Environmental Product Declaration

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

FOAM GLASS AGGREGATE 0-60 mm

from

FOAMIT

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
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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
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CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): *PCR 2019:14 Construction products, version 1.11 Published on 2021.02.05, valid until: 2024.12.20.*
PCR review was conducted by: *the Technical Committee of the International EPD® System. Chair: Claudia A. Peña. Contact via info@environdec.com*
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: TECNALIA R&I Certificación S.L. Auditor: Eva Larzabal Aperribay Accredited by: ENAC. Accreditation no.125/C-PR283
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: Foamit Group Oy, Teknobulevardi 3, 01530 Vantaa, Finland.

Contact: Tiina Partanen.

Description of the organisation: Foamit Group Oy is a group with four production sites in the Nordic countries, which process recycled glass to produce foam glass aggregate as well as glass chips, powder, and sand for industrial purposes.

Product-related or management system-related certifications: Glasopor (Norway): ISO 14001, ISO 9001, ISO 45001 and ISO 50001; Uusioaines (Finland): ISO 14001 and ISO 9001 (ISO 45001 planned for 2022).

Name and location of production site(s):

- Production site 1 - Skjåk, Norway (Glasopor).
- Production site 2 - Onsøy, Norway (Glasopor).
- Production site 3 - Hammar, Sweden (Hasopor).
- Production site 4 - Forssa, Finland (Uusioaines).

Product information

Product name: Foamit foam glass aggregate 0-60 mm.

Product identification: This EPD covers the representative product of foam glass aggregate produced at Foamit Group's (4) different production sites located in Finland, Sweden and Norway. From each production site one representative product has been analysed with the goal of obtaining an average virtual product. The declared performance characteristics of the 4 representative products are presented in Annex A. Results of the Life Cycle Assessment (LCA) will be presented for the average virtual product.

Product description: Foam glass aggregate 0-60 mm is a pumice like aggregate that is used by the infrastructure and construction industries as a lightweight fill material. Foam glass aggregate is manufactured from waste glass cullets, and a foaming agent (typically silicon carbide). Foam glass production prevents landfilling of "reject glass" generated at glass recycling plants. Any organic matter impurities in the raw material combusts in the production process, therefore there is no organic matter in the foam glass product. Foam glass is non-flammable and has good water conductivity properties. Thanks to its foamed cell structure, foam glass aggregate provides excellent thermal insulation. The foam glass aggregate's flexible settling properties and angle of repose ensure a robust substructure on the worksite.

UN CPC code: 37117

Geographical scope: Global.
Products under study are produced in Norway, Finland and Sweden but can be used at a global scale.

LCA information

Functional unit / declared unit: One m^3 of foam glass product bulk (approx. 191 kg/m^3 ± 15%). The density of the virtual average would be 191 kg/m^3. The density of Glasopor and Hasopor foam glass is 180 kg/m^3, but the density of Uusioaines is 210 kg/m^3.

Reference service life: Not applicable.

Time representativeness: All specific data related to the production plants and used for the study dates from 2021.

Database(s) and LCA software used: The primary inventory data has been obtained from Foamit corresponding to four foam glass representative products produced at the four production plants the company operates in Skjåk, Norway (Glasopor); Onsøy, Norway (Glasopor); Hammar, Sweden (Hasopor); and Forssa, Finland (Uusioaines) for the year 2021. Data is for the representative product.

The secondary data has been extracted from the generic Ecoinvent version 3.8 database, included in the SimaPro v9.3.0.2.1 software and internationally recognized. Wherever possible, inventory data relating to the specific study countries, or in its absence from Europe in general, has been selected. These have been used for the stage of production and transport of raw materials, as well as for electricity generation or waste management processes, over which the manufacturer has no direct influence.

Description of system boundaries: For this EPD option a) Cradle to gate with modules C1–C4 and module D (A1–A3 + C + D) has been chosen. Therefore, this EPD report considers the scope “cradle to gate with end of life of the product”, covering the modules of extraction and processing of raw materials (A1), their transportation to the production plant (A2), the foam glass aggregate manufacturing process (A3), end of life (C1-C4) and potential benefits and loads from the reuse and recycling of the foam glass aggregate at its end of life (D).

As permitted by PCR 2019:14 (version 1.11), remaining life cycle stages (modules A4-A5 and B1-B7) have been excluded from the study as not being relevant for this product.

Note that the PCR 2019:14 (version 1.11) requires that an EPD with an approach “cradle to gate (A1–A3)” or “cradle to gate with options (A1–A3 and the additional modules A4 and A5) shall only be used if the following three conditions apply:

- The product or material is physically integrated with other products once installed, so it cannot be separated at its end of life.
- The product or material cannot be identified at its end of life due to physicochemical transformation processes.
- The product or material does not contain biogenic carbon.

Therefore, since the foam glass aggregate can be identified and separated at its end of life, the end of life of the product and possible benefits from material recovery of the Foamit product shall be included in the EPD (i.e., modules C1-C4 and D).

For an EPD of type “a) Cradle to gate with module C1-C4 and module D”, the PCR 2019:14 requires that a declared unit must be used, and the inclusion of reference service life is optional.

Applicable lifecycle stages with the system boundaries and processes are described below.

• Product stage (A1-A3):
    - Raw material supply (A1): This module considers the extraction and processing of raw materials used for the manufacture of foam glass aggregate. Moreover, raw materials’ packaging enabling transportation to the production plant is included. Likewise, the production of the energy necessary for the manufacturing process (electricity, LPG, LNG and other fuels) is also taken into account.

- Transport of the raw materials (A2): This module consists of the transportation of all raw materials covered by module A1, from the extraction, production, and treatment site to the factory, considering the specific distances of each material supplier.
- Manufacturing of foam glass aggregate (A3): This module refers to the production process of the foam glass aggregate in the production plant. It includes the combustion of fuels (LPG, LNG and diesel) and the water consumed during the manufacturing process. It also considers the waste generated from the production process: the treatment and transport from the production plant to the waste manager. Finally, it considers the packaging used for distribution: the production of the primary and secondary packaging of the product (big bags, small bags and wooden pallets), and the transport of this packaging from suppliers to the Foamit factory.

• End of life stage (C):

- Deconstruction or demolition (C1): This includes the dismantling of the foam glass aggregate after its use by a hydraulic digger.
- Transport to the waste processing site (C2): This module considers a default distance of 50 km between the building where the product was installed and the waste manager facility.
- Waste processing (C3): This module includes the reconditioning of the foam glass aggregate waste for its reuse. However, in this study it is assumed that the foam glass aggregate is reused directly without any treatment. Thus, there are not environmental impacts allocated to this module.
- Disposal (C4): This module includes the final discharge of waste that has not been destined for recovery or treatment processes. It has been assumed that the waste losses are negligible and most of the foam glass aggregate is reused. Thus, there are not environmental impacts associated with this module.

Parameter	Units for declared unit (1 m³)	Value
Waste collection process, specified by type	kg collected separately	190
	kg collected mixed with demolition waste	0
Waste recovery process, specified by type	kg for reuse	190
	kg for recycling	0
	kg for energy recovery	0
Waste disposal	kg to landfill	0
Waste transport considerations	km, distance to waste manager facility	50

• Benefits and loads beyond the system boundary (D): This module analyses the benefits and burdens related to the processes of recovery, reuse or recycling of waste from the product under study at their end of life, which could form part of the life cycle of a new product. Module D includes substitution effects for the net outflow, which for this study is only the mass of foam glass product per declared unit (191 kg/m³). Thereby, the benefit of the reuse of the foam glass aggregate results in avoiding the production of 191 kg of natural crushed gravel.

The scenarios for modules C1-C4 and D are realistic and representative of one of the most probable alternatives. The scenarios do not include processes or procedures that are not in current use or whose feasibility have not been demonstrated.

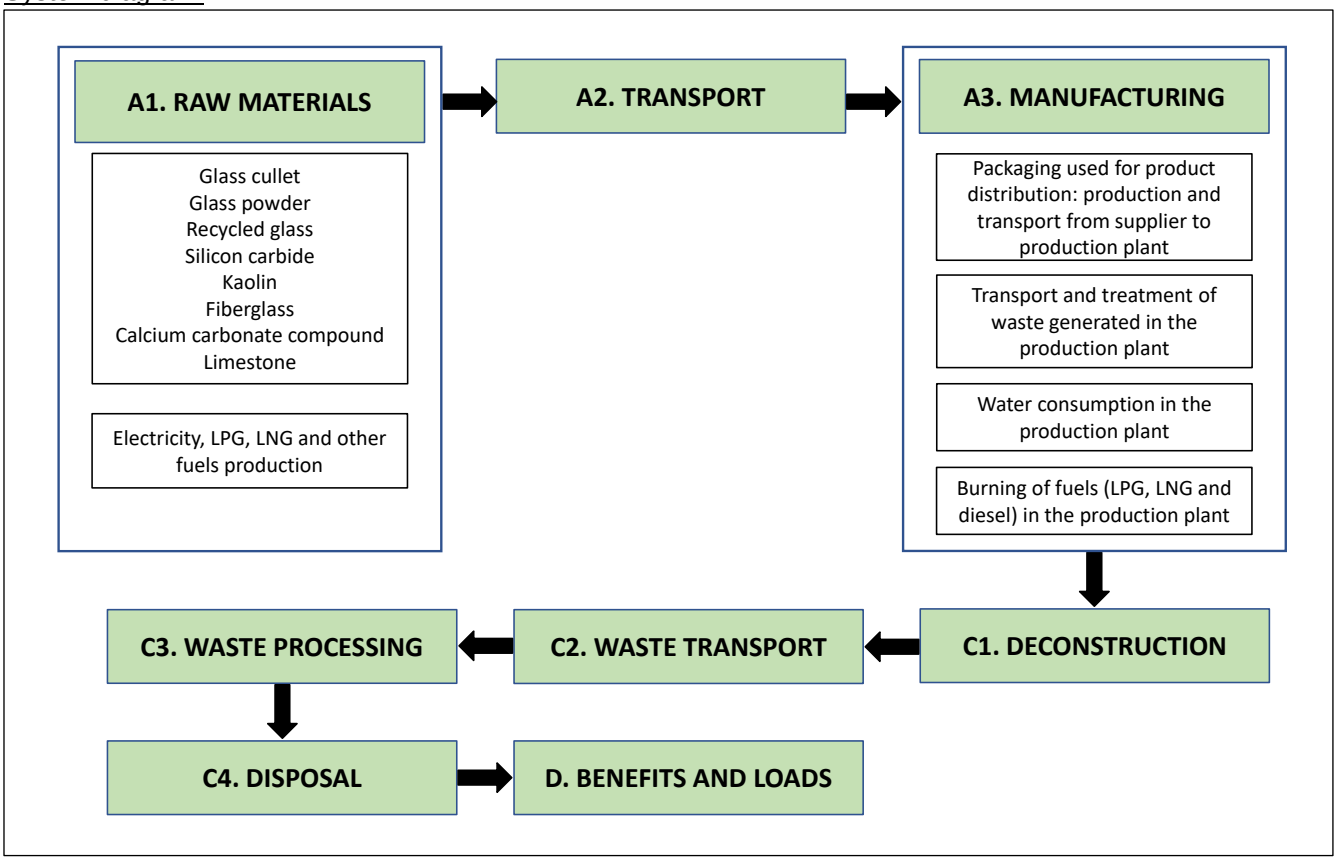
Manufacturing process

The foam glass production process comprises four main stages: 1) drying of the glass, 2) milling of the glass, 3) mixing of the glass powder and the foaming agent, and 4) the foaming process.

The main raw material is waste glass that is received and intermediately stored at the plant. In case the glass material is wet, the glass is first dried. Depending on the plant LPG, LNG, waste heat and/or a combination of these are used in the drying process. Dried glass material is then milled into a powder. The powder is then either placed in intermediate storage or fed directly into a mixing system where the glass powder is mixed with silicone carbide (and/or other foaming agents) before the mixture is distributed onto the conveyor belts of the foaming kilns. Some of the sites have mesh belts that require a fiber glass mat that has been immersed into a clay (kaolin) solution to be placed on the conveyor belt to prevent the powder from falling through the mesh. Kilns are either LPG fired or electric kilns. The mixture is heated at a temperature between 800-900 °C. The glass particles (and the fiber glass mat) fuse together and the foaming agent reacts with ambient air and releases gases that result in the formation of a pore structure within the glass mass thereby creating the foam glass structure. When the foam glass exits the kiln, it cools and breaks into 0-60 mm particle size by shock and thermal shock. The product is then placed on intermediate storage.

The bulk of the production is sold and transported to customers in bulk shipments by truck. A small portion of the production is bagged into small and big bags. Sites also have the capability to produce other particle sizes by crushing and sieving of 0-60 mm foam glass. It should be noted that the production process at the Skjåk, Norway site is slightly different. The Skjåk site does not have the drying and milling processes. Instead, the site receives readymade glass powder from the Onsøy site (i.e., the Onsøy site produces glass powder for its own use and for the Skjåk site).

System diagram:



More information:

Company website for more information: foamit.fi, uusioaines.com, hasopor.se, and glasopor.no.

Name and contact information of LCA practitioner:

Lavola – Anthesis Group
Rambla de Catalunya, 6, planta 2, 08007 Barcelona
+34 938 515 055
www.anthesisgroup.com

Cut-off rules:

In accordance with the provisions of the PCR 2019:14 construction products, version 1.11 and the standard UNE-EN 15804:2012+A2:2020, 100% of total inflows (raw materials and energy) and outflows (including wastes and CO_2 direct emissions from the oxidation of silicon carbide during the foaming process) per module have been considered. The packaging for the distribution of the foam glass aggregate has also been included..

The following processes have not been included in the scope of the study:

- Manufacture of equipment used in production, buildings or any other assets.
- Business trips.
- Maintenance activities at the production plants and research and development.
- Transportation of personnel to and within the plants.
- Diffuse particle emissions during the transport and storage of raw materials.

Allocation procedures

For cases where there is more than one product in the system being studied, ISO 14040/44 prescribes the following procedure for the allocation of material and energy flows and environmental emissions:

- In the first instance, allocation should be avoided, by process sub-division.
- Expanding the product system to include the additional functions related to the co-products.
- Where these methods are not applicable, the ISO 14040/44 requires that allocation reflects the physical relationships of the different products or functions. Allocation based on physical relationships such as mass or energy is a practical interpretation of this, and an approach often used in LCA.
- For some processes, allocation based on mass is not considered appropriate and, in these cases, economic allocation is used.

In this study, no allocations have been applied in the manufacturing of foam glass (i.e., for energy consumption, waste production, etc.). Only an economic allocation has been performed for silicon carbide production.

The silicon carbide used as additive to induce foaming of the raw material in the manufacturing process at the four plants is a by-product of silicon carbide manufacturing. This by-product is generated in the form of small-grained silicon carbide powder, and it was originally treated as waste. According to the silicon carbide provider Saint Gobain, the economic value of this by-product is approximately 1/5 of the main product, and for every 5 kg main product around 1 kg of small-grained silicon carbide is produced. Therefore, a 3.85 % of the impact from silicon carbide production is allocated to the small-grained silicon carbide powder used as additive in the foam glass aggregate production. Other manufacturers are understood to use the same process with similar ratios between main product and by-product, and the costs of the main product and the by-product are similar.

Following the "polluter pays" principle, environmental burdens of reused / recycled materials are allocated to the product system consuming them, rather than the system providing them, and are quantified based on recycling content of the material under analysis.

Hypotheses and considerations applied:

The hypotheses assumed during the study are detailed below:

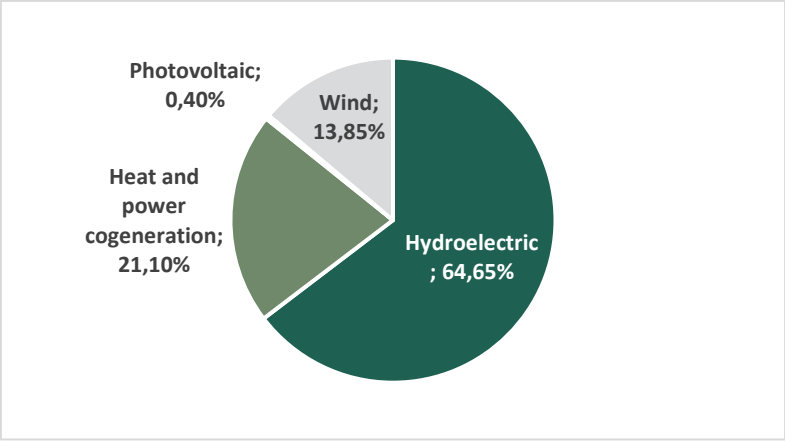
- All the specific data used in this study corresponds to 2021.
- The final product on which the study has been based corresponds to a weighted average representative virtual product of foam glass aggregate based on a representative product of each one of the four plants.
- The glass cullet used for the foam glass aggregate production is acquired directly from the waste handling (glass collection) site, without any additional processing before transport. This glass waste is produced during the glass cullet recycling process and has no use. Glass is purchased as waste and if it is not used to produce foam glass aggregate it is sent to a landfill. Therefore, no impacts have been assigned to the production of the material since it is waste glass, which does not require any further processing.
- Given the low value of the silicon carbide by-product used as additive, an economic allocation has been applied. Thereby, a 3.85 % of the impact from silicon carbide production is allocated to this by-product.
- The oxidation of silicon carbide at high temperatures (900-1,100°C) produces CO_2 as foaming gas. These direct emissions of CO_2 are accounted in the module A3. According to reaction (1), it has been assumed that all carbon from the silicon carbide is oxidized into CO_2, which is emitted into the atmosphere.

$$SiC + O_2 \rightarrow SiO_2 + CO_2 \quad (1)$$

- The electricity mix consumed at the different production plants has been modelled based on the data provided by the manufacturer.
- Regarding the transport of raw materials (module A2), specific distances have been introduced by supplier for each material.
- For the transport of waste from the production plant, specific distances have been introduced for each waste manager facility, which have been provided by Foamit.
- It has been assumed that all road transport complies with the Euro V emissions standard, as it takes place within the European territory. The only exception is for the transport of material to the Glasopor plant in Skjåk (Norway), where Euro VI trucks are used.
- For the end of life of the foam glass aggregate, it has been considered that the product can be reused completely since it does not undergo any physical or chemical transformation process during its use. Moreover, the product does not need any recycling process for its reuse and material losses are negligible.

Additional information:
Since the average electricity consumption of the production plants exceeds the threshold of 30% of the total energy consumption of product stage A1-A3, the resulting electricity mix considered for the study is shown below, divided by its energy sources, as required in the UNE EN 15804:2012+A2 (2020) standard and the *PCR 2019:14 Construction products, version 1.11 Published on 2021.02.05, valid until: 2024.12.20.*

In relation to its contribution to the environmental impacts of the product, the production of 1 kWh of electricity consumed by the average production plant of Foamit Group Oy in 2021 generated 0.0351 kg of CO_2 eq. emissions.



Data quality requirements:
In this study, data quality requirements established by ISO 14025 standards and reference PCRs "PCR 2019:14 Construction products, version 1.11 *Published on 2021.02.05, valid until: 2024.12.20* and UNE-EN 15804:2012+A2:2020 have been applied.

Data has been evaluated through a data quality matrix based on the Product Environmental Footprint Category rules criterion for the data quality management, as it is established in the UNE-EN 15804:2012+A2. As a result of the data quality matrix, it is quantified that the gathered data achieves a good level of quality (3.84 out of 5) in a range of very poor (1), poor (2), medium (3), good (4) and very good (5).

Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation:

	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	ND	ND	ND	ND	ND	ND	ND	ND	ND	x	x	x	x	x
Geography	EU	EU	EU	ND	ND	ND	ND	ND	ND	ND	ND	ND	EU	EU	EU	EU	EU
Specific data used	>95% For modules A1-A3 it comes from specific LCI data					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	From -70% until 59% regards the average product.					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	From -70% until 59% regards the average product.					-	-	-	-	-	-	-	-	-	-	-	-

The four foam glass aggregate products analysed, which are produced in four different production sites, show a variation greater than 10%. Thereby, the range goes from -70% of the foam glass aggregate produced at the Skjåk site (Norway) to +59% at the Forssa site (Finland).

This variance is mainly due to the use of fossil fuels for the production of foam glass. Therefore, on the one hand, the foam glass aggregate produced in the sites of Forssa (Finland) and Onsøy (Norway) has a greater impact on GWP for the product stage (A1-A3) than the average virtual product due to the use of LPG fired kilns. On the other hand, the foam glass aggregate produced in the sites of Hammar (Sweden) and Skjåk (Norway) has a lower impact due to the use of electric kilns.

The deviations between the GWP-GHG results of the representative foam glass aggregate of each production site with respect to the average virtual product are in Annex B.

Content information

Product components	Weight (%)	Post-consumer material, weight (%)	Renewable material, weight (%)
Waste glass cullets	98-99%	100%	0%
Silicon carbide	0-2%	0%	0%
Kaolin	0-2%	0%	0%
Fiber glass	0-2%	0%	0%
Calcium carbonate compound	0-2%	0%	0%
Limestone	0-2%	0%	0%
TOTAL	201 kg		
Packaging materials	**Weight (%)**	**Weight (%) (versus the product)**	
Big bags (polypropylene)	40.8%	0.015%	
Small bags (polypropylene)	9.5%	0.004%	
Pallets	49.7%	0.019%	
TOTAL	6.02E-02 kg	0.030%	

None of the components present in the final product are included in the "Candidate List of Substances of Extreme Concern in the authorization procedure" of the REACH regulation.

Environmental Information

The environmental information related to the analysed products has been calculated with the SimaPro software version 9.3.0.2.1. As required by PCR 2019:14, construction products version 1.11, the characterization factors indicated in Annex C of the EN 15804:2012+A2 standard have been used to estimate the potential environmental impacts (method EN 15804 + A2 Method V1.02 / EF 3.0 normalization and weighting set). With respect to the results corresponding to the rest of the parameters under study, the following methodologies have been used: EDIP to calculate waste production, CED (Cumulative Energy Demand) to calculate energy use and inventory data for output flows.

The environmental results corresponding to the life cycle of the representative average product of Foamit foam glass aggregate are shown below. These are divided by modules, covering the stages defined above in the system boundary section (A1-A3+C1-C4+D), and considering all the impact categories required by the PCR 2019:14 Construction products, version 1.11.

The results presented have been obtained by weighting the composition of the four representative products from the production sites included in the study according to the production of each of them.

Estimated impact results are only relative statements that do not indicate impact category endpoints, exceedances of assessed thresholds, safety margins, or risks.

Potential environmental impact – mandatory indicators according to EN 15804

Indicator	Unit	A1	A2	A3	Tot.A1-A3	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq.	7.65E+00	7.77E+00	1.92E+01	3.46E+01	5.38E-01	2.03E+00	0	0	-2.94E+00
GWP-biogenic	kg CO_2 eq.	3.48E-01	9.09E-03	2.26E-01	5.83E-01	-6.54E-05	1.97E-03	0	0	-2.23E-02
GWP-luluc	kg CO_2 eq.	1.58E-01	4.64E-03	1.59E-03	1.64E-01	3.17E-06	9.63E-04	0	0	-3.01E-03
GWP-total	kg CO_2 eq.	8.15E+00	7.78E+00	1.94E+01	3.53E+01	5.38E-01	2.03E+00	0	0	-2.96E+00
ODP	kg CFC 11 eq.	2.58E-06	1.80E-06	3.66E-08	4.41E-06	8.18E-08	4.60E-07	0	0	-4.08E-07
AP	mol H^+ eq.	5.68E-02	4.03E-02	1.21E-02	1.09E-01	5.55E-03	9.89E-03	0	0	-2.04E-02
EP-freshwater	kg PO_4^{3-} eq.	1.07E-03	5.31E-04	5.48E-04	2.15E-03	1.10E-04	4.72E-04	0	0	-3.09E-03
EP-freshwater	kg P eq.	3.30E-03	1.63E-03	1.68E-03	6.61E-03	3.57E-05	1.54E-04	0	0	-1.01E-03
EP-marine	kg N eq.	1.21E-02	1.32E-02	4.71E-03	2.99E-02	2.37E-03	3.29E-03	0	0	-5.55E-03
EP-terrestrial	mol N eq.	1.74E-01	1.44E-01	5.05E-02	3.68E-01	2.59E-02	3.60E-02	0	0	-6.34E-02
POCP	kg NMVOC eq.	4.37E-02	4.32E-02	1.38E-02	1.01E-01	7.13E-03	1.03E-02	0	0	-1.73E-02
ADP-minerals& metals*	kg Sb eq.	4.96E-05	1.76E-05	1.90E-05	8.61E-05	1.33E-07	9.32E-06	0	0	-2.25E-05
ADP-fossil*	MJ	3.37E+02	1.19E+02	1.33E+01	4.69E+02	7.55E+00	3.05E+01	0	0	-4.30E+01
WDP	m^3	1.40E+00	4.16E-01	7.01E-01	2.52E+00	1.08E+01	1.01E-01	0	0	-2.89E+00
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.*

Potential environmental impact – additional mandatory and voluntary indicators

Indicator	Unit	A1	A2	A3	Tot.A1-A3	C1	C2	C3	C4	D
GWP-GHG[1]	kg CO_2 eq.	7.26E+00	7.71E+00	1.91E+01	3.41E+01	5.33E-01	2.01E+00	0	0	-2.89E+00

Use of resources

Indicator	Unit	A1	A2	A3	Tot.A1-A3	C1	C2	C3	C4	D
PERE	MJ	3.12E+02	1.69E+00	-8.67E-01	3.12E+02	4.10E-02	5.16E-01	0	0	-2.53E+00
PERM	MJ	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00
PERT	MJ	3.12E+02	1.69E+00	2.13E+00	3.15E+02	4.10E-02	5.16E-01	0	0	-2.53E+00
PENRE	MJ	3.72E+02	1.25E+02	1.40E+01	5.12E+02	8.03E+00	3.24E+01	0	0	-4.57E+01
PENRM	MJ	0.00E+00	6.37E-01	0.00E+00	6.37E-01	0.00E+00	0.00E+00	0	0	0.00E+00
PENRT	MJ	3.72E+02	1.26E+02	1.40E+01	5.12E+02	8.03E+00	3.24E+01	0	0	-4.57E+01
SM	kg	1.98E+02	0.00E+00	0.00E+00	1.98E+02	0.00E+00	0.00E+00	0	0	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00
FW	m^3	8.04E-01	1.37E-02	2.13E-02	8.39E-01	2.50E-01	3.56E-03	0	0	-7.23E-02
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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water									

[1] The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus almost equal to the GWP indicator originally defined in EN 15804:2012+A1:2013.

Waste production and output flows

Waste production

Indicator	Unit	A1	A2	A3	Tot.A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed	kg	4.05E-04	2.88E-04	1.88E-05	7.12E-04	4.82E-06	8.18E-05	0	0	-1.61E-04
Non-hazardous waste disposed	kg	2.12E+00	9.72E+00	1.78E-01	1.20E+01	7.48E-03	1.30E+00	0	0	-1.39E+00
Radioactive waste disposed	kg	2.48E-04	8.02E-04	7.29E-05	1.12E-03	2.85E-06	2.05E-04	0	0	-2.44E-04

Output flows

Indicator	Unit	A1	A2	A3	Tot.A1-A3	C1	C2	C3	C4	D
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	3.40E-01	3.40E-01	0.00E+00	0.00E+00	0	0	1.91E+02
Materials for energy recovery	kg	0.00E+00	0.00E+00	3.09E-01	3.09E-01	0.00E+00	0.00E+00	0	0	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	0	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	0	0.00E+00

Results' interpretation

The product stage, A1-A3, is the main contributor to most of the impacts, ranging from 84% to 100% of the total impact depending on the indicator. Within the product stage A1-A3, the raw material extraction stage A1 is the main contributor in 11 impact categories, the manufacturing stage A3 in three categories and the transport of raw materials to the manufacturing plant A2 in one category.

In the raw material stage A1, the major contributors to the impact are the extraction and production of the energy necessary for the manufacturing process (electricity and fossil fuels). The production of raw materials as silicon carbide and fibre glass are important contributors in the indicator's freshwater eutrophication potential (EP-freshwater) and abiotic depletion of non-renewable minerals and metals (ADP-minerals and metals), respectively.

The transport of raw materials to the manufacturing plant (A2) is the principal contributor to the marine eutrophication potential (EP-marine) indictor with 37% of the total impact. Within the transport stage, road transport is the largest pollutant in all the indicators.

In the manufacturing stage (A3), the combustion of fossil fuels (LPG and LNG) for the foam glass production is the main contributor in most of the impact indicators.

For the end-of-life stage (C), the impact occurs only during the deconstruction stage (C1) and waste transport to the waste manager facility (C2). The end-of-life stage (C) is only an important contributor for the water depletion potential (WDP) indicator, where the deconstruction stage (C1) represents an 80% of the total impact. Note that there is no impact from waste processing (C3) and disposal (C4) as the foam glass waste can be reused as such without any processing. Besides, there are benefits in module D because the production and use of natural gravel is avoided.

Concerning the resource use indicators (PERT and PENRT), 36% of the primary energy resources are renewable and 64% non-renewables. 99% of the renewable energy is consumed in the raw material stage (A1) due to the use of renewable energy sources for the electricity generation. In the case of non-renewable primary energy, a 67% is used in the module A1 due to mainly to the production of fossil fuels destined to the kilns in the foam glass production. Moreover, 23% of the non-renewable energy is used in A2 module for the raw materials transport.

The following figure shows how the environmental impacts of the average virtual product are distributed among the different life cycle stages for some selected impact categories.

Regarding the global warming potential (GWP) indicator, the principal contributor to the impact is the production and use of fossil energy sources in the kilns during the foam glass production in the plants of Glasopor (Onsøy, Norway) and Uusioaines (Forssa, Finland). Note that the plants of Glasopor (Skjåk, Norway) and Hasopor (Hammar, Sweden) have electric kilns running on renewable energy, consequently, the impact from this electricity generation is assigned to the stage of extraction of raw materials stage (A1). The transport of raw materials to the manufacturing facilities by road also plays a major role on the GWP indicator.

For the indicators resource use, minerals and metals (ADP-minerals & metals), resource use, fossils (ADP-fossil) and ozone depletion potential (ODP), the raw materials stage (A1) is the main contributor to the impact. The electricity generation is responsible of 31% of the total impact on ADP-minerals & metals. The fossil fuels (LPG and LNG) production is causing 57% and 43% of the total impact on the ADP-fossil and ODP indicators, respectively.

ENVIRONMENTAL CATEGORY AND INDICATOR	A1 RAW MATERIALS	A2 TRANSPORT	A3 MANUFACTURING	C1 DECONSTRUCTION	C2 WASTE TRANSPORT	TOTAL LIFE CYCLE
Global Warming Potential (GWP)	8.15	7.78	19.39	0.54	2.03	**37.89 kg CO_2 eq. / m³**
Resource use, minerals and metals (ADP-minerals & metals)	4.96E-05	1.76E-05	1.90E-05	1.33E-07	9.32E-06	**9.56 E-05 kg Sb eq. / m³**
Resource use, fossils (ADP-fossil)	337.30	118.62	13.28	7.55	30.54	**507.30 MJ / m³**
Water use (WDP)	1.40	0.42	0.70	10.76	0.10	**13.38 m³ depriv. / m³**
Ozone Depletion Potential (ODP)	2.58E-06	1.80E-06	3.66E-08	8.18E-08	4.60E-07	**4.96 E-06 kg CFC-11 eq. / m³**

Information on biogenic carbon content

Results per functional or declared unit		
BIOGENIC CARBON CONTENT	**Unit**	**QUANTITY**
Biogenic carbon content in product	kg C	0
Biogenic carbon content in packaging	kg C	Not applicable*

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO_2.

*As the mass of the packaging is under 5% of the product mass, the amount of biogenic carbon contained in the packaging is not represented, according to UNE-EN 15804:2012+A2:2020.

References

- General Programme Instructions (GPI) of the International EPD system, version 3.01
- Environdec Programme: The International EPD System https://www.environdec.com/home
- The Product Category Rules (PCR) “PCR 2019:14 Construction products, version 1.11 published on 5 February 2021, valid until 20 December 2024” based on the European standard UNE-EN 15804:2012+A2:2020.
- UNE-EN ISO 14040:2006 – Environmental management – Life Cycle Assessment – Principles and framework
- UNE-EN ISO 14044:2006 – Environmental management – Life Cycle Assessment – Requirements
- UNE-EN ISO 14025:2006- Labels and environmental declarations.
- ISO/TR 14047: 2003 – Environmental management – Life Cycle Assessment – LCI application examples
- ISO/TS 14048: 2003 – Environmental management – Life Cycle Assessment – Data inventory
- ISO/TR 14049: 2000 – Environmental management – Life Cycle Assessment – Examples of application of objectives and scope and inventory analysis
- UNE-EN 15804:2012+A2: Sustainability in construction. Product environmental statements. Commodity category rules for construction products.
- IFEU, INFRAS, IVE, 2014. EcoTransIT, Ecological Transport Information Tool for Worldwide Transports Methodology and Data Update.

Annex A. Declared performance characteristics of the representative products

Below is shown the declared performance levels of the four foam glass aggregate 0-60 mm representative products manufactured by FOAMIT group in four different production sites.

Feature	Skjåk, Norway (Glasopor)	Onsøy, Norway (Glasopor)	Hammar, Sweden (Hasopor)	Forssa, Finland (Uusioaines)
Product name	Glasopor® 10-60mm	Glasopor® 10-60mm	Hasopor® Lätt	Foamit 60, foamed glass
Intended usage	Light aggregate in unbound use, made from recycled glass	Light aggregate in unbound use, made from recycled glass	Light ballast for unbound and bound applications	Lightweight aggregate for use in construction
Particle size	10-60 mm	10-60 mm	10-60 mm (oversize ≤ 10%; undersize ≤15%)	0-60 mm
Particle shape	Irregular shape and size	Irregular shape and size	Irregular	Fragmented surface
Uncompacted dry-bulk density	180 kg/m^3	180 kg/m^3	180 kg/m^3 (±15%)	210 kg/m^3 (±15%)
Dry density (comp. factor 1.15-1.2)	<225 (up to) kg/m^3	<225 (up to) kg/m^3	NPD	NPD
Grain density	380 kg/m^3	380 kg/m^3	NPD	NPD
Compressive strength	0.77 MPa at 20% comp.	0.77 MPa at 20% comp.	0.77 MPa at 20% comp.	>0.9 N/mm^2
Water absorption	NPD	NPD	< 30%	NPD
Capillarity	NPD	NPD	< 120 mm	NPD
Freeze-melt resistance	0.2%	0.2%	NPD	NPD
Volume stability	>0.1% for 50 years	>0.1% for 50 years	NPD	NPD
Thermal conductivity (dry)	0.097 W/mK	0.097 W/mK	NPD	NPD
Thermal conductivity (wet)	0.107 W/mK	0.107 W/mK	NPD	NPD
Purity	NPD	NPD	NPD	Contains no organic substances
Volume change during compression	15-25%	15-25%	NPD	NPD
Heavy metal leaching	NPD	NPD	NPD	The amount of leached material is insignificant for the product's usage

NPD: No performance determined

Annex B. Deviation of the GWP-GHG results of the four production sites analysed with respect to the average virtual product

Below is shown the deviation of the results between the environmental performance of the representative foam glass aggregate of each production site with respect to the average virtual product obtained on which the study was based. For this, the GWP-GHG indicator has been used, showing the results as an absolute value, and making a percentage comparison of each site.

Product	Indicator	Unit	A1	A2	A3	Tot.A1-A3	C1	C2	C3	C4	D
Average virtual product	GWP-total	kg CO_2 eq	8.15E+00	7.78E+00	1.94E+01	3.53E+01	5.38E-01	2.03E+00	0	0	-2.96E+00
Skjåk, Norway (Glasopor)	GWP-total	kg CO_2 eq	1.57E+00	5.61E+00	3.27E+00	1.04E+01	5.38E-01	1.92E+00	0	0	-2.80E+00
		%	-81%	-28%	-83%	-70%	0%	-6%	0%	0%	-6%
Onsøy, Norway (Glasopor)	GWP-total	kg CO_2 eq	1.03E+01	3.44E+00	3.03E+01	4.41E+01	5.38E-01	1.92E+00	0	0	-2.80E+00
		%	27%	-56%	56%	25%	0%	-6%	0%	0%	-6%
Hammar, Sweden (Hasopor)	GWP-total	kg CO_2 eq	5.31E+00	5.89E+00	4.86E+00	1.61E+01	5.38E-01	1.92E+00	0	0	-2.80E+00
		%	-35%	-24%	-75%	-55%	0%	-6%	0%	0%	-6%
Forssa, Finland (Uusioaines)	GWP-total	kg CO_2 eq	1.15E+01	1.26E+01	3.21E+01	5.62E+01	5.38E-01	2.24E+00	0	0	-3.26E+00
		%	41%	62%	65%	59%	0%	10%	0%	0%	10%

VERIFICATION STATEMENT CERTIFICATE

CERTIFICADO DE DECLARACIÓN DE VERIFICACIÓN

Certificate No. / Certificado nº: EPD07301

TECNALIA R&I CERTIFICACION S.L., confirms that independent third-party verification has been conducted of the Environmental Product Declaration (EPD) on behalf of:
TECNALIA *R&I CERTIFICACION S.L., confirma que se ha realizado verificación de tercera parte independiente de la Declaración Ambiental de Producto (DAP) en nombre de:*

FOAMIT GROUP OY
Teknobulevardi 3
01530 Vantaa - FINLAND

for the following product(s):
para el siguiente(s) producto(s):

Foam glass aggregate 0-60 mm
***Agregado de espuma de vidrio* 0-60 mm**

with registration number **S-P-07075** in the International EPD® System *(www.environdec.com).*
*con número de registro **S-P-07075** en el Sistema International EPD® (www.environdec.com).*

it´s in conformity with:
es conforme con:

- **ISO 14025:2010 Environmental labels and declarations. Type III environmental declarations.**
- **General Programme Instructions for the International EPD® System v3.01**
- **PCR 2019:14 Construction products (EN 15804:A2) v1.11**
- **UN CPC 37117 Paving blocks, bricks, tiles and other articles of pressed or moulded glass, of a kind used for building or construction purposes; leaded lights and the like; multicellular or foam glass in blocks, plates or similar forms.**

Carlos Nazabal Alsua
Manager

Issued date / *Fecha de emisión:*	04/11/2022
Update date / *Fecha de actualización:*	04/11/2022
Valid until / *Válido hasta:*	03/11/2027
Serial Nº / *Nº Serie:*	EPD0730100-E

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