Environmental Product Declaration

according to ISO 14025

Glunz AG
AGEPAN® OSB
Greenline OSB

Declaration number
EPD-GLU-2010211-E

Institut Bauen und Umwelt e.V.
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Brief version

Environmental Product Declaration

Environmental Product Declaration

Institut Bauen und Umwelt e.V. **www.bau-umwelt.com**	**Programme holder**
Glunz AG Grecostrasse 1 D-49716 Meppen	**Declaration holder**
EPD-GLU-2010211-E	**Declaration number**
OSB, constructive building panels This Declaration is an Environmental Product Declaration according to ISO 14025 and describes the environmental properties of the building products outlined here. It intends to promote the development of environmentally- and health-friendly building. This validated Declaration reveals all of the relevant environmental data. The Declaration is based on the "Wood materials" PCR document dated November 2009.	**Declared construction products**
This validated Declaration entitles the holder to bear the symbol of Institut Bauen und Umwelt e.V. It exclusively applies for the products referred to, for a period of one year from the issue date. The Declaration holder is liable for the data and evidence on which it is based.	**Validity**
The **Declaration** is complete and comprises in detail: - Product definition and physical construction data - Details on base materials and material origin - Descriptions of the product manufacturing process - Information on product processing - Data on the utilisation status, extraordinary effects and re-use phase - Results of the Life Cycle Assessment - Documents and tests	**Content of the Declaration**

25 March 2011		**Issue date**
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)		**Signatures**
This Declaration and the regulations upon which it is based have been tested by the independent Committee of Experts (SVA) in line with ISO 14025.		**Testing the Declaration**
Prof. Dr.-Ing. Hans-Wolf Reinhardt (Chairman of the SVA)	Dr. Frank Werner (tester appointed by the SVA)	**Signatures**

Brief version

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Product description

AGEPAN® and Greenline OSB (Oriented Strand Board) are wood materials comprising large longitudinal wood shavings ("strands") which are glued in a formaldehyde-free process using a synthetic resin binding agent (PMDI). The strands are aligned in a process-controlled manner (oriented) and compressed in an infinite process (ContiRoll technology) in three layers ranging in thickness from 6 to 40 mm. The upper and lower layers are longitudinal while the middle layer runs transverse to the panel direction. Approx. 95% of the OSB volume produced is OSB3 (see below).

Area of application

AGEPAN® and Greenline OSB have a high load capacity and are dimensionally stable. They can be used for both constructive and decorative purposes.

A prerequisite for constructive application is represented by the performance characteristics to DIN EN 13986 and the CE symbol.

Areas of application include: supporting and bracing wall and ceiling panelling, floor installations and installation panels, shop and trade fair stand construction as well as packaging and furniture elements.
Various OSB qualities are numbered 1 to 4 according to EN 300.
The following classifications apply for various applications:

- OSB/1: Panels for general purposes and interior furnishings (incl. furniture) for use in dry areas
- OSB/2: Panels for supporting purposes for use in dry areas
- OSB/3: Panels for supporting purposes for use in wet areas
- OSB/4: High load-capacity panels for supporting purposes for use in wet areas

Life Cycle Assessment framework

The **Life Cycle Assessment** has been performed in accordance with DIN ISO 14040 ff. and the requirements of the IBU Guidelines on Type III Declarations. Specific data on the products tested as well as data from the “GaBi 4” data base was applied. The Life Cycle Assessment comprises the exploitation of raw materials and energy, the transport of raw materials, the actual manufacturing phase, production and thermal utilisation of packaging as well as the End of Life in a biomass power plant with energy recovery. Declaration concerns one cubic metre of mixed OSB boards.

Results of the Life Cycle Assessment

		AGEPAN® and Greenline OSB boards		
Analysis factor	**Unit per m²**	**Total**	**Production**	**End of Life**
Primary energy, non-regenerative	[MJ]	-6,464	5,127	-11,591
Primary energy, regenerative	[MJ]	12,468	12,604	-135.6
Global warming potential (GWP 100)	[kg CO_2 equiv.]	-568.5	-890.0	321.6
Ozone depletion potential (ODP)	[kg R11 equiv.]	-1.38E-06	2.71E-05	-2.85E-05
Acidification potential (AP)	[kg SO_2 equiv.]	9.71E-01	8.50E-01	1.21E-01
Eutrophication potential (EP)	[kg PO_4^{3-} equiv.]	1.60E-01	1.42E-01	1.81E-02
Photochemical ozone creation potential (POCP)	[kg ethene equiv.]	1.97E-01	2.33E-01	-3.56E-02

Drafted by: PE INTERNATIONAL, Leinfelden-Echterdingen in co-operation with Glunz AG

PE INTERNATIONAL
EXPERTS IN SUSTAINABILITY

Documentation and tests

In addition, the following **documentation and tests** are depicted in the Environmental Declaration:

- Formaldehyde in accordance with EN 120 Measuring agency: Material- und Prüfanstalt Brandenburg, Eberswalde
- MDI (diphenyl methane 4.4' diisocyanate) in accordance with RAL-ZU 76/ BIA 7670 Measuring agency: Weßling, Altenberge
- Eluate analysis in accordance with DIN EN 71-3 Measuring agency: Material- und Prüfanstalt Brandenburg, Eberswalde
- EOX (Extractable Organic Halogen Compounds) in accordance with DIN 38414-17, Measuring agency: Material- und Prüfanstalt Brandenburg, Eberswalde
- PCP / Lindane in accordance with CEN/TR 14823 Measuring agency: Material- und Prüfanstalt Brandenburg, Eberswalde

Product group	Wood materials	Drafted
Declaration holder:	Glunz AG, Nettgau Plant	25.03.2010
Declaration number:	EPD-GLU-2010211-E	

Area of applicability

This document refers to coarse and smooth OSB (Oriented Strand Boards) manufactured in the following plant of the Sonae Group:

Glunz AG - Nettgau Plant, Strohmweg 1, D-38489 Nettgau

1 Product definition

Product definition

Definition as per EN 300:

"3.1 board comprising long, slim, oriented strands (OSB): A multi-layer board comprising long strands with a predefined form and thickness and manufactured with a binding agent. The strands in the outer layers are parallel to the board length or width; the strands in the middle layer or layers can be arranged randomly or are generally aligned perpendicular to the strands in the outer layers."

Primarily formaldehyde-free polyurethane glues based on PMDI are used as binding agents for OSB.

The gross densities of OSB are dependent on the quality (OSB1 – OSB4) and thickness and are between 600 and 640 kg/m³. Boards 6 mm to 40 mm thick are manufactured in various standard formats or to special customer specifications.

Application

AGEPAN® and Greenline OSB are permeable wood-based materials in accordance with DIN EN 13986 for constructive and decorative applications.

They can be used in all static, load-bearing applications in accordance with DIN 1052: 2008-12 or DIN EN 1995-1-2 (Eurocode 5).

Product standard / Approval

- EN 13986 – Wood materials for construction applications
- EN 300 - OSB – Definition, classification and abbreviations
- EN 14964 – Rigid underlays for roofing (OSB3/OSB4)

Quality assurance

The quality assurance applied is aligned towards the OSB target market.

- CE marking in accordance with EN 13986 – HFB Leipzig
- KOMO – SKH Wageningen, NL
- GOST – GOST Moscow, RUS
- PEFC, Chain of Custody, CoC-1882551, LGA InterCert GmbH, Nuremberg
- EN ISO 9001: 2000 – DEKRA Certification GmbH, Stuttgart
- ISO 14001: 2004 – DEKRA Certification GmbH, Stuttgart
- OHSAS 18001: 2007 – DEKRA Certification GmbH, Stuttgart

Delivery status, features

AGEPAN OSB 2 (EN 13986 / 300)

CE in accordance with EN 13986 in 6 – 40 mm, characteristic values in accordance with DIN 1052:2004-08 >06 – 25 mm

Standard board - Contiface (EN 300)

Format [mm]	Board strength [mm]												
	6	8	9	10	12	15	18	20	22	25	30	32	40
2440 x 1220			X		X	X	X						

Flooring panel with tongue and groove 4- Contiface (EN 300)

Format [mm]	Board strength [mm]												
	6	8	9	10	12	15	18	20	22	25	30	32	40
2440 x 610							X						

AGEPAN OSB/3 PUR (EN 13986 / 300)

CE in accordance with EN 13986 in 6 – 40 mm, characteristic values in accordance with DIN 1052:2004-08 >06 – 25 mm

Standard board - Contiface (EN 300)

Format [mm]	Board strength [mm]												
	6	8	9	10	12	15	18	20	22	25	30	32	40
2500 x 1250	x	x	x	x	x	x	x	x	x	x			
2440 x 1220			X										
5000 x 1250						x	x		X				
5000 x 2500						x	X		x	x			
3000 x 1250					x	x	X						
2800 x 1250					x	x	X						
2650 x 1250					x	x	X						

Flooring panel with tongue and groove 4 - Contiface (EN 300)

Format [mm]	Board strength [mm]												
	6	8	9	10	12	15	18	20	22	25	30	32	40
2500 x 675					x	x	x		x	X			
2440 x 610							X						
2500 x 1250						x	x		x	x			

Flooring panel with tongue and groove 4 - smooth (EN 300)													
Format [mm]	Board strength [mm]												
	6	8	9	10	12	15	18	20	22	25	30	32	40
2500 x 675					x	x	x		x	x			

Flooring panel with tongue and groove 2 - Contiface (EN 300)													
Format [mm]	Board strength [mm]												
	6	8	9	10	12	15	18	20	22	25	30	32	40
6250 x 675									X				
5000 x 1250									X				
2440 x 1220							X						

Features, delivery status

AGEPAN OSB/4 PUR PUR (EN 13986 / 300)

CE in accordance with EN 13986 in 6 – 40 mm, characteristic values in accordance with DIN 1052:2004-08 >6 – 25 mm

Standard board - Contiface (EN 300)

Format [mm]	Board strength [mm]												
	6	8	9	10	12	15	18	20	22	25	30	32	40
2500 x 1250					x	x	X		x				
3000 x 1250					x	x	X						
2800 x 1250					x	x	X						
2650 x 1250					x	x	x						

Flooring panel with tongue and groove 4 - Contiface (EN 300)

Format [mm]	Board strength [mm]												
	6	8	9	10	12	15	18	20	22	25	30	32	40
2500 x 675						x	x		x	x	X		
2500 x 1250						x	x		x	x			

Strength properties DIN EN 300

OSB/3							
Features	Test standard	Unit	Strength range in mm, nominal size				
			6 to 10	>10 to 18	18 to 25	>25 to 32	>32 to 40
Bending strength, major axis	EN 310	N / mm²	22	20	18	16	14

Bending strength, minor axis	EN 310	N / mm²	11	10	9	8	7
Bending elasticity modulus, major axis	EN 310	N / mm²	3500	3500	3500	3500	3500
Bending elasticity modulus, minor axis	EN 310	N / mm²	1400	1400	1400	1400	1400
Tensile strength	EN 319	N / mm²	0.34	0.32	0.3	0.29	0.26
Thickness swelling after 24 hours	EN 317	%	15	15	15	15	15
Option 1: Tensile strength after cycle test	EN 321 + EN 319	N / mm²	0.18	0.15	0.13	0.1	0.08
Option 1: Bending strength after cycle test, major axis	EN 321 + EN 310	N / mm²	9	8	7	6	6
Option 2: Tensile strength after boil test	EN 1087	N / mm²	0.15	0.13	0.12	0.06	0.05
OSB/4							
Features	Test standard	Unit	Strength range in mm, nominal size				
			6 to 10	>10 to 18	18 to 25	>25 to 32	>32 to 40
Bending strength, major axis	EN 310	N / mm²	30	28	26	24	22

Bending strength, minor axis	EN 310	N / mm²	16	15	14	13	12
Elasticity module, major axis	EN 310	N / mm²	4800	4800	4800	4800	4800
Elasticity module, minor axis	EN 310	N / mm²	1900	1900	1900	1900	1900
Tensile strength	EN 319	N / mm²	0.50	0.45	0.40	0.35	0.30
Thickness swelling after 24 hours	EN 317	%	12	12	12	12	12

According to EN 13986, the thermal conductivity displayed by OSB boards is 0.13 W/m K.

The water vapour diffusion figure μ is referred to in EN 13986 for dry (dry cup) and wet (wet cup) conditions. The dry cup value is 50; the wet cup value is 30. Tests commissioned by us at the Institut für Bauphysik (IBP) in Holzkirchen have however indicated that our boards display higher values. Accordingly, values of 144 (dry cup) and 111 (wet cup) were measured on an OSB/3 board 15 mm thick. An OSB/4 board of the same thickness displayed values of 520 (dry cup) and 480 (wet cup).

2 Base materials

Base materials Primary products

AGEPAN® and Greenline with thicknesses of 6 to 40 mm with an average density of 600 kg/m³ comprise (details provided as mass % per 1 m³ of product):

- Wood chips, primarily pine, > 90%

Consumables / Additives

- Water (moisture), approx. 4.5%
- PMDI adhesive (polymer 4.4' diphenyl methane diisocyanate), approx. 3.5%
- Paraffin wax emulsion, 0.5% to 2%

Explanation of materials

Wood mass: Only fresh wood from thinning measures, primarily pine, is used in the production of AGEPAN® and Greenline OSB.

Paraffin wax emulsion: For the purposes of hydrophobicity (improving resistance to moisture), a paraffin wax emulsion is added to the recipe during glueing.

PMDI adhesive: Hardens fully under pressure and temperature as moisture is added resulting in polyurethane and poly-urea compounds.

Harvesting raw materials and origin of raw materials

Roundwood is the optimum raw material for manufacturing OSB. Trunks with diameters of 80 to 600 mm can be used.

Pine logs from indigenous, largely regional forestry reserves are used for manufacturing AGEPAN® and Greenline OSB. The wood is procured from forests within a radius of approx. 100 km of the plant location. Short transport routes make a particular contribution towards minimising CO_2 emissions and the logistical effort involved in the provision of raw materials.

The entire OSB product range is PEFC-certified. The binding agents used and the raw materials associated with manufacture thereof originate from suppliers located up to approx. 300 km from the production location.

Regional and general availability of raw materials

Wood used in the production of AGEPAN® and Greenline OSB originates exclusively from sustainably managed cultivated forests. These ranges exclusively involve fresh wood gained by thinning and forest maintenance. The binding agent and paraffin emulsion are synthesised from crude oil - a fossil fuel of limited availability.

3 Product manufacture

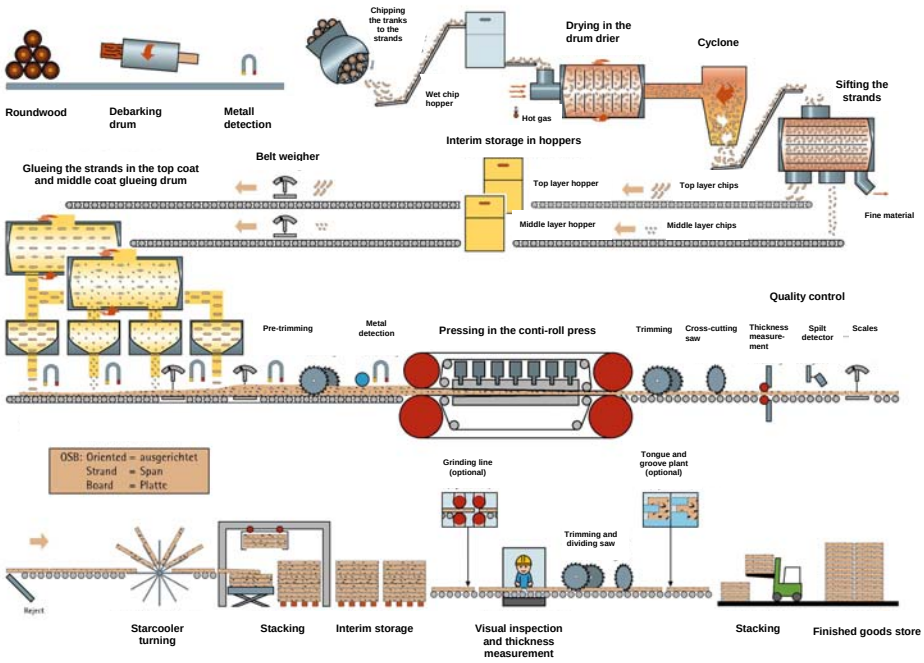
Product manufacture

Breakdown of the manufacturing process:

Manufacturing OSB

1. Debarking the logs
2. Chipping the wood in the knife ring cutter
3. Drying
4. Sifting in top and middle layer fractions
5. Interim storage in proportioning hoppers
6. Belt weigher
7. Separate glueing of the top and middle layer strands
8. Scattering the OSB cake (alignment in strands)
9. Compressing the OSB mat under high pressure in a continuous hot press
10. Distributing the OSB strands as raw board formats
11. Cooling the raw boards in starcoolers
12. Stacking
13. Optional: Grinding the top and underside
14. Optional: Distribution into fixed formats or tongue and groove panels

Manufacturing OSB: From tree trunks to finished boards



Health protection in manufacturing

Measures for avoiding health risks/problems during the manufacturing process:

Owing to the manufacturing conditions, no special health protection measures over and beyond the statutory guidelines are required. The MAK (= maximum allowable concentration) values (Germany) are fallen short of at each point of the plant.

Environmental protection in manufacturing

- Air: Waste air generated during production is cleaned in accordance with statutory specifications. Emissions are below the limit values specified by law in the TA Air
- Water/Soil: No contamination of water or soil. No production-related waste water.
- Noise: Sound protection analyses have established that all values communicated inside and outside the production facilities are below the standards applicable in Germany. Noise-intensive plant areas such as chipping are encapsulated appropriately by structural measures.

4 Product processing

Processing recommendations

AGEPAN® and Greenline OSB can be sawn, drilled and milled using standard (electric) power tools. Carbide-tipped tools should be given preference, especially on circular saws. Respiratory protection should be worn when using hand-held equipment without suction devices.

Industrial safety Environmental protection

The appropriate safety guidelines must be observed when processing and fitting AGEPAN® and Greenline OSB (goggles, dust mask). The guidelines provided by the professional liability associations must be observed during commercial processing.

Residual materials

Residual materials and packaging: Residual material incurred on the building site (cuttings and packaging) must be collected segregated by waste fraction. The specifications outlined by local disposal authorities and the information provided in section 7. "Re-use phase" must be taken into consideration when disposing of residual materials.

Packaging Chipboard, OSB (AVV 15 01 03) and corrugated board (AVV 15 01 01) are used for covering while PET (AVV 15 01 02) or steel tape packing bands (AVV 15 01 04) are used for packing.

5 Condition of use

Contents **Contents in condition of use:**

The materials used in AGEPAN® and Greenline OSB comply with the percentages indicated in section 1. “Base materials”, whereby a polyurethane resin is used as a binding agent for the formaldehyde-free boards. Compression in the press gives rise to poly-urea and polyurethane as water is added. During this process, the polyurethane enters a chemical bond with the wood. Full setting of the glue used is ensured by the high pressing temperatures as well as the prevailing moisture content.

Reliability of condition of use Reliability of condition of use is defined via the application classes in accordance with EN 300 and EN 13986 (please refer to “Product definition” in section 1).

6 Extraordinary effects

Fire **OSB fire performance:**
Classification as fire class D in accordance with EN 13501-1 (see EN 13986 requirements)
Smoke class S2 – normal smoke emissions
d0 – non-dripping

Changing the system condition (burning dripping/falling material): burning dripping material is not possible as OSB boards do not liquefy when heated.

Effects of water No ingredients are washed out which could be hazardous to water. OSB boards are not resistant to permanent exposure to water; damaged areas can however be replaced locally.

Mechanical destruction OSB board breakage features display relatively brittle performance, whereby sharp edges can arise on the broken panel edges (risk of injury).

7 Re-use phase

Re-use AGEPAN® and Greenline OSB boards can be collected separately and utilised thermally in the course of conversion or termination of the use phase of a building in the event of selective renaturation.

Further use AGEPAN® and Greenline OSB boards can be collected separately and utilised in the manufacture of chipboard, for example, in the course of conversion or termination of the use phase of a building in the event of selective renaturation. This is based on the condition that the wooden boards are not fully glued.

Energetic utilisation (in approved systems as per 4 and 17 of BImSchV): owing to the high heat value of approx. 17 MJ/kg, energetic utilisation for generating process energy and electricity (CHP plants) from board leftovers and boards arising from demolition measures on the building site is preferable to landfilling.

Disposal OSB leftovers and residual materials incurred as a result of demolition measures on the building site should be primarily directed towards material recycling. If this is not

possible, they must be directed toward energetic utilisation instead of landfilling (technical instructions governing municipal waste (TASi)).

8 Life Cycle Assessment

8.1 Manufacturing Oriented Strand Board

Declared unit

The Declaration concerns the manufacture of one cubic metre of average AGEPAN® and Greenline OSB.

The End of Life (EoL) is calculated as thermal processing in a bio-mass power plant with energy generation.

System limits

The selected system limits comprise the production of AGEPAN® and Greenline including extraction of the raw material to the packaged product at the factory gate (cradle to gate).

The review framework comprises the following details:

- Forest processes for the provision and transport of wood
- Production of all raw materials, primary products and consumables including the associated relevant transport
- Relevant transport and packaging of raw materials and primary products
- AGEPAN® and Greenline OSB production process (energy, waste, thermal utilisation of production waste, emissions) and provision of energy from the resource
- Manufacturing packaging and thermal utilisation thereof

The utilisation phase for AGEPAN® and Greenline OSB was not examined in this Declaration.

As the End-of-Life scenario, a bio-mass power plant with energy recovery (credits in accordance with the substitution approach) was assumed ("gate to grave"). The analysis framework starts at the gate to the utilisation plant. In terms of output, it is assumed that the ash incurred is directed to a landfill.

Performance criteria

All operating data, i.e. all of the starting materials used, thermal energy, internal fuel and electricity consumption, all direct production waste as well as all emission measurements available were taken into consideration in the analysis. Assumptions were made as regards the transport expenses associated with all input and output data taken into consideration. Accordingly, material and energy flows with a share of less than 1 per cent were also considered.

It can be assumed that the total of all neglected processes does not exceed 5% in the effective categories.

Machinery and plants required in the manufacturing process are neglected.

Transport

The relevant transports of raw materials and consumables used are always taken into consideration.

Period under review

The data used refers to the actual production processes of fiscal 1.1.2008 to 31.12.2008. The Life Cycle Assessment was drawn up for Germany as a reference area. This means that apart from the production processes under these marginal conditions, the pre-stages also of relevance for Germany such as provision of electricity or energy carriers were used.

Background data

“GaBi 4” – the software system for comprehensive analysis (GaBi 2006) – was used for modelling the life cycle for the manufacture and disposal of AGEPAN® and Greenline OSB. All of the background data records of relevance for manufacturing and disposal were taken from the GaBi 4 software data base. The upstream chain for forestry has been balanced in accordance with Schweinle & Thoroe, 2001.

Assumptions

The results of the Life Cycle Assessment are based on the following assumptions:

The transport of all raw materials and/or auxiliaries (by truck) is calculated using data from the GaBi data base.

The energy carriers and energy sources used for the production location were taken into consideration as regards energy supply.

All leftovers incurred during production and final manufacturing (trimmings, cuttings and milling leftovers) are directed to thermal utilisation as "combustion materials". The credits from energy decoupling of the combustion plants are incorporated in the analysis.

The End-of-Life scenario was assumed as thermal utilisation in a bio-mass power plant.

The results of the Life Cycle Inventory and Impact Analysis are indicated as a product mix (combining 90 mass % P2 and 10 mass % P3 boards).

Data quality

The data concerning AGEPAN® and Greenline OSB was recorded directly in the production facility in the Nettgau plant. All input and output data was supplied by Glunz and has been examined as regards plausibility. With the result that good representativity of the data can be assumed.

The data used is less than 5 years old. The majority of background data for upstream chains originates from industrial sources and was collected under consistent time- and method-based constraints. The process data and background data used are consistent. Importance was attached to a high degree of completeness when collating material and energy flows of environmental relevance with the result that the data quality can be regarded as very good.

Allocation

Allocation relates to the assignment of input and output flows for a Life Cycle Assessment module to the product system tested (ISO 14040).

No allocations are necessary for the manufacture of AGEPAN® and Greenline OSB as well as the associated energy supply; any leftovers are utilised energetically. Incineration is balanced using "GaBi 2006" software and energy credits offset as for the End of Life.

Modelled thermal utilisation of disused AGEPAN® and Greenline OSB during the End of Life process is performed in a bio-mass power plant. The credits for energy for electricity produced in the power plant and producible thermal energy are calculated on the basis of the input heating value taking consideration of efficiency. The credits for gas are calculated from the “thermal energy from natural gas” while credits for electricity are based on the German power mix. Emissions dependent on input (e.g. CO_2, HCl, SO_2 or heavy metals) were calculated according to the material composition of the respective ranges. Technology-dependent emissions (e.g. CO) are allocated depending on the waste gas volume.

Information on the usage phase

The usage phase and any possible extraordinary effects were not examined in the Life Cycle Assessment. In system comparisons, life cycle aspects must be taken into consideration depending on stress and load.

8.2 Depicting the analyses and evaluation

Life Cycle Inventory Analysis

The following section outlines the Life Cycle Inventory Analysis as regards primary energy consumption and waste, followed by the estimated impact.

Primary energy

In assessing energy consumption from regenerative and non-regenerative resources, the lower heating value was consistently applied. The Table 8-1 below indicates the energy consumption for manufacturing one cubic metre of AGEPAN® and Greenline OSB product mix. Consumption of non-regenerative energies for board manufacture (cradle to gate) corresponds with 5,127 MJ per m^3, whereby production accounts for approx. 34%, the provision of raw materials accounts for 64% while transport and packaging make up for around 2%.

Additionally, 12,604 MJ of regenerative energy (> 95% mainly solar energy stored in the bio-mass (wood) is used for manufacturing one cubic metre of AGEPAN® and Greenline OSB.

Table 8-1: Primary energy requirements for the manufacture of one cubic metre of OSB

OSB				
Analysis factor	Unit per m³	Total	Production	End of Life
Primary energy, non-regenerative	[MJ]	-6,464	5,127	-11,591
Primary energy, regenerative	[MJ]	12,468	12,604	-136

Closer consideration of the composition of primary energy consumption indicates that the energy stored in the product is converted in the EoL process. This comprises regenerative primary energy (stored in the wood) and non-regenerative primary energy (stored in the glues). One kg of finished OSB has a lower heating value of approx. 17.1 MJ/kg.

Closer analysis of the non-regenerative energy requirements for the manufacture of one cubic metre of OSB reveals that natural gas is used as an essential primary energy carrier which accounts for approx. 39% of the primary energy used. Around 9% of energy requirements are covered by pit coal and 10% by brown coal while another 15% is covered by uranium. The share of uranium in primary energy consumption is attributable to the purchase of external power from the public grid as per the respective power mix at the production locations which also incorporates nuclear energy. The remaining 27% is covered by crude oil (Fig. 8-1).

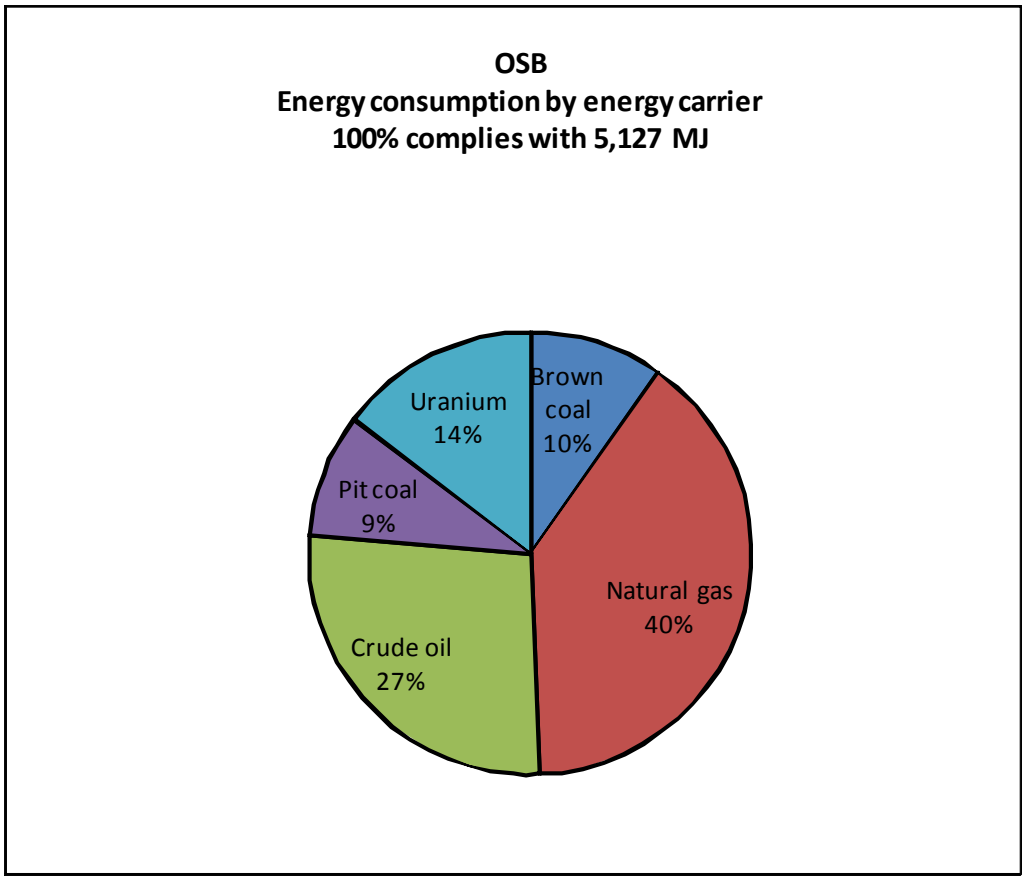


Fig. 8-1: Distribution of non-regenerative energy consumption by energy carrier in the manufacture of 1 m^3 of AGEPAN® and Greenline OSB

The shares of non-regenerative energy carriers correspond to Fig. 8-1. Distribution of non-regenerative energy carriers across the individual processes is depicted in Fig. 8-2, whereby production accounts for approx. 1,770 MJ, the provision of raw materials accounts for 3,289 MJ while transport and packaging account for 68 MJ. This is offset by a credit at the End of Life amounting to 11,591 MJ.

Thermal utilisation of packaging and other waste is modelled as average waste incineration for the respective substance fraction with steam conversion and electricity production. Metal packaging waste is directed to the recycling process (system cut). Incineration gives rise to electricity credits by substituting electricity in the public network in line with the German power mix and a credit for thermal energy as per average production of thermal energy from natural gas per m^3 of finished OSB produced.

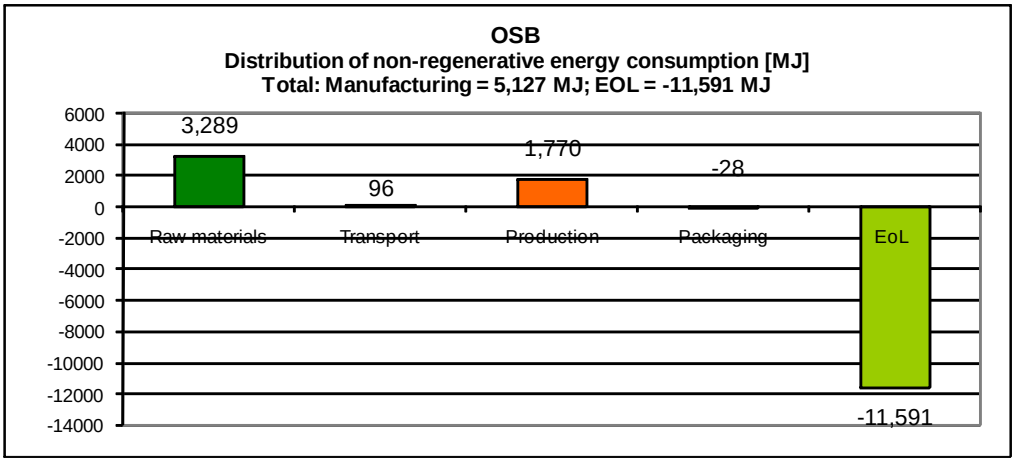


Fig. 8-2: Distribution of non-regenerative energy consumption in the manufacture of 1 m³ of AGEPAN® and Greenline OSB

When manufacturing and End of Life (incineration of OSB in a bio-mass power plant) are taken into consideration, it can be ascertained that the energy credit for electricity and thermal energy (credit for German power mix and German thermal energy from natural gas) complies with -11,591 MJ of non-regenerative energy carriers per m³ OSB. Accordingly, the use of non-regenerative primary energy when offsetting manufacturing and incineration is reduced from 5,127 MJ/m³ to a value of -6,464 MJ/ m³.

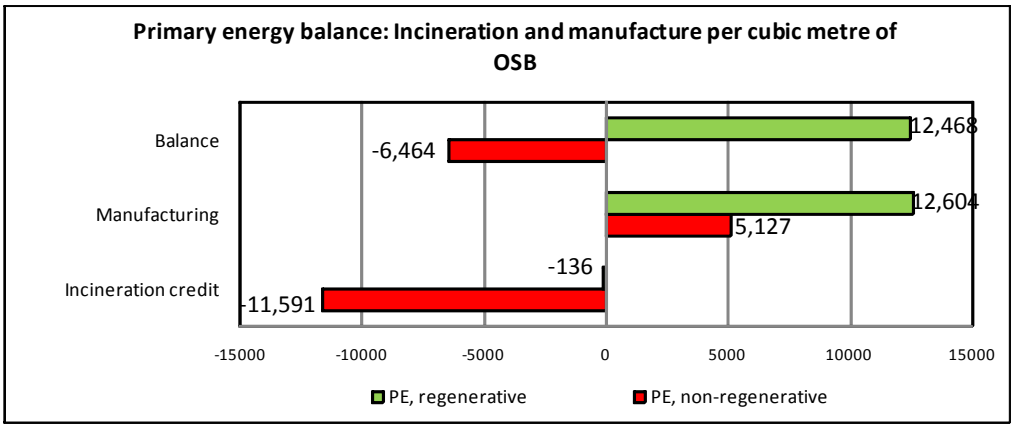


Fig. 8-3: Primary energy balance: Regenerative and non-regenerative energy carriers for the manufacture and incineration of 1 m³ AGEPAN® and Greenline OSB

CO_2 balance

The CO_2 balance depicted in Fig. 8-4 indicates that the manufacture of m³ OSB causes 417 kg of CO_2 emissions. This is offset by the fact that by manufacturing one cubic metre of OSB, a total of 1,342 kg of CO_2 from the air are stored in the wood

during the course of tree growth for which it is in turn required and remains largely bound across the use phase. The CO_2 share bound in one cubic metre of OSB is not released until the end of the life cycle, e.g. during thermal utilisation of the OSB. If CO_2 absorption (Input bar) is offset against CO_2 emissions (Output bar) during manufacturing, this results in an emissions balance of -925 kg per m³ OSB for the manufacturing phase. During End-of-Life incineration in the bio-mass power plant, the carbon stored in the panel is emitted back into the atmosphere primarily in the form of CO_2. At the same time however, substitution of fossil fuels occurs and therefore of CO_2 from incinerating these fossil energy carriers to the effect of 675 kg CO_2. This energetic substitution effect therefore results in an overall balance of -562 kg of CO_2 over the entire life cycle.

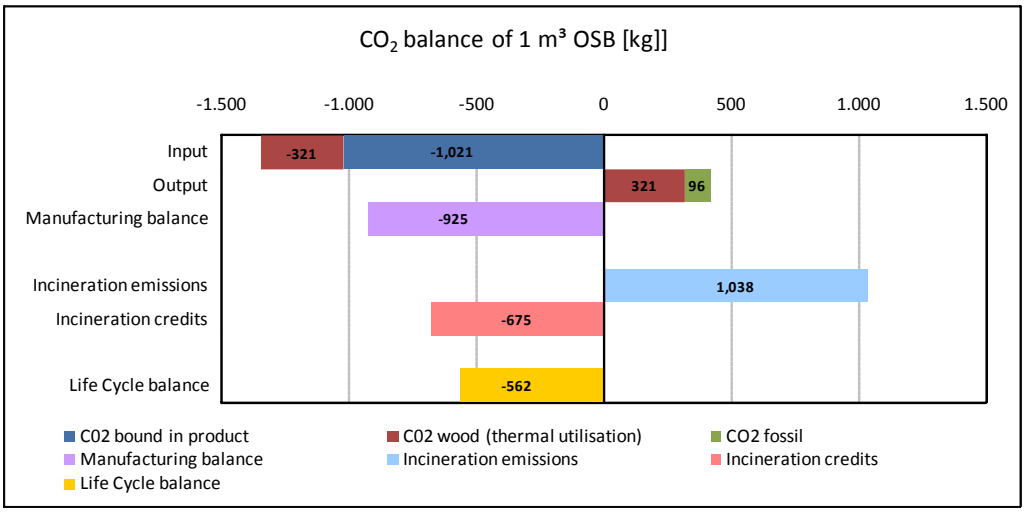


Fig. 8-4: CO_2 balance of manufacture and End of Life of 1 m³ AGEPAN® and Greenline OSB

Water

Table 8-2 indicates the water requirements for manufacture, EoL and the total. The volume indicated in cubic metres primarily comprises groundwater and surface water. Water consumption is more than compensated for in the EoL thanks to the substitution effect and is therefore negative in the EoL.

Table 8-2: Water consumption in the manufacture and incineration of 1 m³ OSB.

Water [m³ / m³ OSB]			
Analysis factor	**Manufacturing**	**End of Life**	**Total**
Water	2.80	-0.98	1.82

Waste

An analysis of waste volumes for the manufacture and End of Life of 1 m³ OSB is depicted separately for the three segments: mining waste / excavation waste (including ore treatment residue), municipal solid waste (including domestic waste and commercial waste) and special waste including radioactive waste (Table 8-3).

Table 8-3: Waste incurred in the manufacture and incineration of 1 m³ of AGEPAN® or Greenline OSB

Waste [kg / m³ OSB]			
Analysis factor	**Manufacturing**	**End of Life**	**Total**
Landfilling / Excavated waste	676.5	-975.7	-299.2
Municipal solid waste	0.073	-0.001	0.072
Special waste	0.900	-0.386	0.514
Of which radioactive waste	0.268	-0.386	-0.118

Mining waste forms by far the most significant quantitative share, followed by special waste and municipal solid waste.

Mining waste forms by far the most significant quantitative share, followed by municipal solid waste and special waste.

As far as **excavated waste** is concerned, mining waste accounts for the most significant quantitative factor in manufacturing with over 99%, followed by ore treatment residue deposits and building rubble etc. with a total share of less than 1%. Mining waste is incurred in particular in the extraction of mineral raw materials and coal in the provision of raw materials and energy carriers. Incineration of OSB at the end of the life cycle substitutes excavated waste in the provision of energy to an extent of 976 kg/m³ OSB.

The most essential influential factors within the **municipal solid waste** segment are represented by unspecific waste and sludge. Incineration at the EoL does not have any effect in this segment.

Special waste is essentially waste from upstream stages. “Sludge” and “Slag" (stored underground) account for the greatest shares of special waste incurred. Each m³ of OSB produced also incurs 0.27 kg of radioactive waste, whereby around 98% of that is accounted for by ore processing residue which is part of the power mix pre-chain. Part of this radioactive waste is substituted in the End of Life.

Estimated impact

Table 8-4 below depicts the contributions by manufacturing and incineration of 1 m³ AGEPAN® and Greenline OSB to the global warming potential (GWP 100), ozone depletion potential (ODP), acidification potential (AP), eutrophication potential (EP) and photochemical ozone creation potential (summer smog potential POCP) effect categories. The regenerative primary energy (PE re.) and non-regenerative primary energy (PE ne) are also outlined.

Table 8-4: Absolute contributions by manufacturing and End of Life per cubic metre of finished AGEPAN® and Greenline OSB to the effect categories under review

	PE n.re.	PE re.	GWP 100	ODP	AP	EP	POCP

Unit	MJ	MJ	kg CO_2 equiv.	kg R11 equiv.	kg SO_2 equiv.	kg PO_4 equiv.	kg ethene equiv.
Raw materials	3,288.66	95.36	-1,188.71	1.29E-05	3.18E-01	6.71E-02	8.10E-02
Production	1,770.05	7,016.63	289.96	1.42E-05	4.89E-01	6.77E-02	1.48E-01
Transport	96.37	5,489.90	6.89	1.14E-08	4.00E-02	6.93E-03	3.04E-03
Packaging	-28.26	1.85	1.85	-8.23E-08	2.63E-03	3.41E-04	1.73E-04
Total: Manu-facturing	**5,126.82**	**12,603.75**	**-890.01**	**2.71E-05**	**8.50E-01**	**1.42E-01**	**2.33E-01**
End of Life	-11,591.18	-135.61	321.55	-2.85E-05	1.21E-01	1.81E-02	-3.56E-02
Total	**-6,464.36**	**12,468.14**	**-568.45**	**-1.38E-06**	**9.71E-01**	**1.60E-01**	**1.97E-01**

If the manufacturing system limit including the End of Life in a bio-mass power plant is taken into consideration, the significance of the type of utilisation and/or disposal over the entire life cycle becomes apparent from an environmental aspect. The additional emissions incurred as a result and/or any associated substitution effects in the energy supply system are depicted graphically in Fig. 8-5. The End-of-Life share depicted arises by offsetting the emissions produced in the incineration process against the emissions avoided for generating electricity and thermal energy. This involves the difference between the emissions of OSB incineration and the emissions avoided as a result in average energy generation (credits). Thanks to these substitution effects at the End of Life, the requisite volume of non-regenerative and regenerative energy carriers is reduced, as well as the ozone depletion potential and the POCP. All other environmental effect categories display increases as the substituted emissions are lower than the emissions arising in the incineration of OSB in the assumed bio-mass power plant.

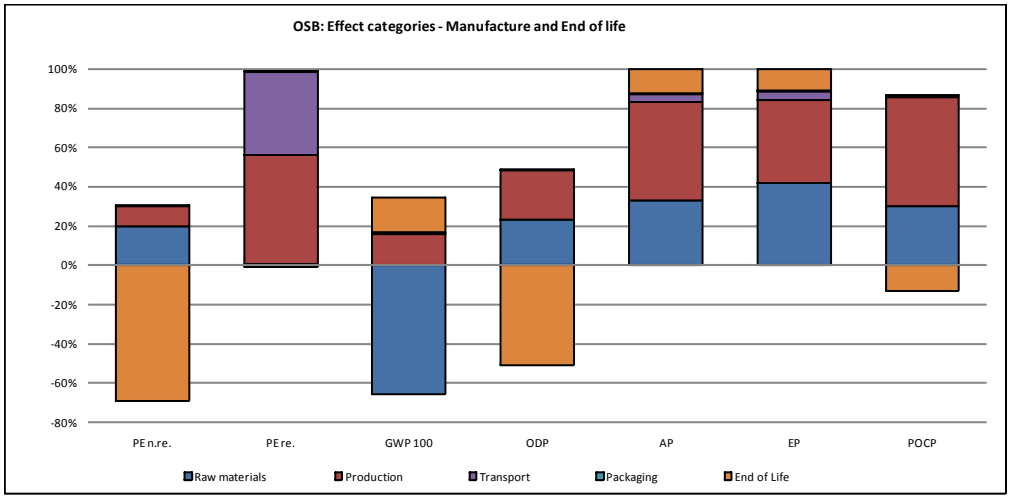


Fig. 8-5: Process shares in the effect categories – system limit plant gate and incineration of AGEPAN® and Greenline OSB at the End of Life

The **global warming potential** is dominated by carbon dioxide in manufacturing. For each cubic metre of OSB, 1,342 kg of CO_2 are integrated in the sustainable raw materials required for production.

This CO_2 integration by using wood is offset by other global warming CO_2 emissions in the provision of raw materials, production, transport and packaging.
More than 95% of emissions comprise carbon dioxide; the rest primarily concerns emissions such as methane. Manufacturing therefore results in emissions of approx. -890 kg CO_2 equivalent. The emission values at the End of Life arise from

incineration minus credit (substitution effects in the power mix as well as in average thermal energy) for energy utilisation from 1 m^3 of finished OSB of 322 kg of CO_2 equivalent. Within the system under review (manufacturing and End of Life), this therefore gives rise to a global warming potential of -569 kg of CO_2 equivalent per cubic metre of OSB.

The provision of raw materials (approx. 48%) and production (52%) essentially contribute towards the **ozone depletion potential**. For each cubic metre of OSB, a total ozone depletion potential of 2.71E-05 kg of R11 equivalent is incurred in production. Substitution of electricity at the End of Life results in an ozone depletion potential value of -1.38E-06 kg of R11 equivalent in the system as a whole.

The provision of raw materials (around 42%) and production (around 52%) essentially contribute towards the **acidification potential**. For each cubic metre of OSB, 8.50E-01 kg of SO_2 equivalent are emitted during the production phase. Incineration emissions minus the emission credits for energetic utilisation of OSB at the End of Life correspond to 1.21E-01 kg of SO_2 equivalent. Accordingly, an acidification potential of 9.71E-01 kg of SO_2 equivalent arises in the overall system under review.

The provision of raw materials (53%) and production (41%) are the most significant contributing factors in terms of the **eutrophication potential** in manufacturing. In manufacturing, the eutrophication potential accounts for 1.42E-01 kg of phosphate equivalent. The EoL increases the eutrophication potential taking consideration of the substitution effects of incineration to another 1.60E-01 kg of phosphate equivalent.

The provision of raw materials contributes approx. 40% and production accounts for 58% in terms of the **photochemical ozone creation potential** (POCP near-ground ozone formation). Overall, the POCP within the plant gate system limit accounts for an ethene equivalent of 2.33E-01 kg. The EoL reduces the POCP by means of energy substitution to 1.97E-01 kg of ethene equivalent.

9 Requisite evidence

9.1 Formaldehyde

Measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany

Test reports, date: 31/09/7487/06E, 07E and 08E OSB2, OSB3 and OSB 4, dated 17 November 2009

Result: In terms of formaldehyde content, the OSB2, OSB3 and OSB4 boards examined in accordance with DIN EN 120 comply with the requirements of the DIBt 100 “Guideline governing classification and monitoring of wood boards as regards formaldehyde emissions” and correspond with E1 quality, i.e. the formaldehyde emissions are far below the limit value of 0.1ppm. The requirements of the German Chemicals Prohibition Regulation (ChemVerbotsV) dated 19 July 1996 are therefore fulfilled.

9.2 MDI

Measuring agency: Wessling – engineering consultants, Altenberge, Germany

Test report, date: IAL-10-0078 OSB (d = 15 mm), dated 12 January 2010

Result: Examination of wood-based materials in a test chamber (MDI). The test was carried out in accordance with the test guidelines stipulated by the RAL - environmental symbol 76 (wood-based materials). Emissions of monomer MDI and other isocyanates could not be determined in the test chamber. The limit of detection was 0.1µg/m^3.

9.3 Eluate analysis

Measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany

Test report, date: 31/09/1188/04 OSB (OSB 3, d = 22 mm), dated 16 December 2009

Result: Migration of heavy metals in accordance with DIN EN 71-3.

In accordance with this standard, the concentration of all elements examined was under the limit of one tenth of the limit value. Limit values: As 1.25 mg/kg, Sb, Cd, Cr, Pb and Hg 2.5 mg/kg, Se 25 mg/kg, Ba 50 mg/kg.

9.4 EOX (Extractable Organic Halogen Compounds)

Measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany

Test report, date: 31/09/1188/03 OSB (OSB 3, d = 22 mm), dated 16 December 2009

Result: EOX in accordance with DIN 38414-S 17. EOX = 23.0 mg/kg

9.5 PCP / Lindane

Measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany

Test report, date: 31/09/1168/10 AGEPAN® OSB 3, d = 18 mm), dated 18 May 2009

Result: The analysis values are under the limit of detection of 0.10 mg/kg (process: CEN/TR 14823, EN 322).

10 PCR document and examination

This Declaration is based on the “Wood materials” PCR document, reference year 11-2009.

Review of the PCR document by the Committee of Experts. Chairman of the Committee of Experts: Prof. Dr.-Ing. Hans-Wolf Reinhardt (University of Stuttgart, IWB)
Independent examination of the Declaration in accordance with ISO 14025: ☐ internal ☒ external
Validation of the Declaration: Dr. Frank Werner

11 Literature

Institut Bauen und Umwelt e.V.	Guidelines on formulating the product group-specific requirements of the IBU Declarations (Type III) for building products, www.bau-umwelt.com
PCR Wood Materials	Institut Bauen & Umwelt; PCR wood materials; www.bau-umwelt.com; valid as at November 2009
GaBi 2006	GaBi 4: Software and data base for comprehensive analysis. PE INTERNATIONAL GmbH, Leinfelden-Echterdingen, 2006

Standards and legislation

ISO 14040	DIN EN ISO 14040:2006-10, Environment Management - Life Cycle Assessment - Basic Principles and Framework Conditions (ISO 14040:2006); German and English versions EN ISO 14040:2006
ISO 14044	DIN EN ISO 14044:2006-10, Environment Management - Life Cycle Assessment - Requirements and Instructions (ISO 14044:2006); German and English versions EN ISO 14044:2006
DIN 1052	DIN 1052:2008-12, Design, Calculation and Dimensioning of Wooden Structures. General dimensioning rules and dimensioning rules for structural engineering
DIN 38414-17	DIN 38414-17:2004-03, Standard German procedure for examining water, waste water and sludge - Sludge and Sediment, (Group S) - Part 17: Determining extractable organic halogens (EOX) (p. 17)
DIN EN 120	DIN EN 120:1992-08: Wood-based materials; Determining the formaldehyde content; Extraction process referred to as the perforator method; German version EN 120:1992
DIN EN 13986	DIN EN 13986: 2005-03, Wood-based materials for use in construction. Features, Evaluating conformity and labelling, German and English versions EN 13986:2005
DIN EN 300	DIN EN 300:2006-09, Panels comprising long, flat, aligned strands (OSB) - Definitions, Classification and Requirements; German version EN 300:200
DIN EN 71-3	DIN EN 71-3: 2002-11, Toy Safety - Part 3: Migration of certain elements; German version EN 71-3:1994 + A1:2000 + AC:2002-11

Please refer to the PCR document for additional literature.

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