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CEN Standard EN 15804 serves as the core PCR	
PCR:	PCR 2012:01 Construction products and construction services, Version 2.3 SUB-PCR to PCR 2012:01: Wood and wood-based products for use in construction. PCR 2012:01-SUB-PCR-E (Date: 2018-11-22)
PCR review was conducted by:	The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com
Independent verification of the declaration and data, according to ISO 14025:	☐ EPD process certification ☒ EPD verification
Third party verifier:	Jane Anderson ConstructionLCA Ltd. www.constructionlca.co.uk
Accredited or approved by:	The International EPD® System

General information

Name of declared products

Medium-density fibreboard (MDF), engineered wood-based panel products manufactured at Norbord site in Cowie, UK.

Statement of conformity to standards

Environmental Product Declaration in accordance with ISO 14025 and EN 15804. EPD of construction products may not be comparable if they do not comply with EN15804. The following Product Category Rules were used to develop this EPD:

- Construction products and construction services. PCR 2012:01 Version 2.3 (Date: 2018-11-15)
- SUB-PCR to PCR 2012:01: Wood and wood-based products for use in construction. PCR 2012:01-SUB-PCR-E (Date: 2018-11-22)

EPD Program Operator

The International EPD® System (www.environdec.com)

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Owner of the Environmental Product Declaration

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UN CPC Code

31441 Medium density fibreboard (MDF).

Declaration Number

S-P-01851

Date of Issue

20/3/2020

Valid to

19/3/2025

Product

Product description

Medium density fibreboard (MDF) products are manufactured from lignocellulose fibres extracted from wood that has been harvested from forest thinning. They are bonded with synthetic resins at high pressure and temperature to create the finished product. The structural integrity of MDF boards is not compromised by changes in humidity or temperature, making them homogenous and reliable products for use as a raw material in the construction industry.

MDF is suitable for use in a wide range of construction and related applications including: shop fitting, general purpose joinery, furniture, wall panelling, architectural mouldings, door manufacture, fire surrounds, exhibition displays, staircases, etc.

Figure 1: MDF finishing (Norbord Europe Ltd, Norbord Media, 2015).

Company description

Norbord is the UK's largest manufacturer of wood panel boards and have supplied the construction industry for over five decades. Norbord places customers, standards of excellence, control of costs, safety and environmental concerns at the heart of its business.

CaberWood MDF is manufactured to the highest standards. This backed up by a support team which assists customers with product and technical assistance. Norbord supplies more than 70 key items across our three product ranges and is committed to quality and customer service.

Product specification

This EPD relates to MDF products made by Norbord Europe Ltd at their production site in Cowie, UK. MDF thickness ranges from 6-30mm with variable measurements on the end-use applications.

The typical material composition of Norbord MDF is given below.

Table 1: Typical material composition of Norbord MDF.

Component	Composition
Wood chips	80-82%
Resin	12%
Wax	~1%
Water	5-7%
Others	<1%

Technical data

The key technical characteristics of Norbord MDF are provided below.

Table 2: Key technical characteristics of Norbord MDF (Technical class MDF, L-MDF, MDF.H, L-MDF.H and for panels with thickness between 6-30 mm)

Technical Properties	Unit	Value	Relevant EN Standard
Thermal Conductivity 'K' Value	W/m.K	0.10-0.13	EN 13986
Internal Bond Strength (IB)	N/mm^2	0.13-0.80	EN 622-5
Modulus of Rupture (MoR)	N/mm^2	5-27	EN 622-5
Modulus of Elasticity (MoE)	N/mm^2	1200-3000	EN 622-5
Moisture Content [ex-plant]	%	5-7	EN 622-5
Thickness Swelling (24 hr immersion)	%	6-30	EN 622-5
Formaldehyde Class E1	mg/100g	<8	EN 13986

LCA system boundaries

The scope of this EPD covers the MDF production process and upstream burdens associated with production and transport of raw materials and generation of energy. It also accounts for the burdens associated with distributing the finished product out to customers. These activities relate to modules A1-A4, according to EN 15804, as shown in the table below. As such, this EPD is of the type "cradle-to-gate with options". No reference service life is reported, as the use-stage modules (B1-B5) have not been declared.

Table 3: Modules of the production life cycle included in the EPD (X = declared module; MND = module not declared)

Production			Installation		Use stage							End-of-Life				Next product system
Raw material supply (extraction, processing, recycled material)	Transport to manufacturer	Manufacturing	Transport to building site	Installation into building	Use / application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to EoL	Waste processing for reuse, recovery or recycling	Disposal	Reuse, recovery or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Modelling the life cycle

The calculation procedures described in EN ISO 14044:2006 and EN15804:2012 were followed and applied consistently throughout the study. The following Product Category Rules were used to develop this EPD:

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Declared unit

The declared unit for MDF reported in this EPD is 1 m^3 of wood-based panel products with an apparent density of 650 kg/m^3. To convert from 1 m^3 to 1 kg MDF, the results in this EPD should be divided by the apparent density of 650 kg/m^3.

System boundary

Figure 2 shows the process steps and activities included within the system boundaries of the EPD study.

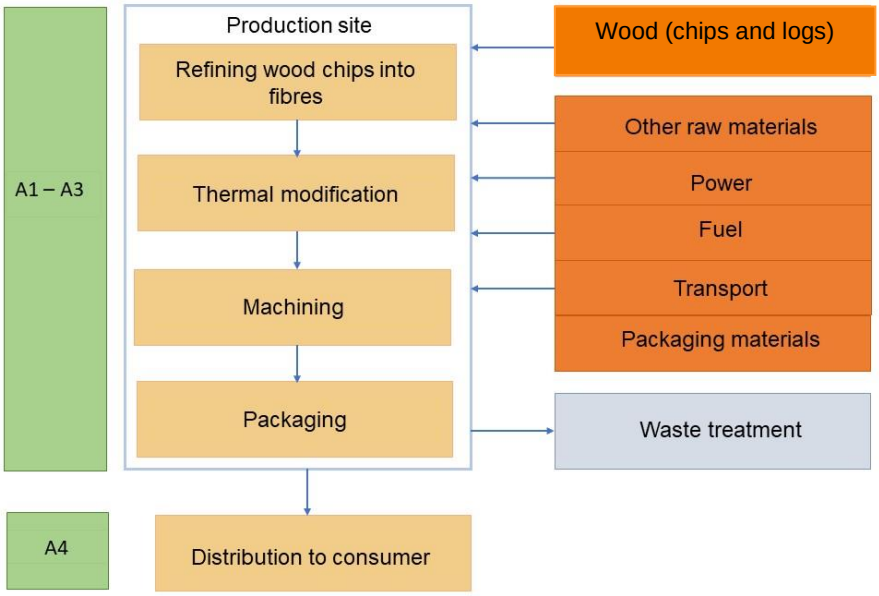

Figure 2: Process flow diagram showing the production and distribution of Norbord MDF

Description of production process

Logs are harvested from Forestry Stewardship Certification (FSC)-managed woodlands and transported to the factory wood yard. The logs are then prepared for processing, where they are cleaned and bark is removed (this is used as biofuel on site). A combination of sawmill chips and roundwood chipping is used for MDF products.

The wood is processed into softwood flakes which are mixed with recycled chips and sawdust. These raw materials are bonded together with resins and a small quantity of wax. The wax and resin increase the resistance of the mixture to moisture and water absorption. The mix is pressed at high pressure and high temperature, which causes the resins to react and forms a rigid board with a smooth surface. The panels are sanded down and cut to size. Thickness ranges from 6-30 mm with variable measurements on the end-use applications. The products are packaged and shipped to the consumer by truck (modelled as Euro 6, 28-32 t gross weight capacity). The average delivery transport distance from the Cowie mill to the consumer is 474 km. These delivery distances have been calculated based on average transport distances provided by Norbord Europe Ltd, and as such are representative of a typical use scenario.

Data quality

Data collection followed the guidance provided in EN 15804, clause 4.3.2.

Wood Environment & Infrastructure Solutions UK Ltd supported the data collection process and obtained and reviewed the information provided by Norbord Europe Ltd. These data were cross-checked for completeness and plausibility using mass balances and stoichiometry, as well as internal and external benchmarking.

All producer-specific data are from 2018 and are based on one-year averaged data, representative of current production at each site.

Background data for LCA modelling were sourced from the GaBi 2019 databases, for which full documentation is available online (thinkstep, 2019). These dataset have documented reference years between 2015 and 2018.

Cut-off criteria

The cut-off criteria applied follow EN 15804, whereby all emissions and their environmental impact contributing greater than 1% to the total must be recorded.

In this assessment, all information gathered from data collection for the production of Norbord MDF has been modelled, i.e. all raw materials used, the electrical energy and other fuels used, use of ancillary materials and all direct production waste. Transport data on input and output flows have also considered. No data on inputs or outputs have knowingly been omitted from the assessment.

Allocation

The only co-products generated during the production of MDF at Norbord's site in Cowie were bark and other biomass from the wood processing activities. These were all used as biofuel for the boilers at site and so were modelled using internal loops.

A small quantity of production waste is reported as going to recycling. As a conservative assumption, no burdens have been allocated to this material (all impacts are allocated to the main MDF product).

Results Indicators

The environmental indicators specified in the tables below are assessed for each module included in the life cycle assessment of the medium density fibreboard.

Table 4: Indicators of life cycle impact assessment inventory on output flows

Indicator	Abbr.	Unit
Global warming potential	GWP	kg CO_2 equivalent
Depletion potential of the stratospheric ozone layer	ODP	kg CFC 11 equivalent
Acidification potential of soil and water	AP	kg SO_2 equivalent
Eutrophication potential	EP	kg $(PO_4)^{3-}$ equivalent
Formation potential of tropospheric ozone	POCP	kg C_2H_4 equivalent
Abiotic depletion potential for non-fossil resources	ADPE	kg Sb equivalent
Abiotic depletion potential for fossil resources	ADPF	MJ, net calorific value

Table 5: Life cycle inventory indicators on use of resources

Indicator	Abbr.	Unit
Use of renewable primary energy as energy carrier	PERE	MJ, net calorific value
Use of renewable primary energy as raw materials	PERM	MJ, net calorific value
Total use of renewable primary energy	PERT	MJ, net calorific value
Use of non-renewable primary energy as energy carrier	PENRE	MJ, net calorific value
Use of non-renewable primary energy as raw materials	PENRM	MJ, net calorific value
Total use of non-renewable primary energy	PENRT	MJ, net calorific value
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ, net calorific value
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value
Net use of fresh water	FW	kg

Table 6: Life cycle inventory indicators on waste categories

Indicator	Abbr.	Unit
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg

Table 7: Life cycle inventory indicators on output flows

Indicator	Abbr.	Unit
Components for reuse	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported electrical energy	EEE	MJ
Exported thermal energy	EET	MJ

LCA Results

The results of this study for MDF manufactured at the Cowie site are reported in the following tables.

Table 8: LCA results for 1 m^3 medium density fibreboard – environmental impact

Parameters describing environmental impacts*					
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**
GWP	[kg CO_2-eq.]	-7.01E+002	9.26E-02	-6.03E+00	2.38E+01
ODP	[kg CFC11-eq.]	6.77E-013	1.36E-17	2.15E-11	3.50E-15
AP	[kg SO_2-eq.]	5.27E-001	6.30E-05	1.56E-02	1.62E-02
EP	[kg PO_4^{3-}-eq.]	1.51E-001	8.58E-06	6.22E-03	2.21E-03
POCP	[kg ethene-eq.]	1.03E-001	-1.95E-06	2.00E-03	-5.02E-04
ADPE	[kg Sb-eq.]	7.60E-005	9.17E-10	9.83E-07	2.36E-07
ADPF	[MJ]	4.63E+003	1.26E+00	7.14E+01	3.24E+02

GWP = Global warming potential; ODP = Ozone depletion potential; AP = Acidification potential; EP = Eutrophication potential; POCP = Photochemical ozone creation potential; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources, WSP = Water scarcity potential

Table 9: LCA results for 1 m^3 medium density fibreboard– resource use, primary energy

Parameters describing resource use, secondary materials and fuels, use of water*					
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**
PERE	[MJ]	5.11E+002	3.79E-03	1.89E+02	9.77E-01
PERM	[MJ]	1.00E+004		1.70E-01	
PERT	[MJ]	1.05E+004	3.79E-03	1.89E+02	9.77E-01
PENRE	[MJ]	2.76E+003	1.26E+00	7.66E+01	3.25E+02
PENRM	[MJ]	2.09E+003			
PENRT	[MJ]	4.84E+003	1.26E+00	7.66E+01	3.25E+02
SM	[kg]			5.15E-01	
RSF	[MJ]				
NRSF	[MJ]				
FW	[m^3]	9.70E-001	5.21E-06	-2.22E-02	1.34E-03

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 = Use of net fresh water

Table 10: LCA results for 1 m³ medium density fibreboard – output flows at end of life and waste categories

Parameters describing environmental impacts*					
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**
HWD	[kg]	2.67E-005	8.94E-11	1.16E-06	2.30E-08
NHWD	[kg]	1.49E+000	1.07E-05	8.27E+00	2.77E-03
RWD	[kg]	8.59E-002	1.45E-06	2.06E-03	3.74E-04
CRU	[kg]				
MFR	[kg]				
MER	[kg]				
EEE	[MJ]				
EET	[MJ]				

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

Interpretation

The following figures shows the percentage contribution of each process step to the environmental impact categories at the Cowie site.

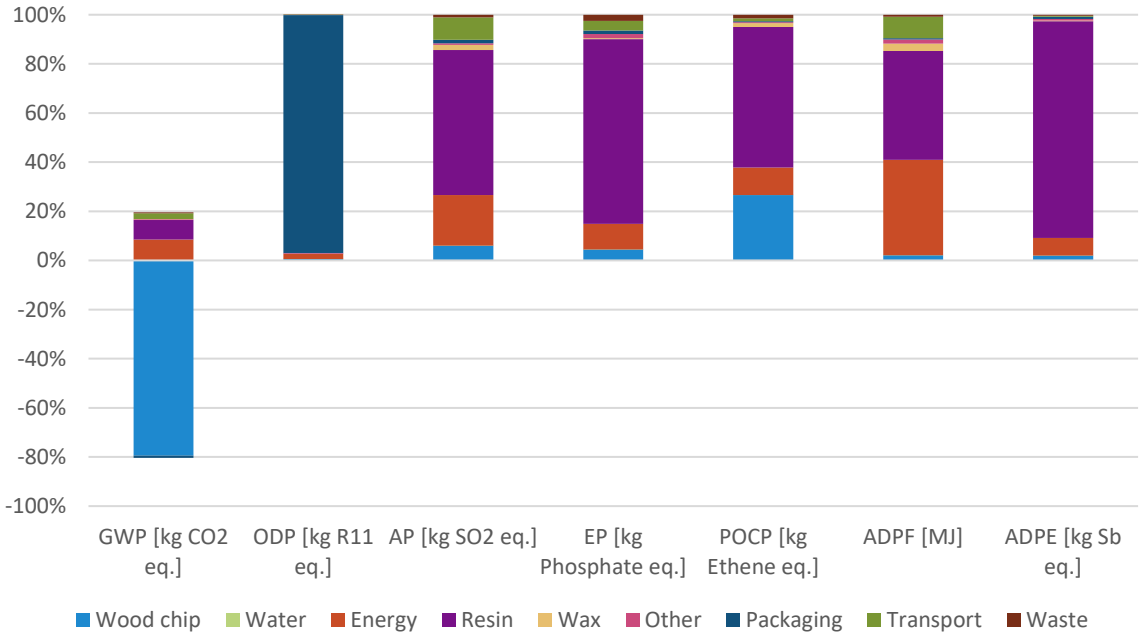

Figure 3: Contribution from different materials and process steps to the total impact (A1-A4) for the impact categories assessed in this EPD study for MDF manufactured in Cowie

The results show that the sequestered carbon in the wood chip raw material is the greatest contributor to the GWP. Impact categories AP, EP, POCP and ADPE are all largely driven by the use of resins in the manufacturing stages. The dominant contributors to ADPF is energy production and use of resins, the main component of the product sourced from non-renewable resources. The

product packaging has substantial burdens in ODP, although the absolute values for this category remain very small.

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