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Environmental Product Declaration
Medium Density Fibreboard (MDF)

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

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Geographical Scope: Australia

WoodSolutions design and build woodsolutions.com.au

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)

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 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 and correction of minor typographical errors.

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

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PCR review was conducted by:
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☑ EPD verification (External)

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Introduction

This Environmental Product Declaration presents the average performance of medium density fibreboard (MDF) manufactured in Australia from Australian grown wood residues 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 MDF.

This EPD has been prepared in accordance with ISO 14025:2006, EN 15804:2013 and PCR 2012:01 (IEPDS 2017). It covers standard and moisture resistant MDF panels that have a decorative overlay produced in accordance with the following standards:

- AS/NZS 1859.2:2004 Reconstituted wood-based panels – Specifications – Dry-processed fibreboard
- AS/NZS 1859.3:2005 Reconstituted wood-based panels – Specifications – Decorative overlaid wood panels

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 100% of total MDF production in Australia.

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

The following companies contributed to this EPD financially and by contributing data:

Company	Financial contributor	Data contributor
Alpine MDF Industries Pty Ltd	X	X
Borg Panels	X	X
The Laminex Group	X	X

Description of the Australian MDF Industry

The Australian MDF industry is an important contributor to the Australian economy – particularly to the regional economies where 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 MDF manufacturers produced 615,708 cubic metres of MDF products in three different facilities.

Description of MDF Products

MDF is a composite panel valued for its homogeneity that allows precision joinery work and finishing. These properties have led to MDF being widely used to manufacture furniture, kitchen cabinets, doors and mouldings. MDF panels are composed of wood residues (from softwood plantation management thinnings, timber harvesting and softwood manufacturing), resin and wax.

Use of EPDs in 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 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 MDF, 16 mm E0 & E1 standard melamine coated
- 1 m^2 of MDF, 18 mm E0 & E1 standard melamine coated
- 1 m^2 of MDF, 25 mm E0 & E1 standard melamine coated
- 1 m^2 of MDF, 16 mm E0 & E1 moisture resistant (MR) melamine coated
- 1 m^2 of MDF, 18 mm E0 & E1 moisture resistant (MR) melamine coated
- 1 m^2 of MDF, 25 mm E0 & E1 moisture resistant (MR) melamine coated

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

Table 1: Properties of MDF products included in this EPD

Properties	Std 16mm	Std 18 mm	Std 25 mm	MR 16 mm	MR 18 mm	MR 25 mm
Area density (kg per m^2)	11.6	13.0	17.5	11.7	13.0	17.6
Density (kg per m^3)	724	722	701	732	721	705
Moisture content (dry basis)	7%	7%	7%	7%	7%	7%
Gross calorific value (MJ/kg)	20.6	20.5	20.6	20.7	20.7	20.6
Net calorific value (MJ/kg)	17.7	17.7	17.8	17.8	17.8	17.8
CO_2 sequestered (kg CO_2e)	17.5	19.8	26.1	17.5	19.4	26.1

Table 2: Composition of MDF products included in this EPD

Materials	Std 16mm	Std 18 mm	Std 25 mm	MR 16 mm	MR 18 mm	MR 25 mm
Softwood (dry)	81.8%	82.4%	80.7%	80.8%	81.0%	80.3%
Urea formaldehyde	4.7%	7.2%	3.3%	0.0%	0.0%	0.0%
Melamine formaldehyde	0.8%	0.7%	0.6%	0.7%	0.6%	0.6%
Melamine urea formaldehyde	4.7%	1.9%	7.7%	10.3%	10.5%	11.5%
Paraffin wax	0.6%	0.5%	0.6%	0.7%	0.6%	0.6%
Lamination paper (dry)	0.7%	0.6%	0.5%	0.6%	0.6%	0.5%
Water	6.7%	6.6%	6.6%	6.8%	6.6%	6.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

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 three MDF plants in Australia. These plants collectively produced 615,708 m3 of MDF 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 three sites surveyed, which collectively produce all Australian-produced MDF, thus the EPD is valid for all MDF 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	31440	Fibreboard of wood or other ligneous materials
All	ANZSIC 2006	1494	Reconstituted Wood Product Manufacturing

LCA Calculation Rules

System Boundary

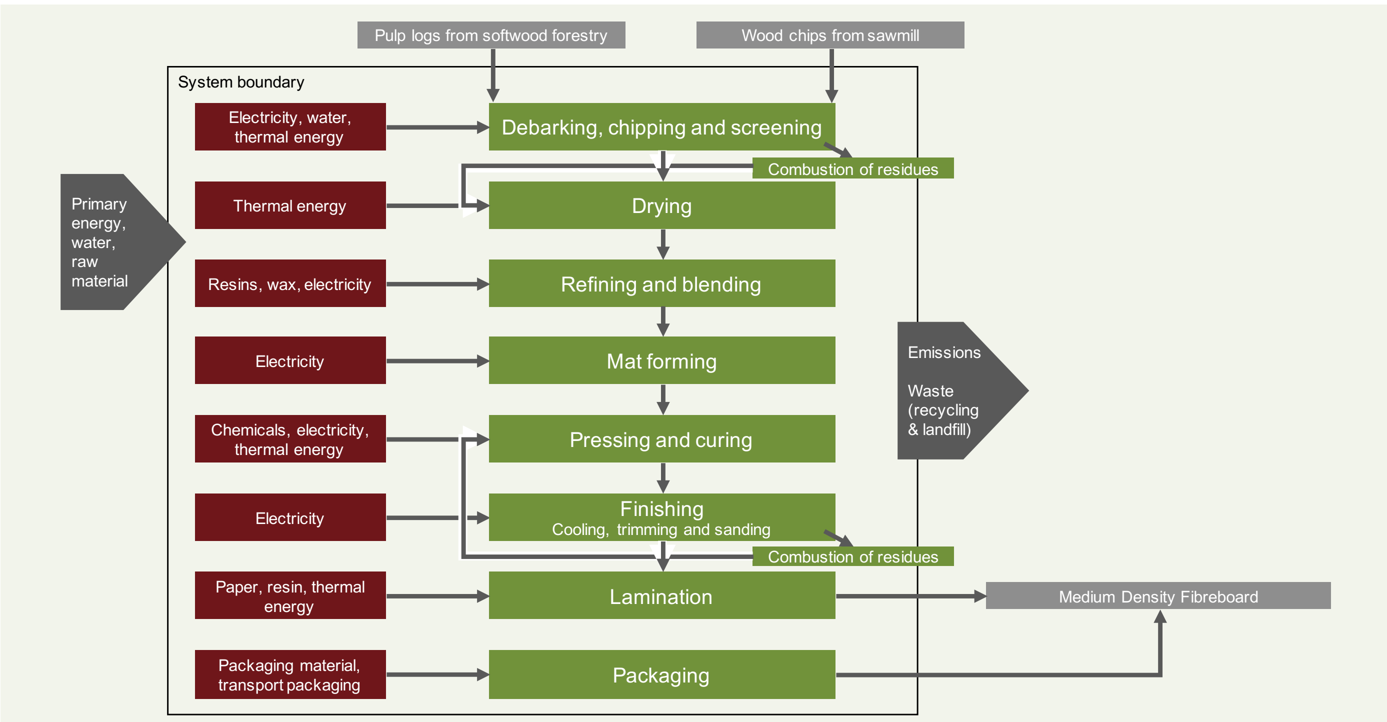
This EPD is of the 'cradle-to-gate' type with options. The options include the end-of-life stage, which is modelled through the use of scenarios.

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

The production stage includes growth and harvesting of wood inputs, production of resin and wax, blending of wood particles with resin and wax, pressing of the mixture to create the MDF substrate, cutting, sanding and then laminating a melamine-impregnated paper layer on the top and bottom surfaces.



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 not included in this EPD as it is not common for MDF. 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):** DOCf = 0.7%. This is based on bioreactor laboratory research by Ximenes et al. (2013).
- **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).

Recycling

MDF 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 sequestered CO_2 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 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 (i.e. different MDF products): Wood particles and energy are allocated per cubic metre of board produced. Decorative overlays are allocated by square metre applied. Resins and waxes are allocated based on the dry mass required in average recipes supplied by manufacturers.

Background Data

Data for primary wood inputs (pulplog and wood chips from sawmills) use the same forestry and sawmilling data as FWPA EPD #01 for Softwood 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

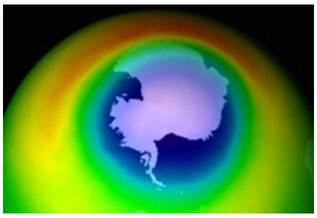
Note: these tables show the impacts associated with production and end-of-life. Any potential credits to future products from recycling or energy recovery are presented in the Other Environmental Information section.

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.

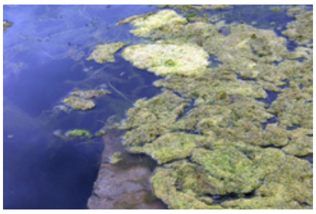
Global Warming Potential (GWP) → Climate Change
A measure of greenhouse gas emissions, such as carbon dioxide and methane. These emissions increase absorption of radiation emitted by the earth, intensifying the natural greenhouse effect. Contributions to GWP can come from either fossil or biogenic sources, 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 16 mm E0 & E1 standard melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-7.66	1.38	7.31	19.4	19.4
GWPF [kg CO_2-eq.]	9.68	0.942	1.05	1.86	1.86
GWPB [kg CO_2-eq.]	-17.3	0.438	6.26	17.5	17.5
ODP [kg CFC11-eq.]	3.72E-11	4.49E-13	4.49E-13	5.07E-15	5.07E-15
AP [kg SO_2-eq.]	0.0396	0.00300	0.00339	7.40E-04	7.40E-04
EP [kg PO_4^{3}-eq.]	0.00798	0.00127	0.0129	1.73E-04	1.73E-04
POCP [kg C_2H_4-eq.]	0.0196	2.69E-04	0.00142	6.42E-05	6.42E-05
ADPE [kg Sb-eq.]	2.34E-06	1.86E-07	1.86E-07	1.47E-09	1.47E-09
ADPF [MJ]	130	13.5	13.5	1.53	1.53

Table 4: Environmental impacts, 1 m² of 18 mm E0 & E1 standard melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-9.29	1.55	8.19	21.7	21.7
GWPF [kg CO_2-eq.]	10.3	1.06	1.17	1.93	1.93
GWPB [kg CO_2-eq.]	-19.6	0.491	7.02	19.8	19.8
ODP [kg CFC11-eq.]	3.45E-11	5.05E-13	5.05E-13	5.68E-15	5.68E-15
AP [kg SO_2-eq.]	0.0454	0.00337	0.00381	8.30E-04	8.30E-04
EP [kg PO_4^{3}-eq.]	0.00838	0.00136	0.0137	1.94E-04	1.94E-04
POCP [kg C_2H_4-eq.]	0.0225	3.02E-04	0.00159	7.20E-05	7.20E-05
ADPE [kg Sb-eq.]	1.84E-06	2.09E-07	2.09E-07	1.64E-09	1.64E-09
ADPF [MJ]	136	15.2	15.2	1.72	1.72

Table 5: Environmental impacts, 1 m² of 25 mm E0 & E1 standard melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-7.90	2.13	11.1	29.3	29.3
GWPF [kg CO_2-eq.]	18.0	1.47	1.65	3.16	3.16
GWPB [kg CO_2-eq.]	-25.9	0.660	9.43	26.1	26.1
ODP [kg CFC11-eq.]	7.28E-11	7.01E-13	7.01E-13	7.66E-15	7.66E-15
AP [kg SO_2-eq.]	0.0685	0.00467	0.00525	0.00112	0.00112
EP [kg PO_4^{3}-eq.]	0.0142	0.00214	0.0225	2.62E-04	2.62E-04
POCP [kg C_2H_4-eq.]	0.0308	4.13E-04	0.00216	9.71E-05	9.71E-05
ADPE [kg Sb-eq.]	4.92E-06	2.90E-07	2.90E-07	2.22E-09	2.22E-09
ADPF [MJ]	243	21.1	21.1	2.32	2.32

Table 6: Environmental impacts, 1 m² of 16 mm E0 & E1 moisture resistant (MR) melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-5.20	1.39	7.38	19.6	19.6
GWPF [kg CO_2-eq.]	12.1	0.944	1.06	2.11	2.11
GWPB [kg CO_2-eq.]	-17.3	0.442	6.31	17.5	17.5
ODP [kg CFC11-eq.]	5.21E-11	4.49E-13	4.49E-13	5.12E-15	5.12E-15
AP [kg SO_2-eq.]	0.0434	0.00300	0.00339	7.47E-04	7.47E-04
EP [kg PO_4^{3}-eq.]	0.00962	0.00138	0.0146	1.75E-04	1.75E-04
POCP [kg C_2H_4-eq.]	0.0192	2.70E-04	0.00144	6.48E-05	6.48E-05
ADPE [kg Sb-eq.]	3.89E-06	1.86E-07	1.86E-07	1.48E-09	1.48E-09
ADPF [MJ]	165	13.5	13.5	1.55	1.55

Table 7: Environmental impacts, 1 m² of 18 mm E0 & E1 moisture resistant (MR) melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-3.55	1.55	8.20	21.7	21.7
GWPF [kg CO_2-eq.]	15.7	1.06	1.19	2.33	2.33
GWPB [kg CO_2-eq.]	-19.2	0.490	7.01	19.4	19.4
ODP [kg CFC11-eq.]	6.16E-11	5.05E-13	5.05E-13	5.67E-15	5.67E-15
AP [kg SO_2-eq.]	0.0568	0.00337	0.00381	8.28E-04	8.28E-04
EP [kg PO_4^{3}-eq.]	0.0117	0.00155	0.0164	1.94E-04	1.94E-04
POCP [kg C_2H_4-eq.]	0.0221	3.02E-04	0.00160	7.19E-05	7.19E-05
ADPE [kg Sb-eq.]	4.61E-06	2.09E-07	2.09E-07	1.64E-09	1.64E-09
ADPF [MJ]	211	15.2	15.2	1.72	1.72

Table 8: Environmental impacts, 1 m² of 25 mm E0 & E1 moisture resistant (MR) melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
GWP [kg CO_2-eq.]	-4.67	2.14	11.2	29.5	29.5
GWPF [kg CO_2-eq.]	21.2	1.47	1.66	3.38	3.38
GWPB [kg CO_2-eq.]	-25.9	0.664	9.49	26.1	26.1
ODP [kg CFC11-eq.]	8.96E-11	7.01E-13	7.01E-13	7.71E-15	7.71E-15
AP [kg SO_2-eq.]	0.0751	0.00467	0.00526	0.00113	0.00113
EP [kg PO_4^{3}-eq.]	0.0162	0.00225	0.0241	2.63E-04	2.63E-04
POCP [kg C_2H_4-eq.]	0.0304	4.15E-04	0.00217	9.76E-05	9.76E-05
ADPE [kg Sb-eq.]	6.66E-06	2.90E-07	2.90E-07	2.23E-09	2.23E-09
ADPF [MJ]	288	21.1	21.1	2.33	2.33

Resource Use

Table 9: Resource use, 1 m² of 16 mm E0 & E1 standard melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	58.2	0.852	0.852	0.0278	0.0278
PERM [MJ]	183	0	0	-183	-183
PERT [MJ]	242	0.852	0.852	-183	-183
PENRE [MJ]	132	13.8	13.8	1.53	1.53
PENRM [MJ]	23.9	0	0	-23.9	-23.9
PENRT [MJ]	156	13.8	13.8	-22.4	-22.4
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m³]	0.0438	1.43E-04	8.03E-04	1.68E-05	1.68E-05

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

Table 10: Resource use, 1 m² of 18 mm E0 & E1 standard melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	69.2	0.958	0.958	0.0312	0.0312
PERM [MJ]	207	0	0	-207	-207
PERT [MJ]	276	0.958	0.958	-207	-207
PENRE [MJ]	138	15.5	15.5	1.72	1.72
PENRM [MJ]	24.8	0	0	-24.8	-24.8
PENRT [MJ]	162	15.5	15.5	-23.1	-23.1
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m³]	0.0434	1.60E-04	8.99E-04	1.88E-05	1.88E-05

Table 11: Resource use, 1 m² of 25 mm E0 & E1 standard melamine coated MDF

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	82.2	1.33	1.33	0.0421	0.0421
PERM [MJ]	273	0	0	-273	-273
PERT [MJ]	356	1.33	1.33	-273	-273
PENRE [MJ]	247	21.5	21.5	2.32	2.32
PENRM [MJ]	41.0	0	0	-41.0	-41.0
PENRT [MJ]	288	21.5	21.5	-38.7	-38.7
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m³]	0.0845	2.18E-04	0.00121	2.54E-05	2.54E-05

Table 12: Resource use, 1 m^2 of 16 mm E0 & E1 moisture resistant (MR) melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	50.8	0.852	0.852	0.0281	0.0281
PERM [MJ]	183	0	0	-183	-183
PERT [MJ]	234	0.852	0.852	-183	-183
PENRE [MJ]	167	13.8	13.8	1.55	1.55
PENRM [MJ]	27.3	0	0	-27.3	-27.3
PENRT [MJ]	195	13.8	13.8	-25.8	-25.8
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m^3]	0.0597	1.44E-04	8.11E-04	1.70E-05	1.70E-05

Table 13: Resource use, 1 m^2 of 18 mm E0 & E1 moisture resistant (MR) melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	56.9	0.958	0.958	0.0311	0.0311
PERM [MJ]	203	0	0	-203	-203
PERT [MJ]	260	0.958	0.958	-203	-203
PENRE [MJ]	214	15.5	15.5	1.72	1.72
PENRM [MJ]	30.1	0	0	-30.1	-30.1
PENRT [MJ]	244	15.5	15.5	-28.4	-28.4
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m^3]	0.0759	1.60E-04	9.00E-04	1.88E-05	1.88E-05

Table 14: Resource use, 1 m^2 of 25 mm E0 & E1 moisture resistant (MR) melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
PERE [MJ]	77.8	1.33	1.33	0.0423	0.0423
PERM [MJ]	273	0	0	-273	-273
PERT [MJ]	351	1.33	1.33	-273	-273
PENRE [MJ]	292	21.5	21.5	2.33	2.33
PENRM [MJ]	43.9	0	0	-43.9	-43.9
PENRT [MJ]	336	21.5	21.5	-41.6	-41.6
SM [kg]	0	0	0	0	0
RSF [MJ]	0	0	0	0	0
NRSF [MJ]	0	0	0	0	0
FW [m^3]	0.105	2.19E-04	0.00122	2.56E-05	2.56E-05

Waste and Output Flows

Table 15: Waste categories, 1 m² of 16 mm E0 & E1 standard melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	6.84E-08	4.98E-08	4.98E-08	2.54E-09	2.54E-09
NHWD [kg]	0.438	11.5	9.70	1.06E-05	1.06E-05
RWD [kg]	7.82E-04	9.74E-05	9.74E-05	9.21E-08	9.21E-08
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	11.6
MER [kg]	0	0	0	11.6	0
EEE [MJ]	0	0.119	1.70	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 18 mm E0 & E1 standard melamine coated MDF

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	7.55E-08	5.59E-08	5.59E-08	2.85E-09	2.85E-09
NHWD [kg]	0.421	12.9	10.9	1.18E-05	1.18E-05
RWD [kg]	7.26E-04	1.10E-04	1.10E-04	1.03E-07	1.03E-07
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	13.0
MER [kg]	0	0	0	13.0	0
EEE [MJ]	0	0.134	1.91	0	0
EET [MJ]	0	0	0	0	0

Table 17: Waste categories, 1 m² of 25 mm E0 & E1 standard melamine coated MDF

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	9.45E-08	7.64E-08	7.64E-08	3.84E-09	3.84E-09
NHWD [kg]	0.660	17.4	14.7	1.60E-05	1.60E-05
RWD [kg]	0.00149	1.52E-04	1.52E-04	1.39E-07	1.39E-07
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	17.5
MER [kg]	0	0	0	17.5	0
EEE [MJ]	0	0.180	2.57	0	0
EET [MJ]	0	0	0	0	0

Table 18: Waste categories, 1 m² of 16 mm E0 & E1 moisture resistant melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	6.62E-08	5.01E-08	5.01E-08	2.57E-09	2.57E-09
NHWD [kg]	0.505	11.6	9.79	1.07E-05	1.07E-05
RWD [kg]	0.00108	9.74E-05	9.74E-05	9.30E-08	9.30E-08
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	11.7
MER [kg]	0	0	0	11.7	0
EEE [MJ]	0	0.120	1.72	0	0
EET [MJ]	0	0	0	0	0

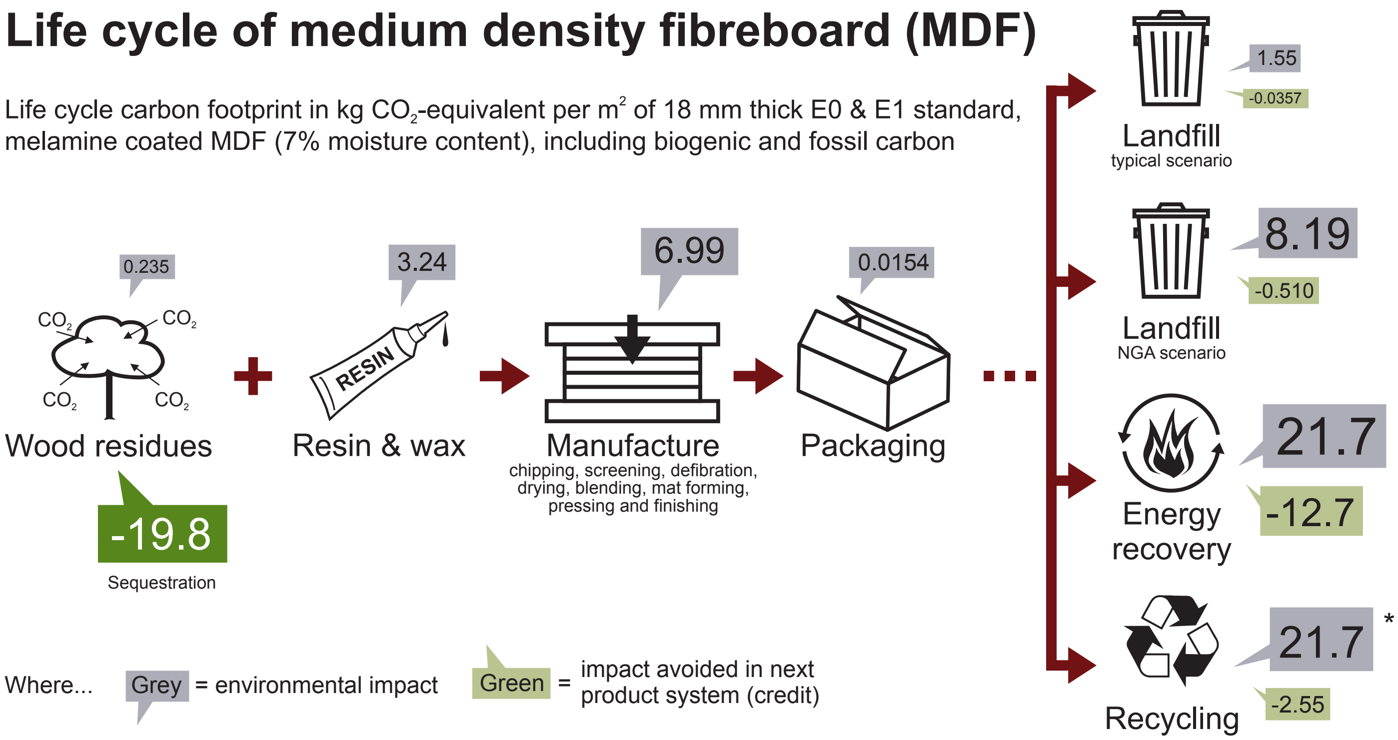
Table 19: Waste categories, 1 m² of 18 mm E0 & E1 moisture resistant melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	7.44E-08	5.59E-08	5.59E-08	2.84E-09	2.84E-09
NHWD [kg]	0.478	12.9	10.8	1.18E-05	1.18E-05
RWD [kg]	0.00126	1.10E-04	1.10E-04	1.03E-07	1.03E-07
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	13.0
MER [kg]	0	0	0	13.0	0
EEE [MJ]	0	0.134	1.91	0	0
EET [MJ]	0	0	0	0	0

Table 20: Waste categories, 1 m² of 25 mm E0 & E1 moisture resistant melamine coated MDF.

	Production	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Parameter [Unit]	**A1-A3**	**C4**	**C4**	**C3**	**C3**
HWD [kg]	9.45E-08	7.67E-08	7.67E-08	3.87E-09	3.87E-09
NHWD [kg]	0.694	17.5	14.7	1.61E-05	1.61E-05
RWD [kg]	0.00182	1.52E-04	1.52E-04	1.40E-07	1.40E-07
CRU [kg]	0	0	0	0	0
MFR [kg]	0	0	0	0	17.6
MER [kg]	0	0	0	17.6	0
EEE [MJ]	0	0.181	2.59	0	0
EET [MJ]	0	0	0	0	0

Understanding the Life Cycle of MDF



* 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 24 below for the environmental impact indicators in modules A1-A3.

Table 21: Inter-site variability for standard MDF (modules A1-A3).

	Standard 16 mm			Standard 18 mm			Standard 25 mm		
Parameter [Unit]	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**
GWP [kg CO_2-eq.]	-2.1%	+47.8%	±19.7%	-8.9%	+46.4%	±15.9%	-26.5%	+46.6%	±30.9%
GWPF [kg CO_2-eq.]	-3.7%	+38.6%	±15.8%	-8.9%	+42.5%	±15.0%	-10.3%	+25.3%	±16.4%
GWPB [kg CO_2-eq.]	-1.2%	+1.4%	±1.1%	-0.5%	+2.1%	±1.2%	-3.3%	+3.8%	±3.0%
ODP [kg CFC11-eq.]	-29.1%	+33.7%	±26.9%	-14.8%	+62.2%	±32.0%	-34.0%	+16.8%	±23.3%
AP [kg SO_2-eq.]	-6.5%	+37.7%	±20.5%	-8.5%	+33.3%	±19.3%	-16.7%	+29.2%	±20.9%
EP [kg PO_4^{3}-eq.]	-18.7%	+22.5%	±17.8%	-13.2%	+27.6%	±18.2%	-23.8%	+17.4%	±17.0%
POCP [kg C_2H_4-eq.]	-3.8%	+3.7%	±3.1%	-5.6%	+1.6%	±3.0%	-5.1%	+5.9%	±4.5%
ADPE [kg Sb-eq.]	-44.9%	+56.9%	±45.5%	-22.1%	+124.4%	±63.5%	-55.6%	+27.3%	±38.7%
ADPF [MJ]	-3.2%	+37.0%	±16.7%	-3.2%	+42.5%	±16.1%	-15.6%	+23.9%	±16.7%

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

Table 22: Inter-site variability for moisture resistant MDF (modules A1-A3).

	MR 16 mm			MR 18 mm			MR 25 mm		
Parameter [Unit]	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**	**Min**	**Max**	**CV**
GWP [kg CO_2-eq.]	-36.5%	+62.9%	±40.9%	-124.8%	+37.3%	±66.8%	-83.1%	+47.4%	±54.1%
GWPF [kg CO_2-eq.]	-14.5%	+24.6%	±16.0%	-25.9%	+7.5%	±13.7%	-22.5%	+12.9%	±14.5%
GWPB [kg CO_2-eq.]	-0.8%	+1.8%	±1.2%	-1.9%	+0.7%	±1.2%	-2.0%	+3.4%	±2.3%
ODP [kg CFC11-eq.]	-13.7%	+10.8%	±10.1%	-18.3%	+5.0%	±9.6%	-13.6%	+5.4%	±7.8%
AP [kg SO_2-eq.]	-13.4%	+33.6%	±22.1%	-25.7%	+14.7%	±19.0%	-24.0%	+21.9%	±21.2%
EP [kg PO_4^{3}-eq.]	-17.8%	+15.7%	±13.8%	-24.1%	+7.0%	±12.8%	-20.5%	+10.3%	±12.8%
POCP [kg C_2H_4-eq.]	-3.5%	+3.5%	±3.0%	-5.6%	+1.2%	±2.9%	-4.8%	+2.5%	±3.2%
ADPE [kg Sb-eq.]	-11.9%	+10.9%	±9.6%	-16.8%	+5.0%	±9.1%	-12.3%	+5.9%	±7.6%
ADPF [MJ]	-12.7%	+23.5%	±15.5%	-23.4%	+7.8%	±13.4%	-19.5%	+12.3%	±13.6%

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 CO_2 sequestration in this EPD in line with EN 16485 (Section 6.3.4.2).

Other Environmental Information

Module D: Recycling, Reuse and Recovery Potentials

Table 23: Module D, 1 m^2 of 16 mm E0 & E1 standard melamine coated MDF.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0319	-0.455	-11.2	-2.27
GWPF [kg CO_2-eq.]	-0.0319	-0.455	-11.2	-2.17
GWPB [kg CO_2-eq.]	-6.51E-07	-9.30E-06	0.0283	-0.1000
ODP [kg CFC11-eq.]	-9.10E-16	-1.30E-14	4.33E-13	-1.89E-13
AP [kg SO_2-eq.]	-1.40E-04	-0.00201	0.00725	-0.0167
EP [kg PO_4^{3-}-eq.]	-1.19E-05	-1.69E-04	0.00155	-0.00386
POCP [kg C_2H_4-eq.]	-7.32E-06	-1.05E-04	0.00238	-0.00686
ADPE [kg Sb-eq.]	-2.37E-09	-3.38E-08	-7.49E-07	-4.12E-07
ADPF [MJ]	-0.363	-5.19	-226	-27.7
Resource Use				
PERE [MJ]	-0.0408	-0.583	0.150	-40.1
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0408	-0.583	0.150	-40.1
PENRE [MJ]	-0.363	-5.19	-226	-27.8
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.363	-5.19	-226	-27.8
SM [kg]	0	0	0	11.6
RSF [MJ]	0	0	183	0
NRSF [MJ]	0	0	23.9	0
FW [m^3]	-1.88E-04	-0.00269	0.00537	-0.00853
Wastes and Outputs				
HWD [kg]	-4.79E-11	-6.85E-10	-1.69E-08	-8.14E-09
NHWD [kg]	-9.27E-05	-0.00132	0.515	-0.285
RWD [kg]	-4.48E-08	-6.40E-07	4.96E-05	-1.00E-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

Table 24: Module D, 1 m^2 of 18 mm E0 & E1 standard melamine coated MDF.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0357	-0.510	-12.7	-2.55
GWPF [kg CO_2-eq.]	-0.0357	-0.510	-12.7	-2.44
GWPB [kg CO_2-eq.]	-7.29E-07	-1.04E-05	0.0319	-0.113
ODP [kg CFC11-eq.]	-1.02E-15	-1.46E-14	4.60E-13	-2.12E-13
AP [kg SO_2-eq.]	-1.57E-04	-0.00225	0.00760	-0.0188
EP [kg PO_4^{3-}-eq.]	-1.33E-05	-1.90E-04	0.00159	-0.00434
POCP [kg C_2H_4-eq.]	-8.21E-06	-1.17E-04	0.00265	-0.00771
ADPE [kg Sb-eq.]	-2.65E-09	-3.79E-08	-8.40E-07	-4.63E-07
ADPF [MJ]	-0.407	-5.82	-253	-31.2
Resource Use				
PERE [MJ]	-0.0457	-0.653	0.157	-45.1
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0457	-0.653	0.157	-45.1
PENRE [MJ]	-0.407	-5.82	-253	-31.2
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.407	-5.82	-253	-31.2
SM [kg]	0	0	0	13.0
RSF [MJ]	0	0	207	0
NRSF [MJ]	0	0	24.8	0
FW [m^3]	-2.11E-04	-0.00302	0.00574	-0.00959
Wastes and Outputs				
HWD [kg]	-5.37E-11	-7.67E-10	-1.89E-08	-9.16E-09
NHWD [kg]	-1.04E-04	-0.00148	0.581	-0.321
RWD [kg]	-5.02E-08	-7.17E-07	5.27E-05	-1.13E-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

Table 25: Module D, 1 m^2 of 25 mm E0 & E1 standard melamine coated MDF.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0481	-0.688	-16.7	-3.54
GWPF [kg CO_2-eq.]	-0.0481	-0.688	-16.7	-3.38
GWPB [kg CO_2-eq.]	-9.84E-07	-1.41E-05	0.0424	-0.156
ODP [kg CFC11-eq.]	-1.37E-15	-1.96E-14	7.75E-13	-2.95E-13
AP [kg SO_2-eq.]	-2.12E-04	-0.00303	0.0133	-0.0261
EP [kg PO_4^{3-}-eq.]	-1.79E-05	-2.56E-04	0.00297	-0.00603
POCP [kg C_2H_4-eq.]	-1.11E-05	-1.58E-04	0.00367	-0.0107
ADPE [kg Sb-eq.]	-3.58E-09	-5.11E-08	-1.12E-06	-6.44E-07
ADPF [MJ]	-0.549	-7.84	-342	-43.3
Resource Use				
PERE [MJ]	-0.0617	-0.881	0.274	-62.6
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0617	-0.881	0.274	-62.6
PENRE [MJ]	-0.549	-7.84	-342	-43.4
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.549	-7.84	-342	-43.4
SM [kg]	0	0	0	17.5
RSF [MJ]	0	0	273	0
NRSF [MJ]	0	0	41.0	0
FW [m^3]	-2.85E-04	-0.00407	0.00921	-0.0133
Wastes and Outputs				
HWD [kg]	-7.24E-11	-1.03E-09	-2.55E-08	-1.27E-08
NHWD [kg]	-1.40E-04	-0.00200	0.767	-0.445
RWD [kg]	-6.76E-08	-9.66E-07	8.82E-05	-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

Table 26: Module D, 1 m² of 16 mm E0 & E1 moisture resistant (MR) melamine coated MDF.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0322	-0.460	-11.2	-2.27
GWPF [kg CO_2-eq.]	-0.0322	-0.460	-11.2	-2.17
GWPB [kg CO_2-eq.]	-6.58E-07	-9.40E-06	0.0284	-0.1000
ODP [kg CFC11-eq.]	-9.20E-16	-1.31E-14	4.87E-13	-1.89E-13
AP [kg SO_2-eq.]	-1.42E-04	-0.00203	0.00847	-0.0167
EP [kg PO_4^{3-}-eq.]	-1.20E-05	-1.71E-04	0.00188	-0.00386
POCP [kg C_2H_4-eq.]	-7.41E-06	-1.06E-04	0.00243	-0.00686
ADPE [kg Sb-eq.]	-2.40E-09	-3.42E-08	-7.55E-07	-4.12E-07
ADPF [MJ]	-0.367	-5.25	-229	-27.7
Resource Use				
PERE [MJ]	-0.0413	-0.590	0.174	-40.1
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0413	-0.590	0.174	-40.1
PENRE [MJ]	-0.368	-5.25	-229	-27.8
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.368	-5.25	-229	-27.8
SM [kg]	0	0	0	11.7
RSF [MJ]	0	0	183	0
NRSF [MJ]	0	0	27.3	0
FW [m^3]	-1.91E-04	-0.00272	0.00592	-0.00853
Wastes and Outputs				
HWD [kg]	-4.85E-11	-6.92E-10	-1.71E-08	-8.14E-09
NHWD [kg]	-9.37E-05	-0.00134	0.514	-0.285
RWD [kg]	-4.53E-08	-6.47E-07	5.61E-05	-1.00E-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

Table 27: Module D, 1 m^2 of 18 mm E0 & E1 moisture resistant (MR) melamine coated MDF.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0358	-0.511	-12.4	-2.55
GWPF [kg CO_2-eq.]	-0.0358	-0.511	-12.4	-2.44
GWPB [kg CO_2-eq.]	-7.30E-07	-1.04E-05	0.0315	-0.113
ODP [kg CFC11-eq.]	-1.02E-15	-1.46E-14	5.50E-13	-2.12E-13
AP [kg SO_2-eq.]	-1.58E-04	-0.00225	0.00964	-0.0188
EP [kg PO_4^{3-}-eq.]	-1.33E-05	-1.90E-04	0.00215	-0.00434
POCP [kg C_2H_4-eq.]	-8.22E-06	-1.17E-04	0.00271	-0.00771
ADPE [kg Sb-eq.]	-2.66E-09	-3.80E-08	-8.36E-07	-4.63E-07
ADPF [MJ]	-0.408	-5.82	-254	-31.2
Resource Use				
PERE [MJ]	-0.0458	-0.654	0.197	-45.1
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0458	-0.654	0.197	-45.1
PENRE [MJ]	-0.408	-5.82	-254	-31.2
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.408	-5.82	-254	-31.2
SM [kg]	0	0	0	13.0
RSF [MJ]	0	0	203	0
NRSF [MJ]	0	0	30.1	0
FW [m^3]	-2.11E-04	-0.00302	0.00664	-0.00959
Wastes and Outputs				
HWD [kg]	-5.38E-11	-7.68E-10	-1.89E-08	-9.16E-09
NHWD [kg]	-1.04E-04	-0.00149	0.570	-0.321
RWD [kg]	-5.02E-08	-7.18E-07	6.34E-05	-1.13E-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

Table 28: Module D, 1 m^2 of 25 mm E0 & E1 moisture resistant (MR) melamine coated MDF.

Parameter [Unit]	Landfill (typical)	Landfill (NGA)	Energy recovery	Recycling
Environmental Impact				
GWP [kg CO_2-eq.]	-0.0485	-0.693	-16.6	-3.54
GWPF [kg CO_2-eq.]	-0.0485	-0.693	-16.7	-3.38
GWPB [kg CO_2-eq.]	-9.90E-07	-1.41E-05	0.0425	-0.156
ODP [kg CFC11-eq.]	-1.38E-15	-1.98E-14	8.25E-13	-2.95E-13
AP [kg SO_2-eq.]	-2.14E-04	-0.00305	0.0145	-0.0261
EP [kg PO_4^{3-}-eq.]	-1.80E-05	-2.58E-04	0.00329	-0.00603
POCP [kg C_2H_4-eq.]	-1.11E-05	-1.59E-04	0.00373	-0.0107
ADPE [kg Sb-eq.]	-3.60E-09	-5.15E-08	-1.13E-06	-6.44E-07
ADPF [MJ]	-0.553	-7.90	-345	-43.3
Resource Use				
PERE [MJ]	-0.0621	-0.887	0.297	-62.6
PERM [MJ]	0	0	0	0
PERT [MJ]	-0.0621	-0.887	0.297	-62.6
PENRE [MJ]	-0.553	-7.90	-344	-43.4
PENRM [MJ]	0	0	0	0
PENRT [MJ]	-0.553	-7.90	-344	-43.4
SM [kg]	0	0	0	17.6
RSF [MJ]	0	0	273	0
NRSF [MJ]	0	0	43.9	0
FW [m^3]	-2.87E-04	-0.00410	0.00973	-0.0133
Wastes and Outputs				
HWD [kg]	-7.29E-11	-1.04E-09	-2.56E-08	-1.27E-08
NHWD [kg]	-1.41E-04	-0.00201	0.767	-0.445
RWD [kg]	-6.81E-08	-9.73E-07	9.43E-05	-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 39 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 29: Green water consumption estimates for modules A1-A3 following CSIRO (2009).

	Std 16 mm	**Std 18 mm**	**Std 25 mm**	**MR 16 mm**	**MR 18 mm**	**MR 25 mm**
Parameter [Unit]	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Green water consumption [m^3]	1.24	1.25	2.03	1.49	1.66	2.22

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 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 MDF 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) with recent studies showing formaldehyde concentrations often 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.

MDF manufactured in Australia uses one of two low formaldehyde emitting amino plastics: urea formaldehyde (UF) or melamine urea formaldehyde (MUF) (EWPAA 2012).

To assure end users that they are using MDF 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 laboratory tests, all Australian MDF mills are permitted to brand a formaldehyde emission class on their MDF products as detailed in Table 30 below.

Table 30: Formaldehyde emission classes for Australian manufactured MDF

Emission Class	Emission Limit (mg/litre)	Emission Limit (ppm)*
E0	Less than or equal to 0.5	Less than or equal to 0.04
E1	Less than or equal to 1.0	Less than or equal to 0.08

** 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 the Emission Class.

MDF with formaldehyde emissions of less than or equal to E1 are compliant with the Green Star Formaldehyde credit. To achieve credit points, 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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