]	-1.48E-09	-1.06E-08	-2.39E-07	-1.80E-07
ADPF [MJ]	-0.227	-1.62	-69.7	-12.1
Resource Use				
PERE [MJ]	-0.0255	-0.182	-0.00511	-17.5
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0255	-0.182	-0.00511	-17.5
PENRE [MJ]	-0.227	-1.62	-69.7	-12.1
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.227	-1.62	-69.7	-12.1
SM [kg]	0	0	0	3.45
RSF [MJ]	0	0	58.7	0
NRSF [MJ]	0	0	4.36	0
FW [m^3]	-1.18E-04	-8.40E-04	6.59E-04	-0.00373
Wastes and Outputs				
HWD [kg]	-2.99E-11	-2.14E-10	-5.33E-09	-3.56E-09
NHWD [kg]	-5.79E-05	-4.13E-04	0.165	-0.125
RWD [kg]	-2.79E-08	-2.00E-07	1.27E-06	-4.38E-06
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 25: Module D, 1 m² of exterior plywood, A-bond, 9 mm.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0255	-0.182	-4.70	-1.27
GWPF [kg CO_2-eq.]	-0.0255	-0.182	-4.71	-1.22
GWPB [kg CO_2-eq.]	-5.21E-07	-3.72E-06	0.0114	-0.0563
ODP [kg CFC11-eq.]	-7.29E-16	-5.20E-15	2.66E-15	-1.06E-13
AP [kg SO_2-eq.]	-1.12E-04	-8.03E-04	-6.37E-04	-0.00939
EP [kg PO_4^3-eq.]	-9.49E-06	-6.78E-05	-3.26E-04	-0.00217
POCP [kg C_2H_4-eq.]	-5.86E-06	-4.19E-05	7.87E-04	-0.00386
ADPE [kg Sb-eq.]	-1.90E-09	-1.35E-08	-3.07E-07	-2.32E-07
ADPF [MJ]	-0.291	-2.08	-89.4	-15.6
Resource Use				
PERE [MJ]	-0.0327	-0.233	-0.00749	-22.6
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0327	-0.233	-0.00749	-22.6
PENRE [MJ]	-0.291	-2.08	-89.4	-15.6
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.291	-2.08	-89.4	-15.6
SM [kg]	0	0	0	4.44
RSF [MJ]	0	0	75.9	0
NRSF [MJ]	0	0	5.01	0
FW [m^3]	-1.51E-04	-0.00108	7.46E-04	-0.00480
Wastes and Outputs				
HWD [kg]	-3.84E-11	-2.74E-10	-6.84E-09	-4.58E-09
NHWD [kg]	-7.42E-05	-5.30E-04	0.213	-0.160
RWD [kg]	-3.58E-08	-2.56E-07	1.21E-06	-5.64E-06
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 26: Module D, 1 m² of formply, A-bond, 17 mm.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling	Reuse
Environmental Impact					
GWP [kg CO_2-eq.]	-0.0508	-0.363	-8.84	-2.41	-8.95
GWPF [kg CO_2-eq.]	-0.0508	-0.363	-8.86	-2.30	-8.95
GWPB [kg CO_2-eq.]	-1.04E-06	-7.42E-06	0.0221	-0.106	0
ODP [kg CFC11-eq.]	-1.45E-15	-1.04E-14	7.29E-14	-2.00E-13	-3.83E-11
AP [kg SO_2-eq.]	-2.24E-04	-0.00160	-0.00165	-0.0177	-0.0414
EP [kg PO_4^3-eq.]	-1.89E-05	-1.35E-04	-7.34E-04	-0.00410	-0.0107
POCP [kg C_2H_4-eq.]	-1.17E-05	-8.35E-05	0.00148	-0.00728	-0.0258
ADPE [kg Sb-eq.]	-3.78E-09	-2.70E-08	-6.07E-07	-4.38E-07	-4.81E-06
ADPF [MJ]	-0.580	-4.14	-177	-29.5	-160
Resource Use					
PERE [MJ]	-0.0651	-0.465	-0.00521	-42.6	-117
PERM [MJ]	0	0	0	0	0
PERT [MJ]	-0.0651	-0.465	-0.00521	-42.6	-117
PENRE [MJ]	-0.580	-4.14	-177	-29.5	-162
PENRM [MJ]	0	0	0	0	-14.4
PENRT [MJ]	-0.580	-4.14	-177	-29.5	-176
SM [kg]	0	0	0	8.75	8.75
RSF [MJ]	0	0	146	0	0
NRSF [MJ]	0	0	14.4	0	0
FW [m^3]	-3.01E-04	-0.00215	0.00248	-0.00906	-0.0904
Wastes and Outputs					
HWD [kg]	-7.65E-11	-5.46E-10	-1.36E-08	-8.65E-09	-1.96E-07
NHWD [kg]	-1.48E-04	-0.00106	0.410	-0.303	-0.804
RWD [kg]	-7.14E-08	-5.10E-07	6.69E-06	-1.06E-05	-6.19E-04
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 27: Module D, 1 m² of formply, B-bond, 17 mm.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling	Reuse
Environmental Impact					
GWP [kg CO_2-eq.]	-0.0517	-0.369	-9.28	-2.41	-8.49
GWPF [kg CO_2-eq.]	-0.0517	-0.369	-9.31	-2.30	-8.49
GWPB [kg CO_2-eq.]	-1.06E-06	-7.54E-06	0.0233	-0.106	0
ODP [kg CFC11-eq.]	-1.48E-15	-1.05E-14	1.85E-13	-2.00E-13	-3.44E-11
AP [kg SO_2-eq.]	-2.28E-04	-0.00163	0.00337	-0.0177	-0.0439
EP [kg PO_4^3-eq.]	-1.92E-05	-1.37E-04	5.75E-04	-0.00410	-0.0128
POCP [kg C_2H_4-eq.]	-1.19E-05	-8.48E-05	0.00184	-0.00728	-0.0311
ADPE [kg Sb-eq.]	-3.84E-09	-2.74E-08	-6.07E-07	-4.38E-07	-4.36E-06
ADPF [MJ]	-0.589	-4.21	-180	-29.5	-120
Resource Use					
PERE [MJ]	-0.0661	-0.472	0.0636	-42.6	-97.9
PERM [MJ]	0	0	0	0	0
PERT [MJ]	-0.0661	-0.472	0.0636	-42.6	-97.9
PENRE [MJ]	-0.589	-4.21	-180	-29.5	-121
PENRM [MJ]	0	0	0	0	-12.9
PENRT [MJ]	-0.589	-4.21	-180	-29.5	-134
SM [kg]	0	0	0	9.28	9.28
RSF [MJ]	0	0	152	0	0
NRSF [MJ]	0	0	12.9	0	0
FW [m^3]	-3.05E-04	-0.00218	0.00285	-0.00906	-0.0935
Wastes and Outputs					
HWD [kg]	-7.77E-11	-5.55E-10	-1.36E-08	-8.65E-09	-1.29E-07
NHWD [kg]	-1.50E-04	-0.00107	0.428	-0.303	-0.765
RWD [kg]	-7.26E-08	-5.18E-07	2.35E-05	-1.06E-05	-6.93E-04
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 28: Module D, 1 m² of plywood flooring, A-bond, 15 mm.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0426	-0.304	-8.27	-2.12
GWPF [kg CO_2-eq.]	-0.0426	-0.304	-8.29	-2.03
GWPB [kg CO_2-eq.]	-8.70E-07	-6.22E-06	0.0191	-0.0938
ODP [kg CFC11-eq.]	-1.22E-15	-8.69E-15	9.46E-16	-1.77E-13
AP [kg SO_2-eq.]	-1.88E-04	-0.00134	-0.00175	-0.0156
EP [kg PO_4^3-eq.]	-1.59E-05	-1.13E-04	-7.11E-04	-0.00362
POCP [kg C_2H_4-eq.]	-9.79E-06	-6.99E-05	0.00125	-0.00643
ADPE [kg Sb-eq.]	-3.17E-09	-2.26E-08	-5.38E-07	-3.86E-07
ADPF [MJ]	-0.486	-3.47	-157	-26.0
Resource Use				
PERE [MJ]	-0.0545	-0.390	-0.0141	-37.6
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0545	-0.390	-0.0141	-37.6
PENRE [MJ]	-0.486	-3.47	-157	-26.0
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.486	-3.47	-157	-26.0
SM [kg]	0	0	0	7.40
RSF [MJ]	0	0	132	0
NRSF [MJ]	0	0	9.53	0
FW [m^3]	-2.52E-04	-0.00180	0.00126	-0.00800
Wastes and Outputs				
HWD [kg]	-6.41E-11	-4.58E-10	-1.21E-08	-7.63E-09
NHWD [kg]	-1.24E-04	-8.85E-04	0.353	-0.267
RWD [kg]	-5.98E-08	-4.27E-07	1.84E-06	-9.39E-06
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 29: Module D, 1 m² of plywood flooring, A-bond, 25 mm.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0712	-0.508	-12.9	-3.54
GWPF [kg CO_2-eq.]	-0.0712	-0.508	-13.0	-3.38
GWPB [kg CO_2-eq.]	-1.45E-06	-1.04E-05	0.0315	-0.156
ODP [kg CFC11-eq.]	-2.03E-15	-1.45E-14	4.04E-14	-2.95E-13
AP [kg SO_2-eq.]	-3.14E-04	-0.00224	-0.00212	-0.0261
EP [kg PO_4^3-eq.]	-2.65E-05	-1.89E-04	-9.88E-04	-0.00603
POCP [kg C_2H_4-eq.]	-1.64E-05	-1.17E-04	0.00213	-0.0107
ADPE [kg Sb-eq.]	-5.29E-09	-3.78E-08	-8.59E-07	-6.44E-07
ADPF [MJ]	-0.811	-5.80	-250	-43.3
Resource Use				
PERE [MJ]	-0.0911	-0.651	-0.0164	-62.6
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0911	-0.651	-0.0164	-62.6
PENRE [MJ]	-0.812	-5.80	-250	-43.4
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.812	-5.80	-250	-43.4
SM [kg]	0	0	0	12.3
RSF [MJ]	0	0	210	0
NRSF [MJ]	0	0	16.5	0
FW [m^3]	-4.21E-04	-0.00301	0.00258	-0.0133
Wastes and Outputs				
HWD [kg]	-1.07E-10	-7.65E-10	-1.92E-08	-1.27E-08
NHWD [kg]	-2.07E-04	-0.00148	0.586	-0.445
RWD [kg]	-1.00E-07	-7.14E-07	5.47E-06	-1.57E-05
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

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 version of this EPD (v1.0) 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 30 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 30: Green water consumption estimates for modules A1-A3 from CSIRO (2009).

	Ext 7 mm	Ext 9 mm	Form A-Bond 17 mm	Form B-Bond 17 mm	Floor 15 mm	Floor 25 mm
Parameter [Unit]	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Green water consumption in forest [m3]	4.69	5.88	14.7	15.1	9.81	16.8

Timber & Forest Certification

Many Australian timber and reconstituted wood products are certified to a forest certification scheme. This certification is an independent auditing process that 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 26.7million hectares of native and plantation forests certified under AFS (AFS 2017) and 1.2 million hectares certified under FSC® interim national standards (FSC 2017).

All Australian plywood manufacturers 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.

Indoor Environment Quality – Formaldehyde Emissions Minimisation

Formaldehyde is a colourless, strong-smelling gas that occurs naturally in the environment. It is present in the air that we breathe at natural background levels of about 0.03 parts per million (ppm) and up to 0.08 ppm in outdoor urban air (EWPAA 2012). Formaldehyde is used as an ingredient in synthetic resins, industrial chemicals and preservatives, and in the production of paper, textiles, cosmetics, disinfectants, medicines, paints, varnishes and lubricants.

The majority (>90%) of plywood products are manufactured in Australia using the adhesive phenol formaldehyde (PF). A small volume (<10%) is produced using an amino plastic, which includes melamine urea formaldehyde (MUF) and urea formaldehyde (UF).

To assure end users that they are using plywood with the lowest possible formaldehyde emissions, an industry-wide formaldehyde testing and labelling program is run by the Engineered Wood Products Association of Australasia. All mills are required to forward samples to EWPAA's National Laboratory on a regular basis for formaldehyde emission testing. On the basis of these laboratory tests, certified mills are permitted to brand a formaldehyde emission class on their plywood products as detailed in Table 27.

Table 31: Formaldehyde emission classes.

Emission class	Emission limit (mg/litre)	Emission limit (ppm)*	Adhesive associated with emission class
Super E0 / (equivalent to F☆☆☆☆)	Less than or equal to 0.3	Less than or equal to 0.03	A-bond (phenol formaldehyde)
E0	Less than or equal to 0.5	Less than or equal to 0.04	B and C bonds (melamine urea formaldehyde and urea formaldehyde)
E1	Less than or equal to 1.0	Less than or equal to 0.08	B and C bonds (melamine urea formaldehyde and urea formaldehyde)

** Based on a test chamber volume of 10litre, zero airflow during the 24hr test cycle, molecular weight of formaldehyde 30.03 and the number of microlitres of formaldehyde gas in 1 micromole at 101KPa and 298K.*

All Australian manufacturers listed in this EPD can supply test certificates that support their emission class.

Plywood with formaldehyde emissions less than or equal to Super E0 (the majority of Australian produced plywood products) are compliant with the Green Star Formaldehyde credit. Other plywood products, which have emissions less than or equal to E1, are also compliant. To achieve credit point(s) all engineered wood products such as particleboard, MDF and plywood used in the project must be in accordance with these requirements.

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