INTERBETON

EPD

Environmental Product Declaration for limestone aggregates

Tanagra Quarry

Programme The International EPD® System, www.environdec.com
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In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019

EPD® THE INTERNATIONAL EPD® SYSTEM

ECO PLATFORM EPD VERIFIED

EURO CERT

GENERAL INFORMATION

Programme:	The International EPD® System
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Accountabilities for PCR, LCA and independent, third-party verification

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

Product category rules (PCR):
PCR 2019:14 Construction products (EN 15804:A2), Version 1.11, dated 2021-02-05, International EPD System
CPC 15200 & CPC 15320 under the UN CPC classification system v2.1

PCR review was conducted by: Technical Committee of the International EPD System

Life Cycle Assessment (LCA)

LCA accountability: EcoVibes
EcoVibes – Environmental Consultants (https://ecovibes.gr/en info@ecovibes.gr)

Third-party verification

Independent third-party verification of the declaration and data, according to ISO 14025:2006:
☒ EPD verification by accredited certification body

Third party verifier:
Eurocert S.A. (https://www.eurocert.gr/ info@eurocert.gr) is an approved certification body accountable for the third-party verification

The certification body is accredited by:
Hellenic Accreditation System E.SY.D. https://esyd.gr/main/

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: Interbeton Building Materials S.A., a member of TITAN Group. 22A Halkidos Str., 11143 Athens, Greece

Contact: Manos Kontekakis, Quality Assurance & Control Administrator and Quality & Environmental Assurance Systems Administrator Aggregates Operations / Tel. 2144056191 / email: e.kontekakis@titan.gr

Description of the organisation: Building materials manufacturer

Geographical Scope:

National (Greece)

Name and location of production sites, all located in Greece

(https://www.interbeton.gr/default.asp?siteID=1&pageid=14&tablepageid=11&langid=1)

1. Thisvi
2. Tanagra
3. Malakasa
4. Xirorema (Aspropyrgos)
5. Volos
6. Lepenou (Agrinio)
7. Drymos
8. Tagarades
9. Leros
10. Rethymno
11. Zoforoi

Description of the organisation

Building on 121 years of industry experience and driven by its commitment to sustainable growth, TITAN Group has become an international cement and building materials producer, serving customers in more than 25 countries worldwide through a network of 14 integrated cement plants and three cement grinding plants. TITAN also operates quarries, ready-mix plants, terminals, and other production and distribution facilities. We create value by transforming raw materials into products – cement, concrete, aggregates, dry mortars and other building materials. We serve society's need for safe, durable, resilient, and affordable housing and infrastructure.

Climate change has mobilized organizations, in many sectors, towards a carbon-neutral future. In 2020, the Global Cement and Concrete Association (GCCA) announced its members' Climate ambition to drive down the CO_2 footprint of operations and products and deliver carbon-neutral concrete to society by 2050. Meanwhile, there is a growing need for enhanced transparency of environmental performance of building materials, such as greenhouse gas (GHG) emissions.

TITAN is working across the built environment value chain to deliver a carbon-neutral future in a circular economy, life cycle context. Aiming for a 35% reduction of the net direct specific CO_2 emissions by 2030 (compared to 1990 levels), TITAN has defined a roadmap for developing low-carbon aggregate and cementitious products and collaborating in carbon capture R&D projects at the cement plants and quarries.

The publication of this aggregates EPD is an important milestone in the road map, helping to communicate to customers the environmental performance of INTERBETON aggregates.

Aggregates and other building materials EPDs will help shape the way the construction industry analyses the environmental impact of buildings and infrastructure works, now and in the future. Our EPDs will also provide a rigorous, science-based framework for driving environmental improvement throughout TITAN's and INTERBETON's sites and supply chain, offering at the same time an advantage to customers wanting to be leaders in the sustainable infrastructure and building industry.

Product-related and management system-related certifications and environmental measurements:

- Quality Management System (EN ISO 9001:2015)
- Environmental Management System (EN ISO 14001:2015)
- 16 Declarations of Performance for the different types and fractions of aggregates, according to the Annex III EU Regulation No.305/2011 (ELOT EN 13139/EN 13242/EN 12620/EN 13043)
- Dust measurements in the environment at the limits of the Tanagra quarry/PM10 (EN ISO 17025, CEN/TS 15675, EN 12341, Greek Law 14122/549/E.103)
- Noise level measurements at the limits of the Tanagra quarry (EN ISO 17025, CEN/TS 15675, IEC 61672-1:2002, IEC 60651:2001, IEC 60804:2000 & IEC 61942:2003, Greek Law 1180/81 (Article 2, Table 1))
- Health and safety of employees' level measurements at the quarry (EN ISO 17025, CEN/TS 15675, Greek law 149/2006)

Name and location of production site:

Tanagra Quarry, Megalos Shinos, Viotia, Greece

PRODUCT INFORMATION

Product name: Limestone aggregates

Product identification: The technical standards (Hellenic Body for Standardization - ELOT and CEN Standards applying to aggregates according to Declarations of Performance) which the aggregate types are compliant with, are presented in Table 1 below.

Table 1. Product types manufactured at the declared site (according to the Declarations of Performance)

Product types (English)	Product types (Greek)	EN-12620 1)	EN-13043 2)	EN-13242 3)	EN-13139 4)
Crushed sand 0/4	Άμμος θραυστή 0/4	X			X
Crushed material 0/4	Υλικό θραυστό 0/4			X	
Full gradation material 0/4	Υλικό πλήρους διαβάθμισης 0/4		X		
Mixed Gravel 0/31,5 (0150)	Ανάμικτο Αμμοχάλικο 0/31,5 (πρ. ΠΤΠ-Ο150)			X	
Mixed Gravel 0/31,5 (0155)	Ανάμικτο Αμμοχάλικο 0/31,5 (πρ. ΠΤΠ-Ο155)			X	
Mixed Gravel 0/31,5 (Type I)	Ανάμικτο Αμμοχάλικο 0/31,5 (ΤΥΠΟΣ Ι)			X	
Mixed Gravel 0/31,5 (Type II)	Ανάμικτο Αμμοχάλικο 0/31,5 (ΤΥΠΟΣ ΙΙ)			X	
Crushed Gravel 31.5/63	Σκύρα θραυστά 31.5/63			X	
Crushed Gravel 4/11,2	Γαρμπίλι 4/11,2	X	X		
Crushed Gravel 8/16	Γαρμπίλι θραυστό 8/16	X	X		
Crushed Gravel 16/31,5	Χαλίκι θραυστό 16/31,5	X	X		
Embankment Fill E4 (0/31,5)	Υλικό Επιχωμάτωσης Ε4 (0/31,5)			X	

1) EN-12620+A1:2008 - Aggregates for Concrete
2) EN-13043/AC:2006 - Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas
3) EN-13242+A1:2007 - Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction
4) EN 13139:2002 Aggregates for Mortar

Product description:

The product types declared are limestone aggregates manufactured by INTERBETON S.A. The declared site is Tanagra (Viotia), a crushing site of INTERBETON in Greece.

In 2021 (reference year of the assessment), around 1,1 million tons of aggregates were produced at the site (product list in Table 2). The declared product types are intended to be used as, e.g. mortar, asphalt, concrete and filling material in civil engineering.

Aggregates are produced in various fractions (product types). From blasted rock to finely crushed 0/4 mm sand (granules between 0 and 4 mm in diameter). There are 10 types of aggregates declared in this EPD (7 main and 3 mixes), representing

the products manufactured at the declared site (see Table 2).

According to the "Mineralogical – Petrographic study of Tanagra quarry sample (IGME, 11/06/2018)", results showed that the parent rock is limestone consisting almost entirely of calcite (CaCO3) (about 98.5%).

Physical – Mechanical properties of the studied aggregates:

- Compressive strength of parent rock 85.3 MPa (ELOT 408, §3.1)
- Resistance to fragmentation: Los Angeles Coefficient 25-30 (depending on aggregate's size) according to EN 1097-2
- Particle Density on a saturated and oven-dried basis (ρssd) 2,67 (Mg/m3), according to EN 1097-6.

Table 2: Product types declared (according to excavation and production)

No.	Products/Aggregates	Diameter (mm)	Production (ton/year 2021)
1	Crushed Gravel (Skyra)	31,5-63	16090
2	Crushed Gravel (Haliki)	16-31,5	172991
3	Crushed Gravel (Garbili)	8-16	157388
4	Crushed Gravel ((Garbili II)	4-11,2	27786
5	Pre-Crushed (Prospasma)	0-12	154148
6	Crushed Material	0-4	45120
7	Sand	0-4	547103
Total Production (A & B stages of crushing facility)			**1120626**
8	Mixed Gravel (0155)*	0-31,5	23000
9	Mixed Gravel (0150)*	0-31,5	20361
10	Mixed Embankment Fill (E4)*	0-31,5	19502
Total Excavated Material**			**1340550**

* Mixed products are produced from mix ratios of 5 main product types after production and do not participate in the A and B crushing stages.

** The excessive material that is not directed to production consists of a quantity of "raw limestone" (17891 tons) and a quantity of spoilage from excavation (202033 tons) that is replaced around the excavation site and is considered in the LCA calculations as inert waste.

UN CPC code:

The products declared are classified according to the United Nations Central Product Classification (UN CPC) 15200 and 15320.

Geographical scope: Worldwide

LCA INFORMATION

Functional unit / declared unit: one (1) tn (1.000 kg) of limestone aggregates

Reference service life: Declaration of the RSL is only possible if B1-B5 are included, so RSL is not assessed.

Time representativeness: The data used in the LCA study cover the reporting year of 2021.

Database(s) and LCA software used: ecoinvent database version 3.8, openLCA software version 1.10.3

Description of system boundaries:
The LCA assessment considers all identifiable activities to provide, as comprehensive as possible, a view of the products cradle-to-gate life cycle. According to EN 15804:2012+A2:2019 and PCR (Section 2.2.2) all three conditions are valid for the studied system, thus modules A1-A3 are being declared.

The system under study (Figure 1) includes raw material (limestone) extraction from limestone quarry (A1) and transportation to the processing facility, production (in terms of modules) and transportation of fuels and energy (A3), production and transportation of machinery consumables and product types participating in production processes (A3), processing of raw materials to produce the final products.

The 7 basic (main) product types (Skyra, Haliki, Garbili, Garbili II, Prospasma, Crushed Material, Sand) are being produced after several individual crushing and sieving processes that take place in primary and secondary crushing facilities. The 3 mixed product types (Type I/0155, Type II/0150, E4) are produced after mixing in a particular way and with a specific ratio basic product types, as stated in Excel sheets, using building machines (loaders). Electricity and fuel production for processes of module A3, are included in module A1 as instructed in EN 15804 (§6.3.5.2).

Data and assumptions are intended to reflect current equipment, processes and market conditions.

Personnel-related impacts, such as transportation to and from work, are not accounted for in the LCI.

System diagram

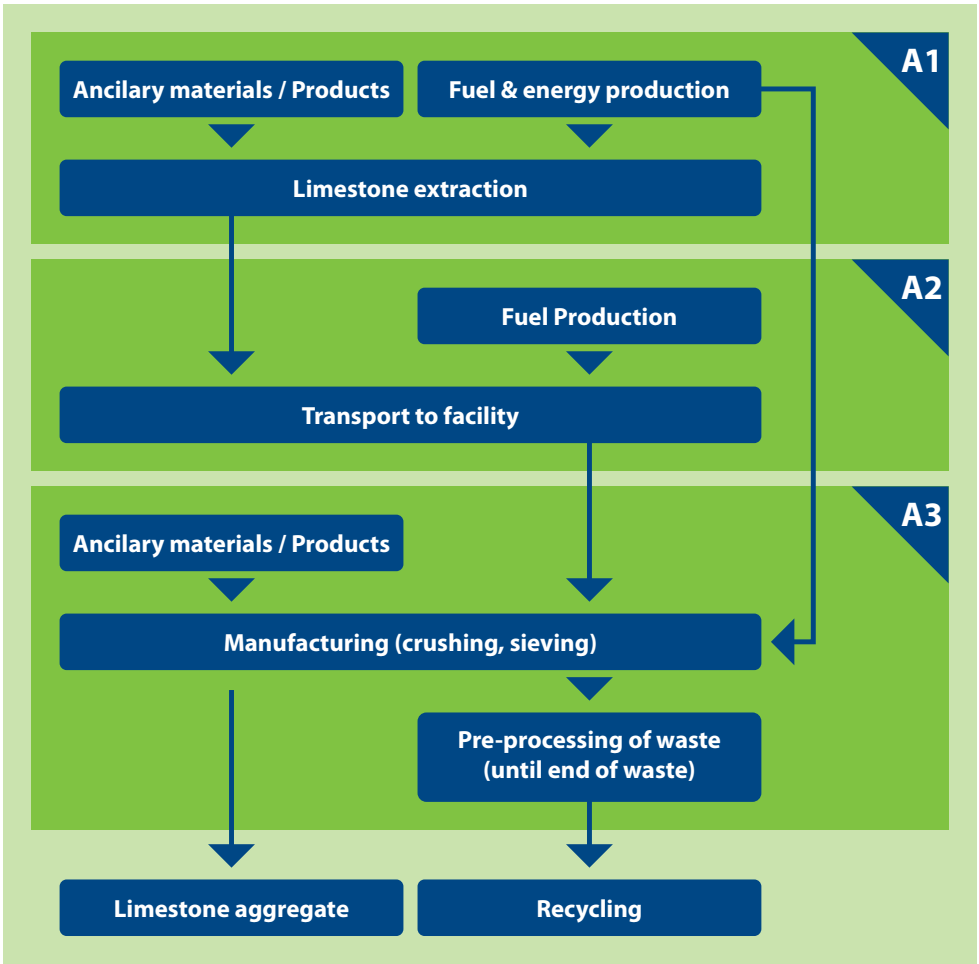


Figure 1. Flow diagram of the studied product system according to declared modules

More information:

- **Cut-off criteria**

All product components and production processes are included when the necessary information is readily available or a reasonable estimate can be made. It should be noted that generic data from the ecoinvent database (version 3.8) are included in the background system of this study in order to be as comprehensive as possible.

- **Primary data**

Modules: Primary data have been collected directly from INTERBETON's Tanagra quarry production process. The Input/Output data on the LCI were categorized into two main groups, excavation/extraction (module A1) and production/processing (module A3). More specifically, A1 includes excavated material, water, explosives (AN-FO, Ammonite), diesel and excavation area and A3 includes total production, water and production area data.

Quantities and electricity: For the 7 main product types (except mixes), production quantities and electricity consumption were also given as primary data. Electricity was calculated from INTERBETON, according to each product type's usage of specific processing equipment (crushers, sieves, conveyor belts, dust filters), so that electricity consumption has been partitioned among the product types. Data regarding mix ratios (from main product types) and diesel consumption (excavator) for the mixing process were also given.

Waste: Waste outputs (Table 3) regard production machinery consumables and their handling routes with coding according to EU Directive 2008/98. Even though the corresponding input consumables have a mass that is negligible compared to total input mass (almost 10-10 order of magnitude and much less than the <1% cut-off threshold according to EN 15804), they are considered in the LCI for purposes of I/O balance. For the case of lubricating oil, evaporation losses throughout operation are assumed to be negligible.

All wastes for recovery are being collected from producer facility by vehicles of waste handlers. For wastes with a positive value to the producer (machine solvents, oils, batteries, scrap metal) the end of waste system boundary (EN 15804) is set at the gate of the producer's facility. For wastes with negative value to the producer (absorbents), since their handling process is not directly specified (according to EU 2008/98), the end of waste system boundary is set at the handler's facility, thus the transportation of the waste is included in the studied product system. Used oil drums have zero value to producer, so the end of waste system boundary is also set at the producer's gate.

Table 3. Waste primary data

Waste type	Disposal/Recovery (EU 2008/98)	Value to the Producer	End-of-waste system boundary
Excavation			
Used lubricating oil	R9	+	Gate of the producer's facility
Used oil drums	R4	0	Gate of the producer's facility
Used batteries	R13	+	Gate of the producer's facility
Used machine solvents	R13	+	Gate of the producer's facility
Production			
Scrap metal	R12	+	Gate of the producer's facility
Used absorbents	R13	-	Handler's facility

Transportation: Transportation distances of materials, fuels and wastes have been recorded according to information from the producer (INTERBETON), based on site-specific averages (from supplier to INTERBETON and from INTERBETON to handler). Excavation site and primary crushing unit are placed at nearby areas. For this reason and due to aggregated primary data, the transportation of raw material from excavation site (module A1) to production facility/primary crushing (module A3) is included in machinery operations of module A1, instead of module A2 (GPI, PCR). Empty returns are also included for all transportation.

Land use occupation and transformation: Area of excavation site and processing facility combined with the total service life of the quarry and the average annual production.

Note: A full list of primary data sources and I/O values is available in the accompanying LCA study and the Microsoft Excel file. For calculation rules please refer to section "Allocation". For transformation of I/O of combustible material into I/O of energy, the net calorific value of fuels was applied according to EN 15804 requirements (section 6.4.2).

- **Generic data**

Additional datasets describing the remaining aspects of the life cycle were collected from the ecoinvent database v3.8. The datasets regard the particulate matter (PM2.5 and PM10) emissions during production, the upstream production of materials (water, explosives, lubricating oil, batteries, solvents, absorbents, metal components), fuels (diesel), energy (electricity) as well as operation of machinery and vehicles.

Electricity mix: National residual mix of Greece calculated from the Moderator of Renewable Energy Resources and Safety of Origin (DAPEEP) for 2021 and also published by the Association of Issuing Bodies. For the allocation of electricity derived from natural gas combustion to combined cycle power plant (CCPP) production and conventional power plant (CPP) production, a recording of Greek power plants was made (80% CCPP and 20% CPP). For hydroelectric production, the modelling choice of run-off river technology was applied, as most appropriate. Regarding the allocation of wind power production to the various available technology regarding turbines' capacity (<1 MW, 1 - 3 MW, >3 MW), the values of the corresponding registry of ecoinvent for the Greek electricity production mix were used.

- **Data Quality**

In the following Table 4, the overall quality of primary (site-specific) and generic data is assessed, according to the requirements of EN 15804.

Table 4: Overall data quality

Criteria	Data Type	Quality level	Comments
Geographical representativeness	Primary	Very good	Collected from the quarry
	Generic	Good	Depict average values in Greece and Europe (main material contributors and market for the product)
Technical representativeness	Primary	Very good	Actual processes
	Generic	Good/Fair	Good for processes of major share to overall mass/energy such as electricity generation Fair for processes with lesser share in mass/energy, such as metal components
Time representativeness	Primary	Very good	Almost the entirety of data from 2021
	Generic	Fair	Majority of them have been recorded within the last 10 years

- **Allocation**

Regarding module A1 there are no co-products occurring from the process, thus no allocation is needed. For module A3, there are also no co-products as outputs, however a series of several product types occur (same product – limestone – but different granulometries).

For electricity consumption (as mentioned before in Section "Quantities and electricity"), a partitioning of the total consumed electricity has been made from INTERBETON personnel to the several basic product types, according to each type's usage of the facility electricity powered equipment. Water consumption is highly dependent on this equipment operation, so an allocation of the primary data regarding the total production has been made to the basic product types, based on electricity consumption for each type's production.

Similarly, the input ancillary materials and their respective output wastes have been allocated to the basic product types according to electricity consumption, since they are also dependent to the operation of electricity-powered equipment.

Allocation procedure based on electricity consumption of each product type seems to be the optimum choice for allocation of I/O to these products, because:

- the allocated flows are indeed correlated with electricity consumption

- allocation based on different criteria (e.g. mass) would not be compatible with the particular product system, where multiple processes leading to product types are overlapping, instead of a straight-forward production line with one main product and several co-products.

A representative example is that although the product type "Sand" accounts for 47,27% of the total mass production, it consumes 78,45% of the total electricity consumption.

- **Electricity at manufacturing**

According to Construction Products PCR v.1.11 (Section 5.3.3), if the bought electricity used in module A3 accounts for more than 30% of the total electricity use in modules A1 to A3, the energy sources behind the electricity grid in module A3 shall be documented in the EPD and used LCA data given in kg CO2eq./kWh (using the GWP-GHG indicator).

None of the product types' energy use exceeds the 30% limit.

- **Packaging**

No packaging is used, limestone aggregates are delivered as bulk material.

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

	Product Stage			Construction Stage		Use Stage							End-of-life Stage				Resource Recovery
	Raw Materials Supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction and 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	ND	ND	ND	ND	ND
Geography	GR	GR	GR														
Specific data used	>90%			-		-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	not relevant			-		-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	not relevant			-		-	-	-	-	-	-	-	-	-	-	-	-

CONTENT INFORMATION

The products declared do not contain any substances of very high concern (SVHC) according to REACH. The below table presents the content declaration for the various product types. The products do not contain biogenic carbon and there is no packaging material.

Product Types	Product components	Weight, kg	Post-consumer material, weight-%	Renewable material, weight-%
10 (7 basic and 3 mixes)	Limestone	1000	0	0

ENVIRONMENTAL INFORMATION

The reference models and results of the life cycle impact assessment (method "EN 15804+A2", openLCA LCIA method package 2.1.2), based on the declared unit and each product type, can be found in the following tables (core and additional environmental indicators, use of resources, waste production and output flows). The EN 15804 reference package based on EF 3.0 has been used.

Impact category	Unit	Model
Climate change, GWP fossil	kg CO2 eq	IPCC 2013 100y + EC-JRC
Climate change, GWP biogenic	kg CO2 eq	IPCC 2013 100y + EC-JRC
Climate change, GWP land use and land use change	kg CO2 eq	IPCC 2013 100y + EC-JRC
Climate change, GWP total	kg CO2 eq	IPCC 2013 100y + EC-JRC
Climate change, GWP-GHG	kg CO2 eq	IPCC 2013 100y
Ozone depletion potential	kg CFC 11 eq	Steady-state ODPs, WMO 2014
Acidification potential	molc H+ eq	Accumulated Exceedance, Seppälä et al. 2006, Posch et al., 2008
Eutrophication, freshwater	kg PO4 eq	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication, freshwater	kg P eq	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication, marine	kg N eq	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication, terrestrial	mol N eq	Accumulated Exceedance, Seppälä et al. 2006, Posch et al.
Photochemical ozone formation	kg NMVOC eq	LOTOS-EUROS ,Van Zelm et al., 2008, as applied in ReCiPe
Depletion of abiotic resources - ADPE elements	kg Sb eq	CML 2002, Guinée et al., 2002, and van Oers et al. 2002.
Depletion of abiotic resources - ADPF fossil fuels	MJ	CML 2002, Guinée et al., 2002, and van Oers et al. 2002.
Water use	m3 deprived	Available WAter REmaining (AWARE) Boulay et al., 2016
Particulate matter, HH	Disease incidence	SETAC-UNEP, Fantke et al. 2016
Ionising radiation, HH	kBq U-235 eq	Human health effect model as developed by Dreicer et al. 1995 update by Frischknecht et al.,2000
Ecotoxicity, freshwater	CTUe	Usetox version 2 until the modified USEtox model is available from EC-JRC
Human toxicity, cancer effects	CTUh	Usetox version 2 until the modified USEtox model is available from EC-JRC
Human toxicity, non-cancer effects	CTUh	Usetox version 2 until the modified USEtox model is available from EC-JRC
Land use/SQP	dimensionless	Soil quality index based on LANCA
"Use of resourses" Indicators	MJ, Kg & m3	Cumulative Energy Demand (LHV), PRé Consultants
"Waste production" Indicators	Kg	Environmental Development of Industrial Products – EDIP
"Output flows" Indicators	Kg & MJ	openLCA LCIA methods, Anderson 2022

Potential environmental impact – mandatory indicators according to EN 15804

Results per declared unit											
Core environmental impact indicators – Total A1-A3*											
Indicator	Unit	Skyra	Haliki	Garbili	Garbili II	Prospasma	Crushed Material	Sand	Mixed (0155)	Mixed (0150)	Mixed E4
GWP-fossil	kg CO_2 eq.	2,92E+00	2,81E+00	2,81E+00	2,46E+00	2,17E+00	2,53E+00	4,55E+00	4,12E+00	3,31E+00	2,97E+00
GWP-biogenic	kg CO_2 eq.	2,94E-02	2,63E-02	2,61E-02	1,61E-02	8,03E-03	1,81E-02	7,58E-02	4,62E-02	2,32E-02	1,37E-02
GWP- luluc	kg CO_2 eq.	2,58E-04	2,42E-04	2,37E-04	2,04E-04	1,72E-04	2,15E-04	4,30E-04	3,31E-04	2,45E-04	2,13E-04
GWP- total	kg CO_2 eq.	2,95E+00	2,84E+00	2,83E+00	2,47E+00	2,18E+00	2,55E+00	4,63E+00	4,16E+00	3,33E+00	2,99E+00
GWP-GHG**	kg CO_2 eq	2,89E+00	2,78E+00	2,77E+00	2,43E+00	2,15E+00	2,50E+00	4,49E+00	4,07E+00	3,27E+00	2,94E+00
ODP	kg CFC 11 eq.	5,67E-07	5,47E-07	5,45E-07	4,80E-07	4,28E-07	4,93E-07	8,69E-07	8,07E-07	6,57E-07	5,95E-07
AP	mol H+ eq.	2,33E-02	2,28E-02	2,28E-02	2,10E-02	1,96E-02	2,14E-02	3,13E-02	3,25E-02	2,85E-02	2,69E-02
EP-freshwater	kg PO_4^3- eq.	2,83E-03	2,54E-03	2,53E-03	1,60E-03	8,62E-04	1,79E-03	7,06E-03	4,37E-03	2,27E-03	1,41E-03
EP-freshwater	kg P eq.	9,23E-04	8,29E-04	8,23E-04	5,22E-04	2,81E-04	5,82E-04	2,30E-03	1,42E-03	7,39E-04	4,58E-04
EP- marine	kg N eq.	8,24E-03	8,16E-03	8,15E-03	7,90E-03	7,71E-03	7,96E-03	9,39E-03	1,15E-02	1,09E-02	1,07E-02
EP-terrestrial	mol N eq.	9,31E-02	9,25E-02	9,24E-02	9,03E-02	8,86E-02	9,07E-02	1,03E-01	1,27E-01	1,23E-01	1,21E-01
POCP	kg NMVOC eq.	2,43E-02	2,41E-02	2,41E-02	2,34E-02	2,28E-02	2,35E-02	2,77E-02	3,39E-02	3,22E-02	3,16E-02
ADP-minerals & metals ***	kg Sb eq.	8,38E-06	8,16E-06	8,14E-06	7,43E-06	6,86E-06	7,58E-06	1,17E-05	9,64E-06	8,00E-06	7,33E-06
ADP-fossil***	MJ	3,96E+01	3,81E+01	3,79E+01	3,30E+01	2,90E+01	3,40E+01	6,27E+01	5,58E+01	4,43E+01	3,96E+01
WDP***	m3	1,39E+00	1,32E+00	1,31E+00	1,08E+00	8,90E-01	1,13E+00	2,47E+00	1,78E+00	1,24E+00	1,02E+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

* Results are presented in aggregated data form of each product stage (sum of A1, A2, A3) for each product type.

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

*** 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 & voluntary indicators*

Results per declared unit											
Additional environmental impact indicators – Total A1-A3											
Indicator	Unit	Skyra	Haliki	Garbili	Garbili II	Prospasma	Crushed Material	Sand	Mixed (0155)	Mixed (0150)	Mixed E4
PM	Disease incidence	4,72E-07	4,70E-07	4,70E-07	4,62E-07	4,56E-07	4,64E-07	5,07E-07	6,53E-07	6,36E-07	6,29E-07
IRP**	kBq U-235 eq	1,60E-01	1,54E-01	1,54E-01	1,35E-01	1,20E-01	1,39E-01	2,48E-01	2,26E-01	1,83E-01	1,65E-01
ETP-fw***	CTUe	1,97E+01	1,91E+01	1,90E+01	1,70E+01	1,54E+01	1,74E+01	2,89E+01	2,71E+01	2,25E+01	2,06E+01
HTP-c***	CTUh	9,97E-10	9,25E-10	9,19E-10	6,86E-10	4,97E-10	7,33E-10	2,08E-09	1,44E-09	9,00E-10	6,79E-10
HTP-nc***	CTUh	1,94E-08	1,86E-08	1,85E-08	1,58E-08	1,35E-08	1,63E-08	3,22E-08	2,70E-08	2,06E-08	1,80E-08
SQP***	dimensionless	5,93E+01	5,91E+01	5,91E+01	5,88E+01	5,85E+01	5,89E+01	6,09E+01	6,08E+01	6,00E+01	5,96E+01

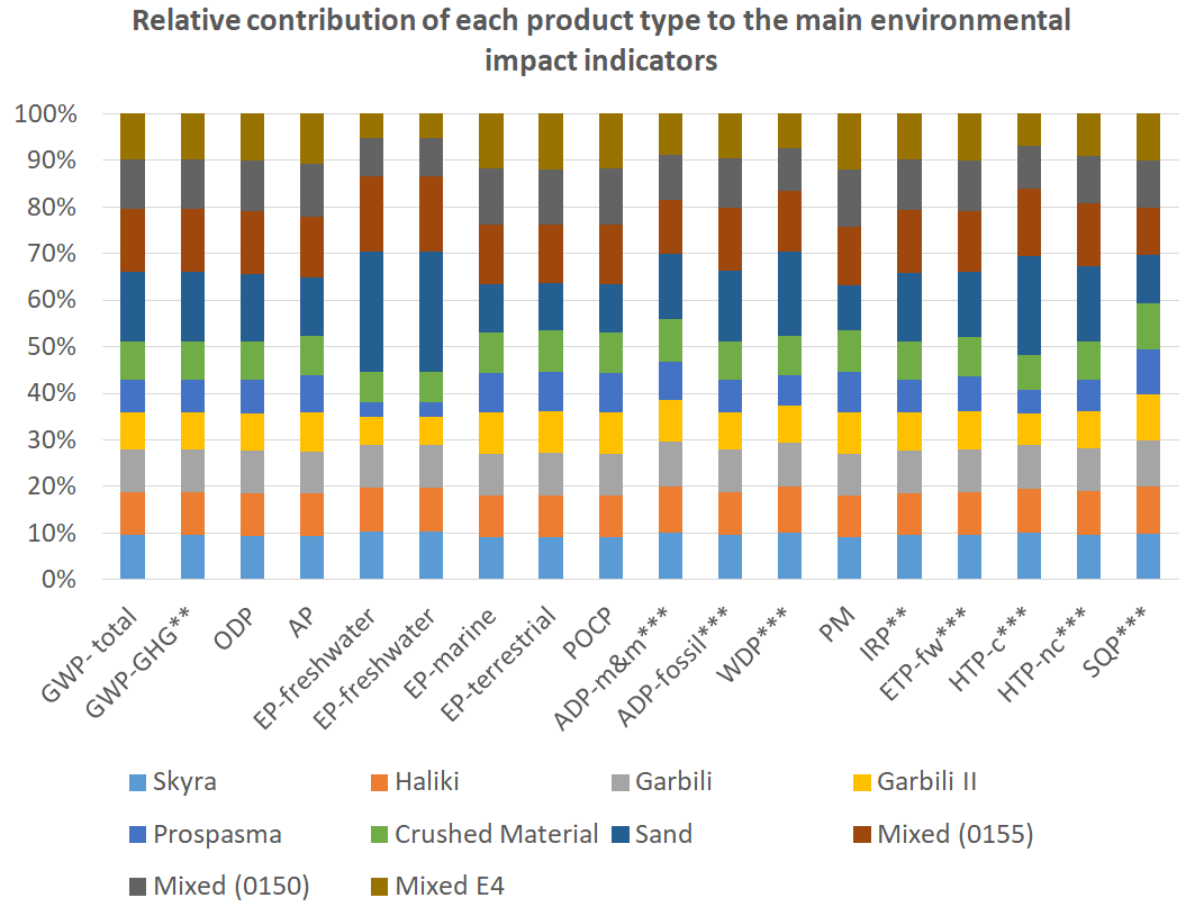
Acronyms

PM = Potential incidence of disease due to PM emissions; IRP = Potential Human exposure efficiency relative to U235; ETP-fw = Potential Comparative Toxic Unit for ecosystems; HTP-c = Potential Comparative Toxic Unit for Humans - cancer; HTP-nc = Potential Comparative Toxic Unit for humans - non-cancer; SQP = Potential soil quality index

* Mandatory indicators' calculations and results for the LCA Assessment (According to EN 15804, 7.2.3.2).

** Disclaimer: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

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



Use of resources

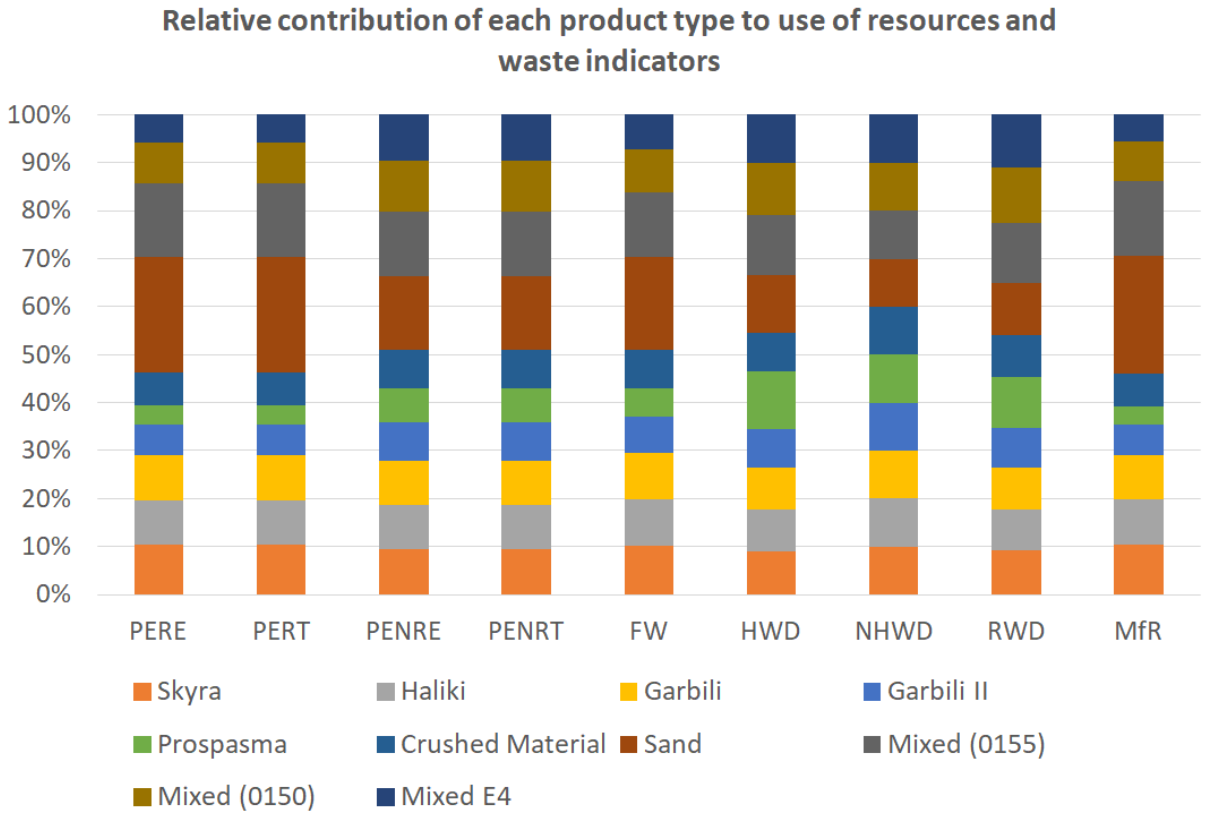
Results per declared unit (Total A1 – A3)											
Indicator	Unit	Skyra	Haliki	Garbili	Garbili II	Prospasma	Crushed Material	Sand	Mixed (0155)	Mixed (0150)	Mixed E4
PERE	MJ	1,15E+00	1,04E+00	1,04E+00	7,10E-01	4,46E-01	7,76E-01	2,66E+00	1,71E+00	9,52E-01	6,42E-01
PERM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	1,15E+00	1,04E+00	1,04E+00	7,10E-01	4,46E-01	7,76E-01	2,66E+00	1,71E+00	9,52E-01	6,42E-01
PENRE	MJ	3,96E+01	3,81E+01	3,79E+01	3,30E+01	2,90E+01	3,40E+01	6,27E+01	5,58E+01	4,43E+01	3,96E+01
PENRM	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
PENRT	MJ	3,96E+01	3,81E+01	3,79E+01	3,30E+01	2,90E+01	3,40E+01	6,27E+01	5,58E+01	4,43E+01	3,96E+01
SM	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
RSF	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
NRSF	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
FW	m3	2,49E-02	2,35E-02	2,33E-02	1,86E-02	1,47E-02	1,95E-02	4,70E-02	3,29E-02	2,19E-02	1,74E-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;

Waste production and output flows

Results per declared unit (Total A1 – A3)											
Waste production											
Indicator	Unit	Skyra	Haliki	Garbili	Garbili II	Prospasma	Crushed Material	Sand	Mixed (0155)	Mixed (0150)	Mixed E4
Hazardous waste disposed	kg	8,21E-05	8,00E-05	7,98E-05	7,28E-05	1,10E-04	7,43E-05	1,10E-04	1,15E-04	9,87E-05	9,21E-05
Non-hazardous waste disposed	kg	1,77E+02	1,77E+02	1,77E+02	1,77E+02	1,77E+02	1,77E+02	1,77E+02	1,77E+02	1,77E+02	1,77E+02
Radioactive waste disposed	kg	1,80E-04	1,70E-04	1,70E-04	1,60E-04	2,11E-04	1,70E-04	2,11E-04	2,47E-04	2,27E-04	2,16E-04
Output flows											
Components for re-use	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for recycling	kg	3,15E-02	2,86E-02	2,84E-02	1,90E-02	1,15E-02	2,09E-02	7,47E-02	4,70E-02	2,55E-02	1,66E-02
Materials for energy recovery	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
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


Relative contribution of each product type to use of resources and waste indicators
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
PERE
PERT
PENRE
PENRT
FW
HWD
NHWD
RWD
MfR
Skyra
Haliki
Garbili
Garbili II
Prospasma
Crushed Material
Sand
Mixed (0155)
Mixed (0150)
Mixed E4


MAN

ADDITIONAL INFORMATION

EPD Type: Single-company, product-specific EPD.

Integrated Annual Report 2022: https://www.titan-cement.com/newsroom/annualreports/

Interested parties can find more details about the company's environmental work on topics related to environmental management, climate change and circular economy, in the link below:

https://www.titan.gr/en/sustainability/environment

Differences versus previous versions

Original version

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