Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019 for:

AKRIPAN® & HYDROPAN® Raw Chipboard from AKRITAS S.A.

Publisher:	AKRITAS S.A., Tychero, Evros Prefecture, Greece (Postal Code: 68083)
Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-03088
Publication date:	2022-02-25
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Valid until:	2027-02-24

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

General information

Programme information:

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

EPD rules and third-party verifier information:

CEN standard EN 15804 serves as the Core Product Category Rules (PCR).

Product category rules (PCR): *Product category rules (PCR): 2019:14 Version 1.1, 2019-09- 14, , EN 15804:2012 + A2:2019: Sustainability of Construction Works, 2012-02-29, c-PCR-006 Wood and wood-based products for use in construction (EN 16485), Version: 2019-12-2020*

Independent third-party verification of the declaration and data, according to ISO 14025:2006:

☐ EPD process certification ☒ EPD verification

Third party verifier:

EUROCERT S.A., Chlois 89, Metamorfosi 144 52, Greece

Email: info@eurocert.gr

Website: www.eurocert.gr

Procedure for follow-up of data during EPD validity involves third party verifier:

☐ Yes ☒ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025.

Company information

Owner of the EPD: AKRITAS S.A. 3, S. Economou Str., 68 100, Alexandroupolis, Greece
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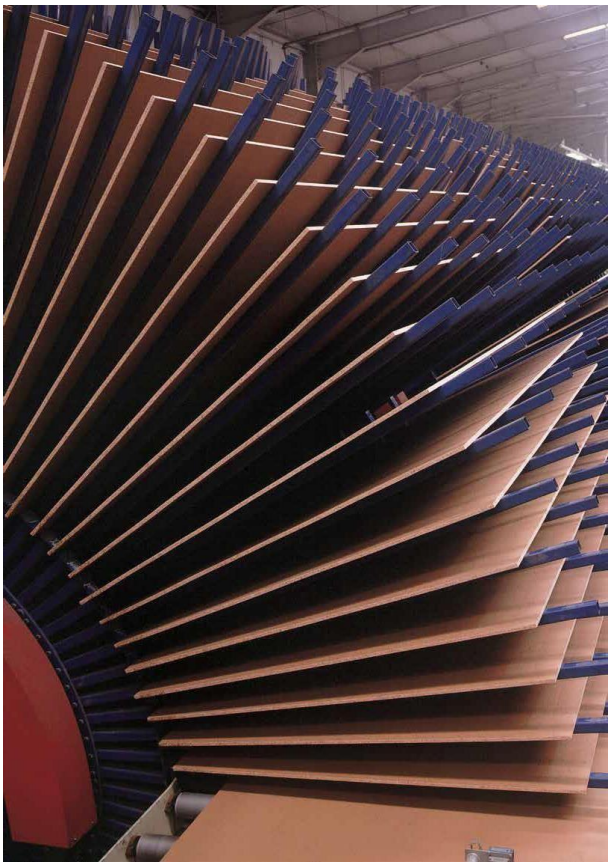
AKRITAS S.A.

AKRITAS S.A. wood processing industry was founded in 1977 in Alexandroupolis, Greece. Our sales network currently expands throughout Greece, with offices in Athens and Thessaloniki, as client service efficiency is our basic priority. Moreover, the company has developed a powerful export activity, thus establishing its presence in numerous countries abroad. Central to our wide range of products is the innovative AKRIPAN® Raw Chipboard and AKRIPAN®-coated products (melamines, worktops, kitchentops, semi-finished furniture postforming, glossy and matt surfaces). AKRITAS' aim is to produce and distribute functional, durable and perfectly designed products, with respect for the environment and the consumer. Thus, all our products comply with international quality standards, while all departments of our industry operate under ISO 9001:2015 regulations. Since its establishment, AKRITAS has been oriented towards new technologies and low energy consumption.

Following our environmental policy program, AKRITAS S.A. is FSC® certified (FSC® C108904). Our FSC® marked products ensure that the materials we use for the production from the initial stages to the final product, are identified, separated and are sourced from suppliers that comply with the Principles of FSC® Standard.

For more than four decades AKRITAS isintent to values based on the combination of the human factor and innovative technology. These values, enforced by our commitment for consistency in sales and environmental protection, have established AKRITAS among the industry pioneers in the market.



AKRITAS S.A. Wood Processing facilities locate in Tychero, Evros Prefecture, Eastern Macedonia and Thrace region, Greece (Postal Code:68083), 48 km northeast of the city of Alexandroupolis.

AKRITAS S.A. Environmental Policy

Wood is an excellent natural material, renewable and is found in increasing abundance in Europe. It helps mitigating climate change by absorbing and storing carbon dioxide (CO_2) from the atmosphere, as 1 m^3 of wood absorbs 1 tonne of CO_2.

AKRITAS S.A. establishes sustainable strategies at the following levels:

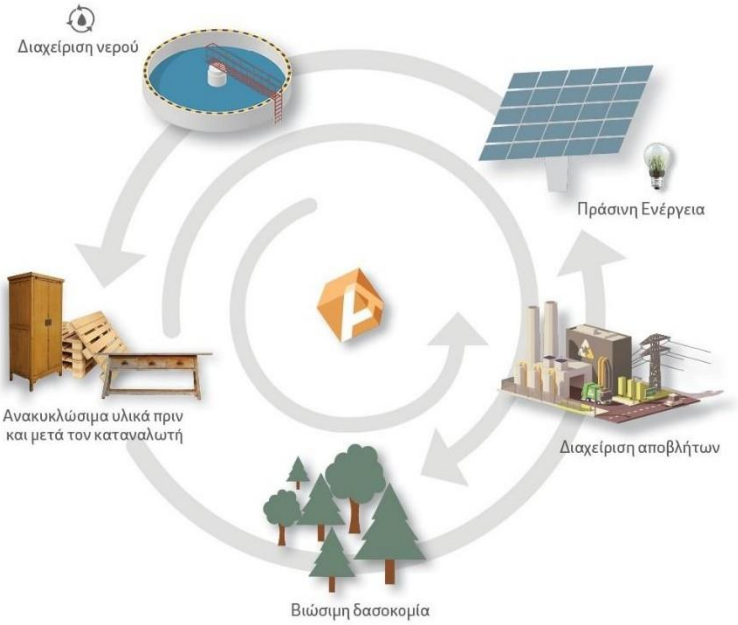
Sustainable forestry:
Emphasis is given on supporting well-managed forestry using timber which is derived from forest service studies.

Pre-consumer and post-consumer recycled content:
Contribution to the circular economy model by reusing solid industrial wood waste and municipal wood waste from commercial and domestic activities on the production line.

Water management:
Reduced water consumption by collecting, treating and reusing rainwater, liquid waste from car washes, production line areas and ancillary activities.

Renewable Energy:
Reduced use of fossil fuels for energy needs and CO_2 emissions through the utilization of by-products resulting from the mechanical processing of wood (biomass combustion). Green Certificate from DAPEEP for the use of electricity produced from Renewable Energy Sources (RES).

Waste management:
Non-wood waste (oils, batteries, electrical & electronic equipment, metals, paper / cardboard, glass, plastics) is collected by licensed companies and transported for recycling.



AKRITAS S.A. Certifications

✓ FSC® (C108904)

AKRITAS S.A. is FSC® certified (C108904). Our FSC® marked products ensure that the materials we use for the production from the initial stages to the final product, are identified, separated and are sourced from suppliers that comply with the Principles and Criteria of FSC® standard.

✓ E1, CARB P2, TSCA TITLE VI

The products comply with the requirements of EN 13986 for the release of formaldehyde and are classified in the European class E1. TSCA title VI and CARB Phase 2 certifications monitor the production of low-release formaldehyde boards and ensure their compliance with the US Environmental Protection Agency (EPA) regulations and are a prerequisite for the movement of products within the US.

✓ ISO 9001:2015

All parts of the production process apply the quality management system according to the international standard ISO 9001: 2015.

✓ ISO 14001:2015

ISO 14001: 2015 is an Environmental Management System which focuses on creating environmental policy and improving environmental performance.

✓ ISO 45001:2018

ISO 45001:2018 is a system for managing the health and safety of employees, but also of all persons involved in the operation of the company.

✓ Safe Loading DEKRA

Certification by the internationally recognized German body DEKRA for the safe loading of product transporting vehicles.

Additionally, on 20 July 2005, via an official letter to the UN, AKRITAS subscribed, adopted and committed to faithfully apply the UN's Global Compact on Corporate Social Responsibility. Since AKRITAS' inception, environmental protection and human rights have been a priority for the company.

AKRITAS Raw Chipboard

- EPD Type: Average EPD for AKRIPAN® and HYDROPAN® Raw Chipboards (UN-CPC: 3143- Particle board and similar board of wood or other ligneous materials), which are similar products differing in the type of resin used (Urea Formaldehyde Resin for AKRIPAN® Raw Chipboard, Melamine Urea Formaldehyde Resin for HYDROPAN® Raw Chipboard). Characteristics per product:

AKRIPAN® Raw Chipboard:
-Standards: EN 312 - Type P1, P2, P4, P6
- Formaldehyde class E1 and CARB 2
-Description: Boards for interior fitments (including furniture) for use in dry conditions (EN 312:2010)

- ✓ High stability
- ✓ Impeccable smooth surface layer
- ✓ Easy to process
- ✓ Outstanding endurance in stretching, loading and assembly
- ✓ Excellent for laminate, veneer and HPL coating

-Dimensions: Width: 1,830-2,200mm, Length: 2,200-4,200mm, Thickness: 6-38mm

-AKRIPAN® Raw Chipboard technical data sheet:

AKRITAS

AKRIPAN®
TECHINICAL DATA SHEET (Type P2 - Class E1)

			6 < T ≤ 13		13 < T ≤ 20		20 < T ≤ 25		25 < T ≤ 32		32 < T ≤ 40	
CONTROL CRITERIA	TEST METHODS	UNIT	EN 312 2010	AKRITAS VALUES	EN 312 2010	AKRITAS VALUES	EN 312 2010	AKRITAS VALUES	EN 312 2010	AKRITAS VALUES	EN 312 2010	AKRITAS VALUES
Length and width tolerance	EN 324-1	mm	± 5	**± 5**	± 5	**± 5**	± 5	**± 5**	± 5	**± 5**	± 5	**± 5**
Thickness tolerance	EN 324-1	mm	± 0,3	**± 0,3**	± 0,3	**± 0,3**	± 0,3	**± 0,3**	± 0,3	**± 0,3**	± 0,3	**± 0,3**
Raw Density	EN 323	Kg/m³	-	**690 ± 2%**	-	**630 ± 1,5%**	-	**620 ± 1,5%**	-	**612 ± 1,0%**	-	**607 ± 1,0%**
Straightness of edges tolerance	EN 324-2	mm/m	1,5	**1,5**	1,5	**1,5**	1,5	**1,5**	1,5	**1,5**	1,5	**1,5**
Squareness	EN 324-2	mm/m	2	**2**	2	**2**	2	**2**	2	**2**	2	**2**
Board moisture	EN 322	%	5 to 13	**5 to 13**	5 to 13	**5 to 13**	5 to 13	**5 to 13**	5 to 13	**5 to 13**	5 to 13	**5 to 13**
Internal bond	EN 319	N/mm²	0,40	**≥ 0,50**	0,35	**≥ 0,40**	0,30	**≥ 0,35**	0,25	**≥ 0,32**	0,20	**> 0,30**
Bending strength	EN 310	N/mm²	11	**> 15**	11	**≥ 13,5**	10,5	**≥ 12**	9,5	**≥ 11,5**	7	**≥ 11**
Bending elasticity modulus	EN 310	N/mm²	1800	**> 2300**	1600	**> 2300**	1500	**> 2200**	1350	**> 2100**	1050	**> 2000**
Resistance to axial withdrawal of screws Vertical surface	EN 320	N	-	-	-	**> 630**	-	**> 620**	-	**> 600**	-	**> 600**
Resistance to axial withdrawal of screws Horizontal surface	EN 320	N	-	-	-	**> 950**	-	**> 1000**	-	**> 1000**	-	**> 1100**
Formaldehyde release	ISO 12460-5	mg/100gr	≤ 8	**Average 6,0**	≤ 8	**Average 6,0**	≤ 8	**Average 6,0**	≤ 8	**Average 6,0**	≤ 8	**Average 6,0**
Surface soundness	EN 311	N/mm²	0,8	**> 1,2**	0,8	**> 1,3**	0,8	**> 1,3**	0,8	**> 1,4**	0,8	**> 1,5**
AKRITAS SPECIFICATION Swelling in thickness after immersion in water 2 Hr	EN 317	%	-	**~ 8**	-	**~ 8**	-	**~ 8**	-	**~ 8**	-	**~ 8**

HYDROPAN® Raw Chipboard:

- Standards: EN 312 - Type P3, P5
- Formaldehyde class E1 and CARB 2
- Description: Boards for use in humid conditions (EN 312:2010)

✓ High stability
✓ Impeccable smooth surface layer
✓ Easy to process
✓ Outstanding endurance in stretching, loading and assembly
✓ Excellent for laminate, veneer and HPL coating
✓ Water Proof

- Dimensions: Width: 1,830-2,200mm, Length: 2,200-4,200mm, Thickness: 6-38mm

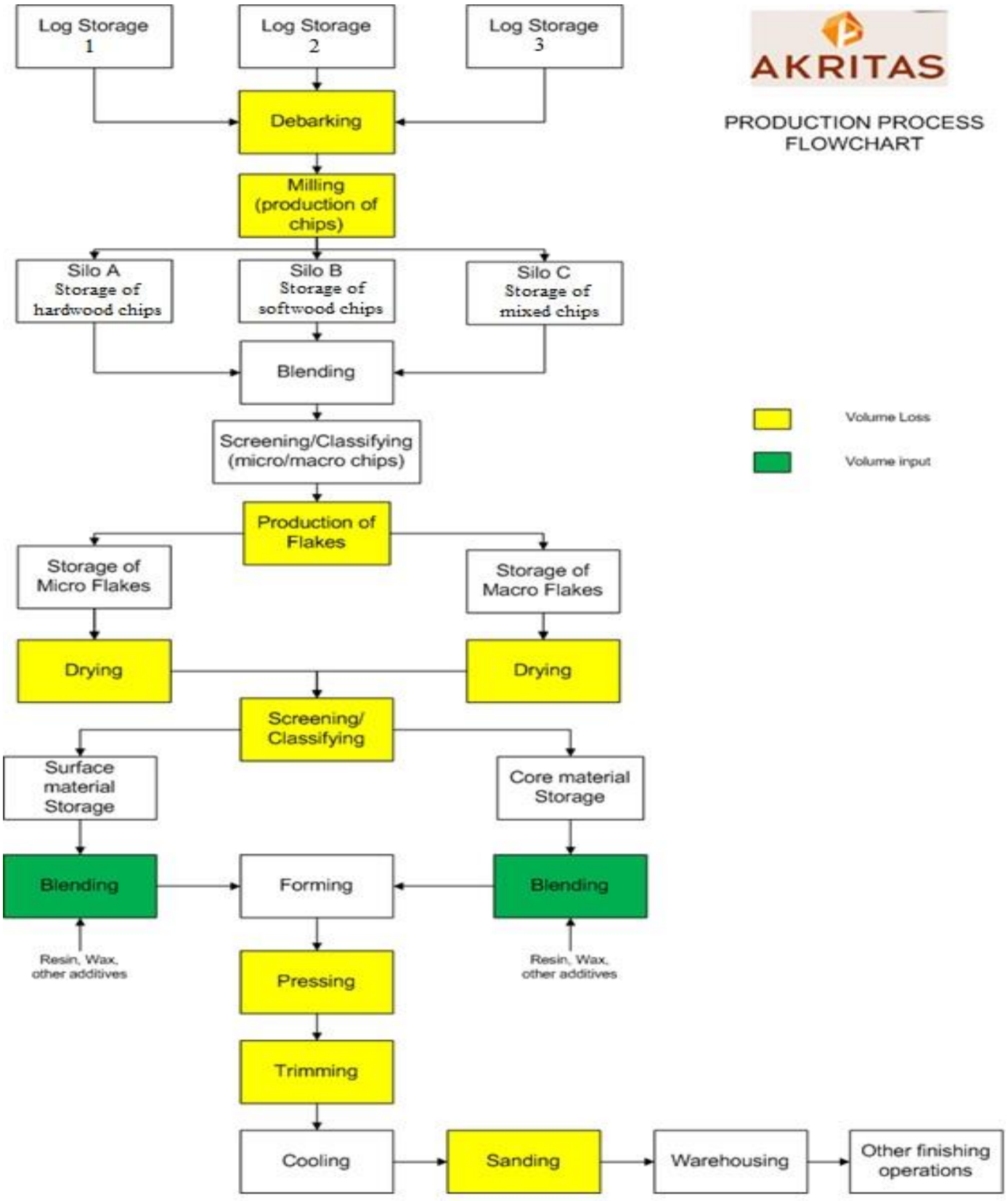
- HYDROPAN® Raw Chipboard technical data sheet:

AKRITAS
HYDROPAN®
TECHINICAL DATA SHEET (Type P5 - Class E1)

			13 < T ≤ 20		25 < T ≤ 32		32 < T ≤ 40	
CONTROL CRITERIA	TEST METHODS	UNIT	EN 312 2010	VALUES AKRITAS	EN 312 2010	VALUES AKRITAS	EN 312 2010	VALUES AKRITAS
Length and width tolerance	EN 324-1	mm	± 5	**± 5**	± 5	**± 5**	± 5	**± 5**
Thickness tolerance	EN 324-1	mm	± 0,3	**± 0,3**	± 0,3	**± 0,3**	± 0,3	**± 0,3**
Raw Density	EN 323	Kg/m³	-	**652 ± 1,5%**		**635 ± 1,5%**		**628 ± 1,5%**
Straightness of edges tolerance	EN 324-2	mm/m	1,5	**1,5**	1,5	**1,5**	1,5	**1,5**
Squareness	EN 324-2	mm/m	2	**2**	2	**2**	2	**2**
Board moisture	EN 322	%	5 to 13	**5 to 13**	5 to 13	**5 to 13**	5 to 13	**5 to 13**
Internal bond	EN 319	N/mm²	0,45	**> 0,58**	0,35	**> 0,54**	0,30	**> 0,50**
Bending strength	EN 310	N/mm²	16	**> 17**	12	**> 15**	10	**> 14**
Bending elasticity modulus	EN 310	N/mm²	2400	**> 2700**	1900	**> 2500**	1700	**> 2200**
Resistance to axial withdrawal of screws Vertical surface	EN 320	N	-	**> 830**	-	**> 750**	-	**> 700**
Resistance to axial withdrawal of screws Horizontal surface	EN 320	N	-	**> 1200**	-	**> 1200**	-	**> 1300**
Formaldehyde release	ISO 12460-5	mg/100gr	≤ 8	**≤ 8**	≤ 8	**≤ 8**	≤ 8	**≤ 8**
Surface soundness	EN 311	N/mm²	0,8	**> 2,0**	0,8	**> 2,0**	0,8	**> 2,2**
Swelling in thickness after immersion in water 24 Hr	EN 317	%	10	**< 8**	10	**< 8**	9	**< 8**
Internal bond after cyclic test	EN 321	N/mm²	0,22	**> 0,22**	0,17	**> 0,17**	0,15	**> 0,15**
Swelling in thickness after cyclic test	EN 321	%	12	**< 12**	10	**< 10**	9	**< 9**

Note: The AKRIPAN® and HYDROPAN® products have been tested for complying with the rule: *"When the EPD is instead based on an average or representative composition of products (in a so-called average EPD) the results for A1-A3 (A1-A5 for services) (ISO 21930:2017) shall as first not differ by more than ±10% for the GWP-GHG indicator"* (PCR 2019:14, Construction Products, version 1.11). The difference of the two products for the GWP-GHG indicator in A1-A3 Modules is within the limit of ±10%, therefore the average EPD statement is valid for AKRIPAN® and HYDROPAN® products. The average product is named as "AKRITAS Raw Chipboard" in the rest of this document.

AKRITAS Raw Chipboard- Manufacturing Stage Overview



LCA Background Information

-Declared unit: 1 m^3 of uncoated AKRITAS Raw Chipboard, with a density of 650 kg/m^3, with the following material composition (and range of variability of each material):

Wood Chips: 86% (±5%)
UF/MUF Glue: 11.5% (±1%)
Paraffin: 0.4% (±0.1%)
Ammonium Sulphate: 0.6% (±0.1%)
Water: 1.5% (±0.2%)

-Goal and Scope: The main goal of the LCA study of this EPD report is the development of an average EPD for the Raw Chipboards manufactured by AKRITAS S.A. It presents in detail the environmental impacts of producing 1 m^3 of AKRITAS Raw Chipboard according to the core mandatory and voluntary environmental indicators that are prescribed for the Life Cycle Impact Assessment (LCIA) for such studies in relevant standards. Simultaneously, this LCA report describes in detail important information about the AKRITAS Raw Chipboard product, such as its material composition, the boundaries of its production system with nature, the main life cycle stages that were considered in the study etc. As a result, the intended audience of this LCA report is considered to be all individuals involved in the validation of the EPD, the EPD certification body and all interested stakeholders that prefer EPD certified products both as raw materials (companies) and final products (customers). Therefore, this LCA study could be considered as a communication tool for AKRITAS S.A. practices of producing AKRITAS Raw Chipboard both for third-party businesses that are interested in being supplied with the AKRITAS Raw Chipboard [Business-To-Business (B2B)], and for customers that take into account the environmental practices of the respective producers in their buying choices [Business-To-Customer (B2C)].

-Time representativeness: The data used for the LCA study for this EPD are specific data from the main production site of AKRITAS S.A. from the year 2021

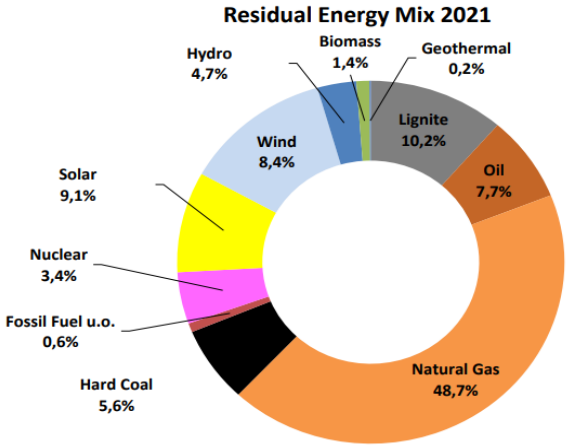
-Databases, LCA software and LCIA methods used: OpenLCA 1.10.3- Ecoinvent 3.7.1., EF 3.0 (adapted), EN15804+A2 Method, CML-IA Method (for "Eutrophication-fw (kg PO_4^{3-})" Indicator), IPCC 2013 (for "GWP-GHG" Indicator), Cumulative Energy Demand-LHV Method (for "Use of Resources")

-Background data collection: Site specific data have been collected for the total year of 2021, including the total production of AKRITAS Raw Chipboard in this year through questionnaire surveys. Additionally, generic data use, employment of assumptions and end-of-life scenarios were applied only for instances for which specific data were not available, as explained in the relevant sections. The questionnaire surveys that were prepared and distributed from the EPD developer to the AKRITAS S.A. representatives, mined specific data regarding inputs in the

following three areas:

i. Natural resources, Energy, raw materials and machinery use
ii. Transportation of raw materials from suppliers to the production site
iii. Wastes and byproducts of manufacturing processes

Regarding the electrical energy used, the DAPEEP S.A. Residual Mix of 2021 is the representative electricity mix in the context of AKRITAS Raw Chipboard production:



2021	Lignite	Hard Coal	Oil	Natural Gas[1]	Fossil Fuel of u.o.[2]	*Sum of Fossil Fuels*	Nuclear	Solar	Wind	Hydro	Biomass	Geothermal	RES of u.o.[2]	*Sum of RES*	*Total*	CO_2 Emissions (gCO_2/kWh)	R.W.[3] (mgRW/kWh)
%	10,17%	5,62%	7,74%	48,72%	0,60%	**72,86%**	3,44%	9,07%	8,35%	4,69%	1,44%	0,15%	0,00%	**23,70%**	**100,00%**	**436,889**	0,140
TWh	5,35	2,96	4,07	25,64	0,31	**38,34**	1,81	4,77	4,39	2,47	0,76	0,08	0,00	**12,47**	**52,63**		

Source: DAPEEP, Residual Energy Mix 2021 (https://www.dapeep.gr/wp-content/uploads/2022/09/Residual%20Energy%20Mix%202021%20-%20English%20short%20version.pdf?_t=1662359071)

In cases of lack of specific data, generic data found in Ecoinvent database and similar with the temporal, geographical and technological context of the AKRITAS Raw Chipboard were used. All assumptions replacing specific data are based on literature sources, as described in the relevant section (See "Assumptions"). Finally, the employed assumptions are representing possible real-life outcomes and based on European Institution publications.

-Geographical scope: The product is produced in Greece and it can be applied in interior constructions at dry (AKRIPAN) and wet conditions (HYDROPAN). The end-of-life of the product is assumed to take place in Greece.

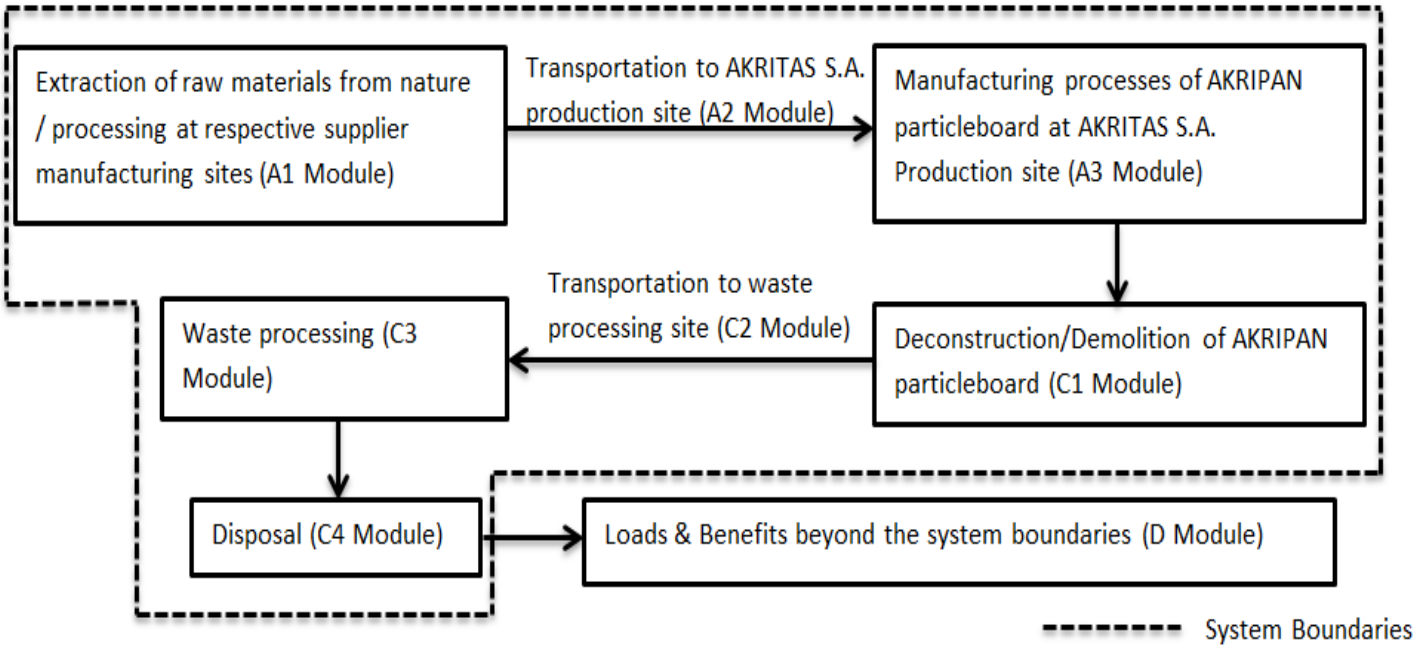
-Comparability: The results of this EPD can be compared with the respective EPDs of similar products, only when they fully comply with EN 15804 standard.

System Boundary:

Cradle to gate with modules C1–C4 and module D (A1–A3 + C + D):

Declared Modules																
	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

System boundary visual representation:



It must be noted that the Life Cycle Assessment Study for this EPD does not include the following:

- Equipment Maintenance
- Human labor and employee transport

Additional information

1. LCA practitioner: Georgios Lanaras-Mamounis, MEng Environmental Engineering, BETECO lab, Department of Environmental Engineering, Democritus University of Thrace, Greece. Contact Info: +302461304515, +306986573767 (tel.), glanaras@env.duth.gr (e-mail)
2. Cut-off rules: No cut-off rules were applied.
3. Allocation rules: In general, allocations have been avoided as much as possible, as instructed by EN 15804: 2012 + A2:2019 standard. Raw materials, energy and all necessary inputs and known outputs (I/O) from the manufacture of AKRITAS Raw Chipboard have been allocated by the respective S.I. unit of each I/O per declared unit (1 m^3) of product, respectively, based on 2021 specific site data. This has been realized by dividing the total amount of every I/O used/released during the production of AKRITAS Raw Chipboard in year 2021 with the total volume of production for the same year.

   Infrastructure flows (buildings, machinery) have been allocated by unit (buildings) and mass (machinery) per declared unit (1 m^3), by taking into account the expected lifetime of these flows declared by the respective providers of these inputs, as described above. The use of energy consuming machines have been allocated to the declared unit by employing either the total consumption of fuels/electricity or time of use in 2021 and dividing with the total production volume for 2021 in order to calculate the consumption per declared unit (KWh, MJ/m^3 AKRITAS Raw Chipboard). Regarding co-product allocations in this LCA study, the co-production of wood and wood processing waste was handled with the latter being used on-site for energy recovery and being accounted as energy input from wood burning in furnaces. Analytically, the main I/O of the respective modules have been allocated to the declared unit as follows:

   Electricity: AKRITAS S.A. allocates the total electricity consumption (as shown in the electricity bills it receives) to the final price of its respective products according to the installed electricity power of the production lines of each respective product. That being said, the average power of the machinery used in the respective production line adds up to the installed power of this line. In total, AKRITAS Raw Chipboard production line is responsible for 77% of the total electricity consumption of AKRITAS S.A. in 2021.

4. Data quality: A data quality assessment was conducted according to the Ecoinvent data quality system, which assesses the quality of the input data in 5 areas:
    i. Reliability
    ii. Completeness
    iii. Temporal Correlation
    iv. Geographical Correlation
    v. Further Technological Correlation

    The results of the data quality assessment are accessible through the LCA Report that has been provided to the EPD verifiers.

5. Assumptions:

    A1-A3 Modules:

I. For certain infrastructure flows that were allocated by unit (buildings) or mass (machinery), no specific data were available. For the instance of buildings, generic representative inputs sourced in the Ecoinvent database were used, and their providers were selected to realistically represent the infrastructure flows necessary for the production of AKRITAS Raw Chipboard, temporally, geographically and technologically. Temporally, generic flows representative of years as close as possible to the year of 2021 were applied. Geographically, providers of European representativeness were chosen, while technologically, the generic data represent wood board factories of similar capacity with the production capacity of AKRITAS S.A.. For the instance of machinery that were allocated by mass to the declared unit, when no mass data were available for the particular model of each machine, generic mass data of similar machines (geographically produced in a similar geographical context, models of same/similar years) of different manufacturers were used. Finally and in more detail for A2 Module (Transportation), specific data were available only for the distances and loads of raw materials per route, as well as the number of routes per raw material for the year 2021. Despite of that, the exact type of trucks/lorries for the transportation of raw materials to the AKRITAS S.A. production site was unknown. Therefore, these inputs were represented with lorries of European origin with an unknown exact EURO class and capacity.

II. AKRITAS imports three different wood species as raw material for the production of AKRITAS Raw Chipboard. Despite the fact that their density and volume is unknown, AKRITAS S.A. measures the weight of each wood species and the total moisture content of the logs used in the production of AKRITAS Raw Chipboard (regarding the moisture content, it was measured to be equal to 79,15% for 2021 before drying). In order to calculate the volume (m^3) of the wood species used in the production of the D.U. of AKRITAS Raw Chipboard the following calculations and assumptions are employed:

✓ The density of every wood species (3 different species) used in the production of 1 m^3 of AKRITAS Raw Chipboard equals to the sum of the moisture amount multiplied with the assumed

moisture density and the dry wood fraction multiplied with the assumed dry wood density, divided by the total yearly production for 2021:

$$Dx=(Dm\times MC)+(Dx\times WCx)$$

Where:

i. Dx is the density of the wood species (kg/m^3)
ii. Dm is the density of the moisture (1000 kg/m^3)
iii. MC is moisture content for each wood species (measured to be 0.7915)
iv. Dx is the density (kg/m^3) of dry wood of each wood species [x: 1,2,3 for the three different wood species and dry wood density for each wood species found in " Science and Technology of Wood, first edition" (Tsoumis, 1991)]
v. WCx is the dry wood content for each species (x: 1,2,3 for the three different wood species and dry wood content for all species assumed to be equal to 20,85%).

Since weight and density of each wood species are known, the volume used for each one of the three wood species is calculated as follows:

$$Vx=Wx/Dx$$

Where

i. Vx is the used volume of the wood species (m^3)
ii. Wx is the weight of the used wood species (kg)

✓ The assumed density of dry logs (Dx), found in the work of G. Tsoumis titled "Science and Technology of wood" (1991), for each one of the imported wood species in order to produce the declared unit of AKRITAS Raw Chipboard are the following:

✓ Pine (Softwood): 410 kg/m^3
✓ Beech (Hardwood): 700 kg/m^3
✓ Poplar (Hardwood): 460 kg/m^3

III. A density of 0.8345 kg/L (Government of Greece, 2001) was assumed for diesel fuel, in order to transform the known used volume from litres to kg. Also, a net calorific value of 42.80 MJ/kg (Greek Ministry of Environment and Energy, 2022) was assumed for this input, for calculating the energy consumption of diesel fuel in diesel-operating machines.

IV. The heat production in the two AKRITAS Raw Chipboard furnaces is measured as the quantities of the fuel used (wood particles, propane) multiplied by their assumed net calorific value. The net calorific value of wood particles is assumed to be 15.6 MJ/kg (EC, 2018), while the net calorific value of propane was assumed to be 46.33 MJ/kg (OECD/International Energy Agency/Eurostat, 2004).

- ✓ Scenario for end-of-life stages of AKRITAS Raw Chipboard: The scenario involves the demolition of end-of-life AKRITAS Raw Chipboard (C1 Module), the transportation of the resulting material to a waste sorting facility (C2 Module), the waste sorting to two fractions i. fraction intended for incineration, 70% of the initial mass of the demolished AKRITAS Raw Chipboard and ii. Fraction intended for landfill, 30% of the initial mass of the demolished AKRITAS Raw Chipboard (C3 Module), the landfill of the landfill intended fraction (C4 Module), and the production of electricity and heat from the incineration intended fraction (D Module), with the avoided grid electricity and natural gas based heat production as well as the environmental impacts of both landfilled fraction and incinerated fraction in the last two modules also accounted for. The scenario of 70% incineration and 30% landfill is inspired by EUROSTAT sources, which state that in 2018, of all the wood waste generated in EU-28, almost 50% was used for energy recovery (https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do). The 3-year progression since the reference year of this statistic table, the probable advance in relevant technologies, in conjunction with the high calorific value of Raw Chipboard products, justifies an optimistic improvement scenario of the 70-30 energy recovery/disposal hypothesis as a reasonable assumption.

C1 Module:

I. The distance between the use site of AKRITAS Raw Chipboard and the site of demolition/deconstruction (C1 Module) was assumed to be equal to 100 km.

II. An energy demand of 0.323 MJ/kg of AKRITAS Raw Chipboard was assumed for the demolition/deconstruction phase of the product (Gervasio et al., 2018).

C2 Module:

I. The distance between the demolition/deconstruction site of AKRITAS Raw Chipboard (C2 Module) and the site of waste sorting (C3 Module) was assumed to be equal to 100 km.

C3 Module:

I. An energy demand of 0.5 MJ/kg for the waste sorting was assumed.

C4 Module:

I. The distance between the waste sorting site of AKRITAS Raw Chipboard (C3 Module) and the site of inert material landfill (C4 Module) was assumed to be equal to 100 km.

D Module:

I. The distance between the waste sorting site of AKRITAS Raw Chipboard (C3 Module) and the site incineration (D Module) was assumed to be equal to 100 km.

II. An efficiency of energy recovery from the incineration process in the form of electricity and heat equal to 60% was assumed. The electricity (20%) and heat (40%) result in avoiding production of grid electricity and natural gas heat purposes (on-site) in a ratio equal to the net calorific value of wood waste (15.6 MJ/kg, 2018/2066/EC).

6. Emissions of substances of very high concern (SVHC): Raw Chipboard and MFC products are known for containing formaldehyde, a basic substance of the glue/resin (UF, MUF) that is used in the manufacturing of these products. Formaldehyde is listed as a candidate substance for the SVHC and REACH lists. Its use in adhesives such as UF resin and other manufacturing purposes is strictly regulated, since formaldehyde, in concentrations over certain limits, causes severe irritation of various forms in humans while it is also considered as a carcinogen. As mentioned earlier in Section "About AKRITAS Raw Chipboard", this average product belongs is the E1 and CARB 2 formaldehyde class, which means that this product does not emit more than 0.1 ppm of formaldehyde into ambient area, and that the formaldehyde emissions of this quantity are well below the tolerance limits set by the SVHC list.

7. Reasons for updating the EPD of AKRITAS Raw Chipboard

I. According to the updated General Programme Instructions of the International EPD system for products that contain biogenic carbon such as the AKRITAS Raw Chipboard, the carbon sequestration that takes place in Modules A1-A3 (from nature to the product) and is represented as negative flow in the relevant LCIA indicators must be accounted for upon its release as a positive flow to the environment at the end-of-life stages of the product in Module D. Since this instruction was not taken into account in the previous version, an update of the EPD was necessary.

II. An updated density of diesel fuel (0.8345 kg/L) was taken into account according to the relevant estimation of Government of Greece (Y.A. 354/2000/2001)

III. A number of different allocation strategies employed in the previous version of the EPD in regard with the allocation of heat, water and diesel/lubricant use and waste production were no longer necessary since AKRITAS S.A. has taken appropriate measures to allow the calculation of the relevant consumptions and productions seperately for the production lines of its various products.

IV. The residual electricity mix was updated to reflect the most recent estimations of the relevant body of Greece (DAPEEP) for 2021.

V. All of the updates mentioned above led to changes of the values of the core mandatory and additional indications that exceeded the ±10% criterion in comparison with some of the respective values of the indicators in the previous version of the EPD; therefore, the update of the EPD was mandatory, according to the rules of the relevant standards.

LCA Results for AKRITAS Raw Chipboard

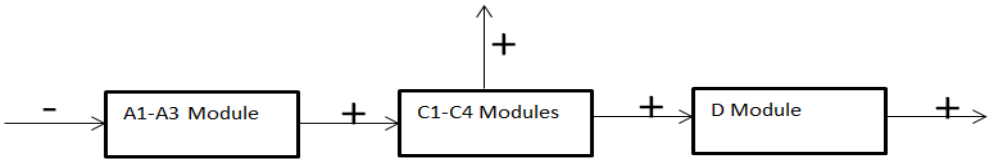
Mandatory indicators

Results per 1 m^3 of AKRITAS® Raw Chipboard							
Indicator	**Unit**	**Tot.A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-fossil	kg CO_2 eq.	**3,67E+02**	**5,21E+01**	**8,52E+00**	**6,71E+01**	**3,08E+00**	**-3,76E+02**
GWP-biogenic	kg CO_2 eq.	**-1,28E+03**	**1,19E-01**	**3,01E-03**	**1,77E-01**	**1,02E-03**	**1,28E+03**
GWP-luluc	kg CO_2 eq.	**8,20E-01**	**5,57E-03**	**2,90E-03**	**3,58E-03**	**9,16E-04**	**-1,62E-02**
GWP-total	kg CO_2 eq.	**-9,15E+02**	**5,22E+01**	**8,52E+00**	**6,73E+01**	**3,08E+00**	**9,07E+02**
ODP	kg CFC 11 eq.	**7,01E-05**	**1,02E-05**	**1,96E-06**	**1,28E-05**	**6,96E-07**	**-8,27E-05**
AP	mol H^+ eq.	**1,76E+00**	**2,32E-01**	**4,79E-02**	**2,82E-01**	**1,96E-02**	**-1,22E+00**
EP-freshwater	kg P eq.	**1,24E-01**	**3,07E-02**	**6,00E-04**	**4,64E-02**	**2,07E-04**	**-2,03E-01**
EP-freshwater	kg PO_4^{3-} eq.	**5,77E-01**	**1,12E-01**	**8,45E-03**	**1,59E-01**	**3,42E-03**	**-6,82E-01**
EP-marine	kg N eq.	**3,70E-01**	**4,63E-02**	**1,75E-02**	**4,41E-02**	**7,51E-03**	**-1,58E-01**
EP-terrestrial	mol N eq.	**4,44E+00**	**4,45E-01**	**1,91E-01**	**3,85E-01**	**8,21E-02**	**-1,26E+00**
POCP	kg NMVOC eq.	**1,32E+00**	**1,37E-01**	**5,46E-02**	**1,25E-01**	**2,33E-02**	**-4,73E-01**
ADP-minerals&metals*	kg Sb eq.	**4,48E-03**	**1,11E-04**	**2,95E-05**	**6,69E-05**	**9,08E-06**	**-3,34E-04**
ADP-fossil*	MJ	**7,31E+03**	**7,33E+02**	**1,31E+02**	**9,29E+02**	**4,65E+01**	**-5,28E+03**
WDP	m^3	**3,52E+02**	**1,84E+00**	**4,11E-01**	**2,09E+00**	**1,47E-01**	**-1,61E+01**
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption						

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Overview of the biogenic carbon flows (GWP-biogenic Indicator)

AKRITAS selects wood of sustainable origin for its products. Additionally, all wood imports come from countries that have opted for the Kyoto Protocol regarding the subject of carbon neutrality of wood. Therefore, the assumption of biogenic carbon neutrality is valid for AKRITAS Raw Chipboard. An overview of the biogenic carbon flows in the different modules considered in this LCA study is presented below:



As seen above, the sustainable planted trees which provide wood for the AKRITAS Raw Chipboard absorbs biogenic carbon for the formation of its vital parts. Its deduction from the environment and entry in the product system of AKRITAS Raw Chipboard is considered as a negative biogenic carbon flow (carbon sequestration). The biogenic carbon moves along the various life cycle stages (Modules) as a positive carbon flow, both when entering these lifecycle stages and as emissions to the environment. In conclusion, the AKRITAS Raw Chipboard stores biogenic carbon which in turn returns to the environment during the end-of-life (and beyond) life cycle stages.

Additional mandatory and voluntary indicators

Results per 1 m^3 AKRITAS® Raw Chipboard							
Indicator	Unit	Tot.A1-A3	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq	**3,60E+02**	**5,13E+01**	**8,45E+00**	**6,61E+01**	**3,05E+00**	**-3,69E+02**
PM	Disease incidence	**1,32E-05**	**1,41E-06**	**7,68E-07**	**9,58E-07**	**3,67E-07**	**-2,88E-06**
IRP*	KBq U235 eq.	**1,84E+01**	**1,14E+00**	**6,87E-01**	**6,85E-01**	**2,38E-01**	**-2,56E+00**
ETP-fw**	CTUe	**4,62E+03**	**2,58E+02**	**9,79E+01**	**2,25E+02**	**3,45E+01**	**-1,04E+03**
HTP-c**	CTUh	**2,33E-06**	**1,30E-08**	**4,41E-09**	**1,17E-08**	**1,53E-09**	**7,79E-08**
HTP-nc**	CTUh	**3,44E-06**	**3,25E-07**	**1,14E-07**	**3,07E-07**	**3,98E-08**	**-1,34E-06**
SQP**	dimensionless	**8,09E+04**	**1,83E+02**	**1,09E+02**	**5,65E+01**	**2,39E+01**	**-1,52E+02**
Acronyms	GWP-GHG = Global Warming Potential-Greenhouse Gases; IRP = Ionizing Radiation, human health; ETP-fw = Eco-toxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects; SQP = Land use related impacts/Soil quality						

* Disclaimer: 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 nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured with this indicator

* *Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Use of Resources

Results per 1 m^3 of AKRITAS® Raw Chipboard							
Indicator	Unit	Tot.A1-A3	C1	C2	C3	C4	D
PERE	MJ	**1,45E+04**	**3,46E+01**	**1,80E+00**	**4,97E+01**	**5,97E-01**	**-2,16E+02**
PERM	MJ	**8,87E+03**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
PERT	MJ	**2,33E+04**	**3,46E+01**	**1,80E+00**	**4,97E+01**	**5,97E-01**	**-2,16E+02**
PENRE	MJ	**7,31E+03**	**7,33E+02**	**1,31E+02**	**9,29E+02**	**4,65E+01**	**-5,28E+03**
PENRM	MJ.	**1,27E+03**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
PENRT	MJ	**8,58E+03**	**7,33E+02**	**1,31E+02**	**9,29E+02**	**4,65E+01**	**-5,28E+03**
SM	kg	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
RSF	MJ	**2,35E+03**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
NRSF	MJ	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
FW	m^3	**9,71E+00**	**8,43E-02**	**1,72E-02**	**1,00E-01**	**6,00E-03**	**-3,30E-01**
Acronyms	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						

Waste/output flows, biogenic carbon content

Results per 1 m^3 of AKRITAS Raw Chipboard							
Waste production							
Indicator	Unit	Tot.A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed	kg	**6,65E-02**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Non-hazardous waste disposed	kg	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**1,95E+02**	**0,00E+00**
Radioactive waste disposed	kg	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Output Flows							
Components for re-use	kg	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Material for recycling	kg	**3,02E-03**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Materials for energy recovery	kg	**1,51E+02**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**4,55E+02**
Exported energy, electricity	MJ	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**1,42E+03**
Exported energy, thermal	MJ	**2,35E+03**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**2,84E+03**
Biogenic carbon content							
Biogenic carbon content (product)	Kg C	Quantity: 325*					
Biogenic carbon content (packaging)	Kg C	Quantity: 0**					

*Disclaimer: The biogenic carbon content is assumed to be 50% of the product

** No packaging is used for AKRITAS Raw Chipboard. Therefore, the biogenic carbon content of packaging material equals to 0.

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