Environmental Product Declaration

according to ISO 14025

EGGER
Raw and Melamine faced Medium and High Density Fibreboard

Declaration Number
EPD-EHW-2008311-E

Institut Bauen und Umwelt e.V.
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Umwelt-Produktdeklaration

Environmental Product-Declaration

Program holder

Institut Bauen und Umwelt e.V.

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Declaration holder

Fritz EGGER GmbH & Co. OG
Holzwerkstoffe
Weiberndorf 20
A – 6380 St. Johann in Tyrol

Declaration number

EPD-EHW-2008311-E

Declared building products

Egger raw / Melamine faced medium and high-density fibreboard

This declaration is an environmental product declaration according to ISO 14025 and describes the environmental rating of the building products listed herein. It is intended to further the development of environmentally compatible and sustainable construction methods.
All relevant environmental data is disclosed in this validated declaration.
The declaration is based on the PCR document "Wood-based materials", year 2009-01.

Validity

This validated declaration authorises the holder to bear the official stamp of the Institut Bauen und Umwelt. It only applies to the listed products for one year from the date of issue.
The declaration holder is liable for the information, evidence and verifications on which the declaration is based.

Content of the declaration

The declaration is complete and contains in its full form:
- Product definition and physical building-related data
- details of the basic materials and origin
- description of how the product is manufactured
- instructions on how to process the product
- data on usage condition, unusual effects, and end of life phase
- life cycle assessment results
- evidence, verifications, and tests

Date of issue

25. February 2011

Signatures

Prof. Dr.-Ing. Horst J. Bossenmayer (President of the Institut Bauen und Umwelt)

Verification of the declaration

This declaration and the rules on which it is based have been examined by an independent expert committee (SVA) in accordance with ISO 14025.

Signatures

Prof. Dr.-Ing. Hans-Wolf Reinhardt (chairman of the expert committee)

Dr. Frank Werner (tester appointed by the expert committee)

Umwelt-Produktdeklaration

Environmental Product-Declaration

Product description

Raw / Melamine faced MDF boards are panel-shaped materials according to EN 622-5 and EN 14322. The boards of material are primarily used in Melamine faced form and as furniture panels. They are used in low-front panel applications in kitchens, for example.
The decorative design is achieved through the use of printed decorative paper. At the same time, a corresponding feel can also be applied to the surface during pressing.

Applications

Melamine faced MDF boards are used in interior applications for higher-quality purposes in furniture manufacturing. Due to their homogenous composition, MDF boards can be milled in three dimensions and then either coated or laminated with a film in a membrane press. Boards manufactured in this way are frequently used as front panels in premium kitchens.

Scope of the LCA

The **Life Cycle Assessment (LCA)** was performed according to DIN ISO 14040 following the requirements of the IBU guideline for type III declarations. Both specific data from the reviewed products and data from the “GaBi 4” database were used. The life cycle assessment encompasses the production of raw materials and energy, transportation of raw materials, the actual manufacturing phase as well as the End of Life in a biomass generating plant with energy utilisation. One each of raw 1 m³ HDF and MDF and 1 m² of Melamine faced MDF with a thickness of 9.3 mm, are declared.

Results of the LCA

MDF boards (per m³)

Evaluation variable	Unit per m³	Total	Manufacturing	End of Life
Primary energy, non renewable	[MJ]	-5179	8734	-13913
Primary energy, renewable	[MJ]	11496	11653	-157,2
Global warming potential (GWP 100)	[kg CO_2 eqv.]	-159,7	-504,6	345,0
Ozone depletion potential (ODP)	[kg R11 eqv.]	2,65E-05	5,96E-05	-3,30E-05
Acidification potential (AP)	[kg SO_2 eqv.]	2,77E+00	1,72E+00	1,06E+00
Eutrophication potential (EP)	[kg Phosphate eqv.]	6,83E-01	4,79E-01	2,04E-01
Photochemical oxidant formation potential (POFP)	[kg ethylene eqv.]	3,37E-01	3,55E-01	-1,81E-02

HDF boards (per m³)

Evaluation variable	Unit per m³	Total	Manufacturing	End of Life
Primary energy, non renewable	[MJ]	-6473	10918	-17391
Primary energy, renewable	[MJ]	14370	14567	-196,5
Global warming potential (GWP 100)	[kg CO_2 eqv.]	-199,6	-630,8	431,2
Ozone depletion potential (ODP)	[kg R11 eqv.]	3,32E-05	7,45E-05	-4,13E-05
Acidification potential (AP)	[kg SO_2 eqv.]	3,47E+00	2,14E+00	1,32E+00
Eutrophication potential (EP)	[kg Phosphate eqv.]	8,54E-01	5,99E-01	2,55E-01
Photochemical oxidant formation potential (POFP)	[kg ethylene eqv.]	4,21E-01	4,44E-01	-2,27E-02

MDF - Melamine faced boards (per m²)

Evaluation variable	Unit per m²	Total	Manufacturing	End of Life
Primary energy, non renewable	[MJ]	-38,3	98,4	-136,7
Primary energy, renewable	[MJ]	108,1	109,6	-1,6
Global warming potential (GWP 100)	[kg CO_2 eqv.]	-0,50	-3,92	3,42
Ozone depletion potential (ODP)	[kg R11 eqv.]	2,70E-07	5,97E-07	-3,27E-07
Acidification potential (AP)	[kg SO_2 eqv.]	2,73E-02	1,78E-02	9,48E-03
Eutrophication potential (EP)	[kg Phosphate eqv.]	6,80E-03	4,94E-03	1,86E-03
Photochemical oxidant formation potential (POFP)	[kg ethylene eqv.]	3,47E-03	3,67E-03	-2,06E-04

Prepared by: PE INTERNATIONAL, Leinfelden-Echterdingen
in cooperation with Fritz EGGER GmbH & Co. OG

PE INTERNATIONAL
EXPERTS IN SUSTAINABILITY

Evidence and verifications

In addition, the results of the following tests are shown in the environmental product declaration:

- Formaldehyde according to EN 120 / EN 717-1, testing institute: WKI Fraunhofer Wilhelm-Klauditz-Institute
- Eluate analysis according to EN 71-3, testing institute: MFPA Leipzig GmbH
- EOX (extractable organic halogen compounds) according to DIN 38414-S17, testing institute: MFPA Leipzig GmbH
- Toxicity of the fire gases according to DIN 53436, testing institute: MFPA Leipzig GmbH
- PCP/lindane according to PA-C-12: 2006-02, testing institute: WKI Fraunhofer Wilhelm-Klauditz-Institute

Area of application

This document applies to raw and Melamine faced medium and high-density fibreboard which is manufactured in the following Group of Company plants:

Egger Holzwerkstoffe Brilon GmbH & Co. KG, Im Kissen 19, D – 59929 Brilon

Egger Holzwerkstoffe Wismar GmbH & Co. KG, Am Haffeld 1, D – 23970 Wismar

0 Product definition

Product definition

Raw / Melamine faced MDF boards are panel-shaped materials according to EN 622-5 and EN 14322. These board materials are primarily Melamine faced and used as furniture panels. They are used as low-front panels in kitchen applications, for example.
The decorative design is achieved through the use of printed decorative paper. At the same time, a corresponding feel can also be applied to the surface during pressing.

Melamine faced MDF boards are divided into different board types – a description of the classes is found in the EN 622-5 requirements.
The board types are primarily divided based on their application as load-bearing or non-load-bearing elements in dry and humid areas:

MDF – general-purpose boards for use in dry conditions
MDF. H – general-purpose boards for use in humid conditions
MDF. LA – load-bearing boards for use in dry conditions
MDF. HLS – load-bearing boards for use in humid conditions
L-MDF – lightweight MDF for use in dry conditions
L-MDF. H – lightweight MDF for use in humid conditions
UL1-MDF – ultra-lightweight MDF for use in dry conditions
UL2-MDF – ultra-lightweight MDF for use in dry conditions
MDF. RWH – boards for use as rigid underlay for roofing and walls

Application

Melamine faced MDF boards are used in interior applications for higher-quality purposes in furniture manufacturing. Due to their homogenous composition, MDF boards can be milled in three dimensions and then either coated or Melamine faced with a film in a membrane press. Boards manufactured in this way are frequently used as front panels in premium kitchens.

Product standard / approval

- EN 622-5 – Fibreboard –Board requirements after the drying process (MDF)
- EN 14322 – Melamine coated boards for use in interior areas
- EN 13986 – CE-labelling of wood-based material for use in construction

Accreditation

- CE-labelling according to EN 13986 – Notified Body WKI – Brunswick, D
- PEFC, Chain of Custody HCA-CoC-183
- EN ISO 9001: 2000 – ÖQS Vienna, A

Delivery status, characteristics

Table 1: MDF board delivery sizes:

Board type	Sizes (mm)	Standard thicknesses [mm]																	
		6	8	10	12	13	14	15	16	18	19	22	24	25	28	30	32	35	38
MDF ST E1 CE	4110 x 2070		X	X		X	X	X	X	X	X	X		X	X		X		X
	2650 x 2070		x	x	X	x	x	x	x	x	x	x		x	x	x	x		x
MDF MB E1 CE	5610 x 2070								x	x	x	x							
MDF MBP-L E1 CE	2650 x 2070				X						x			x					
Production size: 5610 x 2650 mm																			
Full boards: 5610 x 2070 mm																			
Online sectioning: Various options upon request																			

Product group	Wood-based products Medium and High Density Fibreboard	Version
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Table 2: Thin MDF board delivery sizes:

Board type	Size (mm)	Standard thicknesses [mm]									
		2.4	2.8	3	3.4	3.8	4	4.8	5	5.8	6
Thin MDF CE	5610 x 2090	X	x		x	x		x		x	
	2800 x 2090	X	x		x	x		x		x	
	2650 x 2070			x			X		x		x
Production size: 5610 x 2650 mm											
Online sectioning: Various options upon request											

Table 3: HDF board delivery sizes:

Board type	Size (mm)	Standard thicknesses [mm]					
		5.8	6	6.4	6.8	7.4	7.8
HDF-KT CE	2.620 x 2.070	x	x	x	x	x	x
HDF-CL CE	2.620 x 2.070	x	x	x	x	x	x
HDF-CLS CE	2.620 x 2.070	x	x	x	x	x	x
Production size: 6. 300 x 2. 650 mm							
Online sectioning: Various options upon request							

Table 4: General-purpose board requirements for use in dry conditions (also see EN 622-5, table 3):

Properties / test procedure	Unit	Nominal thickness ranges								
	mm	1.8 to 2.5	>2.5 to 4	>4 to 6	>6 to 9	>9 to 12	>12 to 19	>19 to 30	>30 to 45	>45
Raw density MDF board		845	860	885	820	800	780	760	740	720
Raw density HDF board	kg/m	-	-	≥880	≥880	-	-	-	-	-
Material moisture EN 322	%	5-7								
Thermal conductivity EN 12524		0.14								
Water vapour diffusion resistance number EN 12524	-	μ wet= 20; μ dry = 30								
Thickness swelling 24h EN 317	%	45	35	30	17	15	12	10	8	6
Transverse tensile strength EN		0.65	0.65	0.65	0.65	0.60	0.55	0.55	0.50	0.50
Bending strength EN 310		23	23	23	23	22	20	18	17	15
Bending elasticity modulus EN		-	-	2700	2700	2500	2200	2100	1900	1700

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Table 5: Melamine-coated board requirements (also see EN 14322):

	Unit	Thickness ranges		
		< 15 mm	15 – 20 mm	> 20 mm
Thickness relative to nominal dimensions EN 14323	[mm]	±0.3 for abrasion class 1 and 2 +0.5/-0.3 for abrasion class 3A, 3B as well as for shiny surfaces		±0.5
Length and width EN 14323 - standard dimensions - Cuts	[mm]	±5 ±2.5		
Warping EN 14323	[mm/m]	-	≤2	
Edge breakage EN 14323 - standard dimensions - Cuts	[mm]	- ≤10 ≤3		

Surface properties	Testing standard	Unit	Value		
Surface defects Points Longitudinal imperfections	EN 14323	[mm²/m²] [mm/m]	≤2 ≤20 ±2.5		
Behaviour under exposure to scratching	EN 14323	[N]	≥1.5		
Resistance to stains	EN 14323	[Level]	≥3		
Susceptibility to cracking	EN 14323	[Level]	≥3		
Resistance to abrasion Different levels can be attained depending on the coating structure.	EN 14323	[Rotations]	Class 1 2 3A 3B	IP <50 ≥50 ≥150 ≥250	WP <150 ≥150 ≥350 ≥650

Information about some of the properties listed below may be required for particular applications. These must be stipulated separately and can be determined upon request according to the testing procedures specified by EN 14322.

Additional properties	Testing standard
Resistance to cigarette burns	EN 14323
Resistance to water vapour	EN 14323
Resistance to impact loads from falling large-diameter steel ball	EN 14323
Light fastness (xenon arc lamp)	EN 14323
Gloss level	EN 14323
Surface soundness	EN 311

1 Raw materials

Raw materials
Primary products
Secondary materials / additives

MDF/HDF boards with thicknesses between 2.4 and 40 mm with an average density of 720kg/ m³ consisting of (specified in mass-% per 1 m³ of production):

- Wood chips, primarily spruce and pine wood, approx. 82 %
- Water approx. 5-7 %
- UF-glue (urea resin) approx. 11 %
- Paraffin wax emulsion <1 %
- Decorative paper with a grammage of 60-120 g/m²
- Melamine formaldehyde resin

Material explanation

Wood compound: The production of MDF and HDF boards utilizes only fresh wood from thinning measures as well as sawmill leftovers, primarily spruce and pine wood.

UF-glue: consisting of urea-formaldehyde resin. The aminoplastic adhesive hardens fully during the pressing process through polycondensation.

Paraffin wax emulsion: A paraffin wax emulsion is added to the formulation during gluing for hydrophobising (improving resistance to moisture).

Melamine formaldehyde resin: aminoplastic resin for impregnation of décor paper for lamination; in the press, the resin hardens fully into a hard and hard-wearing surface.

Raw material extraction and origin

Wood from indigenous, predominantly regional forest stands is used in the production of raw and Melamine faced MDF boards. The wood is sourced from forests within a radius of approx. 200 km from the production site. The short transportation distances contribute a considerable measure to minimizing the logistical costs of raw materials acquisition. In the selection process, preference is given to woods that are certified according to FSC or PEFC regulations.

PEFC and FSC certified finished goods are indicated separately by the manufacturer and do not represent the entire product range. The bonding agents and impregnating resins or, as the case may be, the raw materials for producing them come from suppliers located at a maximum distance of 450 km from the production site.

Local and general availability of the raw materials

The wood used in the production of raw and Melamine faced MDF and HDF boards is sourced exclusively from cultivated forests managed in a sustainable manner. The selection is composed exclusively out of greenwood from thinning and silviculture as well as sawmill leftovers (wood chips). The bonding agents and/or impregnating resins MUF and urea as well as the paraffin emulsion are synthesised out of crude oil, a fossil raw material with limited availability.

2 Manufacturing of the building product

Manufacturing of the building product

Structure of the manufacturing process:

2. 1 Manufacturing of the rawboard:

1. Debarking of the logs
2. Chipping of the wood
3. Boiling the chips
4. Defibration in the refiner
5. Drying the fibres to approx. 2-3 % residual moisture content
6. Bonding of the fibres with resins
7. Spreading of the glued fibres onto a moulding conveyor
8. Compression of the fibre mat using a continuous hot press
9. Cutting and edge-trimming of the fibre strip to raw board sizes
10. Cooling of the rawboard in radial cooler
11. Destacking into large stacks
12. After acclimatisation phase, sanding of the top and bottom surfaces

2. 2 Manufacturing of the impregnating substances:

1. Unrolling of the base papers
2. Uptake of impregnating resin (MUF) in the system
3. Drying of the impregnated paper in heated dryers
4. Dimensioning of the endless paper by a crosscutter
5. De-stacking of the dimensioned boards onto pallets

2. 3 Manufacturing of Melamine faced MDF/HDF Boards:

1. Placement of the impregnated material on the top/bottom surfaces of the raw board
2. Pressing of the board in a hot press using various textured pressing plates / bands
3. Quality sorting and destacking
4. Acclimatisation phase of up to 14 days

All leftovers which arise during production (trimming, cutting, and milling leftovers) are, without exception, routed to a thermal utilisation process.

Production health and safety

Measures to avoid hazards to health / exposures during the production process:

Due to the manufacturing conditions, no health and safety measures above and beyond the ones required by law and other regulations are required. At all points on site, readings fall significantly below (Germany's) maximum allowable concentration values.

Environmental protection during production

- Air: The exhaust air resulting from production processes is cleaned according to legal requirements. Emissions are significantly below TA Luft (Technical Instructions on Air Quality Control).
- Water/soil: Contamination of water and soil does not occur. Effluent resulting from production processes is processed internally and routed back to production.
- Noise protection measurements show that all readings from inside and outside the production plant fall below German limit levels. Noise-intensive system parts such as chipping are structurally enclosed.

3 Working with the building product

Processing recommendations

Raw and Melamine faced MDF and HDF boards can be sawn and drilled with normal (electric) machines. Hard metal-tipped tools are recommended, especially for circular saws. Wear a respiratory mask if using hand tools without a dust extraction device.

Detailed information and processing recommendations are available at:

www.egger.com.

Job safety, Environmental protection

Apply all standard safety measures for working with solid wood when processing/installing MDF and HDF boards (safety glasses, face mask if dust is produced). Observe all liability insurance association regulations for commercial processing operations.

Residual material

Residual material and packaging: Waste material accumulated on site (cutting waste and packaging) shall be collected and separated into waste types. Disposal shall comply with local waste disposal authority instructions and instructions given in no. 6 "End of life phase".

Packaging

Particle board boards and corrugated cardboard covering as well as PET or steel straps are used.

4 Usage condition

Components

Components in usage condition:
The components of raw and Melamine faced MDF and HDF boards correspond in their fractions to those of the material composition in point 1 “Raw Materials”. During pressing the aminoplastic resin (MUF) is cross-linked three-dimensionally through a non-reversible polycondensation reaction under the influence of heat. The binding agents are chemically inert and bonded firmly to the wood. Very small quantities of formaldehyde are emitted (see formaldehyde certificate chapter 8.1).

Interactions

Environment - Health

Environmental protection:

According to the current state of knowledge, hazards to water, air, and soil cannot occur during proper use of the described products (see point 8. evidence and verifications).

Health protection:

Health aspects: No damage to health or impairments are expected under normal use corresponding to the intended use of MDF/HDF boards. Natural wood substances may be emitted in small amounts. With the exception of small quantities of formaldehyde harmless to health, no emission of pollutants can be detected (see Evidence and verifications 8. 1 Formaldehyde, 8. 2 Eluate-analysis, 8. 3 Toxicity of fire gases, 8. 4 EOX, 8. 5 PCP/lindane).

Long term durability in usage condition The durability under usage conditions is defined through the class of application according to EN 622-5 (see chapter 0 “Product definition" as well as tables 1 through 4).

5 Unusual effects

Fire

Reaction to fire of raw MDF/HDF boards >9mm thick and >600kg/m³:
Classification according to flammability rating D according to EN 13501-1 (see EN 13986 requirement)
Smoke development class S2 – normally smoky
d0 – non-dropping

Reaction to fire of raw thin MDF/HDF boards <9mm thick:
Classification according to flammability rating E according to EN 13501-1 (see EN 13986 requirement)
Smoke development class S2 – normally smoky
d0 – non-dropping

Reaction to fire of Melamine faced MDF/HDF boards:
Classification according to flammability rating C according to EN 13501-1 (test report 3093/ 5855 – 4/06)
Smoke development S2 – normally smoky
d0 – non-dropping

Toxicity of fire gases (test report chapter 8)

Change of phase (dripping by combustion/precipitation): Dripping by combustion is not possible, since the MDF and HDF boards do not liquefy when hot.

Water effects No component materials which could be hazardous to water are washed out. Chipboard is not resistant to sustained exposure to water, but damaged areas can be replaced easily on site.

Mechanical destruction The breaking pattern of an MDF and HDF board illustrates relatively brittle behaviour, and sharp edges can form at the breaking edges of the boards (risk of injury).

6 End of life phase

Reuse During remodelling or at the end of the utilisation phase of a building, MDF and HDF boards can be separated and used again for the same applications if selective deconstruction is practiced

Reclamation During remodelling or at the end of the utilisation phase of a building, MDF and HDF boards can be separated and used again for other applications if selective deconstruction is practiced. This is only possible if the wood-based boards have not been bonded over their entire surface.

Energy utilisation (in correspondingly approved systems): With a high calorific value of approx. 17 MJ/kg, energy utilisation for the generation of process energy and electricity (cogeneration systems) from construction board leftovers as well as boards from deconstruction measures is preferable to putting them in the landfill.

Disposal MDF and HDF board leftovers which arise on the construction site as well as those from deconstruction measures should primarily be routed to a material utilisation stream. If this is not possible, then they must be used for energy utilisation rather than being placed in the landfill (refuse code according to European Waste Catalogue: 170201/030103).

Packaging: The transport packaging of chipboard and steel / PET strapping can be recycled if they are sorted correctly. External disposal can be arranged with the manufacturer on an individual basis.

7 Life cycle assessment

7.1 Manufacturing of raw MDF and HDF boards and Melamine faced MDF boards

Declared unit

The declaration refers to the manufacturing of one cubic meter of average HDF board / MDF board, as well as one square meter of Melamine faced MDF board.

The raw density is 730 kg/m³ for the raw MDF, 900 kg/m³ (+/- 20 kg, moisture 6 %) for the HDF and 6.789 kg/m² for the Melamine faced MDF.

The end of life is calculated as thermal utilisation in a biomass generating plant with energy utilisation.

System boundaries

The selected system boundaries encompass the manufacturing of the raw MDF/HDF and the Melamine faced MDF board including raw materials production through to the final packaged product at the factory gate (cradle to gate).

The database GaBi 2006 was used for the energy generation and transport. In detail, the observed parameters encompass:

- Forestry processes for the provisioning and transporting of wood
- Production of all raw materials, primary products and secondary materials including the associated relevant transportation
- Relevant transportation and packaging of raw materials and primary products
- Production process of the raw MDF/HDF and the Melamine faced MDF board (energy, waste, thermal utilisation of production wastes, emissions) and the energy supply starting with the resource
- Packaging including its thermal utilisation

The reviewed products are produced in the Brilon and Wismar plants.

The utilisation phase of the raw MDF/HDF and Melamine faced MDF boards was not investigated in this declaration. The end of life scenario was assumed to be a biomass generating plant with energy utilisation (credits according to substitution approach) ("gate to grave"). The assessment region begins at the factory gate of the utilisation facility. On the output side, it is assumed that the produced ash is placed in a landfill.

Cut-off criteria

On the input side, at least all those material streams which enter into the system and comprise more than 1% of its entire mass or contribute more than 1% to the primary energy consumption are considered. The output involves all material flows out of the system which comprise more than 1% of the total effects of the analysis effect categories. All inputs used as well as all process-specific waste and process emissions were assessed. In this manner the material streams which were below 1 mass percent were captured. In this manner the cut-off criteria according to the IBU guideline are fulfilled.

Transportation

Transport of the raw materials and secondary materials used is included in principle.

Period under consideration

The data used refer to the actual production processes during the business year 1/5/2007 to 30/4/2008. The life cycle assessment was prepared for the reference area of Germany. This has the effect that in addition to the production processes under these framework conditions, the preliminary stages such as electricity or energy source provisioning which are relevant for Germany were used.

Background data

To model the life cycle for the manufacturing and disposal of Egger products, the software system for comprehensive accounting "GaBi 4" was used (GaBi 2006). All background data sets relevant to the manufacturing and disposal were taken from the GaBi 4 software database. The upstream chain for the harvesting was accounted for according to /Schweinle & Thoroe/ 2001 or, as the case may be, /Hasch 2002/ in the update from Rüter and Albrecht (2007).

Scrap wood is considered from the scrap wood dealer gate. A CO_2 content of 1.851 kg CO_2 per kg of wood dry matter and a primary energy content of 18.482 MJ per kg of wood dry matter were considered. No impacts from the upstream chain were considered, but the chipping of the scrap wood as well as transportation from the scrap wood dealer to the production site (30% wood humidity) were included in the calculation.

Assumptions

The results of the life cycle assessment are based on the following assumptions:

The transportation of all raw materials and/or secondary materials are calculated according to the means of transportation (truck, bulk carrier - ocean-going vessel, conveyor belt) with data from the GaBi database.

The energy carriers and sources used at the production site were considered for the energy supply.

All leftovers which arise during production (trimming, cutting, and milling leftovers) are routed to a thermal utilisation process as “combustible materials”. The credits from the energy extraction of the combustion systems are included in the balance sheet calculation.

The end of life scenario was assumed to be thermal utilisation in a biomass generating plant and modelled according to the composition of the boards.

The results of the inventory life cycle and impact assessment are provided separately for MDF and HDF.

Data quality

The age of the utilized data is less than 5 years.

Data capture for the raw MDF/HDF and the Melamine faced MDF board took place directly in the production facility in the Brilon and Wismar plants. All input and output data of the Egger company were made available. Therefore it can be assumed that the data is very representative.

The predominant part of the data for the upstream chain comes from industrial sources, which were collected under consistent time and methodical framework conditions. The process data and the utilized background data are consistent. Great value was placed on a high degree of completeness in the capturing of environmentally relevant material and energy flows.

The delivered data (processes) were checked for plausibility. They come from the operational data capturing and measurements and the data quality can therefore be described as very good.

Allocation

Allocation refers to the allocation of the input and output flows of a life cycle assessment module to the product system under investigation /ISO 14040/.

The MDF/HDF and Melamine faced MDF board manufacturing system in question and the associated energy supply do not require any allocations; waste materials are utilized as a source of energy. The combustion is accounted for using GaBi 2006 and, similar to end of life, energy credits are assigned.

The modelled thermal utilisation of the boards in the end of life process takes place in a biomass generating plant. The allocation of energy credits for the electricity and gas produced in the waste incineration plant is done based on the calorific value of the input. The credit for the gas is calculated based on “steam from natural gas”; the credit for electricity from the German electricity mix. The calculation of emissions (e.g. CO_2, HCl, SO_2 or heavy metals) which is dependant on the input is performed based on the material composition of the introduced range. The technology-dependant emissions (e.g. CO) are assigned based on the exhaust gas volume.

Notes on usage phase

The usage conditions as well as possible associated unusual effects were not researched in the life cycle assessment. For system comparisons, the lifespan of the raw MDF/HDF and the Melamine faced MDF board must be accounted for under consideration of the stress and loading aspects.

7.2 Thermal Utilisation of MDF, HDF, and Melamine faced MDF

Choice of disposal process

For the life cycle assessment, thermal utilisation in a biomass generating plant was assumed for all products and modelled according to the board composition for the individual products. The system is equipped with SCR exhaust gas denitrification, dry sorption for desulphurisation, and a fabric particle filter. The fuel efficiency factor is 93%.

Credits

The substitution approach is used for energy production. Credits are assigned to the generated products electricity and heat in a suitable manner. They represent the savings in fossil fuels and their emissions during conventional electricity generation (also see allocation). The German: Electricity and German: Thermal energy from natural gas (GaBi 2006 in each case) are substituted.

7.3 Results of the assessment

Life cycle inventory

In the following chapter, the life cycle inventory assessment with regard to the primary energy consumption and wastes and, in following, the impact assessment are shown. Since MDF and HDF share the same production site and the same relative amounts of raw material and energy consumption, the following results are, relative to one another, similar for MDF and HDF.

Primary energy

Table 6 shows the primary energy consumption (renewable and non-renewable, lower calorific value H_u), subdivided for the sum total, production, and end of life for one cubic meter of MDF and HDF board and one square meter of Melamine faced MDF board.

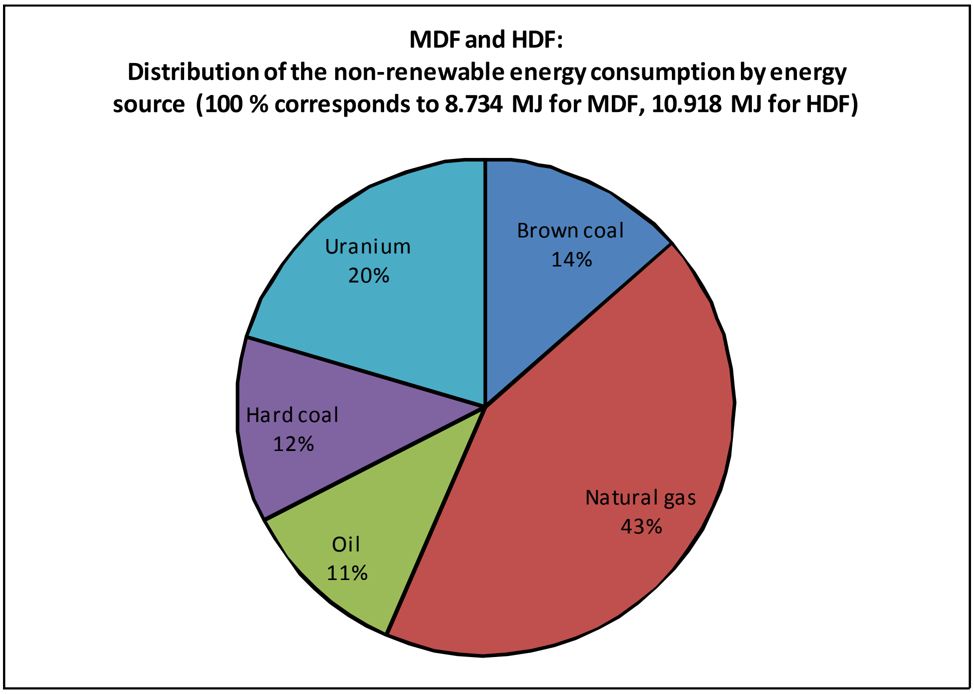
The consumption of non-renewable energy for the manufacturing of MDF/HDF/Melamine faced MDF (cradle to gate) is at a scant 8 734 / 10 918 MJ per m³ / 98.4 MJ per m².

In addition, another 11 653 / 14 567 / 109.6 MJ of renewable energies (100 % of the solar energy stored in the biomass) is used in the manufacturing of one cubic meter of MDF/HDF board and one square meter of Melamine faced MDF board.

Table 6: Primary energy consumption for the manufacturing of 1 m³ of MDF and HDF board or 1 m² of Melamine faced MDF board.

MDF board product mix per m³				
Evaluation variable	Unit per m³	Total	Manufacturing	End of Life
Primary Energy, not renewable	[MJ]	-5.179	8.734	-13.913
Primary energy, renewable	[MJ]	11.496	11.653	-157,20
HDF board product mix per m³				
Evaluation variable	Unit per m³	Total	Manufacturing	End of Life
Primary Energy, not renewable	[MJ]	-6.473	10.918	-17.391
Primary energy, renewable	[MJ]	14.370	14.567	-196,50
MDF melamine faced board per m²				
Evaluation variable	Unit per m²	Total	Manufacturing	End of Life
Primary Energy, not renewable	[MJ]	-38,26	98,40	-136,66
Primary energy, renewable	[MJ]	108,06	109,62	-1,56

A closer investigation of the composition of the primary energy consumption indicates that energy stored in the raw material through photosynthesis mainly stays in the product until its “end of life”. 1 m³ of finished MDF / HDF board has a minimum calorific value of 12 146 / 15 183 MJ. 1 m² of Melamine faced MDF board has a minimum calorific value of 114.2 MJ.



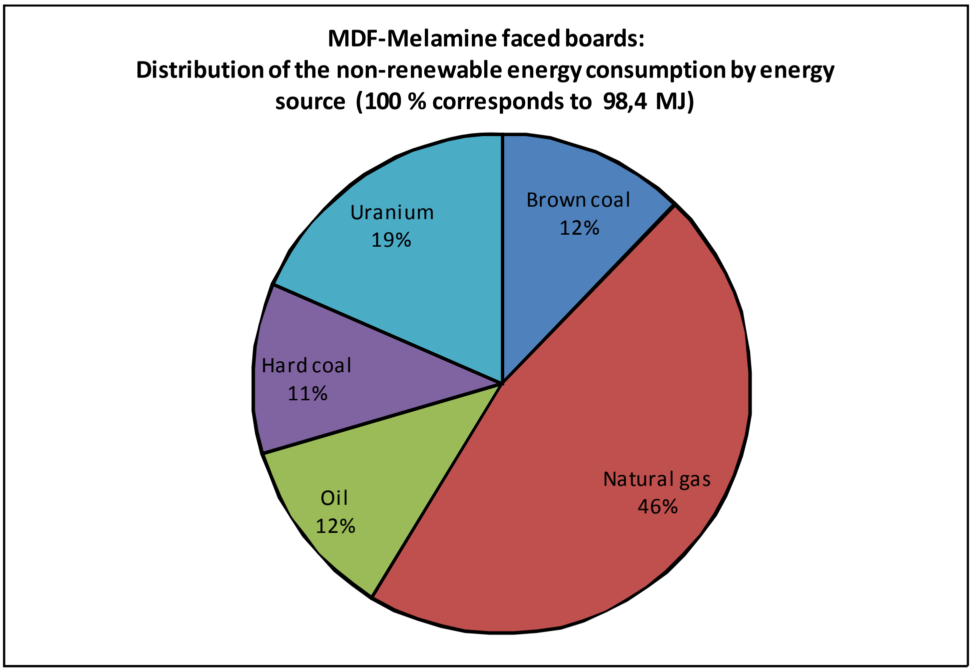
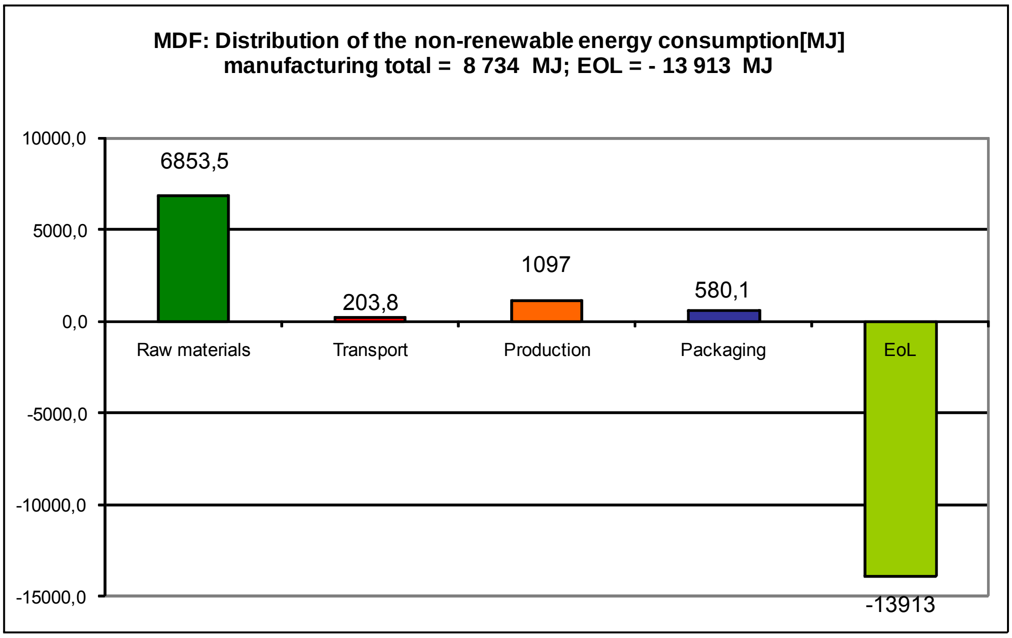
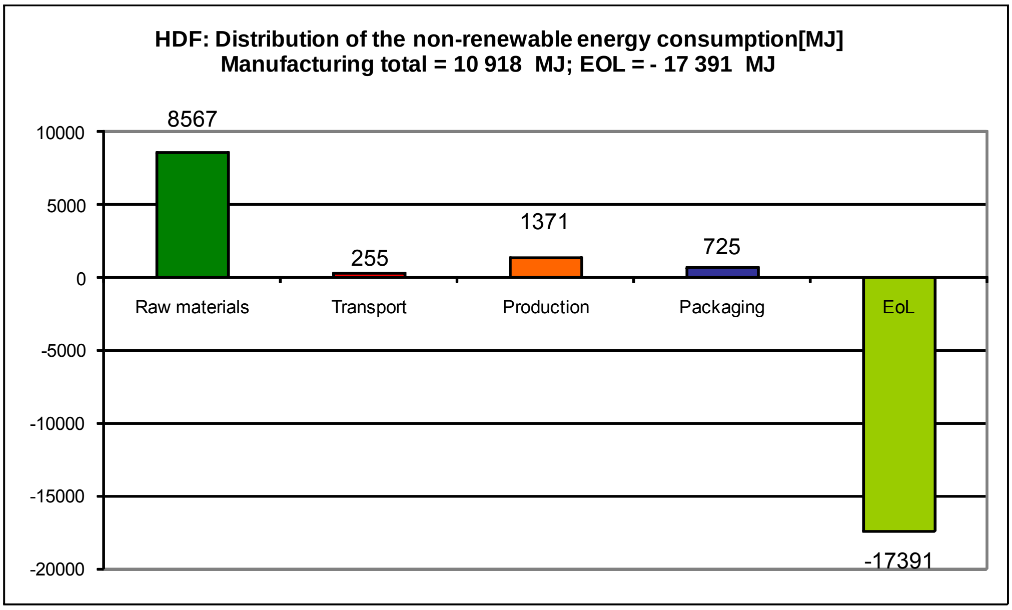


Figure 1: **Distribution of the non-renewable energy consumption by energy source for the manufacturing of 1 m³ MDF/HDF board or 1 m² of Melamine faced MDF board**

A more detailed analysis of the non-renewable energy consumption for the manufacturing of one cubic meter of MDF/HDF board and one square meter of Melamine faced MDF board (figure 1) shows that natural gas is used as a primary energy source which makes up approx. 43% / 47% of the primary energy consumption. About 12% / 11% of the required energy is provided by hard coal and 14% / 12% by brown coal, while another 20% / 18% is covered by uranium. The uranium contribution to the primary energy consumption is due to the use of third-party electricity from the public networks according to the respective electricity mix at the production sites, which also includes atomic energy. The remaining 11% / 12% are covered by crude oil. Figure 2 provides a further level of detail for the non-renewable energy consumption, where production accounts for approx. 12% / 15%, supply of raw materials for 79% / 78%, and transportation and packaging make up around 9% / 7%. At end of life, 13 913 / 17 391 / 137 MJ are substituted.

The thermal utilisation of the packaging and other wastes is modelled by the average waste incineration of the respective material fraction with steam and electricity generation. This results in electricity credits through the substitution of electricity in the public grid according to the respective electricity mix and a credit according to the average production of thermal energy from natural gas per produced m³ of finished raw MDF/HDF or m² of Melamine faced MDF. Wood wastes are utilized in a biomass generating plant. This also results in energy credits.





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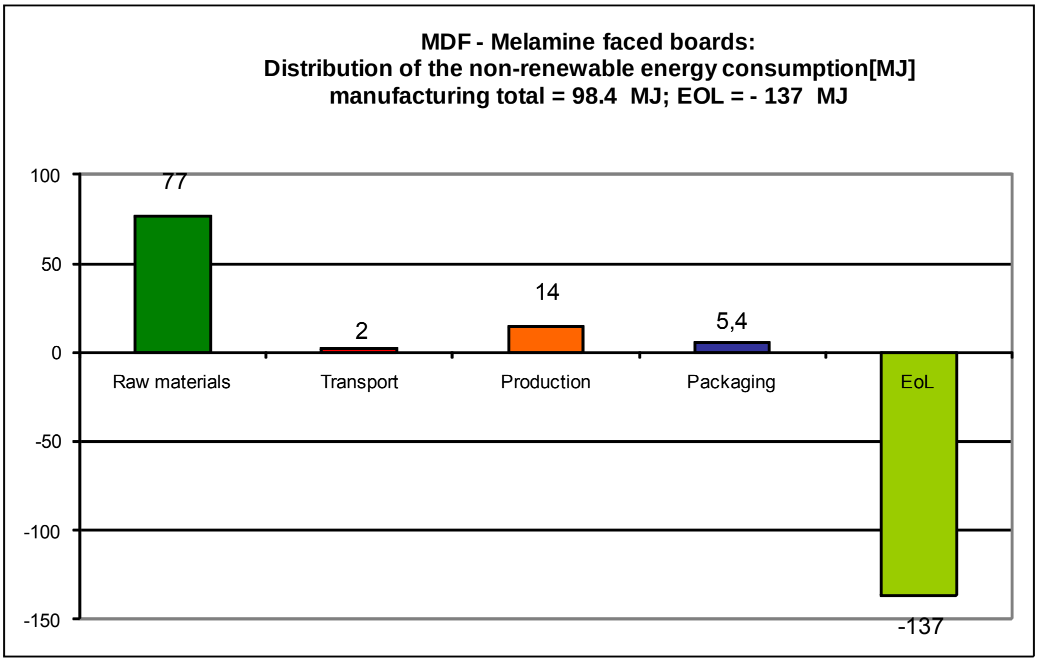
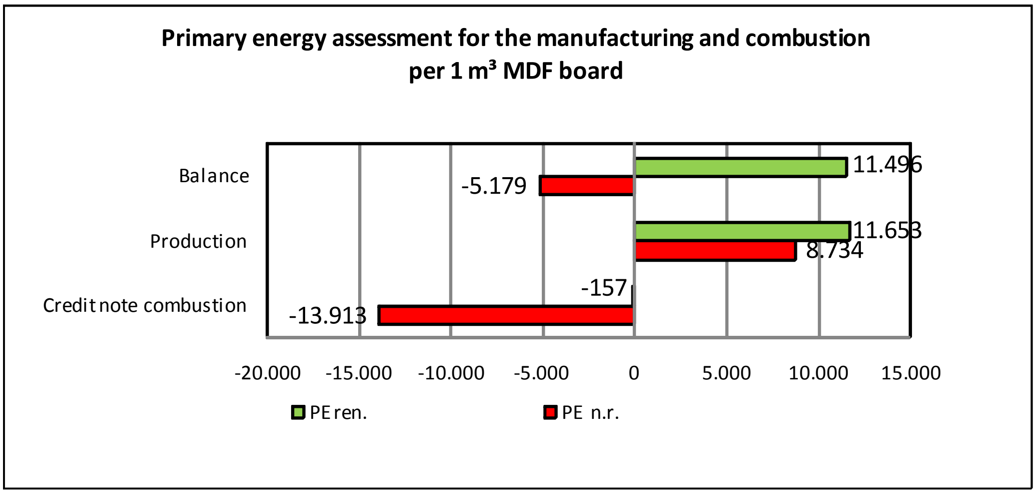


Figure 2: Distribution of the non-renewable energy consumption during the manufacturing of one cubic meter of MDF/HDF board and one square meter of Melamine faced MDF board.

If one considers the manufacturing and end of life (biomass generating plant), then one discovers that the energy credit for electricity and steam (credit for the German electricity mix and thermal energy from natural gas) amounts to 13 913 / 17 391 / 137 MJ of non-renewable energy per m³ of raw MDF/HDF or m² of Melamine faced board. This reduces the non-renewable primary energy consumption from 8734 / 10 918 MJ per m³ / 98.4 MJ per m² to a value of -5179 / -6473 MJ per m³ / -38 MJ per m² when manufacturing and combustion are calculated.



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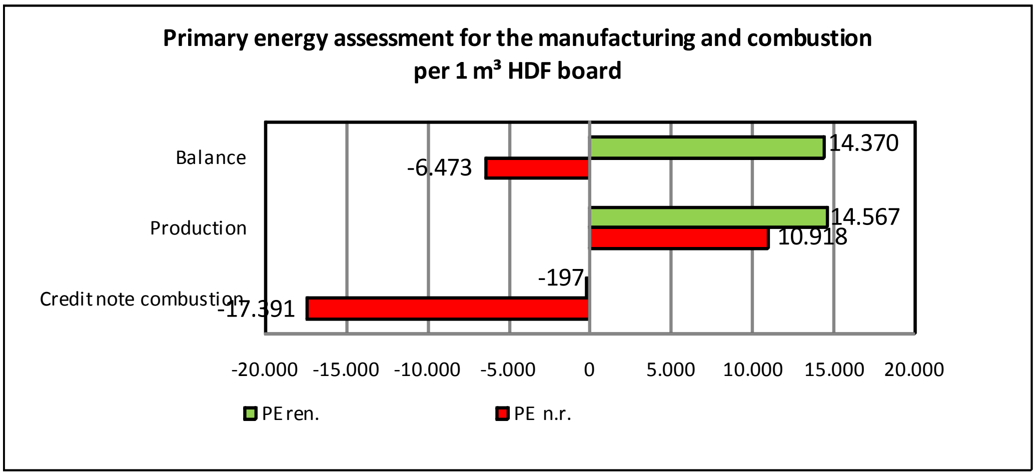

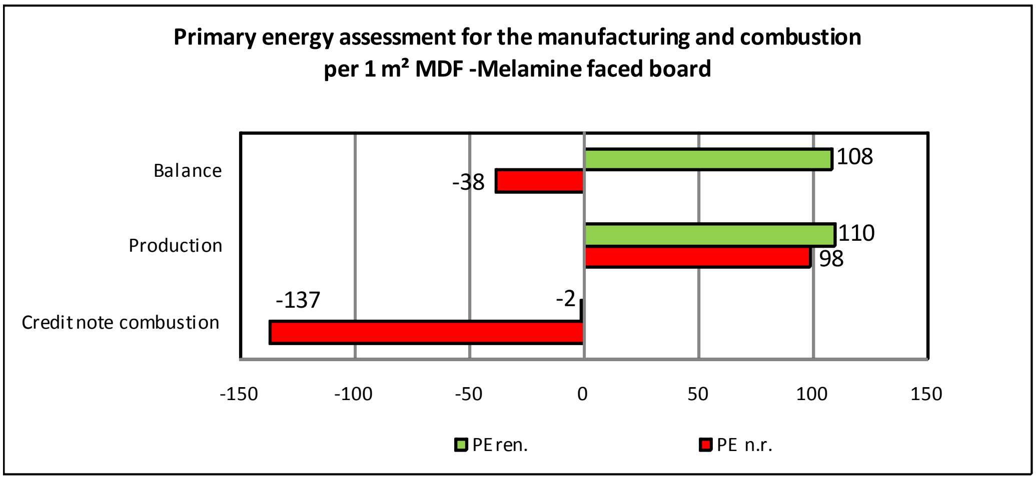

Figure 3: **Primary energy balance sheet for renewable and non-renewable energy sources for the manufacturing and combustion of 1 m³ of MDF / HDF board and 1 m² of Melamine faced MDF board.**

CO_2 balance sheet

The CO_2 balance sheet in figure 4 shows that the manufacturing of one m³ of MDF/HDF board or one m² of Melamine faced MDF board causes 674 / 842 / 7.13 kg of CO_2 emissions, of which 198 / 248 / 1.78 kg CO_2 come from the direct thermal utilisation of wood during the production phase and an additional 476 / 595 / 5.35 kg CO_2 are fossil emissions. On the other hand, a total of 1233 / 1541 / 11.6 kg CO_2 per m³ of MDF/HDF board or m² of Melamine faced MDF board is removed from the air and stored in the wood through photosynthesis as the trees grow, of which 1035 / 1293 kg CO_2 per m³ and 9.9 kg CO_2 per m² remains bound. The CO_2 component bound in the wood of the MDF/HDF/Melamine faced MDF board is only released again at the end of the lifecycle, that is, during the thermal utilisation of the board. If one allocates the manufacturing CO_2 intake (intake bar) and CO_2 emissions (output bar), one obtains, on balance, a CO_2 storage of 559 / 699 / 4.52 kg per m³ MDF-/HDF or m² of Melamine faced MDF board through binding in the product and substitution of non-renewable energy sources. This storage effect is applicable throughout the utilisation phase. During combustion at end of life in the modelled biomass generating plant, the carbon stored in the board is released back into the atmosphere, primarily in the form of CO_2. At the same time, however, a substitution of fossil fuels takes place, and therefore CO_2 from the combustion of these fossil energy sources of -836 / -1046 / -6.1 kg CO_2. On balance, this results in a total of -168 / -210 / -0.65 kg CO_2 over the life cycle.

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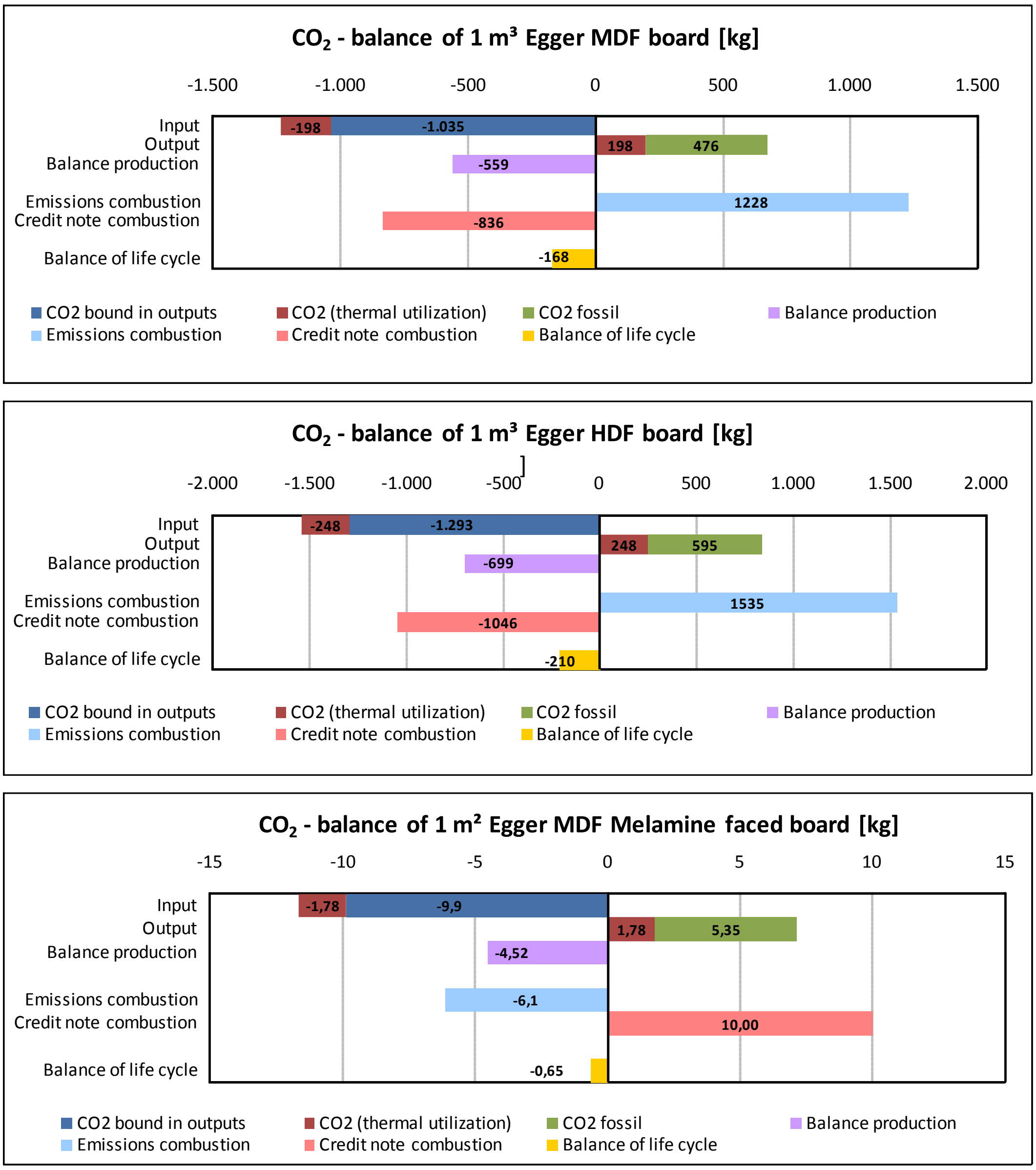

Figure 4: **CO_2 balance for the manufacturing of 1 m³ of MDF/HDF board or 1 m² of Melamine faced MDF board.**

Waste

The evaluation of waste produced to manufacture 1 m³ of MDF/HDF board is shown separately for the three segments construction/mining debris (including ore processing residues), municipal waste (including household waste and commercial waste) and hazardous waste including radioactive wastes (table 7).

Table 7: Waste accumulation during the manufacturing and combustion of 1 m³ of MDF/HDF board or 1 m² of Melamine faced MDF board.

Wastes [kg / m³ MDF board]			
Evaluation variable	**Manufacturing**	**End of Life**	**Total**
Residues / mining debris	1571,08	-1156	415
Municipal waste	0,77	0,00	0,77
Hazardous waste	2,12	-0,46	1,66
of which is radioactive waste	0,63	-0,46	0,18
Wastes [kg / m³ HDF board]			
Evaluation variable	**Manufacturing**	**End of Life**	**Total**
Residues / mining debris	1963,84	-1445,03	518,82
Municipal waste	0,96	0,00	0,96
Hazardous waste	2,64	-0,57	2,07
of which is radioactive waste	0,79	-0,57	0,22
Wastes [kg / m² MDF - Melamine faced board]			
Evaluation variable	**Manufacturing**	**End of Life**	**Total**
Residues / mining debris	16,08	-11,36	4,72
Municipal waste	0,0117	0,0000	0,0117
Hazardous waste	0,0210	-0,0045	0,0165
of which is radioactive waste	0,0065	-0,0045	0,0019

Quantitatively, the mining debris is by far the most significant fraction, followed by hazardous waste and municipal waste.

For the **mining debris** the rubble generated during manufacturing is by far the most significant quantity at 99.7%, followed by ore dressing residues and landfill waste, etc. with a total fraction of less than 1%. Rubble is produced primarily during the mining of mineral raw materials and coal in the production of raw materials and energy sources. The combustion of MDF/HDF/Melamine faced MDF board at the end of life substitutes mining debris in energy production in the amount of 1156 / 1445 kg/m³ / 11.36 kg/m² MDF/HDF/Melamine faced MDF board.

Significant fractions within the **municipal waste** segment are non-specific waste, sludge, and paper. All other fractions play a minor role. The combustion at EoL results in a minor increase in total waste production.

Hazardous wastes here are primarily the waste produced during the upstream stages. The “sludge” fraction contains the largest percentage of hazardous waste. Furthermore, 0.63 / 0.79 / 0.0065 kg of radioactive waste is produced, of which 96-98.5 % is ore dressing residue which is allocated to the electricity-mix upstream chain. However, radioactive waste is substituted through the energy generated at end of life, which results in an overall value of 0.18 / 0.22 kg/m³ / 0.0019 kg/m².

Impact assessment

The following table shows the absolute contributions of manufacturing and combustion of 1 m³ of MDF/HDF board or 1 m² of Melamine faced MDF board to the impact categories global warming potential (GWP 100), ozone depletion potential (ODP), acidification potential (AP), eutrophication potential (EP), and photochemical oxidation formation potential (summer smog potential POCP). In addition the renewable primary energy (PE reg.) and the non-renewable primary energy (PE nr.) are listed again.

Table 8: **Absolute contributions of manufacturing and end of life per m³ of finished MDF/HDF or m² of Melamine faced MDF to PE nr, PE reg, GWP 100, ODP, AP, EP und POCP.**

MDF boards (per m³)				
Evaluation variable	**Unit per m³**	**Total**	**Manufacturing**	**End of Life**
Primary energy, non renewable	[MJ]	-5179	8734	-13913
Primary energy, renewable	[MJ]	11496	11653	-157,2
Global warming potential (GWP 100)	[kg CO_2 eqv.]	-159,7	-504,6	345,0
Ozone depletion potential (ODP)	[kg R11 eqv.]	2,65E-05	5,96E-05	-3,30E-05
Acidification potential (AP)	[kg SO_2 eqv.]	2,77E+00	1,72E+00	1,06E+00
Eutrophication potential (EP)	[kg Phosphate eqv.]	6,83E-01	4,79E-01	2,04E-01
Photochemical oxidant formation potential (POFP)	[kg ethylene eqv.]	3,37E-01	3,55E-01	-1,81E-02
HDF boards (per m³)				
Evaluation variable	**Unit per m³**	**Total**	**Manufacturing**	**End of Life**
Primary energy, non renewable	[MJ]	-6473	10918	-17391
Primary energy, renewable	[MJ]	14370	14567	-196,5
Global warming potential (GWP 100)	[kg CO_2 eqv.]	-199,6	-630,8	431,2
Ozone depletion potential (ODP)	[kg R11 eqv.]	3,32E-05	7,45E-05	-4,13E-05
Acidification potential (AP)	[kg SO_2 eqv.]	3,47E+00	2,14E+00	1,32E+00
Eutrophication potential (EP)	[kg Phosphate eqv.]	8,54E-01	5,99E-01	2,55E-01
Photochemical oxidant formation potential (POFP)	[kg ethylene eqv.]	4,21E-01	4,44E-01	-2,27E-02
MDF - Melamine faced boards (per m²)				
Evaluation variable	**Unit per m²**	**Total**	**Manufacturing**	**End of Life**
Primary energy, non renewable	[MJ]	-38,3	98,4	-136,7
Primary energy, renewable	[MJ]	108,1	109,6	-1,6
Global warming potential (GWP 100)	[kg CO_2 eqv.]	-0,50	-3,92	3,42
Ozone depletion potential (ODP)	[kg R11 eqv.]	2,70E-07	5,97E-07	-3,27E-07
Acidification potential (AP)	[kg SO_2 eqv.]	2,73E-02	1,78E-02	9,48E-03
Eutrophication potential (EP)	[kg Phosphate eqv.]	6,80E-03	4,94E-03	1,86E-03
Photochemical oxidant formation potential (POFP)	[kg ethylene eqv.]	3,47E-03	3,67E-03	-2,06E-04

When considering the **manufacturing system boundary under consideration of the end of life** in a biomass generating plant, the significance of the method of utilisation or disposal on the environmental impact over the entire life cycle becomes apparent. The resulting additional emissions or related substitution effects in the energy supply system are shown graphically in figure 5.

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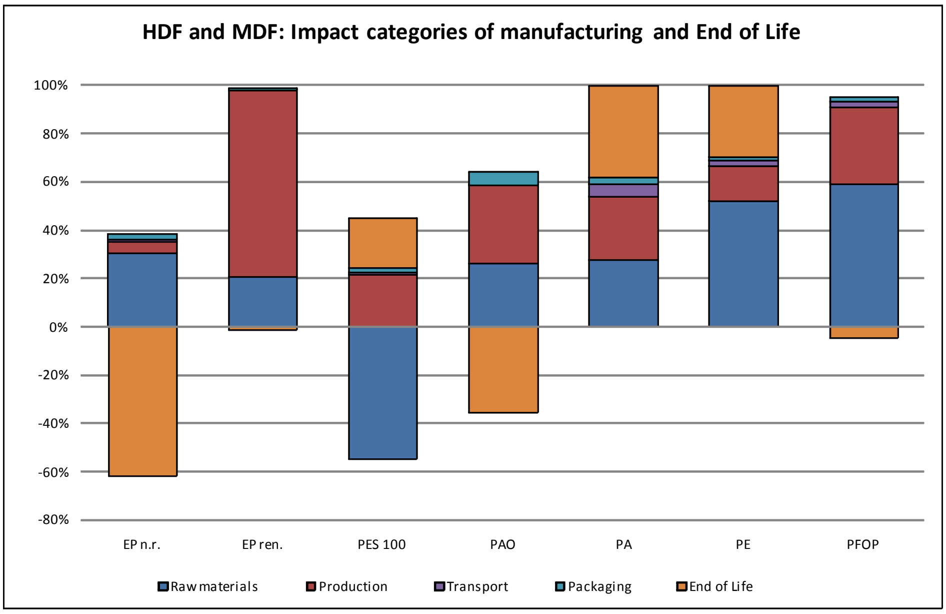

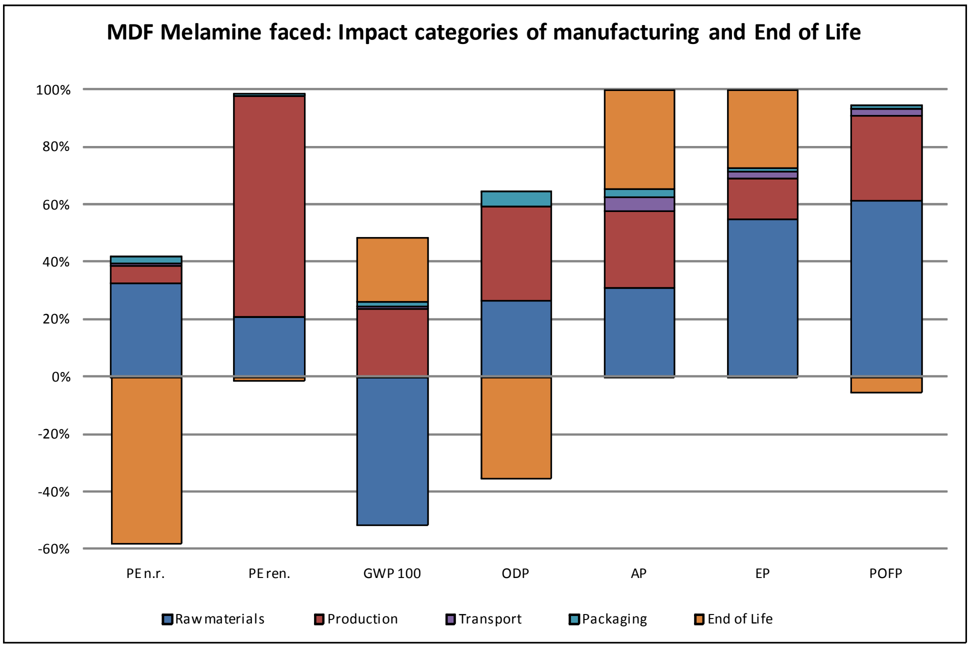

Figure 5: Proportion of the processes relative to the impact categories – factory gate system boundary and combustion of the MDF/HDF boards at end of life.

The illustrated end of life fractions result from the allocation of the emissions resulting from the combustion process against the emissions avoided for the generation of electricity and steam. This is the difference between the emissions for combustion of the boards and the emissions avoided as a result in the average German energy generation (credits). During substitution effects at end of life the need for non-renewable energy sources and the ozone depletion potential are reduced, as is the need for renewable energy sources to a small degree. All other environmental impact categories show an increase. This increase in emissions occurs during the combustion of the MDF/HDF boards in a biomass generating plant. If the MDF/HDF board is burned in a more efficient facility, then these increased emissions can be reduced through an increase in the energy substitution effects. If combustion takes place in less efficient facilities, then this increases the contribution of the end of life processes to the overall emissions.

The **global warming potential** in manufacturing is dominated by carbon dioxide. Per m³ of MDF/HDF or m² of Melamine faced MDF board, 1035 / 1293 / 9.9 kg CO_2 are bound in the renewable raw materials contained in the product. Another 198 / 248 / 1.78 kg CO_2 are bound in the wood utilized for energy production. This binding of CO_2 in the tree growth phase is offset by further CO_2 emissions during the provisioning of raw materials, production, transportation, and packaging. This results in a balance over the product lifespan of approx. negative 504 / 631 / 3.92 kg CO_2 equivalent through the carbon stored in the product. The emission values at end of life of 345 / 431 / 3.42 kg CO_2 equivalent result from the combustion minus the credit (substitution effect in the electricity mix as well as average steam production) for the energy utilisation from 1 m³ of finished MDF/HDF board or m² of Melamine faced MDF board. Within the system being considered (manufacturing and end of life), this results in a global warming potential of -160 / -200 kg CO_2 equivalent per m³ of MDF/HDF or 0.5 kg CO_2 equivalent per m² of Melamine faced MDF board.

The provisioning of raw materials (approx. 40%) and production (50%) are the main contributors to the **ozone depletion potential.** A total of 5.96E-05 / 7.45E-05 / 5.97E-07 kg R11 equivalent ozone depletion potential is generated during production per m³ of MDF/HDF or m² of Melamine faced MDF board. The production of electricity is the main factor resulting in a negative value for the end of life. The total system produces an ozone depletion potential of approx. 2.65E-05 / 3.32E-05 / 2.70E-07 kg R11 equivalent.

The provisioning of raw materials (around 50%) and production (around 35%) are the main contributors to the **acidification potential.** 1.72 / 2.14 / 1.78E-02 kg SO_2 equivalent are emitted during the production phase per m³ of MDF/HDF or m² of Melamine faced MDF board. Combined with the EoL, this results in an acidification potential of approx. 2.77 / 3.47 / 2.73E-02 kg SO_2 equivalent for the overall system under consideration.

For the **eutrophication potential** the provisioning of raw materials (around 80%) and production (around 15%) are the most significant contributing factors. For manufacturing, the eutrophication potential is 0.48 / 0.6 / 4.94E-03 kg phosphate equivalent. The EoL increases the eutrophication potential again to 0.68 / 0.85 / 6.80E-03 kg phosphate equivalent under consideration of the substitution effects.

Provisioning of raw materials (approx. 65%) and production (around 30%) contribute to the **photochemical oxidant creation potential (ground-level ozone formation).** Overall the POCP within the factory gate system boundary is 0.36 / 0.44 / 3.67E-03 kg ethylene equivalent. The POCP is increased to 0.37 / 0.42 / 3.47E-03 kg ethene equivalent by the EoL.

8 Evidence and verifications

8. 1 Formaldehyde

Testing institute: WKI Fraunhofer Wilhelm-Klauditz-Institut

Testing, monitoring, and certification site, Braunschweig, Germany

Test report, date: B3355/2008 raw MDF boards EPF-S from 01/10/2008
B1912/2008 raw MDF boards E1 from 06/06/2008
B3071/2008 Melamine faced MDF boards from 29/08/2008

Result: The testing of the formaldehyde content was performed according to the performator method according to EN 120 and according to the gas analysis method according to EN 717-2. For the raw boards the results are well below the maximum permissible value of 5.0 mg /100 g per board (at 6.5% material moisture content) according to the EPF standard (EPF-S 07/2008). The average results are:

- 4.7 mg HCHO/100 g according to EN 120 for a board thickness of 18mm
- 4.2 mg HCHO/100 g according to EN 120 for a board thickness of 19mm
- <0.1 mg HCHO/m² h according to EN 717-2 for a board thickness of 19mm

8. 2 Eluate analysis

Testing institute: MFPA Leipzig GmbH, Division I – Construction Materials

Accredited testing laboratory, Leipzig Institute for Materials Research and Testing, Leipzig, Germany

Test report, date:

UB 1. 1 / 08 – 162 – raw MDF boards from 15/08/2008

Result for raw MDF board: Determination of elutable heavy metals is performed according to EN 71-3. The following values were determined [mg/kg]: Antimony <1, Arsenic <0.5, Barium 41, Cadmium 0.13, Chrome <0.2, Lead 1, Mercury <0.01, Selenium <1.

Test report, date:

UB 1. 1 / 07 – 520 – Melamine faced HDF board from 29/02/2008

Result for Melamine faced HDF board: Determination of elutable heavy metals is performed according to EN 71-3. The following values were determined [mg/kg]: Antimony <0.01, Arsenic <0.001, Barium 0.05, Cadmium 0.0009, Chrome VI <0.02, Lead 0.003, Mercury <0.0001, Selenium <0.01, Copper 0.008, Nickel 0.005, Zinc 0.09, Chrome <0.002, Molybdenum <0.01.

8. 3 Toxicity of fire gases

Testing institute: MFPA Leipzig GmbH, Division I – Construction Materials

Accredited testing laboratory, Leipzig Institute for Materials Research and Testing, Leipzig, Germany

Test report, date:

UB 1.1 / 08 – 162 – 2.1 raw MDF boards from 15/08/2008

Result for raw MDF board: The determination of toxic fire gases is performed according to DIN 4102 part 1 – class A at 400° C. The results show that after 30 minutes, 7200 ppm of carbon monoxide was measured in the inhalation space, while all other chemical compounds were not detectable within this timeframe. After 60 minutes, the following concentrations were found in the inhalation space: Carbon monoxide 10 000 ppm (hence calculated >50% COHb), carbon dioxide 25 000 ppm, ammoniac 2500 ppm, and hydrocarbons (styrol) 400 ppm. Hydrogen cyanide and hydrogen chloride were not detectable. The relative weight reduction at a test temperature of 400° C was 55.3%.

At the end of the test, dense yellow smoke was present in the inhalation space.

The ammonia concentrations released under the selected test conditions are greater than those released from wood under the same conditions.

Test report, date:

UB 1.1 / 07 – 520 – Melamine faced HDF boards from 29/02/2008

Result for Melamine faced HDF board: The determination of toxic fire gases is performed according to DIN 4102 part 1 – class A at 400° C. The results show that after 30 minutes, 5000 ppm of carbon monoxide was measured in the inhalation space, while all other chemical compounds were not detectable within this timeframe. After 60 minutes, the following concentrations were found in the inhalation space: Carbon monoxide 11 000 ppm (hence calculated >50% COHb), carbon dioxide 10 000 ppm, ammoniac 1000 ppm, and hydrogen cyanide 80ppm. Hydrogen chloride, nitrous gases, nitrogen dioxide, and sulphur dioxide were not detectable. The relative weight reduction at a test temperature of 400° C was 65.5%.
At the end of the test, dense white smoke was present in the inhalation space. The emissions released under the selected test conditions contain 1000 ppm of ammonia.

8.4 EOX (extractable organic halogen compounds)

Testing institute: MFPA Leipzig GmbH, Division I – Construction Materials

Accredited testing laboratory, Leipzig Institute for Materials Research and Testing, Leipzig, Germany

Test report, date:

UB 1.1 / 08 – 162 – raw MDF boards from 15/08/2008

Result for raw MDF board: Determination of the extractable organic compounds (EOX) was done according to DIN 38414-S17 and resulted in a measured value <2 mg/kg.

Test report, date:

UB 1.1 / 07 – 520 – Melamine faced HDF board from 29/02/2008

Result for Melamine faced HDF board: Determination of the extractable organic halogen compounds was done according to DIN 38414-S17 and resulted in a measured value <2 mg/kg.

8.5 PCP / Lindane

Testing institute: WKI Fraunhofer Wilhelm-Klauditz-Institut

Testing, monitoring, and certification site, Braunschweig, Germany

Test report, date:

B43/07 external monitoring of the PCP and lindane content from 09/01/2007

Result: After extraction of the contained substances, the solutions were separated, processed, and then analysed using gas chromatography. The values for PCP and lindane are below the detection limit of 0.1 mg/kg.

(Scrap wood provision)

Not relevant for component materials free from scrap wood.

(MDI according to BIA 7670)

Not relevant for isocyanate-free gluing.

9 PCR Document and Verification

The declaration is based on the PCR document "Wood-based materials", year 2009-1.

Review of the PCR document by the expert committee. Chairman of the expert committee: Prof. Dr.-Ing. Hans-Wolf Reinhardt (University of Stuttgart, IWB (Institute for Materials in Construction))
Independent verification of the declaration according to ISO 14025: ☐ internal ☒ external
Validation of the declaration: Dr. Frank Werner

10 References

/Institut Bauen und Umwelt/ Guideline for the phrasing of product-group specific requirements of the IBU declarations (type III) for construction products, www.bau-umwelt.com

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Standards and Laws

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/DIN EN 13986/ DIN EN 13986: 2005-03, Wood-based materials for use in construction: properties, evaluation of conformity and labelling, German and English versions EN 13986:2005

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/ISO 14044/ DIN EN ISO 14044:2006-10, Environmental management - life cycle assessment - requirements and instructions (ISO 14044:2006); German and English version EN ISO 14044:2006

For further literature see the PCR document

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