ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Sonae Arauco, S.A.
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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AGEPAN® OSB ECOBOARD and OSB ECOBOARD (Oriented Strand Board)

Sonae Arauco, S.A.

Institut Bauen und Umwelt e.V.

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1. General Information

Sonae Arauco S.A.

Programme holder
IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number
EPD-SON-20220209-ICC1-EN

This declaration is based on the product category rules:
Wood based panels, 01.2019
(PCR checked and approved by the SVR)

Issue date
06.09.2022

Valid to
05.09.2027

Dipl. Ing. Hans Peters
(chairman of Institut Bauen und Umwelt e.V.)

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))

Oriented Strand Board, OSB

Owner of the declaration
Sonae Arauco, S.A.
C/Ronda de Poniente, 6 - B
Centro Empresarial Euronova
28760 Tres Cantos (Madrid)
España

Declared product / declared unit
AGEPAN® OSB ECOBOARD and OSB ECOBOARD (Oriented Strand Board), per m^3

Scope:
This document refers to sanded and unsanded OSB manufactured in the following plant of the Sonae Arauco group:

Sonae Arauco Deutschland GmbH
Strohmweg 1
D-38489 Nettgau
Germany

The production volume of this plant covers 100 % of the total production of OSB by Sonae Arauco group.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

The EPD was created according to the specifications of *EN 15804+A2*. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard *EN 15804* serves as the core PCR
Independent verification of the declaration and data according to *ISO 14025:2011*
☐ internally ☒ externally

Dr. Stefan Diederichs
(Independent verifier)

2. Product

2.1 Product description/Product definition

AGEPAN® OSB ECOBOARD and OSB ECOBOARD (Oriented Strand Board) are wood materials comprising large longitudinal wood shavings ("strands") which are glued with formaldehyde-free glue, using a synthetic resin binding agent (pMDI). The strands are aligned in a process-controlled manner (oriented) and compressed in a continuous 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 transversally to the panel direction.

Both AGEPAN® OSB ECOBOARD and OSB ECOBOARD focus on construction, as part of Sonae Arauco solutions for this application.

For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) *Regulation (EU) No. 305/2011 (CPR)* applies. The product needs a declaration of performance taking into consideration *EN 300: 1996, Oriented Strand Boards (OSB) – Definitions, classification and specifications* and the CE-marking. For the application and use, national provisions existing in each country can apply.

2.2 Application

AGEPAN® OSB ECOBOARD and OSB ECOBOARD 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 of *EN 13986* and the CE mark.

Areas of application include: supporting and bracing wall and ceiling paneling, floor installations and installation panels, shop and trade fair stand construction as well as packaging and furniture elements.

Various OSB qualities manufactured by Sonae Arauco are numbered 2 to 4 according to *EN 300*.
The following classifications apply for various applications:

· OSB/2: Panels for load-bearing use in dry conditions
· OSB/3: Panels for load-bearing use in humid conditions
· OSB/4: Panels for heavy duty load-bearing purposes for use in humid conditions

2.3 Technical Data

Values cover OSB/2, OSB/3 and OSB/4:

Name	Value	Unit
Gross density according to EN 300	> 600	kg/m³
Bending strength (longitudinal) according to EN 300	14 - 25	N/mm²
Bending strength (transverse) according to EN 300	7 - 13	N/mm²
E-module (longitudinal) according to EN 300	4930 - 6780	N/mm²
E-module (transverse) according to EN 300	1980 - 2680	N/mm²
Material dampness at delivery	-	%
Thermal conductivity according to EN 13986	0.13	W/(mK)
Sound absorption coefficient	-	%
Water vapour diffusion resistance factor according to EN 13986 (only for OSB/3 and OSB/4)	150 - 250	-
Formaldehyde emissions acc. to EN 717-1	< 62,0	µg/m³

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to *EN 300: 1996, Oriented Strand Boards (OSB) – Definitions, classification and specifications*.

For more details on technical information, please see the AGEPAN® OSB ECOBOARD and OSB ECOBOARD Declaration of Performance (DoP) at: www.sonaearauco.com/dop

2.4 Delivery status

The gross densities of OSB are dependent on the quality (OSB/1 – OSB/4) and thickness and are between 590 and 640 kg/m³. Boards of 6 mm to 40 mm thickness are manufactured in various standard formats or to special customer specifications.

	Min value	Max value	Unit
Thickness	6	40	mm
Width	590	1250	mm
Length	1840	6250	mm

For updated information on available dimensions, please refer to www.agepan.de/produkt

2.5 Base materials/Ancillary materials

AGEPAN® OSB ECOBOARD and OSB ECOBOARD with thicknesses of 6 to 40 mm with an average density of 601 kg/m³ comprise (details provided as mass % per 1 m³ of product):

- Wood chips, primarily softwood, > 90%
- Water (moisture), approx. 3% to 6%
- pMDI adhesive (polymer 4.4' diphenyl methane diisocyanate), approx. 3% to 4.5%
- Paraffin wax emulsion, 0.5% to 2.5%

Logs from indigenous, largely regional forestry plantations are used for manufacturing AGEPAN® OSB ECOBOARD and OSB ECOBOARD. The wood is procured from forests within a radius of approx. 130 km of the plant location.
When wood imports are required, the average wood procurement distances (to the plant) increase to around 200km.

Short transport routes make a particular contribution towards minimising CO2 emissions and the logistical effort involved in the provision of raw materials.

The entire OSB product range is PEFC™ certified. FSC® certified products can be made available on request.

This product contains substances listed in the *ECHA candidate list* (date: 08.06.2021) exceeding 0.1 percentage by mass:
· no
This product contains other carcinogenic, mutagenic, reprotoxic (CMR) substances in categories 1A or 1B which are not on the *ECHA candidate list*, exceeding 0.1 percentage by mass:
· no
Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) *Ordinance on Biocide Products No. 528/2012*:
· no

2.6 Manufacture

The manufacturing of OSB comprises the following steps:

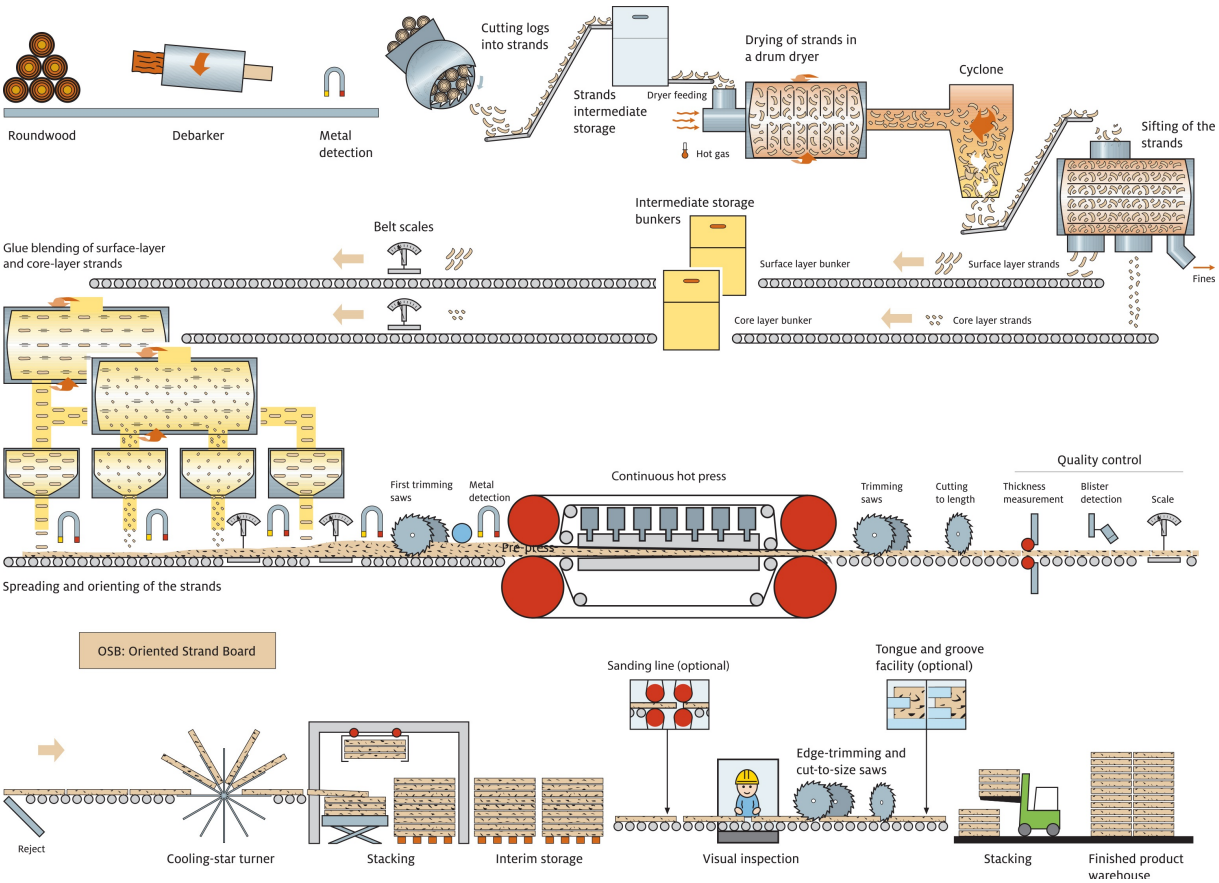
1. Debarking the logs
2. Chipping the wood in the knife ring flaker
3. Drying
4. Sifting in top and middle layer fractions
5. Interim storage in proportioning hoppers
6. Weight determination of strands with scale
7. Separate glueing of the top and middle layer strands
8. Scattering the OSB mat (alignment of the strands)
9. Compressing the OSB mat under high pressure in a continuous hot press
10. Cooling the raw boards in star coolers
11. Stacking
12. Optional: Sanding the top and underside
13. Optional: Distribution into fixed formats or tongue and groove panels

A process diagram is presented below.

The production site is certified according to the following standards:

- *ISO 9001*
- *ISO 45001*
- *ISO 50001*

Additionally, all range includes CE marked products, and PEFCTM and FSC® certified products can be made available on request.



2.7 Environment and health during manufacturing

Health protection: Due to the manufacturing conditions, no special health protection measures over and beyond the regulatory guidelines are required. The reference occupational exposure limit values are complied with.

Emissions into air: Waste air generated during production is cleaned in accordance with regulatory specifications. Emissions are below the limit values specified by the operation license of the site, specified according to German law.

Emissions into water/soil: No normal process contamination of water or soil exists. The production site does not have any 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.

The production site is *ISO 14001* certified.

2.8 Product processing/Installation

AGEPAN® OSB ECOBOARD and OSB ECOBOARD 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.

2.9 Packaging

Particleboard, OSB and corrugated cardboard are used for covering while PET or steel tape packing bands are used for packing.
If re-use or recycling is impractical, the packaging should not be landfilled, but rather directed towards energy recovery.

2.10 Condition of use

The materials used in AGEPAN® OSB ECOBOARD and OSB ECOBOARD comply with the percentages indicated in 2.5., whereby a polyurethane resin is used as a binding agent for the boards with a formaldehyde-free glueing system.

VOC emissions: AGEPAN® OSB ECOBOARD and OSB ECOBOARD are labelled as class A according to the French regulation on the labelling of emissions of volatile pollutants from construction and decoration products (with reference to the wall scenario, as a worst case).

Additionally, parts of the range for AGEPAN® OSB ECOBOARD and OSB ECOBOARD have been certified with the IBU environmental quality label.

AGEPAN® OSB ECOBOARD and OSB ECOBOARD at an average density of 601 kg/m³ store 987 kg CO2-eq/m³ over their service life.

2.11 Environment and health during use

Environmental protection: According to current information, water, air and soil are not exposed to any danger when AGEPAN® OSB ECOBOARD and OSB ECOBOARD boards are used as designated.

Health protection: According to current information, no damage to or impairment of health can be anticipated when AGEPAN® OSB ECOBOARD and OSB ECOBOARD boards are used as designated.

2.12 Reference service life

Due to the wide range of applications AGEPAN® OSB ECOBOARD and OSB ECOBOARD, no reference service life is declared.

2.13 Extraordinary effects

Fire

Fire retardant classification of AGEPAN® OSB ECOBOARD and OSB ECOBOARD boards is done according to *EN 13986*. Fire retardant classes defined in accordance with *EN 13501-1*.

Fire protection

Name	Value
Building material class	D
Smoke gas development	S2
Burning droplets	d0

excluding flooring applications, and for thicknesses ≥ *9 mm without air gap behind the OSB material or with closed or open air gap not more than 22 mm behind*)

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.

2.14 Re-use phase

OSB untreated boards can be re-used for the same or similar application as long as they are collected separately.

Recycling: AGEPAN® OSB ECOBOARD and OSB ECOBOARD boards from construction and any other application can be collected separately and utilized in the manufacture of particleboard. This is based on the condition that the wooden boards are not fully glued or treated with hazardous chemicals

Energy recovery: due to the high heating value of approx. 16.0 MJ/kg at an assumed end-of-life moisture content of 20 %, AGEPAN® OSB ECOBOARD and OSB ECOBOARD boards can be used for energy recovery and the generation of heat and electricity (e.g. in CHP plants), following the cascading principle for wood.

2.15 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 energy recovery instead of landfilling.

Waste code according to the *European List of Waste*: 17 02 01

2.16 Further information

Further information such as technical datasheets etc. can be downloaded under:

www.sonaearauco.com

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit for the LCA is 1 m3 of AGEPAN® OSB ECOBOARD and OSB ECOBOARD. The indicator values represent an average product of a density of 601 kg/m³, which represents the (slightly rounded) weighted production mix of the reference year 2020.

Information on the declared unit

Name	Value	Unit
Declared unit	1	m³
Mass reference	601	kg/m³

3.2 System boundary

Type of the EPD: cradle-to-gate with modules C1 to C4 and module D (A1-A3, C and D)

Modules A1 – A3 of the production stage cover the manufacturing of the products, including raw material extraction and processing, energy generation, the production of ancillary products and packaging materials, transport, as well as all waste treatment processes. Eventual benefits of recycling or energy recovery are neglected.
The resource aspects of wood were inventoried via material inherent properties such as resource extraction of CO_2 from the atmosphere and the lower heating value as the use of renewable energy. Material inherent properties are subject to co-product allocation as ruled in *EN 15804*.

Module A4 covers the transport of the product from the production site to the construction site by a lorry over a default distance of 460 km.

Module A5 covers the transport of the packaging material from the construction site and its disposal. Default end-of-waste states for the packaging materials from the packed products at the construction site are defined in analogy for wastes occurring in modules A1-A3. Eventual further inputs for the installation of the products are not considered due to the broad applicability of the assessed products.
The substituted primary material from the net amount of recycled material and from recovered energy exported from the product system in Module A5 is declared in Module D.

Module C1 manual deconstruction is assumed. The declared values are thus 0.

Module C2 includes the transport of the de-constructed product to a recycling centre by over 50 km.

Module C3 covers the preparation of the post-consumer board to become a secondary fuel; the end-of-waste status for recycled wood-based boards is defined as the point where they have been sorted and chipped, ready to be used as secondary fuels.
In line with *EN 16485*, the export of the biogenic carbon stored in the board, expressed in CO_2-equivalent is also reported in module C3.

Module C4 is not relevant for the assumed end-of-life scenario. The declared values are thus 0.

Module D compiles all the benefits and burdens associated with the secondary fuels, secondary materials and exported energy leaving the production system in the modules A5 and C3.
Therefore, module D covers the avoided burdens from recycling and from energy recovered from the waste treatment in module A5 as well as the transport of the obsolete boards to a biomass combustion plant, the combustion process itself and the loads and benefits of the substitution of fossil fuels and/or electricity.
Substitution effects in module D are always calculated for the net amount of secondary material or secondary fuel of the product system in line with *EN 16485*.

3.3 Estimates and assumptions

For the quantification of the net flows of recycled wood (input of post-consumer wood used as a fuel minus post-consumer wood exiting the product system into module D for energy recovery), it was assumed that all inputs of post-consumer wood are used as a fuel.
Beyond that, no relevant estimates or assumptions had to be made beyond the information provided in this EPD.

3.4 Cut-off criteria

The applicable criteria for the exclusion of inputs and outputs are defined in *EN 15804*, clause 6.3.6, and in the IBU PCR part A *(IBU 2020*), respectively.
All data were taken into account that resulted from the data collection procedure in the plants, e.g., related to fuels, raw material input, use of ancillary materials, waste flows, emissions into air, water use, waste water, transport means and transport distances, etc.
Expenses for the general management, research & development, administration and marketing – if known – were not taken into account.
The production of eventual packaging of ancillary material or other inputs used during production (and some of the reported wastes) was generally neglected; in most cases reusable bins or containers are used. In addition, the amounts of reported (unspecific) wastes are so small that their production can be considered not relevant for the life cycle assessment.
Beyond that some ancillary materials were cut off due to very small amounts and as inputs not directly related to production processes but to the maintenance of infrastructure, e.g., acetylene and oxygen for soldering, etc.
With this approach also mass and energy flows below 1 percent of total mass and energy flows caused by the declared products were included in the assessment.
Beyond that, no material or energy flows were neglected that would have been known by the persons responsible for the project and that could have been expected to contribute significantly to the environmental indicators declared. It can thus be assumed that the total contribution of the neglected processes is not higher than 5 % of the declared impact categories.

3.5 Background data

Datasets from *ecoinvent 3.7.1* were used as background data exclusively. Therefore, the latest update of the background data took place in 2020.

3.6 Data quality

The requirements on the data quality and the background data correspond to the provisions in *EN 15804* and the IBU PCR part A (*IBU 2020*) respectively:

- Data are as current as possible. Datasets used for calculations were updated within the last 10 years for generic data and within the last 5 years for producer-specific data;
- Datasets are based on 1 year averaged data as a general rule;
- The time period over which inputs to and outputs from the system are accounted for is 100 years from the year for which the data set is deemed representative;
- The technological coverage reflects the physical reality of the declared products;
- The background datasets comply with the quality guidelines of ecoinvent 3.7.1; deviations from the methodological prescriptions of *EN 15804* and the IBU PCR part A (*IBU 2020*) respectively are possible but acceptable according to IBU PCR part A (*IBU 2020*).

3.7 Period under review

The company data gathered for this EPD represents the year 2020.

3.8 Allocation

Specific data for the production line for the production of OSB was available for all relevant inputs. Airborne emissions were attributed based on the relative energy consumption of the different products produced in the plant, except for formaldehyde, which was allocated to the products using UF glues. The inventories for the wood inputs were taken from *ecoinvent 3.7.1*, based on *Werner et al. 2015*. In these datasets, resource corrections are made for incorporated biogenic carbon

and renewable energy; these flows thus reflect the real physical flows.
No post-consumer secondary wood is used as an input to produce the OSB; for the end-of-life scenario, the end-of-waste status was defined after the sorting and chipping of the wood-based board in line with *EN 16485* (see also clause 3.2). Loads and benefits of energy recovery are thus reported in module D.
Waste packaging in module A5 was considered not to reach the end-of-waste state as a fuel. Its incineration is reported in A5, the benefits of energy recovery in module D. The benefits of the recycling of a minor amount of cardboard packaging are disregarded.

No co-product allocation was made in the modelling of the life cycle assessment underlying this EPD.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account.

Ecoinvent 3.7.1 was used as the background database.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic carbon

Information on describing the biogenic carbon content at factory gate

Name	Value	Unit
Biogenic carbon content in product	284	kg C
Biogenic carbon content in accompanying packaging	4,22	kg C

The following technical information is a basis for the declared modules or can be used for developing specific scenarios in the context of a building assessment if modules are not declared (MND).

Transport to the construction site (A4)
The product is transported from the production site to the construction site by a lorry (15 % emissions class EURO 5; 85% emissions class EURO 6) over a default distance of 460 km.

Installation into the building (A5)
Eventual further inputs for the installation of the products are not considered due to the broad applicability of the assessed products.
An average transport distance of 30 km was assumed for packaging waste from the construction site to the recycling plant or to the municipal waste incineration plant. The municipal waste incineration plant is assumed to have an overall energy efficiency of 53 % related to the lower heating value of the waste input; 92 % of the recovered energy is heat, 8 % is electricity (according to specifications of MWI plants in *ecoinvent 3.7.1*).

Deconstruction (C1)
manual deconstruction is assumed. The declared values are thus 0.

Transport to waste treatment (C2)
This module includes the transport of the de-constructed product to a recycling center by a lorry (15 % emissions class EURO 5; 85% emissions class EURO 6) by over 50 km.

Waste treatment (C3)
601 kg of OSB are chipped and exported from the product life cycle into module D, assuming a moisture content of 20 % and a lower heating value of 15.7 MJ/kg. The biogenic carbon stored in the product and the content of primary energy are exported from the product system as material inherent properties.

Disposal (C4)
This module is not relevant for the assumed end-of-life scenario. The declared values are thus 0.

Reuse, recycling, recovery potential (D)
According to default assumptions in other IBU EPDs, post-consumer wood is used as a secondary fuel for energy recovery in a biomass combustion plant with an overall energy efficiency of 93 % related to the lower heating value of the fuel input; 91 % of the recovered energy is heat, 9 % is electricity.

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	ND	ND	MNR	MNR	MNR	ND	ND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: AGEPAN® OSB ECOBOARD and OSB ECOBOARD, per m³

Core Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	[kg CO_2-Eq.]	-6.58E+2	4.58E+1	1.66E+1	0.00E+0	6.40E+0	9.91E+2	0.00E+0	-5.33E+2
GWP-fossil	[kg CO_2-Eq.]	3.41E+2	4.58E+1	1.46E+0	0.00E+0	6.40E+0	5.11E+0	0.00E+0	-5.32E+2
GWP-biogenic	[kg CO_2-Eq.]	-1.00E+3	0.00E+0	1.52E+1	0.00E+0	0.00E+0	9.86E+2	0.00E+0	0.00E+0
GWP-luluc	[kg CO_2-Eq.]	2.04E+0	1.57E-2	4.60E-4	0.00E+0	2.67E-3	1.03E-2	0.00E+0	-2.10E-1
ODP	[kg CFC11-Eq.]	5.67E-5	1.04E-5	2.51E-7	0.00E+0	1.41E-6	2.60E-7	0.00E+0	-7.82E-5
AP	[mol H^+-Eq.]	1.57E+0	1.36E-1	6.35E-3	0.00E+0	1.87E-2	2.72E-2	0.00E+0	-5.99E-1
EP-freshwater	[kg P-Eq.]	2.73E-2	3.42E-4	1.66E-5	0.00E+0	5.49E-5	5.29E-4	0.00E+0	-1.04E-2
EP-marine	[kg N-Eq.]	4.87E-1	3.05E-2	2.48E-3	0.00E+0	4.04E-3	3.73E-3	0.00E+0	-4.17E-2
EP-terrestrial	[mol N-Eq.]	4.26E+0	3.38E-1	2.78E-2	0.00E+0	4.49E-2	4.23E-2	0.00E+0	-4.63E-1
POCP	[kg NMVOC-Eq.]	2.13E+0	1.22E-1	8.27E-3	0.00E+0	1.62E-2	1.18E-2	0.00E+0	-2.51E-1
ADPE	[kg Sb-Eq.]	2.48E-3	1.68E-4	4.44E-6	0.00E+0	3.04E-5	1.27E-5	0.00E+0	-2.44E-4
ADPF	[MJ]	6.41E+3	6.94E+2	9.33E+0	0.00E+0	9.58E+1	1.05E+2	0.00E+0	-1.03E+4
WDP	[m^3 world-Eq deprived]	1.06E+2	2.00E+0	2.91E-1	0.00E+0	3.01E-1	1.09E+0	0.00E+0	-1.81E+1

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: AGEPAN® OSB ECOBOARD and OSB ECOBOARD, per m³

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	[MJ]	1.41E+4	9.30E+0	1.90E+2	0.00E+0	1.52E+0	1.62E+1	0.00E+0	-3.30E+2
PERM	[MJ]	1.00E+4	0.00E+0	-1.90E+2	0.00E+0	0.00E+0	-9.85E+3	0.00E+0	0.00E+0
PERT	[MJ]	2.41E+4	9.30E+0	4.57E-1	0.00E+0	1.52E+0	-9.83E+3	0.00E+0	-3.30E+2
PENRE	[MJ]	5.34E+3	6.95E+2	1.86E+1	0.00E+0	9.59E+1	1.06E+2	0.00E+0	-1.03E+4
PENRM	[MJ]	1.10E+3	0.00E+0	-9.24E+0	0.00E+0	0.00E+0	-1.09E+3	0.00E+0	0.00E+0
PENRT	[MJ]	6.43E+3	6.95E+2	9.35E+0	0.00E+0	9.59E+1	-9.81E+2	0.00E+0	-1.03E+4
SM	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.85E-1
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	9.85E+3
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.09E+3
FW	[m^3]	3.05E+0	7.26E-2	1.08E-2	0.00E+0	1.08E-2	6.02E-2	0.00E+0	-8.90E-1

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

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: AGEPAN® OSB ECOBOARD and OSB ECOBOARD, per m³

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD	[kg]	8.63E-3	1.81E-3	9.48E-6	0.00E+0	2.56E-4	4.20E-5	0.00E+0	-1.10E-2
NHWD	[kg]	5.82E+1	3.39E+1	2.00E-1	0.00E+0	3.82E+0	6.55E-1	0.00E+0	1.72E+0
RWD	[kg]	3.60E-2	1.02E-2	1.08E-4	0.00E+0	1.39E-3	1.34E-3	0.00E+0	-3.41E-2
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	3.85E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	6.01E+2	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	6.62E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	7.60E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

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

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: AGEPAN® OSB ECOBOARD and OSB ECOBOARD, per m³

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PM	[Disease Incidence]	ND	ND	ND	ND	ND	ND	ND	ND
IRP	[kBq U235-Eq.]	1.55E+1	3.05E+0	3.92E-2	0.00E+0	4.22E-1	9.10E-1	0.00E+0	-1.98E+1
ETP-fw	[CTUe]	1.22E+4	5.33E+2	7.19E+1	0.00E+0	7.65E+1	5.86E+1	0.00E+0	-1.00E+3
HTP-c	[CTUh]	2.49E-6	1.89E-8	2.76E-9	0.00E+0	3.04E-9	3.50E-9	0.00E+0	1.41E-7
HTP-nc	[CTUh]	2.30E-5	5.24E-7	2.42E-8	0.00E+0	7.09E-8	4.66E-8	0.00E+0	-3.83E-7
SQP	[-]	1.28E+5	4.84E+2	2.19E+0	0.00E+0	5.68E+1	1.54E+1	0.00E+0	-3.34E+2

Caption	PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

ND: emissions of particulate matter (PM) are not declared due to inconsistencies in the reported data.

Disclaimer 1 – for the indicator “potential Human exposure efficiency relative to U235“.This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators: “abiotic depletion potential for fossil resources”, “abiotic depletion potential for non-fossil resources”, “water (user) deprivation potential”, “deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit for humans - cancer effects”, “potential comparative toxic unit for humans – non-cancer effects”, “potential soil quality index”.The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

6. LCA: Interpretation

Indicators of the impact assessment

Figure 1 illustrates the contribution of each life cycle stage to the overall indicator results of the impact assessment (impact from modules A1 - C4 = 100 %).

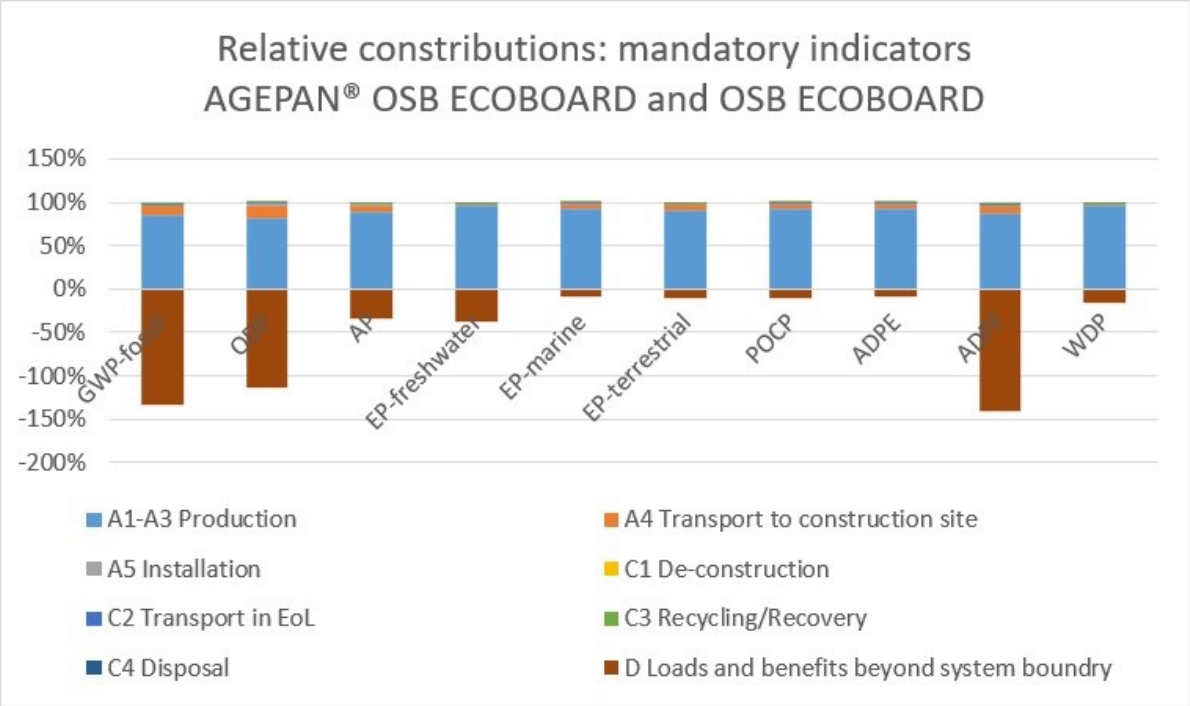


Figure 1: Environmental impacts of AGEPAN® OSB ECOBOARD and OSB ECOBOARD along its life cycle (impacts from production modules A1-C4 = 100 %)

Figure 1 illustrates that the impacts over the life cycle of the product are predominantly caused during the production of the OSB; the impacts from other parts of the life cycle are not significant.
For the GWP, the ODP and the ADP fossil, the benefits from the energy recovery of AGEPAN® OSB ECOBOARD and OSB ECOBOARD are higher than the impacts during the life cycle, notably the impacts from production; for other impact categories, the

benefits of energy recovery lie between 10 % to 35 %, depending on the impact category under consideration.

The *global warming potential (GWP)* is an indicator for the contribution to climate change and is quan-tified based on the emissions of gases that absorb radiative forcing.
The production phase of AGEPAN® OSB ECOBOARD and OSB ECOBOARD is largely caused by the upstream processes of the production of PMDI (around 35 %); the use of natural gas during production and the generation of electricity cause another 17 % of the GWP each; in sum, 20 % of the GWP are related to the forestry processes and by the transport for raw material acquisition.
Figure 2 illustrates that the biogenic carbon stored in the product, expressed as CO_2-equivalent, is higher than the CO_2 emissions from fossil sources, leading to a negative GWP for the production mod-ule A1-A3.
The potential substitution effect in module D more than offsets the GHG emissions during the production phase (module A1-A3).
The GWP is dominated by CO_2 emissions and removals.

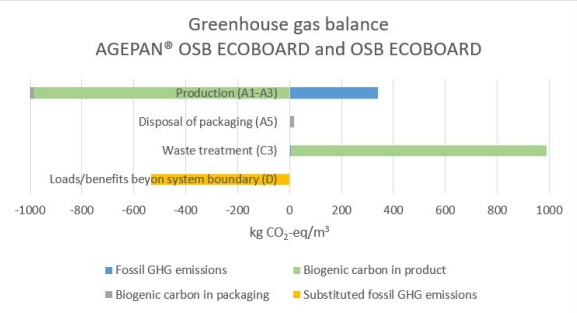


Figure 2: Carbon footprint of AGEPAN® OSB ECOBOARD and OSB ECOBOARD

The *ozone layer depletion potential (ODP)* is quantified based on the emissions of gases that can de-stroy stratospheric ozone.
The ODP is caused mainly by emissions of Halon 1211, which are associated with the production and transport of natural gas. Around 15 % of the ODP are associated with the use of natural gas on-site for the production of AGEPAN® OSB ECOBOARD and OSB ECOBOARDB, the rest of the ODP is caused by the use of natural gas in upstream processes in line with the consumption patterns of natural gas in the process chain, notably for the production of PMDI.

The *acidification potential (AP)* is created with the transformation of airborne emissions into acids, which among other can reduce soil fertility.
Roughly, 15% of the AP are caused by the on-site combustion processes for the production of heat and electricity; the other 85 % are associated with upstream combustion processes, notably for heat production in the production of the PMDI (50 %), for the generation of electricity (10 %), and related to the transport of raw materials.
The AP is caused in comparable shares by emissions of ammonia, nitrogen oxides and sulphur dioxide.

The various *eutrophication potentials (EP)* quantify the accumulation of nutrients in soils and watersheds, which can cause increased growth of algae and shifts in species composition.
The EP is caused by a variety of processes, mainly in combustion processes or disposal processes, e.g., of mining residues from lignite extraction related to the generation of electricity.
The EP is caused mainly by airborne emissions of nitrogen oxides as well as phosphate emissions into the groundwater.

The *photochemical oxidation potential (POCP)* assesses the contribution of airborne emissions that contribute to summer ozone creation.
About 30 % of the POCP are associated with the production of PMDI resins and with on-site emissions during the production of the AGEPAN® OSB ECOBOARD and OSB ECOBOARD; another 30% are caused by harvesting operations of stem wood. These contributions are caused by emissions of SO_2, CO and CH_4.

The *abiotic resource depletion potential of fossil resources (ADP fossil)* assesses the use of scarce fossil resources such as natural gas or crude oil.
The ADP (fossil resources) is caused mainly by the production of PMDI (40 %), the on-site consumption of natural gas (15 %) and by the generation of electricity.

The *abiotic resource depletion potential for mineral resource (ADP elements)* assesses the use of scarce mineral resources such as ores and other mineral raw materials.
The ADP (elements) is caused almost completely by infrastructure processes, such as the buildings required for the production of chemicals; the main resources contributing to the ADP (elements) are copper, zinc and gold.

Selected indicators from the life cycle inventory

The main use of renewable primary energy is the heating value of the wood in AGEPAN® OSB ECOBOARD and OSB ECOBOARDB; this amount of non-used renewable energy is exported in module C3 and used energetically as a renewable secondary fuel in module D. The renewable primary energy used as energy is mainly woody biomass.

The major share of the non-renewable primary energy is used energetically, mainly as natural gas in the upstream processes for the production of PMDI. A minor share is used as a material, i.e., as com-po-nents of the gluing systems; this non-renewable primary energy used as a material is not used within the life cycle of AGEPAN® OSB ECOBOARD and OSB ECOBOARDS; it is exported in module C3 and used energetically as a non-renewable secondary fuel in module D.

The indicator values for *wastes* refer to the amount of waste that is landfilled after an eventual pre-treatment of the wastes.
The main part of the wastes associated with the production of OSB is non-hazardous waste, mainly resulting from the disposal of infrastructure associated with, e.g., production halls or roads.
Hazardous wastes are generated throughout the production chain, e.g., related to disposal of ashes, production wastes from chemical industry or from the production of primary aluminium for infrastruc-ture processes.
The generation of radioactive waste is associated with the production of nuclear power.

The *net consumption of fresh water* is caused mainly by cooling processes throughout the production chain as well as partly for the generation of electricity.

The *further indicators on environmental aspects* are singular values that result from the inventorying of waste streams into thermal waste treatment, energy recovery and recycling.

7. Requisite evidence

7.1 Formaldehyde

AGEPAN® OSB ECOBOARD and OSB ECOBOARD meet the requirements of the German Chemicals Prohibition Regulation (*ChemVerbotsV*)

ZE05 Certificates by MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany.
OSB2 ZE05/20/3949/01 issued 2020
OSB3 ZE05/20/3950/01 issued 2020
OSB4 ZE05/20/3951/01 issued 2020

Test reports by measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany.
Test reports:
OSB2 test report 31/21/ 3949/ 01 QT issued 2021
OSB3 test report 31/21/3950/01 QT issued 2021
OSB4 test report 31/21/3951/01 QT issued 2021

The determination of the formaldehyde content according to *DIN EN 717-1* (chamber method) for AGEPAN® OSB ECOBOARD and OSB ECOBOARD are below 0.062 mg/m³, complying with the E1 requirements of *EN 13986*.

7.2. MDI

This test is not required by the applicable product standard.

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-UZ-76* (wood-based materials). Emissions of monomer MDI and other isocyanates could not be determined in the test chamber. The limit of detection was 0.1 µg/m³.

7.3 Checking for the pre-treatment of the substances used

No post-consumer wood is used in the production of AGEPAN® OSB ECOBOARD and OSB ECOBOARD.

7.4 TVOC emissions

AGEPAN® OSB ECOBOARD and OSB ECOBOARD boards are labelled as class A according to the French regulation on the labelling of emissions of volatile pollutants (with reference to the wall scenario, as a worst case).

Measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany.

Test report reference: OSB3 test report 31/18/3277/14A issued 2019

AGEPAN® OSB ECOBOARD and OSB ECOBOARD meet the requirements of the MVV TB, Appendix 8 ABG applied in Germany.

Attestation reference: OSB_VOC_Gutachten_G-160-18-0003 by Deutsches Institut für Bautechnik (DIBt)

Measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany.

Test report reference: 31/18/3277/15A issued 2019,

AGEPAN® OSB ECOBOARD and OSB ECOBOARD TVOC emissions were determined according to I*SO16000-1*, with the wall panel loading scenario and a load facto of 1.00 m²/m³

Measuring agency: Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut (WKI)

Test report reference: MAIC-2019-3255 issued 2019

AgBB overview of results (3 days [µg/m³])

Name	Value	Unit
TVOC (C6 - C16)	430	µg/m³
Sum SVOC (C16 - C22)	< 5 *	µg/m³
R (dimensionless)	954	-
VOC without NIK	0	µg/m³
Carcinogenic Substances	0	µg/m³

AgBB overview of results (28 days [µg/m³])

Name	Value	Unit
TVOC (C6 - C16)	430	µg/m³
Sum SVOC (C16 - C22)	< 5 *	µg/m³
R (dimensionless)	0.954	-
VOC without NIK	0	µg/m³
Carcinogenic Substances	0	µg/m³

* below detection limits

7.5 PCP/Lindane

Measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany

Test report reference:
OSB2 test report 31/21/3949/01 PL issued 2021
OSB3 test report 31/21/3950/02 PL issued 2021
OSB4 test report 31/21/3951/02 PL issued 2021

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

7.6 Heavy metals migration
Test report according to *EN 71-3*

Measuring agency: ÜV Rheinland LGA Products GmbH

Test report reference: 0001091206/10 AZ 415482a issued 2021

Result: Compliance with all limit values established by *EN 71-3* was confirmed, among which Arsenic, Aluminium, Barium, Cadmium, Chromium, Copper Lead, Mercury and Zinc.

8. References

Product category rules of IBU

IBU (2021)
IBU (2021): General Instructions for the EPD Programme of the Institut Bauen & Umwelt e.V. (General Instructions for the IBU EPD Programme). Version 2.0, Institut Bauen & Umwelt, Berlin.

IBU (2021)
IBU (2021): PCR Part A: Calculation rules for the life cycle assessment and requirements for the project report according to EN 15804+A2:2019. Version 2.1., Institut Bauen & Umwelt, Berlin.

IBU (2019)
Institut Bauen und Umwelt e.V, Berlin (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations for Institut Bauen und Umwelt (IBU), Part B: Requirements on the EPD of wood based panels, 2019-01.

Standards and legal documents

EN 15804
EN 15804+A2:2019, Sustainability of construction works - Environmental product declarations - Core rules for the product category construction products.

ISO 14025
ISO 14025:2006-07, Environmental labels and declarations - Type III Environmental declarations - Principles and procedures.

ISO 14044
EN ISO 14044:2006-07, Environmental management - Life cycle assessment - Requirements and guidance (ISO 14044:2006); German and English versions EN ISO 14044:2006.

ISO 9001
ISO 9001:2015, Quality management systems – Requirements.

ISO 14001
ISO 14001:2015, Environmental management systems – Requirements with guidance for use.

OHSAS 18001
OHSAS 18001:2007, Occupational Health and Safety Management Systems – Requirements.

ISO 45001
ISO 45001:2018:03, Occupational health and safety management systems - Requirements with guidance for use.

ISO 16000
ISO 16000-11:2006, Indoor air – Part 11: Determination of the emission of volatile organic compounds from building products and furnishing – Sampling, storage of samples and preparation of test specimens.

EN 717-1
EN 717-1:2005-01, Wood-based panels – Determination of formaldehyde release – Formaldehyde emission by the chamber method.

EN 13501
EN 13501-1:2019-05, Fire classification of construction products and building elements – Classification using test data from reaction to fire tests.

EN 13986
EN 13986:2015, Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking.

EN 300
EN 300: 2006, Oriented Strand Boards (OSB) – Definitions, classification and specifications.

EN 16485
EN 16485:14-07, Round and sawn timber – Environmental Product Declarations – Product category rules for wood and wood-based products for use in construction.

EN ISO 50001
EN ISO 50001:2018-12, Energy management systems – Requirements with guidance for use.

Regulation No. 305/2011
Regulation No. 305/2011 (Construction Products Regulation, or CPR) of the European Parliament and of the European Council is a regulation of 9 March 2011 that lays down harmonised conditions for the marketing of construction products and replaces Construction Products Directive (89/106/EEC).

ECHA candidate list
Candidate List of substances of very high concern for Authorisation, published in accordance with Article 59(10) of the REACH Regulation. European Chemicals Agency, Brussels.

Ordinance on Biocide Products No. 528/2012
REGULATION (EU) No 528/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 May 2012 concerning the making available on the market and use of biocidal products.

European List of Waste
Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste (notified under document number C(2000) 1147).

Werner et al. 2015
Werner F., Bauer C., Büsser S., Doka G., Kaufmann E., Kono J., Luginbühl, U., Mina M., Frischknecht R., Thees O, Wallbaum H., Zimmermann W., Hischier R. (2014): Aktualisierung der Modelle und Datensatze zu Holz und Holzprodukten in der Datenbank ecoinvent. Commissioner: Bundesamt fur Umwelt, Aktionsplan Holz, Bern. Final report 18. February 2015.

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