Background report – natural stone

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Contents

1. General description

The degree of prefabrication of stones and stone structures has increased, and the amount of work done on site has decreased accordingly. At the same time, the thickness of the natural stone products in building construction has decreased in all stone applications.[1]

Energy efficiency and the energy sources in stone quarrying, drilling, sawing, grinding, and polishing processes are the main issues that affect the carbon footprint of natural stone products used in buildings. Thus, the GWP of electricity significantly affects the carbon footprint of stone products when looking the phases A1-A3.

As natural stone products are imported also from long distances, the share of A4 may be significant.

2. Market description

The biggest share of natural stone in building construction is used in yard structures. The use of natural stone in buildings is at present quite low. Natural stone is used in buildings primarily as a surface and cladding material. The purpose of the stone is to give the structures a finished look and good durability.

Regarding infra construction, the share of imported stone products is very high. Imported stone comes mainly from China. Regarding building construction, a rough estimate is that half of the market is covered by domestic production. Stone products for building construction are imported from China and Mediterranean area. Slate products are also imported from Norway.

China produces roughly half of the world granite production (in total 150-170 million sqm/year by China)[2].

3. Selected typical values

The outline of expanded clay insulation products, the essential methods of the manufacturing process, key issues that affect the carbon footprint of the product, and the current market were discussed together with a representative of KIVI ry (association representing expertise in stone industry).

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[1] http://www.suomalainenkivi.fi/vanha/wp-content/uploads/2016/03/luonnonkivirakenteiden_suunnitteluohje_osa1.pdf .

[2] World Natural Stone Association WONASA, http://www.wonasa.com/en/reports.html

The sources considered in the selection of the typical values are shown in Annex 1. Summary of these sources is shown in following table:

Relevance	**Product**	**GWP (A1-A3)**
Finland	Natural stone block	0,0377
Finland	Floor and facade stone	0,312
Finland	Yard and facad stone, Slate	0,0289
Finland	Paving stone rectangular	0,050
Finland	Curbstone, staircase and wall stone, solid	0,104
Norway	Natural stone for pavement block, massive slabs, wall cladding, flooring tiles, window sills, roofing, steps – broken edges	0,058
Norway	Natural stone for pavement block, massive slabs, wall cladding, flooring tiles, window sills, roofing, steps – sawn edges	0,131
Norway	Natural stone, broken edges, even thickness	0,084
Norway	Natural stone, sawn edges, even thickness	0,277
EURO ROC	Tiles and Slabs from natural stone	0,0255
Germany	Natural stones slabs for facades, thickness 30 mm	0,416
Germany	Natural stones slabs for facades, thickness 20 mm	0,623
Germany	Marble slab, thickness 20 mm	0,313

The GWP results vary a lot in accordance with the degree of processing, source of energy used in processing, and type of stone. The Finnish results for facade stone significantly less than the results published in Ökobaudat.

The selection is to apply the Finnish published results as those represent several manufacturers. However, as the share of domestic products is only roughly half for natural stone products used in buildings and significantly less for stone products used in infra structures, it must be noted that the average values may be double or even more.

Now, following *items* are declared to database:

- *Natural stone, tile for facades and floors*
- *Natural stone, slate for facades and yard*
- *Natural stone, rectangular paving stone*
- *Natural stone, solid curb stone*

For each *item,* following indicators are determined according to selected sources:

- GWP fossil (A1-A3)
- Conversion factor
- Content of renewable materials
- Content of recycled materials
- Content and type of harmful substances (SVHC)

Waste processing (C3) emissions and carbon handprints are declared as stand-alone items within other database sections. See those sections[3], including background reports, for more information.

[3] Rakentamisen päästötietokanta (see sections: waste process & carbon handprint)

Annex 1: Reference values

RTS EPD

https://cer.rts.fi/wp-content/uploads/rts_epd_53_20_natural-stone_kivi_ry-1.pdf

Kivi ry

GWP fossil (A1 – A3)	0,0377
Carbon handprint	-
SVHC (%)	0
Sahre of renewable materials	0
Share of secondary materials	0
End of life scenario	-

Natural stone (tarvekivi)

Declared unit 1000 kg.

This EPD represents average natural stone blocks produced in Finland. The market of the product is Finland.

RTS EPD

Kivi ry

https://cer.rts.fi/wp-content/uploads/rts_epd_56_20_floor-and-facade-stone_kivi-ry.pdf

GWP fossil (A1 – A3)	0,312
Carbon handprint	-
SVHC (%)	0
Sahre of renewable materials	0
Share of secondary materials	0
End of life scenario reuse (%) recycling (%)	 50 50

Floor and facade stone

The EPD covers the environmental impacts of Finnish floor and façade stone.

This EPD represents average floor and façade stones made in Finland. The market of the product is Finland.

Declared unit 1000 kg.

Typical thickness for floor stone 20 mm, weight 54 kg/m2

Typical thickness for facade stone 30 mm, weight 81 kg/m2.

Density 2700 kg/m3

RTS EPD

Kivi ry

https://cer.rts.fi/wp-content/uploads/rts_epd_57_20_slate-yard-and-facade-stone_kivi-ry.pdf

GWP fossil (A1 – A3)	0,0289
Carbon handprint	-
SVHC (%)	0
Sahre of renewable materials	0
Share of secondary materials	0
End of life scenario reuse (%) recycling (%)	 50 50

Slate: yard and facade stone

The EPD covers the environmental impacts of Finnish slate yard and façade stone.

Typical thickness for yard stone 40 mmm, weight 108 kg/m2

Typical thickness for facade stone 80 mm, weight 216 kg/m2.

density 2700 kg/m3.

RTS EPD

Kivi ry

https://cer.rts.fi/wp-content/uploads/rts_epd_55_20_rectangular-paving-stone_kivi-ry.pdf

GWP fossil (A1 – A3)	0,050
Carbon handprint	-
SVHC (%)	0
Sahre of renewable materials	0
Share of secondary materials	0
End of life scenario	

reuse (%) recycling (%)	50 50

Rectangular paving stone

EPD represents average rectangular paving stones made in Finland. The market of the product is Finland.

Use in yard covering regarding building construction.

There are two methods for making rectangular paving stones: guillotine cutting and sawing. In cutting, the stone is simply cut to appropriate size, but in sawing the upwards facing side is often also treated by burning.

Thickness 100 mmm, weight 270 kg/m2

Thickness for facade stone 140 mm, weight 378 kg/m2.

Density 2700 kg/m3.

RTS EPD

Kivi ry

https://cer.rts.fi/wp-content/uploads/rts_epd_54_20_curbstone-solid-staircase-and-solid-wall-from-stone_kivi-ry.pdf

GWP fossil (A1 – A3)	0,104
Carbon handprint	-
SVHC (%)	0
Sahre of renewable materials	0
Share of secondary materials	0
End of life scenario reuse (%) recycling (%)	 50 50

Curbstone (reunakivi), solid staircase and solid wall from stone

EPD represents average curbstone, solid staircase and solid wall from stone made in Finland. The market of the product is Finland.

Curbstone, solid staircase and solid wall from stone are manufactured from Finnish natural stone and they are used outdoors as street curbstones, in staircases, and in stone walls.

Typical width 170 mm, typical height 270 mm, weight per running meter 124 kg/rm.

Density 2700 kg/m3.

EPD Norge

Minera Skifer AS

https://mineraskifer.no/wp-content/uploads/2015/04/EPD-Oppdal-quartzite-natural-cleft-surface-broken-or-sawn-edge.pdf

GWP fossil (A1 – A3) -broken edges -sawn edges Carbon handprint SVHC (%) Sahre of renewable materials Share of secondary materials End of life scenario	 0,058 0,131 - 0 0 0

Natural stone, quartzite schist

Natural cleft surface, with broken or sawn edges

Declared unit 1000 kg

Use: Pavement block, massive slabs, wall cladding, flooring tiles, brick, slabs, fireplace mantels, stone furniture, window sills, roofing and steps.

Standard thickness 30 mm

density 2700 kg/m3

Market: Norway and Nordic countries

EPD Norge

Minera Skifer AS

https://mineraskifer.no/wp-content/uploads/2015/04/EPD-Oppdal-quartzite-even-thickness-broken-or-sawen-edge.pdf

GWP fossil (A1 – A3) -broken edges -sawn edges Carbon handprint SVHC (%) Share of renewable materials Share of secondary materials End of life scenario	 0,084 0,177 - 0 0 0

Natural stone quartzite schist, even thickness, with broken or sawn edges.

Declared unit: Production of 1 ton of natural stone of quartzite schist, adjusted thickness, with broken or sawn edges.

Standard thickness 12 mm

density 2700 kg/m3

Market: Norway and Nordic countries

IBU

EUROROC - European & International Federation of Natural Stone Industries

https://nvs.ch/fileadmin/user_upload/nvs/0_Landing_Page/PDF_EPD_Naturstein.pdf

GWP fossil (A1 – A3)	0,0255

Tiles and Slabs from natural stone EURO-ROC

This documentation includes information related to 1 ton tiles and slabs from natural stone which are produced by the 10 EUROROC member companies.

EUROROC association represents 60% to 65% of European natural stone producers.

The shares of the rock types of the total production volume of all manufacturers is:

- igneous rock 27%,
- sedimentary rock 64%,
- metamorphic rock 9%.

Natural stones are used as tiles (thickness up to 12 mm), slabs (thickness more than 12 mm up to 80 mm) or massive slabs (thickness more than 80 mm) with different sizes.

The declared product is an average natural stone from these three rock types with an average thickness of 40 mm as an average of 10 different companies, weighted by their production volumes.

Gross density 2744 kg/m3

The average thickness of the product is 0.04 m. It means 1 ton of product is equal to 9.11 m².

Ökobaudat

https://www.oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=cb3f4a56-460c-4a3e-ae43-3e0a9dcb4319&stock=OBD_2020_II&lang=en

GWP fossil (A1 – A3)	0,416

Natural stone slab, rigid, facade (thickness 0.030 m); 78 kg/m2

The data set represents the country specific situation in Germany, focusing on the main technologies, the region specific characteristics and / or import statistics.

The LCA of natural stones slabs for facades covers the cradle-to-gate phase, that is, the extraction of granite and the further processing (steel grit, grinding road, saw). Between the location of extraction and the processing location an average distance of 20 km is defined. The observation is based on a mix of origin: 50% of natural stones are from China, 7% from Germany and 43% from the rest of Europe.

Reference flow Natural stone slab, rigid, facade (m2)

GWP(A1-A3)= 32,41 kg/m2

= 32,41 kg CO2e / 78 kg

= 0,416 kg/kg

Ökobaudat

https://www.oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=e8db532f-ee15-42a4-89c3-5ef789e1fb8f&stock=OBD_2020_II&lang=en

GWP fossil (A1 – A3)	0,623

Natural stone slab, rigid, intdoor

usage (thickness 0.02 m); 52 kg/m2

The data set represents the country specific situation in Germany, focusing on the main technologies, the region specific characteristics and / or import statistics.

The LCA of natural stones slabs for facades covers the cradle-to-gate phase, that is, the extraction of granite and the further processing (steel grit, grinding road, saw). Between the location of extraction and the processing location an average distance of 20 km is defined. The observation is based on a mix of origin: 50% of natural stones are from China, 7% from Germany and 43% from the rest of Europe.

Reference flow 2 cm granite plate for indoor floors (Density 2600kg/m3)

GWP(A1-A3)= 31,75 kg/m2

= 31,75 kg CO2e / 52 kg

= 0,623 kg/kg

Ökobaudat

https://www.oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=e9be7506-62ce-45b8-853f-c45c3f82401f&stock=OBD_2020_II&lang=en

GWP fossil (A1 – A3)	0,313

Marble slab (thickness 0.02 m); 52 kg/m2

The data set represents the country specific situation in Germany, focusing on the main technologies, the region specific characteristics and / or import statistics.

This dataset refers to the production of 1 m² marble slab with a thickness of 2 cm. The surface weight is 52 kg.

Marble slabs are mainly used as floor- or wall covering as well as for the production of kitchen worktops or window sills.

GWP(A1-A3)= 16,28 kg/m2

= 16,28 kg CO2e / 52 kg

= 0,313 kg/kg

Ökobaudat

https://www.oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=79075297-4dc0-42c6-bc90-e3bf9fa0fb4c&stock=OBD_2020_II&lang=en

GWP fossil (A1 – A3)	0,156

Natural stone slab, flexible, facade (40 mm); 104 kg/m2

The data set represents the country specific situation in Germany, focusing on the main technologies, the region specific characteristics and / or import stati

The LCA of natural stones slabs for facades covers the cradle-to-gate phase, that is, the extraction of limestone and the further processing (grid, grinding road, multi-blade saw). Between the location of extraction and the processing location an average distance of 20 km is defined. The observation is based on a mix of origin: 50% of natural stones are from China, 7% from Germany and 43% from the rest of Europe.

GWP(A1-A3)= 16,23 kg/m2

= 16,23 kg CO2e / 104 kg

= 0,156 kg/kg

Ökobaudat

https://www.oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=ef0d9cbc-4e89-4e78-8cb2-68f02a49b87d&stock=OBD_2020_II&lang=en

GWP fossil (A1 – A3)	0,287

Natural stone slab, flexible, indoor usage (thickness 0.020 m); 52 kg/m2

The data set represents the country specific situation in Germany, focusing on the main technologies, the region specific characteristics and / or import statistics.

The LCA of natural stone slabs used for indoor floors covers the cradle-to-gate phase, that is, the extraction of limestone and the further processing (grid, grinding road, multi-blade saw).

GWP(A1-A3)= 14,92 kg/m2

= 14.92 kg CO2e / 52 kg

= 0,287 kg/kg

VTT

GWP fossil (A1 – A3)	0,408

Verhoilu, luonnonkivi, 20 mm

Including A4+A5 (loss)

ICE

Product	GWP fossil (A1 – A3)
General	0,079
Granite	0,70
Limestone	0,09
Marble	0,13

Marble tile	0,21
Sandstone	0,06
Shale	0,002
Slate	0.007 to 0.063