Łukasiewicz
Institute of Ceramics
and Building Materials

HOLCIM

ENVIRONMENTAL PRODUCT DECLARATION

no. 04-12/2023/1

HOLCIM STONE WOOL

Holcim Polska S.A.

Owner of the EPD:	*Holcim Polska S.A.*
Programme owner:	*Łukasiewicz Research Network – Institute of Ceramics and Building Materials*
Name of programme:	*Deklaracje Środowiskowe Produktów – B2B*
Issued:	***13.12.2023***
Valid until:	***13.12.2028***

1. GENERAL INFORMATION

Owner of the EPD: Holcim Polska S.A.	**Products covered by the EPD:** Holcim stone wool with density ρ = 30-200 kg/m^3 (avg. density ρ = 115 kg/m^3)
Programme owner: Łukasiewicz Research Network - Institute for Ceramics And Building Materials Environmental Engineering Center **http://www.icimb.pl/opole/**	**Właściciel deklaracji:** Holcim Polska S.A. ul. Warszawska 110, 28-366 Małogoszcz Telefon: +48 41 248 7000 Adres: e-mail: recepcja.malogoszcz@holcim.com **www.holcim.pl/welna-skalna**
Date of issuance: 13.12.2023	**Declared product/declared unit :** Declared unit (DU) is 1 m^3 (1 cubic meter) of stone wool with a density ρ = 115 kg/m^3. Additionally, the results have been calculated for 1 m^2 (1 square meter) of stone wool with thickness ensuring thermal resistance of R = 1 m^{2}K/W.
EPD valid until: 13.12.2028	**Scope:** Declaration covers total production of stone wool with density ρ = 30-200 kg/m^3 produced by Holcim Polska S.A. in Wykroty, 55 Wyzwolenia str. It contains information about the impact of the declared products on the environment. All data on the production cycle have been collected by Holcim Polska S.A. from 01.05.2021 until 30.04.2022 (12 months) and correspond to the production technology of that time. These data are averaged over the plant's total stone wool production. The life cycle assessment has been developed in accordance with the requirements of PN-EN ISO 15804+A2:2020, PN-EN ISO 14025 and PN-EN ISO 14040. The rules for product categorization have been adopted in accordance with with the PN-EN 15804 standard. The declaration owner is responsible for the underlying information and evidence. Łukasiewicz Research Network - Institute for Ceramics and Building Materials Environmental Engineering Center in Opole is not responsible for the manufacturer's information and data and evidence regarding the life cycle assessment. Declarations resulting from different programs or performed not in accordance with the standard may not be comparable.

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Product Category Rules (PCR)	According to: PN-EN 15804 + A2: 2020-03 Sustainability of construction works. Environmental product declarations. Basic principles of categorization of construction products.
Representativeness:	Polish product, year 2021/2022
Reference Service Life (RSL):	50 years
Reasons for performing LCA:	B2B
Analiza cyklu życia (LCA):	LCA covers modules A1-A3, C1-C4 and D according to PN-EN 15804+A2 standard (Cradle-to-Gate with options)

Łukasiewicz Research Network - Institute of Ceramics and Building Materials, Environmental Engineering Center provides access to the type III EPD for Holcim stone wool by Holcim Polska S.A. to the interested parties.

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Director of the environmental engineering center

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Leader of Process Engineering Research Group

Verification:

CEN PN-EN 15804+A2 standard serves as main PCR.
Independent EPD and data verification according to PN-EN ISO 14025:2010 standard.

☐ internal ☒ external

Katarzyna Grzesik, PhD Eng.

2. MANUFACTURER AND PRODUCT DECLARATION

HOLCIM POLSKA is a manufacturer of innovative and sustainable solutions for the construction industry. It implements low-carbon technologies and solutions that can be applied at every stage of a building's life cycle—from design and construction to repairs and renovations.

This document concerns non-combustible, hydrophobised thermal and sound insulation boards with an irregular fibre orientation structure, which are used as a layer for thermal, acoustic, and fire insulation in residential, industrial, and commercial buildings. Holcim stone mineral wool is a product with a wide range of applications, as presented in the table below.

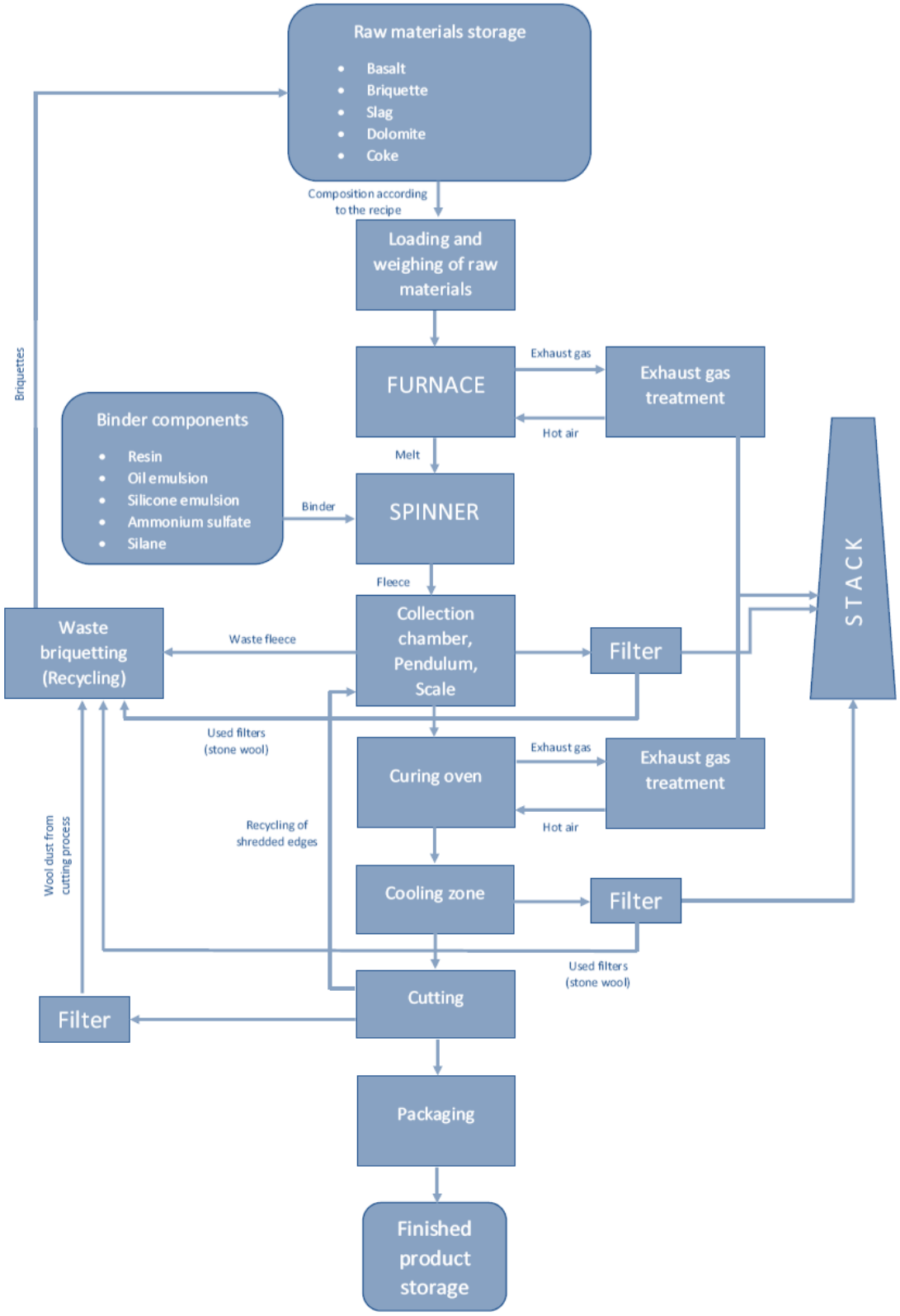
PRODUCT GROUP	APPLICATIONS
General construction	*Insulation of attics, partition walls, wooden beam ceilings and floors on joists.*
Ventilated facades	*Insulation of three-layer walls, partition walls or frame construction. The ideal solution for ventilated facades with different claddings, such as glass, stone or aluminum.*
ETICS	*External and internal insulation of buildings used in jointless thermal insulation systems (ETICS).*
Flat roofs	*Top and base layer for thermal insulation of flat roofs. Including panels with increased mechanical parameters for use on roofs with the installation of photovoltaic panels.*
Floating floors	*Internal insulation of floating floors in buildings. Used for soundproofing and eliminating vibrations from impact sounds.*
Ceilings	*Insulation of ceilings and walls of garages, basements or technical rooms.*
Industrial products	*As a core in sandwich panels, acoustic and fireproof partitions. Semi-finished product for the production of lagging and technical insulation.*

Holcim stone wool is available in a wide range of densities, thicknesses and thermal insulation properties. Usage properties are listed in the table below.

Parameter	Symbol	Unit	Value	Method
Declared thermal conductivity	λD	W/mK	0,034 – 0,044	EN 12667, EN 12939
Thickness tolerance class	T	mm	T2 – T5	EN 823
Dimensional stability under certain temperature and humidity conditions	DS(70,90)	%	≤ 1	EN 1604
Compressive stress at 10% deformation or compressive strength	CS(10) or CS(Y)	kPa	0,5 – 120	EN 826
Tensile strength perpendicular to the faces	TR	kPa	1 – 200	EN 1607
Point load at 5 mm deformation	PL(5)	N	50 – 1000	EN 12430
Air flow resistivity	AFr	kPa·s/m2	5	EN 9053-1
Short-term water absorption	WS	kg/m2	≤ 1	EN 29767
Long-term water absorption	WL(P)	kg/m2	≤ 3	EN 16535
Water vapor diffusion resistance coefficient	MU	-	MU1	EN 13162+A1
Reaction to fire	RtF	Euroclass	A1	EN 13501-1, EN 15715

STONE WOOL PRODUCTION PROCESS

The stone wool production process at the Holcim Polska S.A. plant in Wykroty is presented in the diagram below.



Mineral fibers are produced by melting raw materials (natural rocks) and converting the molten material into fine fibers using a double four-roller centrifuge. The production method is continuous. The components of the raw material are fed to the furnace in a specific proportion, depending on their chemical composition, in order to obtain a homogeneous alloy with specific properties.

The components of the charge and the energy carrier - coke are loaded into the furnace. The energy carrier raises the temperature to about 1500°C. The molten charge flows out of the furnace in the form of melt. The heavy metal sludge formed as a result of production is periodically removed and used as a secondary raw material.

The melt is directed further to a multi-shaft centrifuge. Melt drops are transformed into fibers under the influence of centrifugal force. These fibers are blown into a special chamber of the belt conveyor. When the fibers are blown, they are cooled and treated with a binder and a water repellent. The processed rock fiber is then transported to the forming chamber conveyor belt.

The fibers are deposited on a perforated conveyor belt in a collecting chamber and transported by a conveyor belt to a shuttle conveyor. The swinging device lays the stone wool mat in layers. A special scale weighs the stone wool mat and automatically controls the line speed to achieve a specific density of the stone wool mat. The stone wool mat then goes to a kneading machine where the material is formed into a corrugated shape to improve the physical and mechanical properties of the product.

Next, the stone wool mat is subjected to thermal treatment in the polymerization chamber, where the water evaporates, the binder is polymerized and the finished material is given the appropriate thickness. The product that leaves the polymerization chamber is cooled, cut to the specified thickness, width and length, stacked and packed in polyethylene film, and then palletized. A stretch hood is put on the pallet with the products, and the finished pallet goes to the finished goods warehouse.

SAFETY

Stone wool is a material that categorized as safe for the environment, the finished product does not contain hazardous substances. Potentially hazardous substances used in the production process are neutralized, e.g. phenolic resin with additives polymerizes, there are no leaks of hazardous substances to the environment.

COMPOSITION

The main components of stone wool and their mass fractions are presented in the table below.

Material	Mass share per declared unit	Description
Non-scarce primary mineral materials and secondary materials	**88,6%**	The main components of stone wool: basalt, blast furnace slag, dolomite and coke, as well as briquettes from waste material from production, i.e. non-fibred mass from the smelting, shavings and scraps of wool from the cutting process.
Binders	**4,2%**	Phenolic resin and additional chemicals to bind the stone wool fibers.
Oils	**<0,2%**	Oil and silicone emulsions used as binder additives.
Packaging materials	**7,0%**	Packaging foil, labels and wooden pallets in various sizes.

RECYCLED CONTENT

The production technology is waste-free, working in a closed loop cycle. Shavings and scraps of stone wool and non-fibered melt are briquetted. These, along with the primary raw materials, are then mixed and melted in a furnace. However, this does not negatively affect the final quality of the product, on the contrary - thanks to this, the quality of the final product increases, while the final amount of waste decreases.

We define recycled content as the proportion by mass, of recycled material in the finished product.

For the calculation pre-consumer material diverted from the waste stream during a manufacturing process and post-consumer material which was generated by households or industrial facilities in their role as end-users of the product, which can no longer be used for its intended purpose were taken into account.

As stated above, it was established that the total minimum amount of recycled content of mineral wool produced in Holcim Polska S.A. is **27%**.

The calculation of pre-consumer and post-consumer recycled material was based on production data from 2022.

3. LCA: CALCULATION RULES

System boundaries

The life cycle analysis of the tested products includes A1-A3, C1-C4 and D (Cradle to Gate with options) modules in accordance with PN-EN 15804. It includes the following modules:

- **A1** - extraction and preparation of raw materials, generation of electricity and energy carriers for auxiliary processes,
- **A2** - transport of raw materials to the gate of the production plant,
- **A3** - production, including ancillary processes and emissions.
- **C1** – deconstruction/demolition,
- **C2** – transport to the waste processing facility,
- **C3** – processing of waste material,
- **C4** – treatment of waste material,
- **D** – re-use potential.

Data collection period

Data on the production process was collected in the years 2021-2022 in the period from 01/05/21 do 30/04/22.

Declared unit (DU)

The declared unit (DU) is **1 m³** of stone wool with average density of ρ = 115 kg/m^3 (based on averaged data) produced in Holcim Polska S.A. in Wykroty.
Additional unit is 1 m^2 wełny skalnej **m³** of stone wool with average density of ρ = 115 kg/m^3 and thickness ensuring thermal resistance of R = 1 m^{2}K/W.

Assumptions

A1 - extraction and consumption of raw materials refers to specific mass shares in the production process per declared unit of the product.

A2 - distances from the place of obtaining raw materials to the production plant individual for each raw material, means of transport differentiated due to the method of raw materials delivery.

A3 - values of CO2, NOx, SO2, dust and other emissions from the production process obtained as a result of measurements carried out at the plant, other estimated on the basis of fuel consumption.

C1 – module C1 describes the disassembly/demolition of the material. Data is collected on the basis of a developed scenario. Disassembly of stone wool does not require large energy and material expenditures, it is possible to dismantle it manually or with the use of power tools. The impact of these operations is so small that the environmental impact resulting from module C1 is negligible.

C2 – module C2 relates to the transport of waste from stone wool demolition to a waste recovery or disposal facility. Data is collected on the basis of a developed scenario. The transport of stone wool waste is directed to a landfill.

C3 – Module C3 takes into account the environmental impact of C&D waste treatment. Stone wool does not require processing for reuse, therefore the impact values resulting from this module are not included in the declaration.

C4 – module C4 should take into account the environmental impact of stone wool storage. Data is collected on the basis of a developed scenario.

D – module D deals with the impacts and effects of using recycled material. Thermal utilization of packaging materials and the coke waste fraction outside the boundaries of the system is assumed, according to the developed scenario.

Cut-off criteria

99% of all mass streams involved in the production process were taken into account.
All the energy used in the process has been taken into account in the environmental declaration.

Generic data

The main source of general and auxiliary data is the EcoInvent 3.8 database, ELCD and manufacturer's reports.

Allocation

The product covered by the environmental declaration is produced in the plant in Wykroty. All data provided by the manufacturer have been referred to the declared unit (DU) of the product - 1 m^3 of stone wool with an average density of ρ = 115 kg/m^3 produced by Holcim Polska S.A. In addition, the results were related to a unit of 1 m^2 of stone wool with an average density of ρ = 115 kg/m^3 and a thickness ensuring thermal resistance of R = 1 m^2K/W.

4. LCA: SCENARIOS AND ADDITIONAL TECHNICAL DATA

For the "Cradle to gate with options" life cycle analysis of products covered by the environmental declaration, scenarios were developed for modules C2, C4 and D:

Module C2:

In order to calculate the impact of this module, the following assumptions were made:

- 100% of the stone wool waste mass is transported to the waste disposal site,
- Transportation is carried out using trucks with a load capacity

7.5 - 16 tons, meeting EURO 5 emission standards,

- The material is transported to a waste disposal site located 100 km from the demolition site.

Module C4:

It is assumed that nearly 100% of the material obtained as a result of the activity specified in module C1 is stored. Material and energy consumption are taken into account according to national statistical data on the handling of stone wool waste.

Module D:

Thermal utilization of packaging materials (pallets, packaging foil) is assumed. Energy benefits resulting from the process of thermal waste processing were presented. Waste coke (fraction <20 mm), which is generated as a result of screening at the plant, is also included. The scenario envisages energy use of waste coke outside the system boundaries.

5. LCA: RESULTS

The table below shows the LCA modules included in the calculation of the environmental impact categories for the products covered by the declaration.

SYSTEM BOUNDARIES (X – MODULE INCLUDED IN LCA, MND – MODULE NOT DECLARED, INA – INDICATOR NOT ASSESSED)															
Product stage			**Construction process stage**		**Use stage**							**End-of-life stage**				**Benefits and loads beyond the system boundary**
Raw material supply	Transport	Production	Transport to the construction site	Construction proces	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction	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**
X	**X**	**X**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**X**	**X**	**X**	**X**	**X**

The following tables present the results of the LCA analysis for Holcim stone wool. Explanations of the abbreviations used to describe the impact categories are given below:

GWP	Global warming potential
ODP	Depletion potential of the stratospheric ozone layer
AP	Acidification potential of land and water
EP	Eutrophication potential
POCP	Formation potential of tropospheric ozone photochemical oxidants
ADP-minerals&metals	Abiotic depletion potential for nonfossil resources
ADP-fossil	Abiotic depletion potential for fossil resources
WDP	Water (user) deprivation potential
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 (cancerogenic)
HTP-nc	Potential comparative Toxic Unit for humans (non-cancerogenic)
SQP	Potential soil quality index
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 nonrenewable primary energy resources used as raw materials
PENRT	Total use of non-renewable primary energy resources
SM	Use of secondary material
RSF	Use of renewable secondary fuels
NRSF	Use of non-renewable secondary fuels
FW	Use of net fresh water

CORE ENVIRONMENTAL IMPACT INDICATORS: 1 m³ of Holcim stone wool (ρ = 115 kg/m³)

Life Cycle Stage

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	7,46E+01	8,37E+00	9,23E+01	0,00E+00	2,47E+00	0,00E+00	8,95E-01	-1,73E+00
GWP-fossil	kg CO_2 eq.	9,17E+01	8,36E+00	9,23E+01	0,00E+00	2,47E+00	0,00E+00	8,92E-01	-1,74E+00
GWP-biogenic	kg CO_2 eq.	-1,73E+01	7,13E-03	1,74E-03	0,00E+00	2,24E-03	0,00E+00	1,07E-03	8,28E-03
GWP-luluc	kg CO_2 eq.	2,34E-01	3,28E-03	3,56E-04	0,00E+00	1,16E-03	0,00E+00	1,45E-03	-6,17E-04
ODP	kg CFC11 eq.	5,64E-06	1,93E-06	1,23E-06	0,00E+00	5,54E-07	0,00E+00	3,37E-07	-2,67E-07
AP	mol H+ eq.	5,20E-01	3,39E-02	1,64E-01	0,00E+00	9,80E-03	0,00E+00	8,02E-03	-1,31E-02
EP-freshwater	kg PO_4 eq.	8,04E-03	5,86E-05	2,25E-05	0,00E+00	2,00E-05	0,00E+00	9,71E-06	-3,28E-04
EP-marine	kg N eq.	8,17E-02	1,01E-02	7,42E-02	0,00E+00	2,82E-03	0,00E+00	2,79E-03	-2,23E-03
EP-terrestrial	mol N eq.	9,27E-01	1,12E-01	4,97E-01	0,00E+00	3,12E-02	0,00E+00	3,06E-02	-2,61E-02
POCP	kg NMVOC eq.	5,44E-01	3,42E-02	2,00E-01	0,00E+00	9,58E-03	0,00E+00	8,89E-03	-2,93E-02
ADP-minerals & metals	kg Sb eq.	4,90E-04	2,91E-05	-5,24E-06	0,00E+00	1,12E-05	0,00E+00	2,18E-06	-1,32E-06
ADP-fossil	MJ	1,98E+03	1,26E+02	1,94E+02	0,00E+00	3,68E+01	0,00E+00	2,34E+01	-6,59E+01
WDP	m^3 world eq. deprived	3,12E+01	3,79E-01	1,38E+00	0,00E+00	1,22E-01	0,00E+00	9,86E-01	-2,32E-01

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS: 1 m³ of Holcim stone wool (ρ = 115 kg/m³)

Life Cycle Stage

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PM	Disease incidency	4,99E-06	7,19E-07	8,20E-07	0,00E+00	1,83E-07	0,00E+00	1,60E-07	-2,73E-07
IRP	kBq U235 eq.	2,37E+00	5,49E-01	-4,58E-02	0,00E+00	1,60E-01	0,00E+00	9,59E-02	-2,13E-02
ETP-fw	CTUe	3,04E+03	9,86E+01	-1,73E+01	0,00E+00	3,00E+01	0,00E+00	1,53E+01	-1,43E+02
HTP-c	CTUh	7,20E-07	3,19E-09	3,86E-09	0,00E+00	1,10E-09	0,00E+00	4,13E-10	-5,45E-08
HTP-nc	CTUh	1,36E-06	1,03E-07	1,09E-08	0,00E+00	3,04E-08	0,00E+00	1,06E-08	-4,61E-08
SQP	-	2,11E+03	8,68E+01	-1,19E+02	0,00E+00	2,17E+01	0,00E+00	4,71E+01	-1,26E+01

PARAMETERS DESCRIBING RESOURCE USE: 1 m³ of Holcim stone wool (ρ = 115 kg/m³)

Life Cycle Stage

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PERE	MJ	2,29E+03	1,31E+02	2,23E+02	0,00E+00	0,00E+00	3,82E+01	2,46E+01	-9,09E+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
PERT	MJ	2,29E+03	1,31E+02	2,23E+02	0,00E+00	0,00E+00	3,82E+01	2,46E+01	-9,09E+01
PEN-RE	MJ	3,51E+02	1,79E+00	-7,01E-01	0,00E+00	6,23E-01	5,07E-02	2,30E-01	-9,13E-01
RE	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
PENRT	MJ	3,51E+02	1,79E+00	-7,01E-01	0,00E+00	6,23E-01	5,07E-02	2,30E-01	-9,13E-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
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
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
FW	m^3	3,47E+02	1,19E+01	-5,48E+00	0,00E+00	4,05E+00	1,35E-03	1,46E+00	-2,53E+00

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS : 1 m³ of Holcim stone wool (ρ = 115 kg/m³)

Life Cycle Stage

Parameter	Unit (expressed per DU)	A1	A2	A3	C1	C2	C3	C4	D
Indicator	kg	INA	INA	6,31E-03	INA	INA	INA	INA	INA
Hazardous waste	kg	INA	INA	3,64E+01	INA	INA	INA	INA	INA
Non-hazardous waste	kg	INA	INA	0,00E+00	INA	INA	INA	INA	INA
Radioactive waste	kg	INA	INA	5,64E+01	INA	INA	INA	INA	INA
Components for re-use	kg	INA	INA	1,17E+00	INA	INA	INA	INA	INA
Materials for recycling	kg	INA	INA	1,10E+01	INA	INA	INA	INA	INA
Materials for energy recovery	MJ/energy carrier	INA	INA	0,00E+00	INA	INA	INA	INA	INA

CORE INVIRONMENTAL IMPACT INDICATORS: 1 m² of Holcim stone wool (ρ = 115 kg/m³, d = 3,6 cm, R = 1 m²K/W)

Life Cycle Stage

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	2,69E+00	3,01E-01	3,32E+00	0,00E+00	8,89E-02	0,00E+00	3,22E-02	-6,23E-02
GWP-fossil	kg CO_2 eq.	3,30E+00	3,01E-01	3,32E+00	0,00E+00	8,89E-02	0,00E+00	3,21E-02	-6,26E-02
GWP-biogenic	kg CO_2 eq.	-6,23E-01	2,57E-04	6,26E-05	0,00E+00	8,06E-05	0,00E+00	3,85E-05	2,98E-04
GWP-luluc	kg CO_2 eq.	8,42E-03	1,18E-04	1,28E-05	0,00E+00	4,18E-05	0,00E+00	5,22E-05	-2,22E-05
ODP	kg CFC11 eq.	2,03E-07	6,95E-08	4,43E-08	0,00E+00	1,99E-08	0,00E+00	1,21E-08	-9,61E-09
AP	mol H+ eq.	1,87E-02	1,22E-03	5,90E-03	0,00E+00	3,53E-04	0,00E+00	2,89E-04	-4,72E-04
EP-freshwater	kg PO_4 eq.	2,89E-04	2,11E-06	8,10E-07	0,00E+00	7,20E-07	0,00E+00	3,50E-07	-1,18E-05
EP-marine	kg N eq.	2,94E-03	3,64E-04	2,67E-03	0,00E+00	1,02E-04	0,00E+00	1,00E-04	-8,03E-05
EP-terrestrial	mol N eq.	3,34E-02	4,03E-03	1,79E-02	0,00E+00	1,12E-03	0,00E+00	1,10E-03	-9,40E-04
POCP	kg NMVOC eq.	1,96E-02	1,23E-03	7,20E-03	0,00E+00	3,45E-04	0,00E+00	3,20E-04	-1,05E-03
ADP-minerals & metals	kg Sb eq.	1,76E-05	1,05E-06	-1,89E-07	0,00E+00	4,03E-07	0,00E+00	7,85E-08	-4,75E-08
ADP-fossil	MJ	7,13E+01	4,54E+00	6,98E+00	0,00E+00	1,32E+00	0,00E+00	8,42E-01	-2,37E+00
WDP	m^3 world eq. deprived	1,12E+00	1,36E-02	4,97E-02	0,00E+00	4,39E-03	0,00E+00	3,55E-02	-8,35E-03

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS: 1 m² of Holcim stone wool (ρ = 115 kg/m³, d = 3,6 cm, R = 1 m²K/W)

Life Cycle Stage

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PM	Disease incidency	1,80E-07	2,59E-08	2,95E-08	0,00E+00	6,59E-09	0,00E+00	5,76E-09	-9,83E-09
IRP	kBq U235 eq.	8,53E-02	1,98E-02	-1,65E-03	0,00E+00	5,76E-03	0,00E+00	3,45E-03	-7,67E-04
ETP-fw	CTUe	1,09E+02	3,55E+00	-6,23E-01	0,00E+00	1,08E+00	0,00E+00	5,51E-01	-5,15E+00
HTP-c	CTUh	2,59E-08	1,15E-10	1,39E-10	0,00E+00	3,96E-11	0,00E+00	1,49E-11	-1,96E-09
HTP-nc	CTUh	4,90E-08	3,71E-09	3,92E-10	0,00E+00	1,09E-09	0,00E+00	3,82E-10	-1,66E-09
SQP	-	7,60E+01	3,12E+00	-4,28E+00	0,00E+00	7,81E-01	0,00E+00	1,70E+00	-4,54E-01

PARAMETERS DESCRIBING RESOURCE USE: 1 m² of Holcim stone wool (ρ = 115 kg/m³, d = 3,6 cm, R = 1 m²K/W)

Life Cycle Stage

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PERE	MJ	8,24E+01	4,72E+00	8,03E+00	0,00E+00	0,00E+00	1,38E+00	8,86E-01	-3,27E+00
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
PERT	MJ	8,24E+01	4,72E+00	8,03E+00	0,00E+00	0,00E+00	1,38E+00	8,86E-01	-3,27E+00
PEN-RE	MJ	1,26E+01	6,44E-02	-2,52E-02	0,00E+00	2,24E-02	1,83E-03	8,28E-03	-3,29E-02
RE	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
PENRT	MJ	1,26E+01	6,44E-02	-2,52E-02	0,00E+00	2,24E-02	1,83E-03	8,28E-03	-3,29E-02
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
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
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
FW	m³	1,25E+01	4,28E-01	-1,97E-01	0,00E+00	1,46E-01	4,86E-05	5,26E-02	-9,11E-02

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 m² of Holcim stone wool (ρ = 115 kg/m³, d = 3,6 cm, R = 1 m²K/W)

Life Cycle Stage

Parameter	Unit (expressed per DU)	A1	A2	A3	C1	C2	C3	C4	D
Indicator	kg	INA	INA	2,27E-04	INA	INA	INA	INA	INA
Hazardous waste	kg	INA	INA	1,31E+00	INA	INA	INA	INA	INA
Non-hazardous waste	kg	INA	INA	0,00E+00	INA	INA	INA	INA	INA
Radioactive waste	kg	INA	INA	2,03E+00	INA	INA	INA	INA	INA
Components for re-use	kg	INA	INA	4,21E-02	INA	INA	INA	INA	INA
Materials for recycling	kg	INA	INA	3,96E-01	INA	INA	INA	INA	INA
Materials for energy recovery	MJ/energy carrier	INA	INA	0,00E+00	INA	INA	INA	INA	INA

6. INTERPRETATION OF LCA

As a result of the LCA analysis carried out in accordance with the requirements and assumptions regarding the system boundaries and cut-off criteria for Holcim stone wool the following results were achieved.

Impact category values for individual life cycle modules - Holcim stone wool

IMPACT CATEGORY	A1 [%]	A2 [%]	A3 [%]	C2 [%]	C4 [%]	D [%]
GWP-total	42,2	4,7	52,2	1,4	0,5	-1,0
GWP-fossil	47,3	4,3	47,6	1,3	0,5	-0,9
GWP-biogenic	100,1	0,0	0,0	0,0	0,0	0,0
GWP-luluc	97,6	1,4	0,1	0,5	0,6	-0,3
ODP	59,8	20,5	13,1	5,9	3,6	-2,8
AP	72,0	4,7	22,7	1,4	1,1	-1,8
EP-freshwater	102,8	0,7	0,3	0,3	0,1	-4,2
EP-marine	48,2	6,0	43,8	1,7	1,6	-1,3
EP-terrestrial	59,0	7,1	31,6	2,0	1,9	-1,7
POCP	70,9	4,5	26,1	1,2	1,2	-3,8
ADP-minerals & metals	93,2	5,5	-1,0	2,1	0,4	-0,3
ADP-fossil	86,3	5,5	8,5	1,6	1,0	-2,9
WDP	92,2	1,1	4,1	0,4	2,9	-0,7
PM	75,6	10,9	12,4	2,8	2,4	-4,1
IRP	76,3	17,7	-1,5	5,2	3,1	-0,7
ETP-fw	100,5	3,3	-0,6	1,0	0,5	-4,7
HTP-c	106,8	0,5	0,6	0,2	0,1	-8,1
HTP-nc	92,6	7,0	0,7	2,1	0,7	-3,1
SQP	98,9	4,1	-5,6	1,0	2,2	-0,6

- The LCA analysis proved that the processes related to the acquisition of raw materials and energy and the production of stone wool (A1 and A3) have the greatest impact on the value of environmental impact indicators. Only in the climate change category, module A3 has a greater impact than module A1 - about 52% to about 42% of the total impact. The remaining values resulting from module A1 for stone wool account for approximately 60 to nearly 100% of the total value of the impact category. The largest share in the main impact categories is attributed to processes related to the production of stone wool at the plant (process emissions from fuel combustion and processing of raw materials - A3), coke (A1), phenolic resin (A1) and electricity production (A1).

- High values of the impact category for these processes result from the fact that they are energy-intensive processes, requiring the supply of large amounts of heat and electricity (mainly from non-renewable sources) and the acquisition of non-renewable raw materials.

- The impact of transport to the plant (A2) on the impact categories is from approx. 1 to approx. 20% of the total impact in the main categories. This is due to the fact that the raw materials are mostly delivered to the place of production from Poland and Europe.

- Due to the nature of the production process, which involves the dissolution of rock material at a very high temperature, which requires the supply of huge amounts of heat, the values of the main impact categories in the A3 module are up to 52% in the analyzed product groups.

- Transport to the waste treatment site (module C2) has a relatively minor impact on the final values of the LCIA analysis, the contribution of module C2 to the main impact categories is up to approx. 6% of the total values.

- The impact of waste storage and handling (module C4) also has a minor impact on the total value of the impact category due to the relatively small amount of waste per declared unit. Category values contribute up to 3% of the total.

- The potential for reuse of packaging material waste generated at the end of the product's life is immeasurable, it allows to reduce the value of some impact categories by up to approx. 8% compared to the total values.

- Taking into account the above conclusions, the owner of the declaration has an impact on the values of environmental impact indicators, because it depends to a large extent on the production technology and (to a lesser extent) on external entities. It is possible, for example, to recover part of the energy lost as waste heat for technological processes, which will contribute to reducing the consumption of electricity and heat in the plant. It may also try to change suppliers to those that operate closer to the production plant.

7. LITERATURE

- ✓ PN-EN ISO 14025: 2014-04, Environmental labels and declarations - Type III environmental declarations - Rules and procedures.
- ✓ PN-EN 15804 + A2: 2020, Sustainability of construction works - Environmental product declarations - Basic rules for categorizing construction products.
- ✓ PN-EN ISO 14040: 2009 Environmental management. Life Cycle Assessment. Principles and structure.
- ✓ PN-EN ISO 14044: 2009, Environmental management. Life Cycle Assessment. Requirements and guidelines.
- ✓ EN 15942: 2012, Sustainability of construction works - Environmental product declarations - Communication format business-to-business.

Data from company website: *www.holcim.pl/welna-skalna*

Explanatory materials can be found on the manufacturers website: **www.holcim.pl/welna-skalna**