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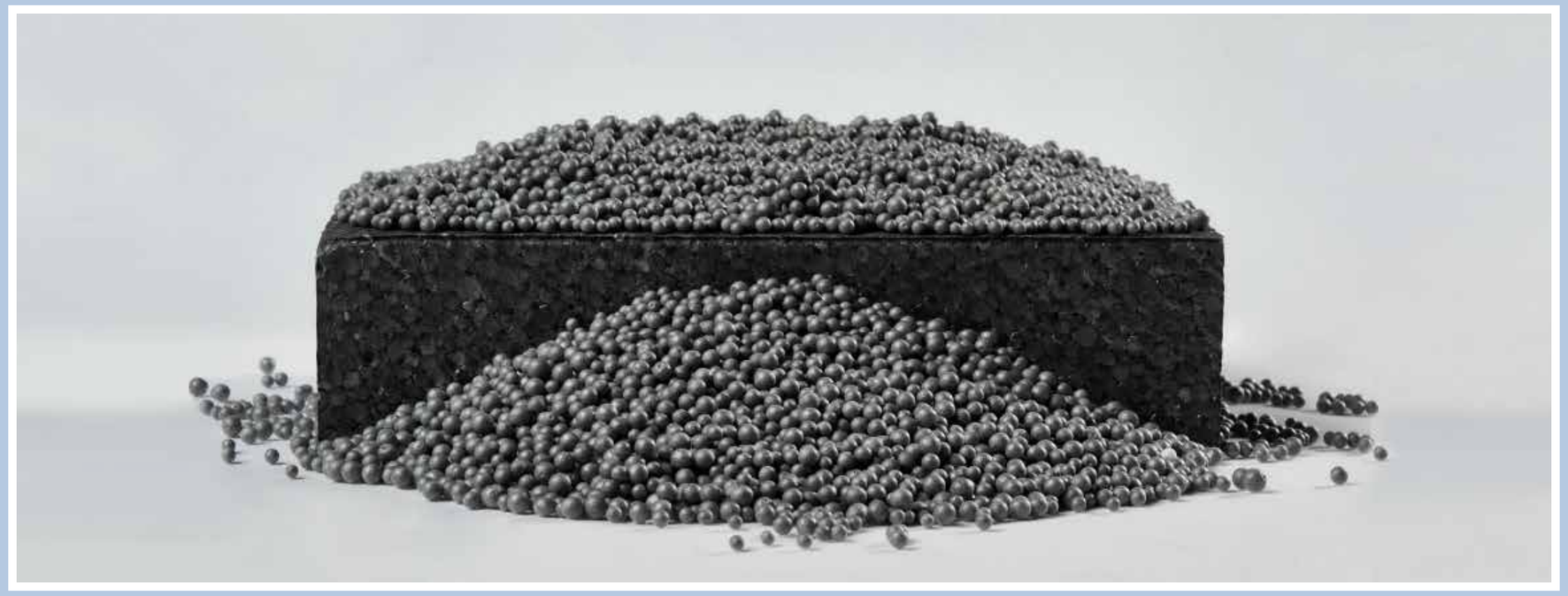

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PROGRAM
The International EPD® System
www.environdec.com

PROGRAM OPERATOR
EPD International AB

UN CPC
369 – Other Plastics Products

ENVIRONMENTAL PRODUCT DECLARATION

G. K. RIZAKOS S.A. – EPS Graphite Products
(NEOCOAT & NEOCOAT THP)
In accordance with ISO 14025 and EN 15804 + A2

PROGRAM INFORMATION

PROGRAM OPERATOR

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Product category rules (PCR):	PCR 2019:14 Construction products version 1.11 (EN 15804:A2) C-PCR-005 Thermal insulation products (EN 16783)
PCR review was conducted by:	The Technical Committee of the International EPD System Contact via info@envrirondec.com
Independent third-party verification of the declaration and data, according to ISO 14025:	☐ EPD process certification ☒ EPD verification (external)
Verified by:	Dr-Ing Nikolay Minkov, Greenzero.me GmbH nikolay.minkov@greenzero.me
Approved by:	The International EPD® System Technical Committee, supported by the Secretariat
Technical support:	SustChem Technical Consulting S.A. www.sustchem.gr

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.

COMPANY'S PROFILE

Due to the specialized skills, the in-depth understanding of the market needs and the multiyear experience in the field of INSULATION – CONSTRUCTION – DECORATION & PACKAGING, G.K.RIZAKOS S.A. is in the position to offer to their customers a complete portfolio of products and services and to create innovative solutions, hence satisfying the demands of the market as well as those of the end user. Since 1980, **G.K.RIZAKOS S.A.** presents a continual growth and thus has gained a proven insight into the market requirements of INSULATION – CONSTRUCTION – DECORATION & PACKAGING. This awareness, along with the company's customer-centered philosophy, has turned the company's customers into their accredited collaborators whose profitability is also company's key objective. From the beginning to date, there is a careful and long-term planning in the company's operations. The decisive factors are the research and development capabilities and the use of innovative technologies that can lead to sustainable excellence in manufacturing. In this way, the products' quality was guaranteed from the start and that ensured the establishment of the brand name "RIZAKOS" in the market.

Having developed its corporate identity as a well-established and reliable partner, G.K.RIZAKOS S.A. is identified with:

- Reliability of products, human potential, and benefit of services to each collaborator
- Standing next to its customers, offering technical support even after sales are completed
- Support its customers with products & services of the highest quality while retaining at the same time its competitive sale prices
- Continuous research and development for new products

Values and Vision

G.K.RIZAKOS S.A. philosophy is to work closely with its customers seeing them as actual partners. At the same time, the company aims to offer the full portfolio of products and services, revolutionary ideas that will satisfy the market and end consumer needs, thus creating added value.

The company's objective is to be the leading force in the Greek Market in providing solutions for Insulation, Construction, Decoration & Packaging, in entrepreneurial ability and competitiveness and in respect to the individual, the society and the environment. The company's mission statement is:

- Profitable sales growth
- Customer Satisfaction
- Continuous cost reduction of the products and services to customer
- Employee training
- Constant update/education of the customer
- Complete alignment with the Regulations and Norms in effect
- Co-ordination and Communication
- Continuous improvement

Loyal to its long-held values of reliability, sincerity, confidence, dignity and morality the company is committed to retain and further develop its in-depth knowledge of EPS operation, follow-up on technological developments and keep improving towards a more sustainable and environmentally friendly way of doing business. The current LCA depicts partly the company's commitment to intergrade the principles of sustainability in its operation moving forward.

Further information on www.rizakos.gr

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Milestones

1980: Establishment of **G.K.Rizakos S.A.**

1987: The company becomes anonymous with initial capital 200.000 € and relocates at new privately-owned installations on 1st km of Lamia - Domokos Old National Road, where the modernization of EPS production for construction products takes place for the first time.

1993: company expands by setting up its first subsidiary in Athens, where production starts for protective packaging (Flow Packing) and it installs a pantograph with two axes cutting equipment (CAD/CAM) for foam plastics.

1995: The first shape molding machines for molded EPS products are installed in the production line of Lamia. The company enters the Packaging sector.

2001: The company establishes new subsidiary in Thessaloniki.

2004: Relocation of the headquarters and production to the new industrial facilities at the Lamia Industrial Estate (building surface 9000m^2).

2005: Take-over of the company ATLANTIS SA, EPS packaging manufacturer

2007: New industrial facilities in Menidi, Attica, set up in privately-owned location of 5.500 m^2, in order to merge the two Athens subsidiaries.

2020: The company begins construction of a new production building spanning 3.000 m^2 in the company's headquarters in the Industrial Estate of Lamia.



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Quality & Certification

For G.K.Rizakos S.A. the Quality Assurance of products and services offered to its customer is top priority. Therefore, it zealously seeks the opportunities for continuous improvement in its operation that are identified during a certification process.

G.K.Rizakos S.A. operations and products hold the following certifications:

- **ISO 9001:2015 Quality Management System**
- **ISO 14001:2015 Environmental Management System**
- **ISO 45001:2018 Occupational Health & Safety System**
- **Product Certificates according to European CE marking standard EN 13163:2012+A1:2015**
- **Certificate of Factory Production Control according to the European standard EN 13172:2012**
- **Declaration of Compliance for food contact according to European Regulation (EC) No 1935/2004 and Article 26 of Code for Food and Beverage**
- **Certificates of Analysis for migration tests performed by ESYD-accredited lab**

EPS Graphite Products (NEOCOAT & NEOCOAT THP)

The thermal insulation material of the future is called NEOCOAT. Neocoat is produced from Neopor®, a product of intense research by BASF®, and is a new innovative expanded polystyrene material. It has a silver-gray color and offers significantly improved thermal insulation performance compared to conventional heat insulating materials.

In each material, heat is transmitted through conduction, convection, and radiation. In closed cell materials such as Extruded Polystyrene (EPS), there can be no air movement, and thus heat transmission by treatment is minimized.

Tiny graphite molecules containing 3% of its composition act as reflectors that block the transmission of heat through radiation, allowing only convection to contribute to heat loss. As a result, NEOCOAT thermal insulating panels have 15% - 20% better thermal insulation properties than conventional white expanded polystyrene (EPS).

Based on the compressive strength applied and the raw material used, the following NEOCOAT products are produced:

NEOCOAT TX/BT/TT EPS 60 RF CE, NEOCOAT TX/BT/TT EPS 80 RF CE, NEOCOAT Plus EPS 80 RF CE, NEOCOAT BT/TX-/TT EPS 100 RF CE, NEOCOAT BT/TX EPS 150 RF CE, NEOCOAT BT-AM EPS 200 RF CE

The THP product line of the NEOCOAT group is a group of graphite EPS products that was created exclusively for ETICS (External Thermal Insulation Composite Systems) applications. All products of the Neocoat THP line are made from BASF's Neopor® self-blooming material containing flame retardants. The NEOCOAT THP products show excellent dimensional stability, with the tightest tolerances not only in their dimensions' measurements but also in squareness and flatness.

Based on the compressive strength applied and the raw material used the following NEOCOAT THP products are manufactured:

NEOCOAT PLUS THP EPS 60 RF CE, NEOCOAT THP EPS 80 RF CE, NEOCOAT PLUS THP EPS 80 RF CE, NEOCOAT THP EPS 100 RF CE, NEOCOAT THP EPS 150 RF CE, NEOCOAT THP EPS 200 RF CE

- NEOCOAT EPS 80 (covering both NEOCOAT TX/BT/TT EPS 80 RF CE and NEOCOAT THP EPS 80 RF CE) is used as reference product. Certain conversion factors (presented in p.8) can be used to convert Potential Environmental Impacts to other nominal densities of EPS.

- No substances included in the Candidate List of Substances of Very High Concern for authorization under the REACH Regulations that exceed 0.1% of the total weight are present in the examined products.

NEOCOAT EPS 80

Parameter	Unit	Value	Control Norm
Thermal conductivity λ 10°C	W/m*K	0.031	EN 12667
Thermal Resistance R (30 mm)	m²K/W	0.968	EN 823
Thermal Resistance R (50 mm)	m²K/W	1.613	EN 823
Thermal Resistance R (80 mm)	m²K/W	2.581	EN 823
Thermal Resistance R (100 mm)	m²K/W	3.226	EN 823
Dimension Tolerance			
Length & Width (EPS 80 RF CE)	mm	± 3	EN 822
Length & Width (THP 80 RF CE)	mm	± 2	EN 822
Thickness (EPS 80 RF CE)	mm	± 2	EN 823
Thickness (THP 80 RF CE)	mm	± 1	EN 823
Squareness (EPS 80 RF CE)	mm	± 5	EN 824
Squareness (THP 80 RF CE)	mm	± 2	EN 824
Flatness per meter run (EPS 80 RF CE)	mm	± 10	EN 825
Flatness per meter run (THP 80 RF CE)	mm	± 5	EN 825
Characteristics-specifications			
Bending strength σb	kPa	125	EN 12089
Compression strength for 10% deformation σ10	kPa	80	EN 826
Tensile strength perpendicular to faces σmt (evaluated only for THP)	kPa	150	EN 1607
Resistance to vapour diffusion μ (Air μ=1)	-	20 - 40	EN 12086
Resistance to fire	-	E	EN 13501-1

Neocoat

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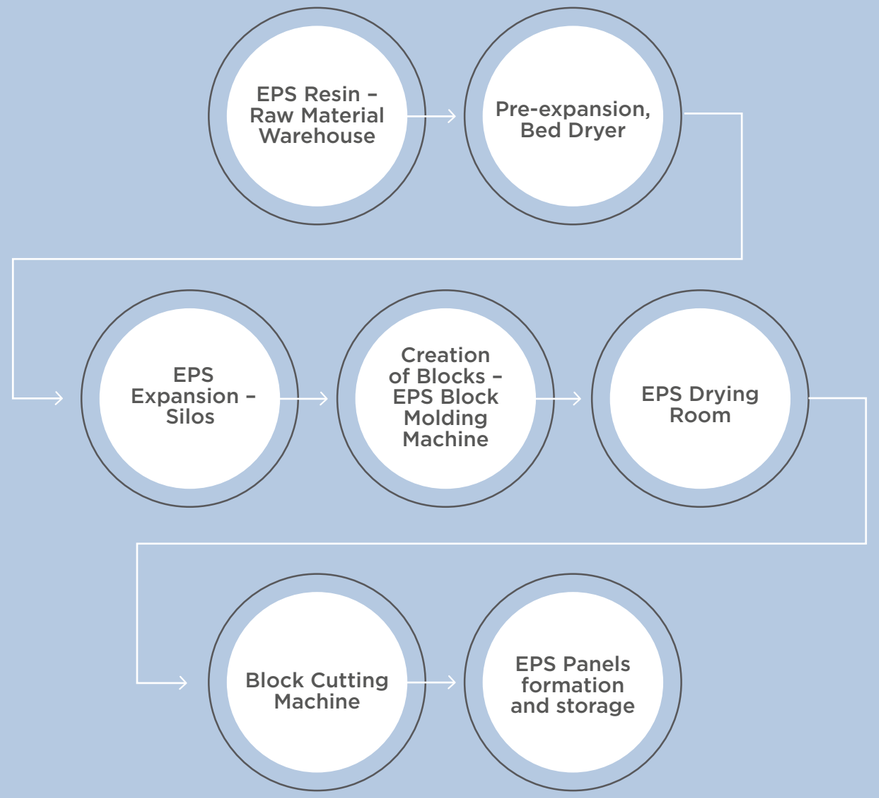
Manufacturing Process

EPS Graphite production is a continuous process divided into distinct phases which take place at Rizakos S.A. Plant (see the respective flowchart).

It should be mentioned that the manufacturing procedure of all EPS Graphite Product types (i.e. NEOCOAT TX/BT/TT EPS 80 RF CE, NEOCOAT BT/TX-/TT EPS 100 RF CE etc.) are exactly the same in terms of type of materials and utilities used and they only differ based on the compression strength applied as well as the quantity of raw materials used. As a result, the numerical value i.e., 100 means that the specific product affords a compressive strength of 100 KPa for a deformation of 10%.

Similarly, independently of the fact that all NEOCOAT THP products are created especially for ETICS (External Thermal Insulation Composite Systems), all products of this line follow the same manufacturing procedure and their only difference in relation to NEOCOAT has to do with the strictness of compliance with specific technical specifications (Dimension Tolerance). The conformance with stricter specifications (such as the accepted deviation in relation to thickness values) is achieved based on a different appliance of the EPS blocks cutting machine.



Functional Unit

The functional unit is one (1) m^2 of EPS 80 with 31 mm thickness, R-value of 1 $K*m^2/W$ (covering both NEOCOAT TX/BT/TT EPS 80 RF CE and NEOCOAT THP EPS 80 RF CE) .

Conversion factors to other classes

The LCA Results can be converted to account for the other EPS types (R-Value=1) using the conversion factors of the following table. The same conversion factors can be used for the calculation of Potential Environmental Impacts for NEOCOAT THP products too. The thickness value in which the R-value=1 is achieved for the various EPS types is also depicted. Apart from the reference product, Potential Environmental Impacts of EPS 100 are also presented in the results section, demonstrating the way that the conversion factors can be applied.

System boundaries

This EPD covers the "cradle-to-grave and module D" approach. Therefore, the defined system boundaries include modules A1-A3, A4-A5, B, C and D.

Reference Period Considered

January 2021 – December 2021

Reference Service Life

Based on bibliography it is concluded that the EPS Products retain their technical characteristics for a period of 70 years minimum.

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ENVIRONMENTAL IMPACTS CONVERSION FACTORS

EPS Type	EPS 60	EPS 80	EPS 80 PLUS	EPS 100	EPS 150	EPS 200
Conversion Factor	0.853	1	0.968	1.110	1.366	1.679
Thickness value (mm) for R=1 $K*m^2/W$	31	31	30	30	30	30

DESCRIPTION OF EXAMINED MODULES

	Product Stage			Construction Process Stage		Use Stage							End of Life Stage				Resource Recovery Stage
	Raw material	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction, demolition	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling potentials
Modules	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules Declared	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Geography	EU27	EU27	GR	EU27		EU27							EU27				EU27
Specific data used	>80%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation - products	From -14.70% to +67.90%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation - sites	Not relevant			-	-	-	-	-	-	-	-	-	-	-	-	-	-

* The variations of -14.70% and +67.90% correspond to the difference in GWP-GHG indicator results in A1-A3 between the reference product (EPS 80) and the EPS 60 and EPS 200, respectively.

EPD TYPE

Specific

SOFTWARE

GaBi ts version 10.6.0.110

DATABASE

Ecoinvent 3.8.1 & Professional 2021

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DESCRIPTION OF EXAMINED MODULES



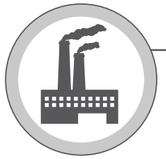
A1: Raw Material Extraction/Production

Module A1 includes the production of all raw materials (polystyrene granulate, graphite, etc.) and utilities (i.e. electricity, HFO, water) required for the manufacturing procedure.



A2: Transport to Rizakos' Facilities

Module A2 includes the transport of all raw materials and utilities to the company's plant at the Industrial Estate of Lamia.



A3: Manufacturing

Module A3 depicts the environmental impact potentials attributed to all processes taking place at the EPS manufacturing plant of G.K. Rizakos.



A4: Finished Products Transport

Module A4 includes the transport of finished products (NEOCOAT & NEOCOAT THP) to clients/Building sites. Actual data of distances of sites locations have been taken into account.



A5: Construction Installation

EPS products are installed manually to the construction, and thus, no ancillary material, water or any other energy resource is required for the installation. The wastage of finished products during installation is assumed to be equal to 2% of the total.



B1-B7: Use phase

NEOCOAT and NEOCOAT THP products do not require maintenance, repair, replacement or refurbishment during use in standard conditions and in case that they are properly installed. No consumption of energy or water is taking place during use phase of building.



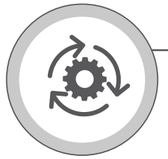
C1: Deconstruction/Demolition

Regarding deconstruction/demolition, a scenario has been developed since no actual data are available. More specifically, it has been considered that an excavator (diesel, 100kW) is used.



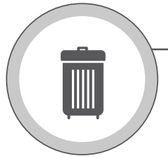
C2: EPS Waste Transport

A nominal distance of 100 km is assumed for the transport of EPS from building demolition to sorting/recovery plants and disposal facilities (Truck 12-14 tons).



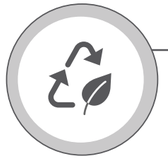
C3: EPS Waste Processing

Based on bibliography in relation to European market, EPS construction waste energy recovery via incineration equals to 67%. Recycling accounts for 10% of the total construction waste.



C4: Disposal

The remaining quantity of 23% is being disposed.



D: Reuse, Recovery, Recycling Potential

Module D covers the net benefits arising from the substitution of primary polystyrene with secondary material (10%) and the energy produced from the incineration of 67% of the EPS Waste retrieved from buildings' demolition.

LIFE CYCLE ASSESSMENT INFORMATION

Cut-off criteria

All major raw materials, elements and all the essential energy required are included within the system boundaries. Data for elementary flows to and from the product system contributing to minimum of 99% of the declared environmental impacts are included in the study. Thus, it is assumed that the total neglected input flows are less than 1% of total energy and mass. The only flow that has been omitted from the modelling of the studied system is the evaporation of the pentane since the total potential environmental impacts in relation to the GWP occurring from the specific stream is less than 0.5% of the total GWP of the modelled system.

- G.K. Rizakos' production processes yield no commercial by-products in its plant. Thus, there is no need for by-product allocation in the manufacturing process.
- A nominal distance of 100 km from the construction sites was taken into account in relation to the transportation of PE (used for packaging) waste to sorting facilities and the transportation of collected EPS waste to treatment and disposal facilities.
- A default mean of road transportation "Truck Euro 6 – 9.3t payload – 12-14t gross weight" was assumed. Weighted average of the distance covered, and time needed was taken into account. Regarding ship transportation, "Average ship, 3,500t pay- load capacity" was assumed due to lack of actual data.
- Energy recovery (incineration) rate of 67% is assumed for construction applications based on European Bibliography. 10% of the total EPS waste is recycled while the remaining 23% is considered to be disposed.

Background data and data quality

For all processes, primary data were collected and provided by G.K.RIZAKOS S.A.
Data related to material and energy flows of the defined system, were acquired from the company developing the EPD and data related to life cycle impacts resulted from calculations based on widely used and trust-worthy databases.
Primary data refer to January – December 2021 reference period.
Regarding modules C1-C4 and D no actual data were available and hence specific scenarios were developed based on bibliography and the most common industry practices. However, these scenarios were modeled based on accurate and area representative datasets available either into Professional 2021 or Ecoinvent 3.8.1. Thus, these data are expected to be of high quality too.
The LCA software GaBi ts version 10.6.0.110 was used for inventory and impact assessment calculations based on data entry of the developed mode. A compilation of Ecoinvent v.3.8.1 and Professional 2021 databases was used.

Comparability

EPDs within the same product category but registered in different EPD programs, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterization factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

ENVIRONMENTAL PERFORMANCE INDICATORS

EPS Graphite Products (NEOCOAT & NEOCOAT THP)

POTENTIAL ENVIRONMENTAL IMPACTS / 1 m² of EPS 80, 31 mm thickness, R-value of 1 K*m²/W

Core Environmental Impact Indicators	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total	D
Global Warming Potential -total	kg CO_2 eq.	2.325E+00	4.750E-05	7.594E-02	0.00E+00	3.257E-04	6.412E-03	1.211E+00	8.599E-03	**3.627E+00**	-6.039E-01
Global Warming Potential – fossil fuels	kg CO_2 eq.	2.315E+00	4.719E-05	7.576E-02	0.00E+00	3.378E-04	6.367E-03	1.211E+00	8.683E-03	**3.617E+00**	-6.004E-01
Global Warming Potential – biogenic	kg CO_2 eq.	9.128E-03	-6.014E-08	1.707E-04	0.00E+00	-1.480E-05	-8.153E-06	6.518E-05	-9.064E-05	**9.250E-03**	-3.182E-03
Global Warming Potential – land use and land use change	kg CO_2 eq.	3.106E-04	3.869E-07	1.185E-05	0.00E+00	2.665E-06	5.220E-05	1.838E-05	7.260E-06	**4.033E-04**	-3.691E-04
Global Warming Potential (GWP-GHG)	kg CO_2 eq.	2.316E+00	4.756E-05	7.577E-02	0.00E+00	3.405E-04	6.420E-03	1.211E+00	8.690E-03	**3.617E+00**	-6.007E-01
Ozone Depletion Potential	kg CFC 11 eq.	2.173E-11	6.036E-21	2.802E-11	0.00E+00	4.157E-20	8.147E-19	1.380E-09	2.095E-17	**1.429E-09**	-5.964E-15
Acidification Potential	Mole of H+ eq.	8.836E-03	4.617E-08	1.911E-04	0.00E+00	1.604E-06	6.230E-06	1.597E-04	2.602E-05	**9.221E-03**	-7.982E-04
Eutrophication Potential Freshwater	kg P eq.	2.248E-06	1.402E-10	6.819E-07	0.00E+00	9.660E-10	1.893E-08	2.579E-06	1.604E-06	**7.132E-06**	-7.912E-07
Eutrophication Potential Marine	kg N eq.	1.785E-03	1.442E-08	4.166E-05	0.00E+00	7.545E-07	1.945E-06	4.422E-05	5.902E-06	**1.880E-03**	-2.257E-04
Eutrophication Potential Terrestrial	mol N eq.	1.945E-02	1.739E-07	4.443E-04	0.00E+00	8.351E-06	2.347E-05	6.592E-04	6.470E-05	**2.065E-02**	-2.420E-03
Formation Potential of Tropospheric Ozone	kg NMVOC eq.	5.863E-03	3.960E-08	1.329E-04	0.00E+00	2.122E-06	5.344E-06	1.225E-04	1.888E-05	**6.145E-03**	-6.749E-04
Abiotic Depletion Potential, minerals and metals*	kg Sb eq.	2.469E-07	3.596E-12	8.529E-09	0.00E+00	2.478E-11	4.855E-10	9.856E-08	5.977E-10	**3.551E-07**	-9.651E-08
Abiotic Depletion Potential, fossil resources*	MJ net calorific value	6.366E+01	6.290E-04	1.332E+00	0.00E+00	4.331E-03	8.488E-02	3.379E-01	1.266E-01	**6.554E+01**	-1.226E+01
Water Deprivation Potential*	m^3 world eq. deprived	2.799E-01	4.104E-07	8.709E-03	0.00E+00	2.826E-06	5.537E-05	1.011E-01	-1.070E-04	**3.897E-01**	-4.361E-02

* 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.

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RECYCLING PACKAGING INSULATION CONSTRUCTION DECORATION

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ENVIRONMENTAL PRODUCT DECLARATION

ENVIRONMENTAL PERFORMANCE INDICATORS

EPS Graphite Products (NEOCOAT & NEOCOAT THP)

POTENTIAL ENVIRONMENTAL IMPACTS / 1 m² of EPS 80, 31 mm thickness, R-value of 1 K*m²/W

Use of Resources	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ. net calorific value	2.208E+00	3.509E-05	4.750E-02	0.00E+00	2.417E-04	4.737E-03	3.615E-02	9.192E-03	**2.306E+00**	-2.026E+00
Use of renewable primary energy resources used as raw materials	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ. net calorific value	2.208E+00	3.509E-05	4.750E-02	0.00E+00	2.417E-04	4.737E-03	3.615E-02	9.192E-03	**2.306E+00**	-2.026E+00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ. net calorific value	6.370E+01	6.296E-04	1.333E+00	0.00E+00	4.337E-03	8.500E-02	3.381E-01	1.267E-01	**6.559E+01**	-1.227E+01
Use of non-renewable primary energy resources used as raw materials	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ. net calorific value	6.370E+01	6.296E-04	1.333E+00	0.00E+00	4.337E-03	8.500E-02	3.381E-01	1.267E-01	**6.559E+01**	-1.227E+01
Use of secondary material	kg	5.270E-03	0.00E+00	1.054E-04	0.00E+00	0	0	0	0	**5.375E-03**	0
Use of renewable secondary fuels	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Use of non-renewable secondary fuels	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Use of net fresh water	m^3	1.036E-02	4.018E-08	2.801E-04	0.00E+00	2.767E-07	5.422E-06	2.369E-03	1.167E-06	**1.301E-02**	-2.442E-03

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EPS Graphite Products (NEOCOAT & NEOCOAT THP)

POTENTIAL ENVIRONMENTAL IMPACTS / 1 m² of EPS 80, 31 mm thickness, R-value of 1 K*m²/W

Categories	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total	D
Hazardous Waste Disposed	kg	4.518E-09	3.174E-14	9.150E-11	0.00E+00	2.186E-13	4.281E-12	2.407E-11	2.278E-11	**4.661E-09**	-2.295E-09
Non-hazardous Waste Disposed	kg	1.290E-02	9.356E-08	2.759E-03	0.00E+00	6.445E-07	1.263E-05	4.297E-03	1.207E-01	**1.407E-01**	-4.924E-03
Radioactive Waste Disposed	kg	2.078E-04	7.617E-10	4.344E-06	0.00E+00	5.248E-09	1.028E-07	7.676E-06	1.471E-06	**2.214E-04**	-6.391E-04
Output Flows	**Unit**										
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	1.426E-02	0.00E+00	0.00E+00	0.00E+00	5.270E-02	0.00E+00	**6.696E-02**	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.534E-01	0.00E+00	**3.534E-01**	0.00E+00
Exported energy. electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Exported energy. thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Additional Environmental Impact Indicators	**Unit**										
Particulate matter emissions	Disease incidence	6.130E-08	2.766E-13	1.603E-11	0.00E+00	1.816E-11	3.734E-11	1.572E-09	2.550E-10	**6.320E-08**	-6.564E-09
Ionizing radiation human	kBq U235 eq.	2.255E-02	1.091E-07	2.645E-04	0.00E+00	7.511E-07	1.472E-05	2.254E-03	2.109E-04	**2.530E-02**	-1.042E-01
Eco-toxicity, freshwater	CTUe	3.685E+01	4.545E-04	1.024E-02	0.00E+00	3.132E-03	6.132E-02	2.621E-01	1.203E-01	**3.730E+01**	-3.930E+00
Human toxicity, cancer effects	CTUh	8.607E-10	9.172E-15	3.105E-14	0.00E+00	6.317E-14	1.238E-12	3.015E-11	5.391E-12	**8.976E-10**	-1.271E-10
Human toxicity, non-cancer effects	CTUh	3.339E-08	4.744E-13	9.920E-12	0.00E+00	3.799E-12	9.750E-13	4.150E-10	4.517E-10	**3.427E-08**	-5.286E-09
Land use related impacts/Soil quality	dimensionless	8.978E-01	2.160E-04	3.153E-02	0.00E+00	1.488E-03	2.915E-02	1.882E-01	8.612E-03	**1.157E+00**	-1.394E+00

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POTENTIAL ENVIRONMENTAL IMPACTS / 1 m² of EPS 100, 30 mm thickness, R-value of 1 K*m²/W

Core Environmental Impact Indicators	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total	D
Global Warming Potential -total	kg CO_2 eq.	2.581E+00	5.273E-05	8.430E-02	0.00E+00	3.615E-04	7.117E-03	1.344E+00	9.546E-03	**4.026E+00**	-6.704E-01
Global Warming Potential – fossil fuels	kg CO_2 eq.	2.570E+00	5.238E-05	8.410E-02	0.00E+00	3.750E-04	7.068E-03	1.344E+00	9.639E-03	**4.015E+00**	-6.665E-01
Global Warming Potential – biogenic	kg COv eq.	1.013E-02	-6.676E-08	1.894E-04	0.00E+00	-1.643E-05	-9.050E-06	7.235E-05	-1.006E-04	**1.027E-02**	-3.532E-03
Global Warming Potential – land use and land use change	kg CO_2 eq.	3.448E-04	4.295E-07	1.315E-05	0.00E+00	2.958E-06	5.795E-05	2.040E-05	8.059E-06	**4.477E-04**	-4.097E-04
Global Warming Potential (GWP-GHG)	kg CO_2 eq.	2.570E+00	5.280E-05	8.411E-02	0.00E+00	3.779E-04	7.126E-03	1.344E+00	9.646E-03	**4.016E+00**	-6.668E-01
Ozone Depletion Potential	kg CFC 11 eq.	2.413E-11	6.700E-21	3.111E-11	0.00E+00	4.615E-20	9.043E-19	1.531E-09	2.326E-17	**1.587E-09**	-6.620E-15
Acidification Potential	Mole of H+ eq.	9.809E-03	5.125E-08	2.122E-04	0.00E+00	1.781E-06	6.916E-06	1.772E-04	2.889E-05	**1.024E-02**	-8.860E-04
Eutrophication Potential Freshwater	kg P eq.	2.495E-06	1.557E-10	7.569E-07	0.00E+00	1.072E-09	2.101E-08	2.863E-06	1.780E-06	**7.917E-06**	-8.783E-07
Eutrophication Potential Marine	kg N eq.	1.982E-03	1.600E-08	4.624E-05	0.00E+00	8.376E-07	2.159E-06	4.908E-05	6.552E-06	**2.086E-03**	-2.505E-04
Eutrophication Potential Terrestrial	mol N eq.	2.159E-02	1.931E-07	4.932E-04	0.00E+00	9.271E-06	2.605E-05	7.318E-04	7.182E-05	**2.292E-02**	-2.686E-03
Formation Potential of Tropospheric Ozone	kg NMVOC eq.	6.509E-03	4.396E-08	1.475E-04	0.00E+00	2.355E-06	5.932E-06	1.359E-04	2.095E-05	**6.821E-03**	-7.491E-04
Abiotic Depletion Potential, minerals and metals*	kg Sb eq.	2.741E-07	3.992E-12	9.467E-09	0.00E+00	2.750E-11	5.389E-10	1.094E-07	6.635E-10	**3.942E-07**	-1.071E-07
Abiotic Depletion Potential, fossil resources*	MJ net calorific value	7.066E+01	6.982E-04	1.479E+00	0.00E+00	4.807E-03	9.422E-02	3.751E-01	1.406E-01	**7.276E+01**	-1.361E+01
Water Deprivation Potential*	m^3 world eq. deprived	3.107E-01	4.556E-07	9.667E-03	0.00E+00	3.137E-06	6.146E-05	1.122E-01	-1.187E-04	**4.326E-01**	-4.841E-02

* 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.

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POTENTIAL ENVIRONMENTAL IMPACTS / 1 m² of EPS 100, 30 mm thickness, R-value of 1 K*m²/W

Use of Resources	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ. net calorific value	2.451E+00	3.895E-05	5.273E-02	0.00E+00	2.683E-04	5.258E-03	4.012E-02	1.020E-02	**2.560E+00**	-2.249E+00
Use of renewable primary energy resources used as raw materials	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ. net calorific value	2.451E+00	3.895E-05	5.273E-02	0.00E+00	2.683E-04	5.258E-03	4.012E-02	1.020E-02	**2.560E+00**	-2.249E+00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ. net calorific value	7.071E+01	6.989E-04	1.480E+00	0.00E+00	4.814E-03	9.436E-02	3.753E-01	1.406E-01	**7.281E+01**	-1.362E+01
Use of non-renewable primary energy resources used as raw materials	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ. net calorific value	7.071E+01	6.989E-04	1.480E+00	0.00E+00	4.814E-03	9.436E-02	3.753E-01	1.406E-01	**7.281E+01**	-1.362E+01
Use of secondary material	kg	5.850E-03	0.00E+00	1.170E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**5.967E-03**	0.00E+00
Use of renewable secondary fuels	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Use of non-renewable secondary fuels	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Use of net fresh water	m³	1.150E-02	4.460E-08	3.110E-04	0.00E+00	3.072E-07	6.019E-06	2.629E-03	1.296E-06	**1.445E-02**	-2.710E-03

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POTENTIAL ENVIRONMENTAL IMPACTS / 1 m² of EPS 100, 30 mm thickness, R-value of 1 K*m²/W

Categories	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total	D
Hazardous Waste Disposed	kg	5.016E-09	3.524E-14	1.016E-10	0.00E+00	2.426E-13	4.752E-12	2.672E-11	2.529E-11	**5.174E-09**	-2.547E-09
Non-hazardous Waste Disposed	kg	1.432E-02	1.039E-07	3.062E-03	0.00E+00	7.154E-07	1.402E-05	4.769E-03	1.340E-01	**1.562E-01**	-5.466E-03
Radioactive Waste Disposed	kg	2.307E-04	8.455E-10	4.822E-06	0.00E+00	5.826E-09	1.141E-07	8.520E-06	1.632E-06	**2.458E-04**	-7.095E-04
Output Flows	**Unit**										
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	1.583E-02	0.00E+00	0.00E+00	0.00E+00	5.850E-02	0.00E+00	**7.433E-02**	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.923E-01	0.00E+00	**3.923E-01**	0.00E+00
Exported energy. electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Exported energy. thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00
Additional Environmental Impact Indicators	**Unit**										
Particulate matter emissions	Disease incidence	6.805E-08	3.071E-13	1.779E-11	0.00E+00	2.016E-11	4.145E-11	1.745E-09	2.830E-10	**7.015E-08**	-7.287E-09
Ionizing radiation human	kBq U235 eq.	2.503E-02	1.211E-07	2.936E-04	0.00E+00	8.338E-07	1.634E-05	2.502E-03	2.341E-04	**2.808E-02**	-1.157E-01
Eco-toxicity, freshwater	CTUe	4.090E+01	5.045E-04	1.137E-02	0.00E+00	3.477E-03	6.807E-02	2.909E-01	1.336E-01	**4.141E+01**	-4.362E+00
Human toxicity, cancer effects	CTUh	9.554E-10	1.018E-14	3.447E-14	0.00E+00	7.012E-14	1.374E-12	3.347E-11	5.984E-12	**9.964E-10**	-1.411E-10
Human toxicity, non-cancer effects	CTUh	3.706E-08	5.266E-13	1.101E-11	0.00E+00	4.217E-12	1.082E-12	4.607E-10	5.014E-10	**3.804E-08**	-5.868E-09
Land use related impacts/Soil quality	dimensionless	9.966E-01	2.397E-04	3.500E-02	0.00E+00	1.651E-03	3.236E-02	2.089E-01	9.560E-03	**1.284E+00**	-1.547E+00

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The following figure represents the contribution of each examined module (A1-A5, C1-C4) on the core environmental impact indicators formation. It can be clearly depicted that the majority of the ana- lyzed impact categories are mainly influenced by modules A1, A3 and C3.

- The Global Warming Potential – total in relation to the production of 1 m^2 of EPS 80 with 31 mm thickness, R-value of 1 $K*m^2/W$, is shared among the extraction / production of raw materials and the treatment of EPS Waste accounting for 40.55% and 33.38% respectively. The manufacturing of NEOCOAT EPS 80 accounts for 23.53% of the total environmental impact of modules A1-A4 and C1-C4.

- Regarding Ozone Depletion Potential, C3 – Waste Processing is the dominant parameter that contributes to the overall impact indicator approaching the value of 100%.

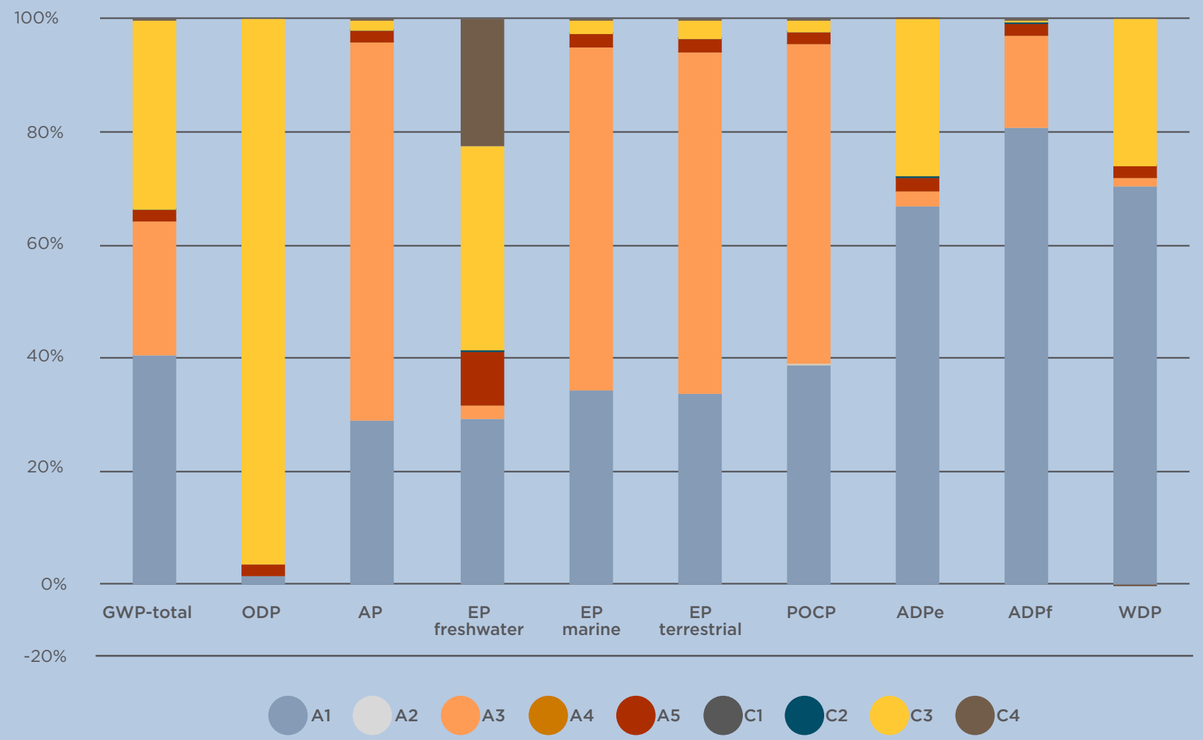
- Depletion of abiotic resources (fossil) is highly influenced by Module A1 (approximately 81%) whereas for the Depletion of minerals and metals abiotic resources production/extraction of raw materials is the main contributor to the overall impact indicator (66.77%), followed by Module C3 (27.75%).

- Acidification Potential is mainly influenced by module A3 with the respective percentage being equal to 66.83%. Raw material production (Module A1) follows with a percentage of 28.99%.

- As for the Eutrophication Potential Freshwater it is observed to be mainly influenced by module C3 (36.16%) while raw materials production and EPS Waste disposal adds on the total impact indicator for approximately 29.12% and 22.48%, respectively.

RESULTS INTERPRETATION

Relative Contribution of the examined modules



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References

- International EPD® System, c-PCR-005 Thermal Insulation Products (EN 16783:2017), version 2019-12-20
- International EPD® System, PCR 2019:14 Construction Products, version 1.11 (EN 15804:A2)
- EN 15804:2012+A2:2019 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- International EPD® System, General Program Instructions for the International EPD System, version 4
- International Organization for Standardization (ISO), Environmental labels and declarations – Type III environmental declarations – Principles and procedures. ISO 14025:2006
- International Organization for Standardization (ISO), Environmental management – Life Cycle assessment – Principles and framework. ISO 14040:2006
- International Organization for Standardization (ISO), Environmental management – Life Cycle assessment – Requirements and guidelines. ISO 14044:2006
- The International EPD® System – The International EPD System is a programme for type III environmental declarations, maintaining a system to verify and register EPDs as well as keeping a library of EPDs and PCRs in accordance with ISO 14025. www.environdec.com
- EN ISO 14001:2015 – Environmental Management Systems – Requirements
- ISO 14020:2000 – Environmental Labels and Declarations – General Principles
- Sphera – GaBi Product Sustainability software – www.sphera.com
- EPS construction waste treatment in Europe – https://polystyreneloop.eu/wp-content/uploads/2021/01/Conversio-study.pdf
- Reference Service Life – https://www.epshellas.com/

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