Type III Environmental Product Declaration No. 447/2023

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Group of ECO LINE concretes

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Basic information

This declaration is the Type III Environmental Product Declaration (EPD) based on EN 15804 and verified according to ISO 14025 by an external auditor. It contains the information on the impacts of the declared construction materials on the environment. Their aspects were verified by the independent body according to ISO 14025. Basically, a comparison or evaluation of EPD data is possible only if all the compared data were created according to EN 15804.

Life cycle analysis (LCA): modules A1-A4, C1-C4 and D in accordance with EN 15804
The year of preparing the EPD: 2022
Product standard: PN-EN 206+A2:2021-08 + PN-B-06265:2022-08
Service Life: no reference service life of concretes is declared as they are intermediate products
PCR: ITB-PCR A (PCR based on EN 15804+A2)
Declared unit: 1 m^3 of the concrete mix
Reasons for performing LCA: B2B
Representativeness: Polish, European

BASIC INFORMATION

Concrete manufacturer, BUDOKRUSZ is a private enterprise with 100% Polish capital, operating in the construction sector since 1990. It is a leading producer of ready-mixed concrete and paving stones in Poland. As a producer of ready-mixed concrete, company has own aggregate mines that guarantee production stability and the development of new technologies.
Declaration covers specific concrete group C30/37 produced by 8 concrete manufacturing plants owned by Budokrusz S.A. located in Poland.
Cement CEM III/A 42,5N-LH/HSR/NA and CEM II/AV 42,5R used for this concrete class are produced by technological leaders in the production of eco-cements in Poland. The life-cycle assessment was carried out according to the following standards: PN-EN 15804+A2, PN-EN ISO 14025, PN-EN ISO 14040 and the product categorization rules provided in document ITB PCR-A (latest version).
Declared reference unit is 1 m^3 of concrete mix. All LCI data was collected by Budokrusz S.A. from all 8 manufacturing plants between January and December 2021 (12 months) and gathered data is representative for a production technology used in 2021. LCA assessment was carried out using verified ITB algorithms dedicated to calculate the LCA and specific data for clinker and cement production and Ecoinvent data-sets. Specific cements production (used in concrete) is characterized by the use of alternative fuels and green electricity.
A concrete production takes place in modern, fully computer-controlled plants, guaranteeing the equality and repeatability of subsequent deliveries of concrete mix.

PRODUCTS DESCRIPTION

Concrete is specified and supplied in accordance with EN 206 with Polish amendment PN-B-06265. Concrete is used for site-mixed structures, precast structures and structural precast products in buildings prefabricated structures and structural prefabricated products in buildings and buildings. The product assessed is a specific 1 m^3 of mixed concrete, where the constituent proportions are provided in Table 1 based on average values from 8 plants.

Table 1. ECO Line Concretes - mix recipes in % per m^3

Element of mix	C30/37_ECO S3 XC4	C30/37_ECO S4 (W8)XC4 XA2	C30/37_ECO S3 (W8) XC4 XA2	C30/37_ECO S3 (W8,F150) XF3
CEM III/A 42,5N-LH/HSR/NA	6%	14%	14%	15%
CEM II/AV 42,5R	6%	-	-	-
Fly ash	3%	3%	3%	-
Sand/aggregates	79%	76%	78%	79%
Additives	Less than 1%	Less than 1%	Less than 1%	Less than 1%
Water	6%	6%	6%	6%

Ready-mixed concrete is commonly used in construction for: internal and external walls, roofs, foundations, piles, columns, supports, joists and other elements. More detailed information is available in the respective manufacturer's documentation (e.g. product data sheets available on request).

LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Unit

The declared unit is 1 m^3 of representative ECO LINE concretes based on recipes according to Table 1 produced in 8 plants (Białystok, Kłudno, Mszczonów, Mysiadło, Sokołów, Skierniewice, Warszawa Ks.Anny, Warszawa Grodziska). In order to obtain the impact results for 1 ton of concrete, the values in the Table 3 should be divided by the factor of density (approx.2.3 ton/m^3).

System boundary

The EPD covers the product stage analysis A3, A4 + end of life C and D ("cradle to gate" with options). The selected system boundaries comprise the production of input raw materials' extraction up to the finished product at the factory gate (ready concrete). The product stage contains: Module A1: extraction and processing of raw materials (ash, sand, gravel, additives, water, and cement) and fuels, Module A2: transportation up to factory gate of raw materials and primary fuels, Module A3: concrete production (mixing). Inputs and processes of product system are presented in Figure 1.

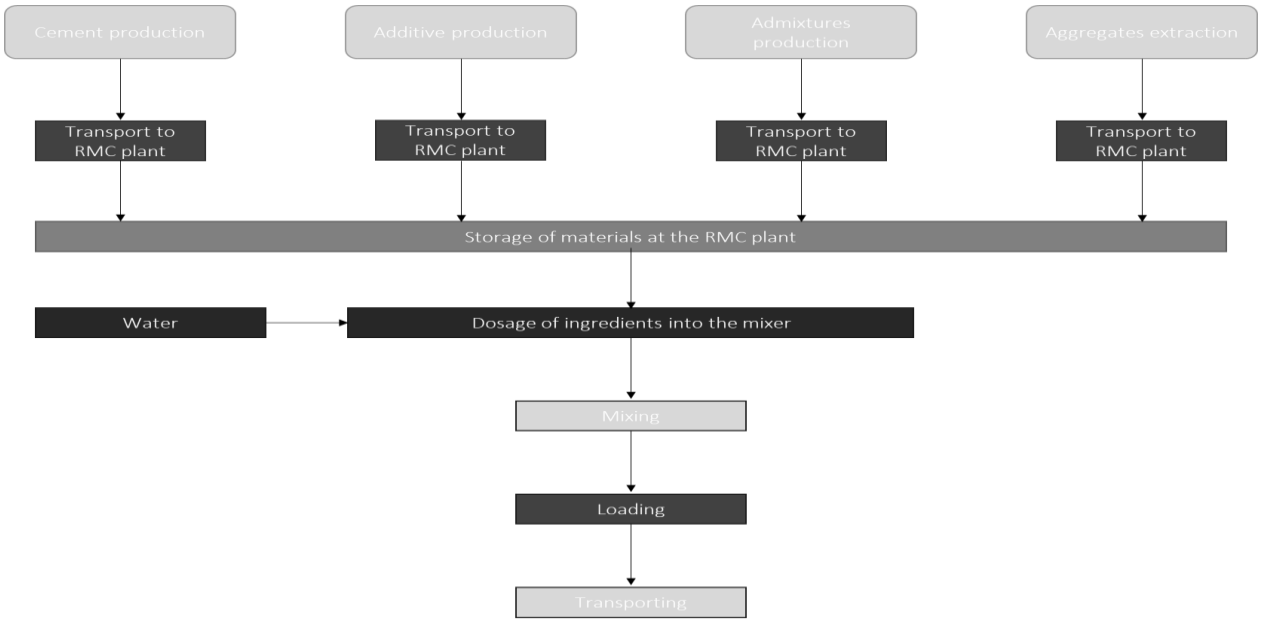

***Figure 1**. Concrete production scheme- Inputs and processes of the product system*

Allocation rules

The allocation rules used for this EPD are based on general ITB PCR A and EN 15804. Each manufacturing plant was subjected to LCI data analysis. The values adopted for the calculations were averaged from 8 plants using a weighted average. As no co-products are produced, the flow of materials and energy and also the associated release of substances and energy into the environment are related exclusively to the concrete mix produced. Cement used is produced in Poland and the weighted average mass of CEM III/A 42,5N-LH/HSR/NA and CEM II A/V 42,5 production was used for allocation. Minimum 99.5% of impacts from the production were allocated to product covered by this declaration. Emissions allocated in cement production are assessed by ITB using EN 15804+A2 (specific EPDs). Calculations for GWP indicator are made considering gross emissions. The indicated gross value includes the CO_2 emissions from waste incineration (excluding biomass fraction of fuels).

System limits

In this assessment, all information gathered from data collection for the production of concrete has been modelled, i.e. all raw materials used, the electrical energy and other fuels used (oil and diesel), use of ancillary materials and all direct production waste. Transport data on input was considered. The machines and facilities (capital goods) required for and during production are excluded, as is transportation of employees. Calculations

for GWP indicator are made considering gross emissions. The concrete recipe is based on weighted average data from 8 locations.

A1 – A2 Modules: Raw materials supply and transport

Concrete according to EN 206 + PN-B-06265 is made by mixing coarse and fine aggregates, cement and water in controlled proportions. Chemical admixtures are used to reduce water content and improve fresh and hardened concrete properties. The averaged compositions are provided in Table 1. Transport of input materials to 8 production plants was inventoried.

A3 Module Production

Substrates for concrete production are transported to the plant and then stored in silos. Electricity and oil are used for production. Substrates are weighed and mixed according to of the process shown in Figure 1. The production uses specific Polish cements. Water consumption for the concrete mix by the plant was allocated in A1.

A4 Module Transport to construction site

A distance of 15 km to construction site with a concrete truck was assumed.

Modules *C and D: End-of-life (EOL)*

The concrete end-of-life process scenario is generalized from the most common methods. The product (at the end of life in building) is to be removed from an object using heavy mechanical equipment. In the adapted end-of-life scenario, the de-constructed products are transported to a crushing plant distant by 100 km on > 16t lorry EURO 5, where undergo shredding with the use of crawler gear crusher (115 kW, electric drive) – module C3. Recovered materials undergo recycling (new aggregate production, 95%) and landfilling (5%) according to the actual treatment practice of concrete wastes. Environmental impacts declared in module C4 are associated with landfill (5%). Module D presents potential credits resulting from the use of crushed concrete wastes as new aggregates for a road foundation.

Data collection period

The data for manufacture of the declared products refer to period between 01.01.2021 – 31.12.2021 (1 year). The life cycle assessments were done for Poland as reference area.

Data quality - production

The values determined to calculate A1 (cement) and A3 originate from verified LCI inventory data from cement production plants (ITB-EPD) and 22 concrete production plants. A1 values (raw materials) were prepared considering specific data and Eco invent data for the aggregates and ashes.

Assumptions and estimates

Data regarding production per 1 m^3 of product were averaged for the analyzed production in accordance with the manufacturer's declaration. Part of the plant impacts, such as waste, has been assigned to the product by means of mass allocation.

Calculation rules

LCA was done in accordance with ITB PCR A document. Characterization factors are CML ver. 4.2 based. ITB-LCA algorithms were used for impact calculations. A1 was calculated based on data from specific cements like CEM III/A 42,5N-LH/HSR/NA and generic aggregates and water. Modules A3 and A2 are calculated based on the LCI questionnaires provided by the manufacturer.

Databases

The background data for the processes come from the following databases: Ecoinvent v.3.9 (sand, water, transport, additives, fly ash), specific data, specific emission reporting data for cements, KOBiZE (combustion factors for selected fuels, Polish electricity mix). Specific (LCI) data quality analysis was a part of audit. The time related quality of the data used is valid (5 years).

Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to EN 15804+A2 and the building context, respectively the product-specific characteristics of performance, are considered. In practice, this means that concrete may be compared in a specific application with the selected usage scenario.

LIFE CYCLE ASSESSMENT (LCA) – Results

Declared unit

The declaration refers to declared unit (DU) – 1 m^3 of concrete product the following life cycle modules (Table 2) were included in the analysis. The following Tables present the environmental impacts of the life cycle of product (4 types of ECO Line concretes – see Table 1).

Table 2. *System boundaries for the environmental characteristic included in LCA*

Environmental assessment information (MD – Module Declared, MND – Module Not Declared, INA – Indicator Not Assessed)															
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse-recovery-recycling potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
MD	**MD**	**MD**	**MD**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MD**	**MD**	**MD**	**MD**	**MD**

Table 3. Life cycle assessment (LCA) results of the precast concrete product C30/37_ECO S3 XC4- environmental impacts (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	1.60E+02	5.46E+01	1.88E+00	2.17E+02	3.83E-01	8.37E+00	3.83E+01	3.83E+01	1.22E+00	-2.19E+01
Greenhouse potential - fossil	eq. kg CO_2	1.60E+02	5.44E+01	1.82E+00	2.16E+02	3.81E-01	4.87E+00	3.81E+01	3.81E+01	1.21E+00	-2.19E+01
Greenhouse potential - biogenic	eq. kg CO_2	5.06E-01	1.86E-01	5.33E-02	7.45E-01	1.30E-03	1.09E-02	1.30E-01	1.30E-01	1.22E-02	-1.31E-03
Global warming potential - land use and land use change	eq. kg CO_2	3.23E-02	2.13E-02	6.04E-04	5.43E-02	1.50E-04	1.31E-03	1.50E-02	1.50E-02	1.22E-03	-1.00E-01
Stratospheric ozone depletion potential	eq. kg CFC 11	5.79E-06	1.26E-05	6.44E-08	1.84E-05	8.83E-08	9.77E-07	8.83E-06	8.83E-06	3.68E-07	-4.10E-06
Soil and water acidification potential	eq. mol H+	5.13E-01	2.21E-01	1.96E-02	7.53E-01	1.55E-03	1.29E-01	1.55E-01	1.55E-01	1.02E-02	-9.16E-01
Eutrophication potential - freshwater	eq. kg P	2.03E-02	3.65E-03	3.20E-03	2.72E-02	2.56E-05	6.61E-03	2.56E-03	2.56E-03	3.51E-04	-3.32E-02
Eutrophication potential - seawater	eq. kg N	1.27E+02	6.66E-02	3.26E-03	1.27E+02	4.67E-04	2.83E-02	4.67E-02	4.67E-02	3.52E-03	-8.13E-02
Eutrophication potential - terrestrial	eq. mol N	1.53E+00	7.26E-01	2.46E-02	2.28E+00	5.10E-03	3.09E-01	5.10E-01	5.10E-01	3.83E-02	-1.09E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	4.25E-01	2.22E-01	6.88E-03	6.55E-01	1.56E-03	8.12E-02	1.56E-01	1.56E-01	1.11E-02	-2.62E-01
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	4.61E-04	1.93E-04	8.33E-06	6.62E-04	1.35E-06	2.82E-05	1.35E-04	1.35E-04	4.09E-06	-6.50E-03
Abiotic depletion potential - fossil fuels	MJ	7.12E+02	8.07E+02	3.02E+01	1.55E+03	5.66E+00	6.31E+01	5.66E+02	5.66E+02	2.79E+01	-7.66E+02
Water deprivation potential	eq. m^3	5.12E+01	3.73E+00	6.78E-01	5.56E+01	2.62E-02	2.39E-01	2.62E+00	2.62E+00	1.62E-01	-5.67E+01

Table 4. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S3 XC4 – additional impacts indicators (DU: 1 m^3)

Indicator	Unit	A1-A4	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA

Table 5. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S3 XC4- the resource use (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Consumption of renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Total consumption of renewable primary energy resources	MJ	1.83E+02	1.16E+01	2.12E+00	1.97E+02	8.12E-02	6.92E-01	8.12E+00	8.12E+00	4.90E-01	-8.80E+01
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Consumption of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Total consumption of non-renewable primary energy resources	MJ	7.14E+02	8.07E+02	3.04E+01	1.55E+03	5.66E+00	7.13E+01	5.66E+02	5.66E+02	3.02E+01	-7.67E+02
Consumption of secondary materials	kg	9.27E+01	2.70E-01	2.97E-03	9.30E+01	1.90E-03	0.00E+00	1.90E-01	1.90E-01	6.07E-06	2.18E+03
Consumption of renew. secondary fuels	MJ	3.90E+02	2.98E-03	1.53E-05	3.90E+02	2.09E-05	4.09E-06	2.09E-03	2.09E-03	1.59E-07	-2.82E-02
Consumption of non-renewable secondary fuels	MJ	2.94E+02	0.00E+00	2.29E-02	2.94E+02	0.00E+00	6.89E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	8.34E+00	1.02E-01	2.78E-02	8.47E+00	7.12E-04	3.22E-03	7.12E-02	7.12E-02	4.39E-03	-1.39E+00

Table 6. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S3 XC4– waste categories (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	1.96E+00	9.05E-01	1.69E-03	2.87E+00	6.35E-03	8.76E-03	6.35E-01	6.35E-01	7.46E-05	-5.34E+00
Non-hazardous waste	kg	1.09E+02	1.61E+01	2.14E-01	1.26E+02	1.13E-01	1.62E-01	1.13E+01	1.13E+01	1.15E+02	-1.49E+02
Radioactive waste	kg	4.82E-04	6.02E-05	3.39E-05	5.76E-04	4.23E-07	4.34E-04	4.23E-05	4.23E-05	1.70E-04	-2.02E-03
Components for re-use	kg	3.25E-01	0.00E+00	0.00E+00	3.25E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	2.29E+00	2.50E-03	2.10E-01	2.50E+00	1.75E-05	3.86E-08	1.75E-03	1.75E-03	5.78E-08	-1.04E-02
Materials for energy recovery	kg	1.63E-05	2.02E-05	2.70E-07	3.68E-05	1.42E-07	9.20E-10	1.42E-05	1.42E-05	6.85E-10	-9.63E-04
Exported Energy	MJ	1.63E+01	0.00E+00	8.88E-02	1.64E+01	0.00E+00	5.60E-03	0.00E+00	0.00E+00	0.00E+00	-2.08E+00

Table 7. Life cycle assessment (LCA) results of the precast concrete product C30/37_ECO S4 (W8) XC4 XA2- environmental impacts (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	1.52E+02	5.46E+01	1.88E+00	2.09E+02	3.83E-01	8.37E+00	3.83E+01	3.83E+01	1.22E+00	-2.19E+01
Greenhouse potential - fossil	eq. kg CO_2	1.52E+02	5.44E+01	1.82E+00	2.08E+02	3.81E-01	4.87E+00	3.81E+01	3.81E+01	1.21E+00	-2.19E+01
Greenhouse potential - biogenic	eq. kg CO_2	5.62E-01	1.86E-01	5.33E-02	8.01E-01	1.30E-03	1.09E-02	1.30E-01	1.30E-01	1.22E-02	-1.31E-03
Global warming potential - land use and land use change	eq. kg CO_2	3.71E-02	2.13E-02	6.04E-04	5.91E-02	1.50E-04	1.31E-03	1.50E-02	1.50E-02	1.22E-03	-1.00E-01
Stratospheric ozone depletion potential	eq. kg CFC 11	3.22E-06	1.26E-05	6.44E-08	1.59E-05	8.83E-08	9.77E-07	8.83E-06	8.83E-06	3.68E-07	-4.10E-06
Soil and water acidification potential	eq. mol H+	5.00E-01	2.21E-01	1.96E-02	7.40E-01	1.55E-03	1.29E-01	1.55E-01	1.55E-01	1.02E-02	-9.16E-01
Eutrophication potential - freshwater	eq. kg P	1.42E-02	3.65E-03	3.20E-03	2.11E-02	2.56E-05	6.61E-03	2.56E-03	2.56E-03	3.51E-04	-3.32E-02
Eutrophication potential - seawater	eq. kg N	1.38E+02	6.66E-02	3.26E-03	1.38E+02	4.67E-04	2.83E-02	4.67E-02	4.67E-02	3.52E-03	-8.13E-02
Eutrophication potential - terrestrial	eq. mol N	1.30E+00	7.26E-01	2.46E-02	2.05E+00	5.10E-03	3.09E-01	5.10E-01	5.10E-01	3.83E-02	-1.09E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	3.40E-01	2.22E-01	6.88E-03	5.70E-01	1.56E-03	8.12E-02	1.56E-01	1.56E-01	1.11E-02	-2.62E-01
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.51E-04	1.93E-04	8.33E-06	3.52E-04	1.35E-06	2.82E-05	1.35E-04	1.35E-04	4.09E-06	-6.50E-03
Abiotic depletion potential - fossil fuels	MJ	8.87E+02	8.07E+02	3.02E+01	1.72E+03	5.66E+00	6.31E+01	5.66E+02	5.66E+02	2.79E+01	-7.66E+02
Water deprivation potential	eq. m^3	5.12E+01	3.73E+00	6.78E-01	5.56E+01	2.62E-02	2.39E-01	2.62E+00	2.62E+00	1.62E-01	-5.67E+01

Table 8. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S4 (W8) XC4 XA2– additional impacts indicators (DU: 1 m^3)

Indicator	Unit	A1-A4	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA

Table 9. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S4 (W8) XC4 XA2- the resource use (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Consumption of renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Total consumption of renewable primary energy resources	MJ	9.70E+01	1.16E+01	2.12E+00	1.11E+02	8.12E-02	6.92E-01	8.12E+00	8.12E+00	4.90E-01	-8.80E+01
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Consumption of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Total consumption of non-renewable primary energy resources	MJ	8.87E+02	8.07E+02	3.04E+01	1.72E+03	5.66E+00	7.13E+01	5.66E+02	5.66E+02	3.02E+01	-7.67E+02
Consumption of secondary materials	kg	1.99E+02	2.70E-01	2.97E-03	1.99E+02	1.90E-03	0.00E+00	1.90E-01	1.90E-01	6.07E-06	2.18E+03
Consumption of renew. secondary fuels	MJ	2.12E+02	2.98E-03	1.53E-05	2.12E+02	2.09E-05	4.09E-06	2.09E-03	2.09E-03	1.59E-07	-2.82E-02
Consumption of non-renewable secondary fuels	MJ	3.61E+02	0.00E+00	2.29E-02	3.61E+02	0.00E+00	6.89E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	1.62E+01	1.02E-01	2.78E-02	1.64E+01	7.12E-04	3.22E-03	7.12E-02	7.12E-02	4.39E-03	-1.39E+00

Table 10. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S4 (W8) XC4 XA2– waste categories (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	2.10E+00	9.05E-01	1.69E-03	3.00E+00	6.35E-03	8.76E-03	6.35E-01	6.35E-01	7.46E-05	-5.34E+00
Non-hazardous waste	kg	1.22E+02	1.61E+01	2.14E-01	1.38E+02	1.13E-01	1.62E-01	1.13E+01	1.13E+01	1.15E+02	-1.49E+02
Radioactive waste	kg	4.78E-04	6.02E-05	3.39E-05	5.72E-04	4.23E-07	4.34E-04	4.23E-05	4.23E-05	1.70E-04	-2.02E-03
Components for re-use	kg	7.90E-01	0.00E+00	0.00E+00	7.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	2.35E+00	2.50E-03	2.10E-01	2.56E+00	1.75E-05	3.86E-08	1.75E-03	1.75E-03	5.78E-08	-1.04E-02
Materials for energy recovery	kg	1.60E-05	2.02E-05	2.70E-07	3.64E-05	1.42E-07	9.20E-10	1.42E-05	1.42E-05	6.85E-10	-9.63E-04
Exported Energy	MJ	1.80E+01	0.00E+00	8.88E-02	1.81E+01	0.00E+00	5.60E-03	0.00E+00	0.00E+00	0.00E+00	-2.08E+00

Table 11. Life cycle assessment (LCA) results of the precast concrete product C30/37_ECO S3 (W8) XC4 XA2- environmental impacts (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	1.43E+02	5.46E+01	1.88E+00	1.99E+02	3.83E-01	8.37E+00	3.83E+01	3.83E+01	1.22E+00	-2.19E+01
Greenhouse potential - fossil	eq. kg CO_2	1.42E+02	5.44E+01	1.82E+00	1.99E+02	3.81E-01	4.87E+00	3.81E+01	3.81E+01	1.21E+00	-2.19E+01
Greenhouse potential - biogenic	eq. kg CO_2	5.28E-01	1.86E-01	5.33E-02	7.67E-01	1.30E-03	1.09E-02	1.30E-01	1.30E-01	1.22E-02	-1.31E-03
Global warming potential - land use and land use change	eq. kg CO_2	3.52E-02	2.13E-02	6.04E-04	5.71E-02	1.50E-04	1.31E-03	1.50E-02	1.50E-02	1.22E-03	-1.00E-01
Stratospheric ozone depletion potential	eq. kg CFC 11	3.03E-06	1.26E-05	6.44E-08	1.57E-05	8.83E-08	9.77E-07	8.83E-06	8.83E-06	3.68E-07	-4.10E-06
Soil and water acidification potential	eq. mol H+	4.72E-01	2.21E-01	1.96E-02	7.13E-01	1.55E-03	1.29E-01	1.55E-01	1.55E-01	1.02E-02	-9.16E-01
Eutrophication potential - freshwater	eq. kg P	1.33E-02	3.65E-03	3.20E-03	2.02E-02	2.56E-05	6.61E-03	2.56E-03	2.56E-03	3.51E-04	-3.32E-02
Eutrophication potential - seawater	eq. kg N	1.27E+02	6.66E-02	3.26E-03	1.27E+02	4.67E-04	2.83E-02	4.67E-02	4.67E-02	3.52E-03	-8.13E-02
Eutrophication potential - terrestrial	eq. mol N	1.23E+00	7.26E-01	2.46E-02	1.98E+00	5.10E-03	3.09E-01	5.10E-01	5.10E-01	3.83E-02	-1.09E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	3.22E-01	2.22E-01	6.88E-03	5.51E-01	1.56E-03	8.12E-02	1.56E-01	1.56E-01	1.11E-02	-2.62E-01
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.48E-04	1.93E-04	8.33E-06	3.49E-04	1.35E-06	2.82E-05	1.35E-04	1.35E-04	4.09E-06	-6.50E-03
Abiotic depletion potential - fossil fuels	MJ	8.29E+02	8.07E+02	3.02E+01	1.67E+03	5.66E+00	6.31E+01	5.66E+02	5.66E+02	2.79E+01	-7.66E+02
Water deprivation potential	eq. m^3	5.12E+01	3.73E+00	6.78E-01	5.56E+01	2.62E-02	2.39E-01	2.62E+00	2.62E+00	1.62E-01	-5.67E+01

Table 12. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S3 (W8) XC4 XA2– additional impacts indicators (DU: 1 m^3)

Indicator	Unit	A1-A4	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA

Table 13. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S3 (W8) XC4 XA2- the resource use (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Consumption of renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Total consumption of renewable primary energy resources	MJ	9.38E+01	1.16E+01	2.12E+00	1.07E+02	8.12E-02	6.92E-01	8.12E+00	8.12E+00	4.90E-01	-8.80E+01
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Consumption of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Total consumption of non-renewable primary energy resources	MJ	8.29E+02	8.07E+02	3.04E+01	1.67E+03	5.66E+00	7.13E+01	5.66E+02	5.66E+02	3.02E+01	-7.67E+02
Consumption of secondary materials	kg	1.87E+02	2.70E-01	2.97E-03	1.88E+02	1.90E-03	0.00E+00	1.90E-01	1.90E-01	6.07E-06	2.18E+03
Consumption of renew. secondary fuels	MJ	2.00E+02	2.98E-03	1.53E-05	2.00E+02	2.09E-05	4.09E-06	2.09E-03	2.09E-03	1.59E-07	-2.82E-02
Consumption of non-renewable secondary fuels	MJ	3.40E+02	0.00E+00	2.29E-02	3.40E+02	0.00E+00	6.89E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	8.34E+00	1.02E-01	2.78E-02	8.47E+00	7.12E-04	3.22E-03	7.12E-02	7.12E-02	4.39E-03	-1.39E+00

Table 14. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S3 (W8) XC4 XA2– waste categories (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	1.95E+00	9.05E-01	1.69E-03	2.86E+00	6.35E-03	8.76E-03	6.35E-01	6.35E-01	7.46E-05	-5.34E+00
Non-hazardous waste	kg	9.31E+01	1.61E+01	2.14E-01	1.09E+02	1.13E-01	1.62E-01	1.13E+01	1.13E+01	1.15E+02	-1.49E+02
Radioactive waste	kg	4.77E-04	6.02E-05	3.39E-05	5.71E-04	4.23E-07	4.34E-04	4.23E-05	4.23E-05	1.70E-04	-2.02E-03
Components for re-use	kg	7.44E-01	0.00E+00	0.00E+00	7.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	2.21E+00	2.50E-03	2.10E-01	2.42E+00	1.75E-05	3.86E-08	1.75E-03	1.75E-03	5.78E-08	-1.04E-02
Materials for energy recovery	kg	1.60E-05	2.02E-05	2.70E-07	3.65E-05	1.42E-07	9.20E-10	1.42E-05	1.42E-05	6.85E-10	-9.63E-04
Exported Energy	MJ	1.54E+01	0.00E+00	8.88E-02	1.55E+01	0.00E+00	5.60E-03	0.00E+00	0.00E+00	0.00E+00	-2.08E+00

Table 15. Life cycle assessment (LCA) results of the precast concrete product C30/37_ECO S3 (W8, F150) XF3 environmental impacts (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	1.54E+02	5.46E+01	1.88E+00	2.10E+02	3.83E-01	8.37E+00	3.83E+01	3.83E+01	1.22E+00	-2.19E+01
Greenhouse potential - fossil	eq. kg CO_2	1.53E+02	5.44E+01	1.82E+00	2.09E+02	3.81E-01	4.87E+00	3.81E+01	3.81E+01	1.21E+00	-2.19E+01
Greenhouse potential - biogenic	eq. kg CO_2	4.66E-01	1.86E-01	5.33E-02	7.05E-01	1.30E-03	1.09E-02	1.30E-01	1.30E-01	1.22E-02	-1.31E-03
Global warming potential - land use and land use change	eq. kg CO_2	3.74E-02	2.13E-02	6.04E-04	5.94E-02	1.50E-04	1.31E-03	1.50E-02	1.50E-02	1.22E-03	-1.00E-01
Stratospheric ozone depletion potential	eq. kg CFC 11	3.26E-06	1.26E-05	6.44E-08	1.59E-05	8.83E-08	9.77E-07	8.83E-06	8.83E-06	3.68E-07	-4.10E-06
Soil and water acidification potential	eq. mol H+	5.02E-01	2.21E-01	1.96E-02	7.42E-01	1.55E-03	1.29E-01	1.55E-01	1.55E-01	1.02E-02	-9.16E-01
Eutrophication potential - freshwater	eq. kg P	1.38E-02	3.65E-03	3.20E-03	2.07E-02	2.56E-05	6.61E-03	2.56E-03	2.56E-03	3.51E-04	-3.32E-02
Eutrophication potential - seawater	eq. kg N	1.32E+02	6.66E-02	3.26E-03	1.32E+02	4.67E-04	2.83E-02	4.67E-02	4.67E-02	3.52E-03	-8.13E-02
Eutrophication potential - terrestrial	eq. mol N	1.30E+00	7.26E-01	2.46E-02	2.05E+00	5.10E-03	3.09E-01	5.10E-01	5.10E-01	3.83E-02	-1.09E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	3.34E-01	2.22E-01	6.88E-03	5.63E-01	1.56E-03	8.12E-02	1.56E-01	1.56E-01	1.11E-02	-2.62E-01
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.49E-04	1.93E-04	8.33E-06	3.50E-04	1.35E-06	2.82E-05	1.35E-04	1.35E-04	4.09E-06	-6.50E-03
Abiotic depletion potential - fossil fuels	MJ	8.57E+02	8.07E+02	3.02E+01	1.69E+03	5.66E+00	6.31E+01	5.66E+02	5.66E+02	2.79E+01	-7.66E+02
Water deprivation potential	eq. m^3	5.12E+01	3.73E+00	6.78E-01	5.56E+01	2.62E-02	2.39E-01	2.62E+00	2.62E+00	1.62E-01	-5.67E+01

Table 16. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S3 (W8, F150) XF3– additional impacts indicators (DU: 1 m^3)

Indicator	Unit	A1-A4	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA

Table 17. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S3 (W8, F150) XF3- the resource use (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Consumption of renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Total consumption of renewable primary energy resources	MJ	9.88E+01	1.16E+01	2.12E+00	1.12E+02	8.12E-02	6.92E-01	8.12E+00	8.12E+00	4.90E-01	-8.80E+01
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Consumption of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Total consumption of non-renewable primary energy resources	MJ	8.57E+02	8.07E+02	3.04E+01	1.69E+03	5.66E+00	7.13E+01	5.66E+02	5.66E+02	3.02E+01	-7.67E+02
Consumption of secondary materials	kg	2.05E+02	2.70E-01	2.97E-03	2.05E+02	1.90E-03	0.00E+00	1.90E-01	1.90E-01	6.07E-06	2.18E+03
Consumption of renew. secondary fuels	MJ	2.18E+02	2.98E-03	1.53E-05	2.18E+02	2.09E-05	4.09E-06	2.09E-03	2.09E-03	1.59E-07	-2.82E-02
Consumption of non-renewable secondary fuels	MJ	3.71E+02	0.00E+00	2.29E-02	3.72E+02	0.00E+00	6.89E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	8.34E+00	1.02E-01	2.78E-02	8.47E+00	7.12E-04	3.22E-03	7.12E-02	7.12E-02	4.39E-03	-1.39E+00

Table 18. Life cycle assessment (LCA) results of the precast concrete C30/37_ECO S3 (W8, F150) XF3– waste categories (DU: 1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	2.00E+00	9.05E-01	1.69E-03	2.91E+00	6.35E-03	8.76E-03	6.35E-01	6.35E-01	7.46E-05	-5.34E+00
Non-hazardous waste	kg	6.81E+00	1.61E+01	2.14E-01	2.31E+01	1.13E-01	1.62E-01	1.13E+01	1.13E+01	1.15E+02	-1.49E+02
Radioactive waste	kg	4.72E-04	6.02E-05	3.39E-05	5.66E-04	4.23E-07	4.34E-04	4.23E-05	4.23E-05	1.70E-04	-2.02E-03
Components for re-use	kg	8.13E-01	0.00E+00	0.00E+00	8.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	2.41E+00	2.50E-03	2.10E-01	2.63E+00	1.75E-05	3.86E-08	1.75E-03	1.75E-03	5.78E-08	-1.04E-02
Materials for energy recovery	kg	1.53E-05	2.02E-05	2.70E-07	3.57E-05	1.42E-07	9.20E-10	1.42E-05	1.42E-05	6.85E-10	-9.63E-04
Exported Energy	MJ	1.04E+01	0.00E+00	8.88E-02	1.05E+01	0.00E+00	5.60E-03	0.00E+00	0.00E+00	0.00E+00	-2.08E+00

Verification

The process of verification of this EPD is in accordance with ISO 14025 and ISO 21930. After verification, this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years, if the underlying data have not changed significantly.

The basis for LCA analysis was EN 15804 and ITB PCR A
Independent verification corresponding to ISO 14025 (sub clause 8.1.3.) [x] external [ ] internal
External verification of EPD: Halina Prejzner, PhD. Eng. LCA, LCI audit and input data verification: Michał Piasecki, PhD., D.Sc., Eng.

Note: The declaration owner has the sole ownership, liability, and responsibility for the declaration. Declarations 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.

Normative references

- ITB PCR A General Product Category Rules for Construction Products
- PN-EN 206+A2:2021-08: Concrete. Specification, performance, production and conformity
- PN-B-06265:2022-08: Beton - Wymagania, właściwości użytkowe, produkcja i zgodność - Krajowe uzupełnienie PN-EN 206+A2:2021-08
- PN-EN 197-1:2012: Cement - part 1: Composition. specifications and conformity criteria for common cements
- PN-EN ISO 14025:2010 Environmental labels and declarations. Type III environmental declarations. Principles and procedures.
- PN-EN 15804+A2:2020-03 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.
- PN-EN 16908:2017-02 Cement and building lime. Environmental product declarations. Product category rules complementary to EN 158044.
- PN-EN ISO 14040:2009 Environmental management - Life cycle assessment - Principles and frame-work
- ECRA (European Cement Research Academy) – Background report “TR-ECRA 0181/2014 Environmental Product Declarations for representative European cements “
- PN-EN 15942:2012 Sustainability of construction works – Environmental product declarations – Communication format business-to-business
- PN-B-19707:2013-10: Cement - Cement specjalny - Skład, wymagania i kryteria zgodności

Signature Not Verified
Dokument podpisany przez
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CERTIFICATE № 447/2023
of TYPE III ENVIRONMENTAL DECLARATION

Products:

Group of ECO LINE concretes

Manufacturer:

Budokrusz S.A.

Odrano Wola, ul. Osowiecka 47, 05-825 Grodzisk Mazowiecki, Poland

confirms the correctness of the data included in the development of
Type III Environmental Declaration and accordance with the requirements of the standard

EN 15804+A2

Sustainability of construction works.
Environmental product declarations.
Core rules for the product category of construction products.

This certificate, issued on 11* April 2023 is valid for 5 years
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics and Environment Department
Agnieszka Winkler-Skalna, PhD

INSTYTUT TECHNIKI BUDOWLANEJ

Deputy Director for Research and Innovation
Krzysztof Kuczyński, PhD

Warsaw, April 2023