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ENVIRONMENTAL PRODUCT DECLARATION

EPS White and Graphite Products
STYROPAN S.A.

In accordance with ISO14025:2006 and EN 15804:2012+A2:2019

EPD REGISTRATION NUMBER
S-P-09825

PUBLICATION DATE
2023-07-21

DATE OF VALIDITY
2028-07-20

PROGRAM
The International EPD® System
www.environdec.com

PROGRAM OPERATOR
EPD International AB

UN CPC
369: Other
plastic products.

EPD®
ENVIRONMENTAL PRODUCT DECLARATION
ECO PLATFORM
EPD
VERIFIED

PROGRAM INFORMATION

PROGRAM OPERATOR

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EPD OWNER

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Product Category Rules (PCR):	CEN Standard EN 15804 serves as the Core Product Category Rules (PCR) PCR 2019:14 Construction products version 1.11 (EN 15804:A2)
LCA accountability:	SustChem Technical Consulting S.A. www.sustchem.gr
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via:	☒ EPD verification by individual verifier
Third-party verification:	Prof. Vladimír Kočí Šárecká 5,16000, Prague 6 - Czech Republic www.lcastudio.cz
Approved by:	The International EPD® system
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.
The EPD is for multiple products
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'S PROFILE

Styropan S.A., a prominent Greek industrial company founded in 1982 specializes in the production of a vast portfolio of insulation products , such as :

- Thermal Insulation boards for expanded, graphite expanded and extruded polystyrene
- Building materials (Geofoam)
- Special parts and ready-made decoration solutions (e.g. moldings, rosettes, 3D wall panels etc.)

Styropan's vision and priority, is providing effective solutions to enable environmental sustainability and human prosperity.

STYROPAN AND SUSTAINABILITY

For many years, Styropan applies such practices that relate to sustainable development support and continuously aims to reduce the impact of its activity on the environment, through conscious choices across its supply chain.

Indicatively but not exclusively such practices include:

- At a corporate level: Implementation of an Environmental Management system certified according to the **ISO 14001: 2015 standard.**
- At a product level: Polystyrene insulation products that have **very low thermal conductivity coefficient value (λ)** and reduce the total energy consumption of the building.

PRODUCT INFORMATION

The examined products categories comprise of a number of Expanded Polystyrene (EPS) products, widely used in construction industry for thermal insulation purposes. The EPS products are divided into two main subcategories, based on the raw materials used during tier production process, as well as on their compressive strength achieved in 100% distortion. Namely, the EPS consist of:

- White Expanded Polystyrene (branded under the names, Styropan EPS and Styropan Geofoam)
- Grey Graphite Expanded Polystyrene (with the brand name, Styropan Graphite EPS).

EPS WHITE PRODUCTS		EPS GRAPHITE PRODUCTS	
STYROPAN EPS30	STYROPAN EPS100	STYROPAN GRAPHITE EPS60	STYROPAN GRAPHITE EPS100 PLUS
STYROPAN EPS50	STYROPAN EPS120	STYROPAN GRAPHITE EPS80	STYROPAN GRAPHITE EPS150
STYROPAN EPS60	STYROPAN EPS150	STYROPAN GRAPHITE EPS100	STYROPAN GRAPHITE EPS200
STYROPAN EPS80	STYROPAN EPS200		

CPC Code
The Central Product Classification code 369 has been used. The specific code applies for other plastic products

Styropan's cutting-edge advanced technology resulted in the thermal insulation materials of tomorrow, them being STYROPAN EPS, STYROPAN GEOFOAM and STYROPAN GRAPHITE EPS. EPS products provide innovative and effective solutions for a wide range of buildings, offering benefits from their foundations to their roofs. These products, consisting of 98% air, possess a remarkably low weight. They can be seamlessly integrated with various building materials such as cement, plasters, and organic/inorganic mortars. One key advantage of Styropan products is their environmentally friendly nature and ecological efficiency. They incorporate a percentage of recycled raw materials and are entirely recyclable, making a significant contribution to reducing the overall demand for raw materials by as much as 50%. Heat transfer occurs through conduction, convection, and radiation in all materials. In the case of closed cell materials like Extruded Polystyrene (EPS), air movement is restricted, resulting in minimized heat transmission through treatment. Specifically, EPS Graphite Products provide an enhanced thermal insulation performance of up to 20% compared to traditional EPS products. This improvement is achieved by incorporating a small amount of graphite, which enables absorption and radiation of infrared radiation, while significantly reducing thermal conductivity.

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PRODUCT INFORMATION

MATERIAL CONTENT OF THE FINAL EPS PRODUCTS (IN WEIGHT %)

EPS Type	STYROPAN EPS Products	STYROPAN GRAPHITE EPS Products
Expandable Polystyrene	>95%	>92%
Pentane	5%	5%
Graphite	-	>3%.

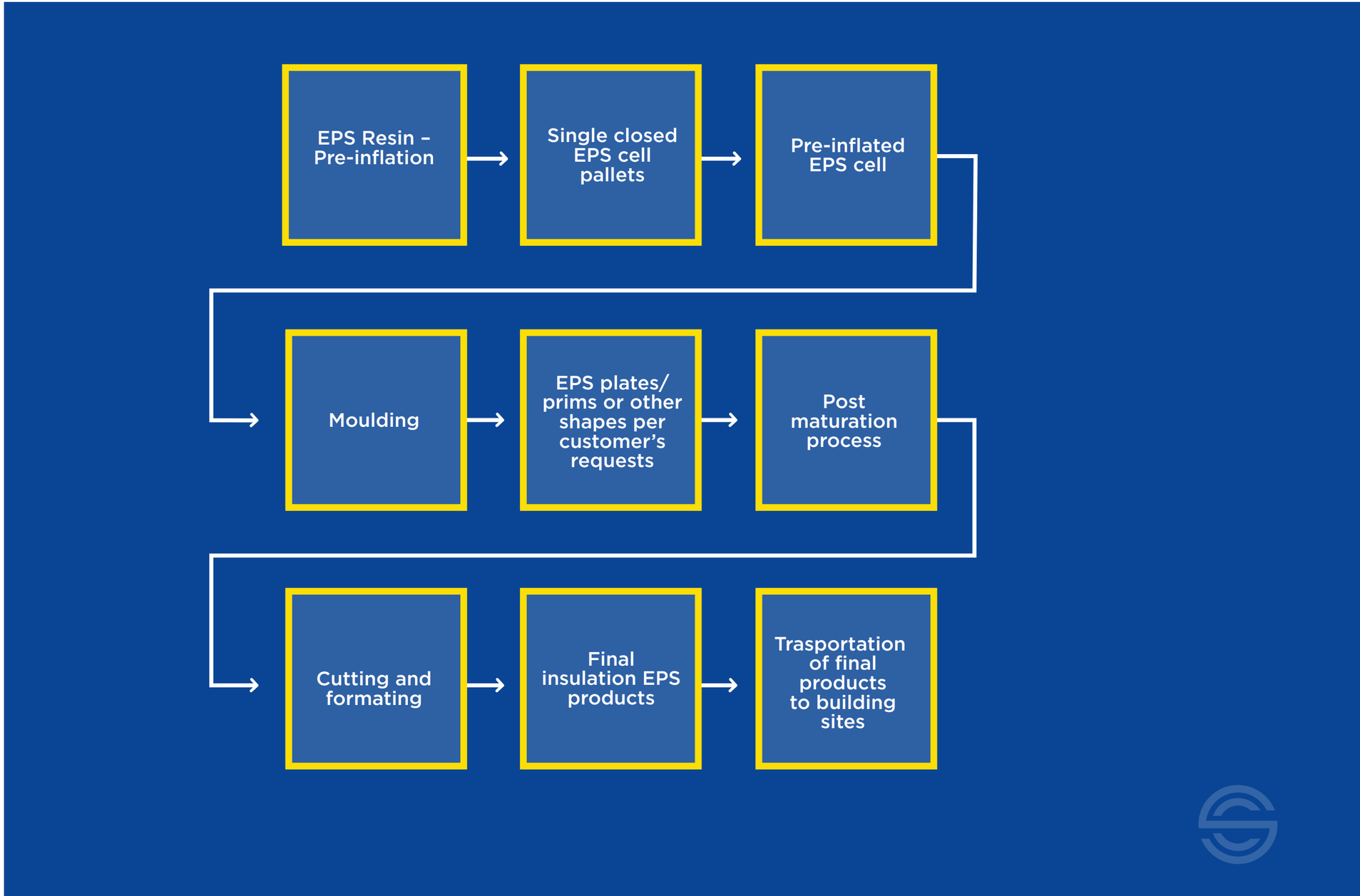
STYROPAN EPS 80 is used as reference product and serves as a benchmark. Conversion factors, outlined below, are available for converting Potential Environmental Impact to different nominal densities of EPS White and Graphite products.

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 systems.

TECHNICAL SPECIFICATIONS EPS 80

Description	Unit	Value
Thermal conductivity λ_D 10°C	W/m*K	0.036
Thermal Resistance R (30 mm width)	m^2K/W	0.80
Thermal Resistance R (50 mm width)	m^2K/W	1.35
Thermal Resistance R (80 mm width)	m^2K/W	2.20
Thermal Resistance R (100 mm width)	m^2K/W	2.75
Dimension Tolerance		
Length L	mm	±2
Width W,	mm	±2
Thickness,	mm	±1
Squareness S,	mm	±2/1000
Flatness P per meter run	mm	5
Characteristics-specifications		
Bending strength σ_b	KPa	≥125
Compression strength for 10% deformation σ_{10}	KPa	≥80
Resistance to vapor diffusion μ (Air μ=1)	-	20
Resistance to fire	-	Class E

MANUFACTURING PROCESS



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LCA INFORMATION

Declared Unit
1 m2 of EPS80 with 36mm thickness, R-value of 1K*m2/W.

System Boundaries
This LCA study follows a “cradle-to-grave and module D” approach. Therefore, the defined system boundaries include modules A1-A3, A4-A5, B, C and D.

Reference Service Life
Reference Service Life of the products, it is concluded based on relevant study from the panhellenic EPS Association and based on the manufacturer’s estimation that the EPS Products retain their technical characteristics and insulation properties for at least a 70 years period.

Time Representativeness
January 2022 – December 2022

Geographical Scope
Europe

EPD TYPE
Specific

SOFTWARE
GaBi ts version 10.6.0.110

DATABASE
Ecoinvent 3.8.1 & Professional 2021

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%			>80%		-	-	-	-	-	-	-	-	-	-	-	-
Variation - products	From -23.61% to +60.42%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation - sites	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

* The variations ranges correspond to the differences in GWP-GHG indicator results in A1-A3 between the reference product (EPS80) and EPS30 and EPS200, respectively.

DESCRIPTION OF EXAMINED MODULES

A1: Raw Material Extraction/Production

Module A1 includes the production of all raw materials, and utilities required for the manufacturing process of mortars,

A2: Transport to Styropan's Facilities

Module A2 includes the transportation to Styropan's manufacturing plant of all raw materials and components used for the formation of the examined products.

A3: Manufacturing

Module A3 depicts the environmental impact potentials attributed to all processes taking place at the manufacturing plant of Styropan.

A4: Finished Products Transport

Module A4 includes the transportation of the system components to construction sites. Actual data of distances of sites locations have been considered.

A5: Construction Installation

EPS products is manually installed, requiring only mixing them with water. A wastage of 5% is assumed during product's installation. Water consumption is in accordance with the respective Technical Data Sheets (TDS).

B1-B7: Use phase

EPS products do not require maintenance, repair, replacement or refurbishment during use in standard conditions and in case that it is 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 waste from building demolition to disposal facilities (Truck 12-14 tons).

C3: EPS Waste Processing

The whole quantity of EPS waste is incinerated and hence a 100% energy recovery via incineration is assumed

C4: Disposal

The whole quantity of EPS waste from building demolition is lead to thermal recycling and thus no process is included in Module C4

D: Reuse, Recovery, Recycling Potential

Module D covers the net benefits arising from the substitution of primary raw materials (polystyrene, paper, PE) with secondary, depicted as credits from waste recovery processes (sorting-shredding) in Modules A3 and A5.

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CONVERSION FACTORS

The LCA Results can be adjusted to include other types of EPS (with an R-Value=1) by utilizing the conversion factors provided in the table. The thickness required to achieve an R-Value of 1 for different EPS types is also indicated. Additionally, the results section includes the Potential Environmental Impacts of Graphite EPS80, aside from the reference product, to showcase the application of the conversion factors.

ENVIRONMENTAL IMPACTS CONVERSION FACTORS FOR WHITE EPS PRODUCTS

EPS Type	EPS 30	EPS 50	EPS 60	EPS 80	EPS 100	EPS 120	EPS 150	EPS 200
Thickness corresponding to R=1 m² K/W	44	40	37	36	34	34	34	33
Conversion factors for White EPS products	0.764	0.833	0.899	1.000	1.092	1.210	1.417	1.604

ENVIRONMENTAL IMPACTS CONVERSION FACTORS FOR GRAPHITE EPS PRODUCTS

EPS Type	EPS 60	EPS 80	EPS 100	EPS 120	EPS 150	EPS 200
Thickness corresponding to R=1 m² K/W	32	31	30	30	30	30
Final Conversion factors for Graphite EPS products	0.318	0.352	0.394	0.437	0.511	0.597

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CONTENT INFORMATION

RAW MATERIAL PRODUCT COMPONENTS	Weight, kg/m²
Primary Polystyrene Granulate	0.501
Secondary Polystyrene Granulate	0.0719
Pentane	0.0264
TOTAL	**0.5593**
PACKAGING MATERIALS	**Weight, kg/m²**
Polyethylene Film	0.0148
Paper Labels	0.0001
TOTAL	**0.0149**
OUTPUT PRODUCT	**Weight, kg/m²**
1m² EPS 80 with 36mm thickness, R-value of 1K*m²/W.	**0.5760**

The variation in the final product quantity compared to its original composition can be attributed to the evaporation of pentane that occurs during the swelling process.

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LIFE CYCLE ASSESSMENT INFORMATION

Cut-off Criteria

All major raw materials, elements and 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. 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 1% of the total GWP of the modelled system and thus considered negligible.

Allocations, Assumptions and Limitations

Styropan's production processes yield no commercial by-products, and thus, there is no need for by-product allocation in the manufacturing process. Thus, there is no need for by-product allocation in the manufacturing process

A nominal distance of 100 km from the various construction sites was taken into account in relation to the transportation of PE and paper waste to sorting facilities and the transportation of collected EPS waste to treatment facilities.

Multimodal transportation takes place (Truck and Vessel). A truck with a payload of 9,3 tonnes, total gross weight 12-14 tonnes EURO 6 and utilization factor 0,51 and an inland vessel with a payload of 3.500 tonnes, total gross weight 2.275 tonnes and utilization factor 0,65 are considered to be used.

a 100% energy recovery via incineration is assumed, yet a multimodal EPS waste treatment/disposal method takes place, based on a study, as a worst-case scenario

Background data and data quality

For all processes, primary data are collected and provided by Styropan. Data related to material and energy flows of the defined system, are 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.

Regarding electricity consumption, the Greek residual electricity mix has been considered, when modelling the electricity consumption used to produce EPS products.

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 are based on accurate and area representative datasets available either in 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 is used for inventory and impact assessment calculations.

Comparability

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.

This EPD and PCR 2019:14 "Construction products" v.1.11 are available on the website of the International EPD® System (www.environdec.com).

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ENVIRONMENTAL PERFORMANCE INDICATORS

EPS White and Graphite Products

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	D
Global Warming Potential – total	GWP-total	kg CO_2 eq.	1.456E+00	6.426E-03	8.935E-04	0.00E+00	3.469E-04	6.829E-03	1.892E+00	0.000E+00	-9.173E-01
Global Warming Potential – fossil	GWP-fossil	kg CO_2 eq.	1.447E+00	6.382E-03	8.513E-04	0.00E+00	3.598E-04	6.782E-03	1.892E+00	0.000E+00	-9.495E-01
Global Warming Potential – biogenic	GWP-biogenic	kg CO_2 eq.	7.590E-03	-8.124E-06	3.722E-05	0.00E+00	-1.576E-05	-8.663E-06	5.841E-05	0.000E+00	-5.603E-03
Global Warming Potential – land use and land use change	GWP-luluc	kg CO_2 eq.	9.674E-04	5.234E-05	4.963E-06	0.00E+00	2.839E-06	5.562E-05	9.390E-06	0.000E+00	-9.191E-04
Global Warming Potential – GHG(1)	GWP-GHG	kg CO_2 eq.	1.449E+00	6.434E-03	8.563E-04	0.00E+00	3.627E-04	6.838E-03	1.892E+00	0.000E+00	-9.117E-01
Ozone Depletion Potential	ODP	kg CFC 11 eq.	8.309E-11	8.17E-19	9.766E-11	0.00E+00	4.429E-20	8.677E-19	1.314E-16	0.000E+00	-1.734E-10
Acidification Potential	AP	Mole of H+ eq.	2.162E-03	7.873E-06	4.116E-06	0.00E+00	1.709E-06	6.588E-06	1.663E-04	0.000E+00	-1.266E-03
Eutrophication Potential – freshwater	EP-freshwater	kg P eq.	2.036E-06	1.889E-08	1.544E-07	0.00E+00	1.029E-09	2.016E-08	1.757E-08	0.000E+00	-1.422E-06
Eutrophication Potential – freshwater	EP-freshwater	kg $PO4^{-3}$ eq.	6.251E-06	5.799E-08	4.740E-07	0.00E+00	3.159E-09	6.189E-08	5.394E-08	0.000E+00	-4.367E-06
Eutrophication Potential – marine	EP-marine	kg N eq.	5.739E-04	2.827E-06	1.318E-06	0.00E+00	8.036E-07	2.072E-06	3.651E-05	0.000E+00	-3.592E-04
Eutrophication Potential – terrestrial	EP-terrestrial	mol N eq.	6.240E-03	3.312E-05	1.412E-05	0.00E+00	8.896E-06	2.500E-05	7.820E-04	0.000E+00	-3.847E-03
Photochemical Oxidant Formation Potential	POCP	kg NMVOC eq.	2.146E-03	7.920E-06	3.952E-06	0.00E+00	2.260E-06	5.690E-06	1.076E-04	0.000E+00	-1.071E-03
Abiotic Depletion Potential – elements(2)	ADPe	kg Sb eq.	1.833E-07	4.867E-10	2.096E-09	0.00E+00	2.639E-11	5.171E-10	1.985E-09	0.000E+00	-1.621E-07
Abiotic Depletion Potential. fossil resources(2)	ADPf	MJ net calorific value	4.677E+01	8.510E-02	1.280E-02	0.00E+00	4.614E-03	9.041E-02	2.145E-01	0.000E+00	-1.934E+01
Water Deprivation Potential(2)	WDP	m^3 world eq. deprived	1.456E+00	6.426E-03	8.935E-04	0.00E+00	3.469E-04	6.829E-03	1.892E+00	0.000E+00	-9.173E-01

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ENVIRONMENTAL PERFORMANCE INDICATORS

EPS White and Graphite Products

POTENTIAL ENVIRONMENTAL IMPACTS/1 m2 of White EPS 80, Thickness 36 mm, R-value=1 K*m2/W

Resource Use Indicators		Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ. net calorific value	1.159E+00	4.749E-03	6.554E-04	0.000E+00	2.575E-04	5.046E-03	4.237E-02	0.000E+00	-3.237E+00
Use of renewable primary energy resources used as raw materials	PERM	MJ. net calorific value	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total use of renewable primary energy resources	PERT	MJ. net calorific value	1.159E+00	4.749E-03	6.554E-04	0.000E+00	2.575E-04	5.046E-03	4.237E-02	0.000E+00	-3.237E+00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ. net calorific value	4.681E+01	8.521E-02	1.280E-02	0.000E+00	4.621E-03	9.053E-02	2.146E-01	0.000E+00	-1.934E+01
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ. net calorific value	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total use of non-renewable primary energy resources	PENRT	MJ. net calorific value	4.681E+01	8.521E-02	1.280E-02	0.000E+00	4.621E-03	9.053E-02	2.146E-01	0.000E+00	-1.934E+01
Use of secondary material	SM	kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Use of renewable secondary fuels	RSF	MJ. net calorific value	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Use of non-renewable secondary fuels	NRSF	MJ. net calorific value	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Use of net fresh water	FW	m^3	6.284E-03	5.436E-06	2.343E-06	0.000E+00	2.948E-07	5.775E-06	3.590E-03	0.000E+00	-3.845E-03

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ENVIRONMENTAL PERFORMANCE INDICATORS

EPS White and Graphite Products

POTENTIAL ENVIRONMENTAL IMPACTS/ 1 m2 of White EPS 80, Thickness 36 mm, R-value=1 K*m2/W

			A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Waste Indicators		**Unit**									
Hazardous waste disposed	HWD	kg	4.924E-09	4.294E-12	1.211E-13	0.00E+00	2.328E-13	4.562E-12	3.824E-11	0.000E+00	-3.653E-09
Non-hazardous waste disposed	NHWD	kg	1.020E-02	1.266E-05	3.570E-07	0.00E+00	6.864E-07	1.345E-05	6.826E-03	0.000E+00	-7.801E-03
Radioactive waste disposed	RWD	kg	1.306E-04	1.031E-07	2.907E-09	0.00E+00	5.589E-09	1.095E-07	1.219E-05	0.000E+00	-1.018E-03
Output Flows		**Unit**									
Components for re-use	CRU	kg	7.19E-02	0.000E+00	0.000E+00	0.00E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Material for recycling	MFR	kg	8.40E-03	0.000E+00	1.49E-02	0.00E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Materials for energy recovery	MER	kg	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.000E+00	0.000E+00	5.61E-01	0.000E+00	0.000E+00
Exported energy	EE	MJ	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Additional Environmental Impact Indicators		**Unit**									
Particulate matter emissions	PM	Disease incidence	1.607E-08	9.504E-11	5.330E-11	0.00E+00	1.934E-11	3.947E-11	9.753E-10	0.000E+00	-1.052E-08
Ionizing radiation human[3]	IRP	kBq U235 eq.	1.459E-02	1.476E-05	7.145E-05	0.00E+00	8.001E-07	1.568E-05	1.936E-03	0.000E+00	-1.659E-01
Eco-toxicity. freshwater[2]	ETP-fw	CTUe	2.208E+01	6.150E-02	1.240E-02	0.00E+00	3.335E-03	6.533E-02	9.660E-02	0.000E+00	-6.110E+00
Human toxicity. cancer effects[2]	HTP-c	CTUh	5.042E-10	1.241E-12	4.866E-13	0.00E+00	6.728E-14	1.319E-12	1.036E-11	0.000E+00	-2.085E-02
Human toxicity. non-cancer effects[2]	HTP-nc	CTUh	2.354E-08	6.483E-11	1.006E-11	0.00E+00	4.047E-12	6.820E-11	3.352E-10	0.000E+00	-8.348E-09
Land use related impacts/Soil quality[2]	SQP	dimensionless	1.134E+00	2.922E-02	7.794E-03	0.00E+00	1.585E-03	3.105E-02	6.005E-02	0.000E+00	-2.232E+00

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ENVIRONMENTAL PERFORMANCE INDICATORS

EPS White and Graphite Products

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

Core Environmental Impact Indicators		Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Global Warming Potential – total	GWP-total	kg CO_2 eq.	6.154E-01	6.426E-03	8.935E-04	0.000E+00	3.469E-04	6.829E-03	1.892E+00	0.000E+00	-3.232E-01
Global Warming Potential – fossil	GWP-fossil	kg CO_2 eq.	6.119E-01	6.382E-03	8.513E-04	0.000E+00	3.598E-04	6.782E-03	1.892E+00	0.000E+00	-3.345E-01
Global Warming Potential – biogenic	GWP-biogenic	kg CO_2 eq.	2.930E-03	-8.124E-06	3.722E-05	0.000E+00	-1.576E-05	-8.663E-06	5.841E-05	0.000E+00	-1.974E-03
Global Warming Potential – land use and land use change	GWP-luluc	kg CO_2 eq.	3.454E-04	5.234E-05	4.963E-06	0.000E+00	2.839E-06	5.562E-05	9.390E-06	0.000E+00	-3.238E-04
Global Warming Potential – GHG[1]	GWP-GHG	kg CO_2 eq.	6.124E-01	6.434E-03	8.563E-04	0.000E+00	3.627E-04	6.838E-03	1.892E+00	0.000E+00	-3.212E-01
Ozone Depletion Potential	ODP	kg CFC 11 eq.	6.493E-11	8.17E-19	9.766E-11	0.000E+00	4.429E-20	8.677E-19	1.314E-16	0.000E+00	-6.108E-11
Acidification Potential	AP	Mole of H+ eq.	8.228E-04	7.873E-06	4.116E-06	0.000E+00	1.709E-06	6.588E-06	1.663E-04	0.000E+00	-4.460E-04
Eutrophication Potential – freshwater	EP-freshwater	kg P eq.	7.806E-07	1.889E-08	1.544E-07	0.000E+00	1.029E-09	2.016E-08	1.757E-08	0.000E+00	-5.011E-07
Eutrophication Potential – freshwater	EP-freshwater	kg $PO4^{-3}$ eq.	2.396E-06	5.799E-08	4.740E-07	0.000E+00	3.159E-09	6.189E-08	5.394E-08	0.000E+00	-1.538E-06
Eutrophication Potential – marine	EP-marine	kg N eq.	2.267E-04	2.827E-06	1.318E-06	0.000E+00	8.036E-07	2.072E-06	3.651E-05	0.000E+00	-1.265E-04
Eutrophication Potential – terrestrial	EP-terrestrial	mol N eq.	2.470E-03	3.312E-05	1.412E-05	0.000E+00	8.896E-06	2.500E-05	7.820E-04	0.000E+00	-1.355E-03
Photochemical Oxidant Formation Potential	POCP	kg NMVOC eq.	8.321E-04	7.920E-06	3.952E-06	0.000E+00	2.260E-06	5.690E-06	1.076E-04	0.000E+00	-3.771E-04
Abiotic Depletion Potential – elements[2]	ADPe	kg Sb eq.	7.186E-08	4.867E-10	2.096E-09	0.000E+00	2.639E-11	5.171E-10	1.985E-09	0.000E+00	-5.709E-08
Abiotic Depletion Potential. fossil resources[2]	ADPf	MJ net calorific value	1.814E+01	8.510E-02	1.280E-02	0.000E+00	4.614E-03	9.041E-02	2.145E-01	0.000E+00	-6.812E+00
Water Deprivation Potential[2]	WDP	m^3 world eq. deprived	6.154E-01	6.426E-03	8.935E-04	0.000E+00	3.469E-04	6.829E-03	1.892E+00	0.000E+00	-3.232E-01

ENVIRONMENTAL PERFORMANCE INDICATORS

EPS White and Graphite Products

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

Resource Use Indicators		Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ. net calorific value	4.102E-01	4.749E-03	6.554E-04	0.000E+00	2.575E-04	5.046E-03	4.237E-02	0.000E+00	-1.140E+00
Use of renewable primary energy resources used as raw materials	PERM	MJ. net calorific value	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00 -
Total use of renewable primary energy resources	PERT	MJ. net calorific value	4.102E-01	4.749E-03	6.554E-04	0.000E+00	2.575E-04	5.046E-03	4.237E-02	0.000E+00	1.140E+00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ. net calorific value	1.816E+01	8.521E-02	1.280E-02	0.000E+00	4.621E-03	9.053E-02	2.146E-01	0.000E+00	-6.813E+00
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ. net calorific value	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total use of non-renewable primary energy resources	PENRT	MJ. net calorific value	1.816E+01	8.521E-02	1.280E-02	0.000E+00	4.621E-03	9.053E-02	2.146E-01	0.000E+00	-6.813E+00
Use of secondary material	SM	kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Use of renewable secondary fuels	RSF	MJ. net calorific value	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Use of non-renewable secondary fuels	NRSF	MJ. net calorific value	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Use of net fresh water	FW	m^3	2.218E-03	5.436E-06	2.343E-06	0.000E+00	2.948E-07	5.775E-06	3.590E-03	0.000E+00	-1.355E-03

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ENVIRONMENTAL PERFORMANCE INDICATORS

EPS White and Graphite Products

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

			A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Waste Indicators		**Unit**									
Hazardous waste disposed	HWD	kg	2.106E-09	4.294E-12	1.211E-13	0.00E+00	2.328E-13	4.562E-12	3.824E-11	0.000E+00	-3.653E-09
Non-hazardous waste disposed	NHWD	kg	4.056E-03	1.266E-05	3.570E-07	0.00E+00	6.864E-07	1.345E-05	6.826E-03	0.000E+00	-7.801E-03
Radioactive waste disposed	RWD	kg	4.620E-05	1.031E-07	2.907E-09	0.00E+00	5.589E-09	1.095E-07	1.219E-05	0.000E+00	-1.018E-03
Output Flows		**Unit**									
Components for re-use	CRU	kg	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Material for recycling	MFR	kg	2.700E-03	0.000E+00	1.490E-02	0.00E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Materials for energy recovery	MER	kg	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.000E+00	0.000E+00	5.61E-01	0.000E+00	0.000E+00
Exported energy	EE	MJ	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Additional Environmental Impact Indicators		**Unit**									
Particulate matter emissions	PM	Disease incidence	6.318E-09	9.504E-11	5.330E-11	0.00E+00	1.934E-11	3.947E-11	9.753E-10	0.000E+00	-3.705E-09
Ionizing radiation human(3)	IRP	kBq U235 eq.	5.187E-03	1.476E-05	7.145E-05	0.00E+00	8.001E-07	1.568E-05	1.936E-03	0.000E+00	-5.844E-02
Eco-toxicity. freshwater(2)	ETP-fw	CTUe	7.802E+00	6.150E-02	1.240E-02	0.00E+00	3.335E-03	6.533E-02	9.660E-02	0.000E+00	-2.153E+00
Human toxicity. cancer effects(2)	HTP-c	CTUh	1.905E-10	1.241E-12	4.866E-13	0.00E+00	6.728E-14	1.319E-12	1.036E-11	0.000E+00	-7.344E-03
Human toxicity. non-cancer effects(2)	HTP-nc	CTUh	8.978E-09	6.483E-11	1.006E-11	0.00E+00	4.047E-12	6.820E-11	3.352E-10	0.000E+00	-2.941E-09
Land use related impacts/Soil quality(2)	SQP	dimensionless	4.046E-01	2.922E-02	7.794E-03	0.00E+00	1.585E-03	3.105E-02	6.005E-02	0.000E+00	-7.862E-01

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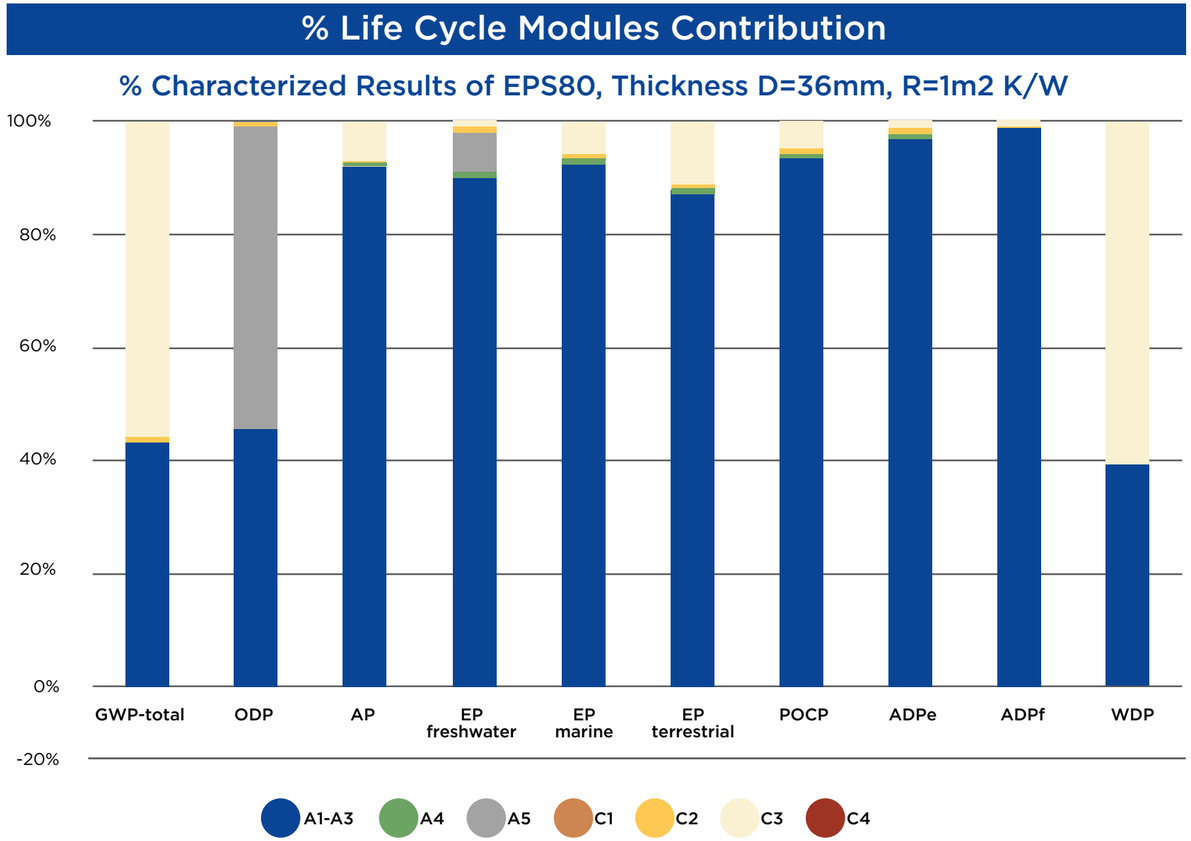
INTERPRETATION

The following figure represents the contribution of each examined module (A1-A3, A4, A5 & C1-C4) on the core environmental impact indicators formation using the results of the representative product in the form of a normalized dominance analysis as depicted in the following diagram. Each column represents the different life cycle modules examined within the defined system boundary.
It can be clearly depicted that the majority of the analyzed impact categories are mainly influenced by modules A1-A3.

The Global Warming Potential - total in relation to the production of 1 m2 of EPS 80 with 36 mm thickness, R-value of 1 K*m2/W, is shared among the extraction / production of raw materials and the treatment of EPS Waste accounting for 44% and 56% respectively.

Regarding Ozone Depletion Potential total impacts are shared between Modules A1 – A3 accounting for more than 45% of the total emissions and Module A5 accounting for almost 57% of the impacts respectively.

In terms of water use, the highest impact share is attributed to Module C3 reaching 60,63% of the total emissions.



REFERENCES

- 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
- Ecoinvent/ Ecoinvent Centre – www.Eco-invent.org
- International EPD® System, General Program Instructions for the International EPD System, version 3.01
- ISO 14025:2006 - Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 14040:2006 - Environmental management – Life Cycle assessment – Principles and framework
- ISO 14044:2006 - Environmental management – Life Cycle assessment – Requirements and guidelines
- 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
- ISO 14020:2000 – Environmental Labels and Declarations – General Principles
- Sphera – GaBi Product Sustainability software – www.sphera.com
- Reference Service Life - https://www.epshellas.com/
- Residual Energy Mix 2021 from Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)

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