Pumice and scoria

Environmental product declaration

Programme The International EPD® System

Programme operator EPD International AB

EPD registration number S-P-04773

Publication date 2021-10-26

Valid until 2026-10-25

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com.

in accordance with ISO 14025 and 15804:2012+A2:2019

EPD® THE INTERNATIONAL EPD® SYSTEM

ECO PLATFORM EPD EN 15804 VERIFIED

JEI

CONTACT INFORMATION

EPD owner		Nesbraut 1, 815 Þorlákshöfn, Iceland Email: jei@jei.is www.jei.is
LCA author		Vallakór 4, 203 Kópavogur, Iceland Email: info@resource.is www.resource.is
Programme operator		Valhallavägen 81, 114 27 Stockholm, Sweden Email: info@environdec.com www.environdec.com
Third party verifier		prof. Ing. Vladimír Kočí, Ph.D., MBA Email: vlad.koci@vscht.cz www.lcastudio.cz

PROGRAMME-RELATED INFORMATION

Product group classification: UN CPC 163
The CEN standard EN 15804 serves as the core Product Category Rules (PCR)
PCR 2019:14 Construction products (EN 15804:A2); Version 1.11; 2021-02-05
PCR review was conducted by The Technical Committee of the International EPD® System
Independent third-party verification of the declaration and data in accordance with ISO14025:2006 ☒External ☐Internal covering ☐ EPD process certification ☒ EPD verification
Procedure for follow-up during EPD validity involves third party verifier ☐ Yes ☒ No
The EPD owner has the sole ownership, liability and responsibility of 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

Long known for its research of aggregates found in southern Iceland, the firm Jardefnaidnadur, abbreviated "JEI", now specializes in processing pumice from Mt. Hekla for building and horticulture. The main export markets of JEI are in Denmark, Netherlands, Germany, U.S.A., Sweden, Norway, and Belgium.

Jarðefnaiðnaðurinn ehf. (JEI) is the commissioner and EPD owner. JEI works according to the standard ÍST EN 13055-1:2002 which is regulated by the British Standards Institute[1]. The goal of JEI is to work in harmony with nature, minimise negative environmental impact and be at the forefront of environmental issues among companies in comparable operations. The company's guidelines are as follows:

- Environmental performance is an essential component of our business
- The planning of the eventual closure of quarries are taken into account at any time with a responsible approach of minimising environmental and social impact
- Comply with and monitor changes in environmental laws and regulations
- The environmental awareness and responsibilities of the employees are emphasised
- Efficient use of energy and water through processes, appropriate waste treatment to all waste and selection of consumables in accordance with environmental protection
- Reduce greenhouse gas emissions and annual offsetting carbon emissions in all of JEI's operations and projects by approved methods.

This cradle-to-gate with options environmental product declaration (EPD) is for 1000 kg of pumice and/or scoria production from the locations owned and operated by Jarðefnaiðnaðurinn ehf. in southern Iceland, as follows:

Location 1: Hekla, Rangárþing ytra, Iceland

Location 2: Seyðishólar, Grímsnes- og Grafningshreppur, Iceland

For further information regarding JEI and its sustainability strategy, visit: https://jei.is/carbon-offset.html

[1] *Certificate Number: 2797 CPR 587730*

PRODUCT DESCRIPTION

Hekla pumice is a lightweight, chemically inert, porous stone of volcanic origin created by a sicilic explosive eruption about 3000 years ago. The high porosity is due to the escape of gases and steam as the pumice grains rapidly cooled down while falling to the ground from the eruption. The tephra layer from this eruption, in which this pumice is found, covered over 80% of Iceland and has been found in northern Europe, as far as 2000 km from its source. Iceland's primary pumice resources are in the southern part of the country. **The Grímsnes scoria** is a porous, chemically inert, dark colored volcanic rock formed by an effusive lava eruption about 5-6000 years ago in the Grímsnes area. JEI excavates the pumice from the base of Mt. Hekla in the south-west of Iceland, and the scoria from Seyðishólar in Grímsnes.

The product declared are pumice and scoria manufactured by JEI based in Þorlákshöfn, Iceland. These products are produced according to harmonised European Standards ÍST EN 13055-1:2002. European Standards specifies the properties of Ligthweight Aggregates of mineral origin. Aggregates are classified under the following UN CPC group and class: UN CPC 15320 Pebbles, gravel, broken or crushed stone, macadam, granules, chippings, and powder stone.

JEI's pumice and scoria are mainly used for construction and technological applications. A list of potential applications is mentioned below:

- **Building material**
- **Growing medium**
- **Biotechnology**

APPLICATION

Solidification of this foamed magma results in this porous aggregate with excellent insulating properties, high particle strength and very low density. Hekla Pumice can support the application of biological organisms and biological processes to manufacturing and service industries. The pumice can be used as a shelter for microscopic organisms, and it can also be used to filter chemical and biochemical substances. Hekla pumice is the natural key to the production of several building products which have unique qualities such as being resistant to expansion this being heat resistant.

CONTENT DECLARATION

The products technical characteristics and composition are presented in the tables below. Table 1 shows the average amount of pores, glass and minerals in the product. Hekla pumice belongs to the dacite group of volcanic rocks and has the composition shown in table 2. Grímsnes scoria belongs to the basaltic group of volcanic rocks and its composition can also be found in table 2. The pumice mostly consists of volcanic glass with minor amounts of crystallized minerals, mostly plagioclase, pyroxene and olivine. The pumice is free of clay minerals, gypsum, sulphur, and fibrous minerals but crystalline materials in minor quantities are present. Fragments of basalt and andesite are embedded in the pumice and are removed in the washing process, but quartz and cristobalite are not traceable by conventional x-ray diffraction analysis. No substances included in the Candidate List of Substances of Very High Concern for authorization under the REACH Regulations that exceed 0.1% of the total weight.

Table 1. Glass, pores and minerals in 5-10 mm pumice by volume.

Glass and pores	Volume rate
Glass	25%
Closed pores	24%
Open pores	51%
Composition	**wt%**
Glass	95,4
Plagioclase	3,6
Pyroxene	0,2
Olivine	0,5
Magnetite	0,3

Table 2. Major element composition of Hekla pumice, i.e. the contribution (% w/w) of materials to the declared unit

	Pumice wt%	Scoria wt%
Silicon dioxide (SiO_2)	66,29	48,00
Titanium dioxide (TiO_2)	0,58	1,62
Aluminum oxide (Al_2O_3)	15,90	12,91
Ferric oxide (Fe_2O_3)	1,85	4,06
Ferrous oxide (FeO)	3,26	6,86
Manganese oxide (MnO)	0,13	0,19
Magnesium oxide (MgO)	0,67	10,35
Calcium oxide (CaO)	2,70	13,10
Sodium oxide (Na_2O)	3,25	1,95
Potassium oxide (K_2O)	2,27	0,28
Phosphorus pentoxide (P_2O_5)	0,50	0,22
H_2O^+	1,26	0,55
H_2O^-	0,18	0,04
Loss on ignition (LOI)	1,40	48,00

Physical properties of the pumice are dependent on grain-size distribution and, in the case of wet bulk density, of water content.

Loose dry bulk density: 0,26 to 0,49 kg/dm^3
Loose wet bulk density: 0,54 to 0,72 kg/dm^3
Specific gravity of glass: 2,56
Heat conductivity: 0,07 to 0,10 kcal/m h°C

This EPD provides information concerning seven types of pumice and scoria produced by JEI as detailed in Table 3.

Table 3. Product information of pumice and scoria produced by JEI and are subject to the EPD

Location	Material Description	Material Size/Type	Average density kg/m3	Application	% of production
Hekla	Pumice	0-10 mm, 0-100 mm, 0-6,3 mm, 10-100 mm, 10-100 mm, 1-8 mm, unprocessed	700	building blocks, chimneys, fireplaces, horticulture landscaping, green-roofing	93
Grímsnes	Scoria	0-8 mm, 0-16 mm	870	green-roofing, landscaping	7

3.6 FURTHER INFORMATION

The production addresses all relevant environmental laws in Iceland regarding the excavation of raw natural materials, the rehabilitation of quarries, water and waste treatment.

LCA INFORMATION

GOAL OF STUDY

This study aims to generate an environmental profile of pumice excavated, processed, and delivered from the locations operated by JEI in Iceland. Type III EPD is to be generated and made public via the International EPD system.

EPD TYPE

Product specific

DECLARED UNIT

The declared unit of the LCA is **1000 kg** of excavated product consisting of 93% pumice and 7% scoria, delivered to the port of one of JEI's customers after being quarried and processed in the south of Iceland. The LCA is established for the weighted average product of this processing procedure. The average is based on the mass of the product produced and the reference year for this LCA is 2020.

GOAL AND SCOPE

This LCA evaluates the environmental impacts of the production of 1000 kg of pumice and scoria (various granulometries) from cradle-to-gate with options (additional module A4).

BACKGROUND DATA

Specific data from manufacturer is used in combination with LCA databanks provided by OpenLCA. In OpenLCA the various datasets from the EF database are integrated into one database. It contains datasets from the Life Cycle Data Network (ILCD)[2].

PRODUCT SUSTAINABILITY SOFTWARE

OpenLCA 1.10.3.

DATA QUALITY

Energy mix and other processes are valid for the production site in Thorlakshöfn in Iceland. JEI provided data for one-year of operation, for the year 2016 for transportation data and for the year 2020 for all other data. Modelling of the life cycle of JEI pumice and scoria was performed using OpenLCA software developed by GreenDelta. All relevant background LCI datasets were gathered from EF databanks[2]. The data quality for the entire study can be judged as good (measured directly at a specific process site or scaled from measurements).

TIME REPRESENTIVENESS

All primary data used in this study are for the entire year 2020 apart from information on fuel consumption which is from the year 2016 but hasn't changed considerably since and is therefore treated as the most up to date.

GEOGRAPHICAL SCOPE

Worldwide.

ASSUMPTIONS

This LCA study describes the impacts of pumice and scoria produced by **JARÐEFNAIÐNAÐUR EHF.** in Þorlákshöfn, Iceland, using aggregated values, taking into account the different granulometries of the extracted aggregates. Differences in energy consumption in the extraction and production of different pumice and scoria granulometries, are considered to be marginal, as the production process is the same.

ALLOCATIONS

100% of the natural aggregates produced by JEI's operations in Iceland are covered by the framework of this LCA/EPD. No allocation of total site energy and fuel used, as well as emissions occurred, was required. Therefore, the flows of materials and energy, as well as the associated emission releases into the environment, are related exclusively to the production of 1000 kg of product.

COMPARABILITY

EPDs of construction products may not be comparable if they do not comply with EN

[2] *https://eplca.jrc.ec.europa.eu/LCDN/contactListEF.xhtml*

15804. EPDs within the same product category but from different programmes may not be comparable.

CUT-OFF RULES

All raw materials and consumable item inputs, associated internal transports and external transports, as well as process energy use, are included in the LCA study apart for water usage in module A3. It is considered that the total potential neglected input flows are much less than 0.1% of total energy, area, area-time activities and mass. All associated process specific data are determined and modelled by the use of generic data provided by OpenLCA databases.

SYSTEM BOUNDARY

The scope of this study is "Gradle to gate with options" covering the product stage (modules A1-A3), and part of the construction stage (module A4) since the product fulfills the three conditions required by EN 15804:2012+A2:2019, about the exclusion of modules C1-C4 and D. Cradle to gate with options includes the product stage A1–A3 and additional modules. The additional modules may be A4 and/or A5. This type of EPD is only possible for construction products that are exempt from declaring modules C and D. This type of system boundary is chosen because other life cycle stages are dependent on scenarios which can be developed for specific building or construction works. The pumice and scoria can be incorporated in cement paste to produce lightweight concrete, incorporated with other minerals to produce other cement products, used in agriculture – both mixed with other substrates and used on its own, and therefore cannot be separated at the end-of-life stage. Life cycle stages that are covered in this EPD are marked with X and those who are not covered are indicated as MND (Module Not Declared) (Table 4).

Table 4. Modules included in the EPD of pumice and scoria: A1 - Raw material supply, A2 - Transport. A3 - Manufacturing and A4 – Transport from the gate to the site

Product stage			Construction stage		Use stage							End-of-life Stage				Resource recovery
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	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	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

PRODUCTION PROCESS

The mains steps of the production of pumice are illustrated in Figure 1.

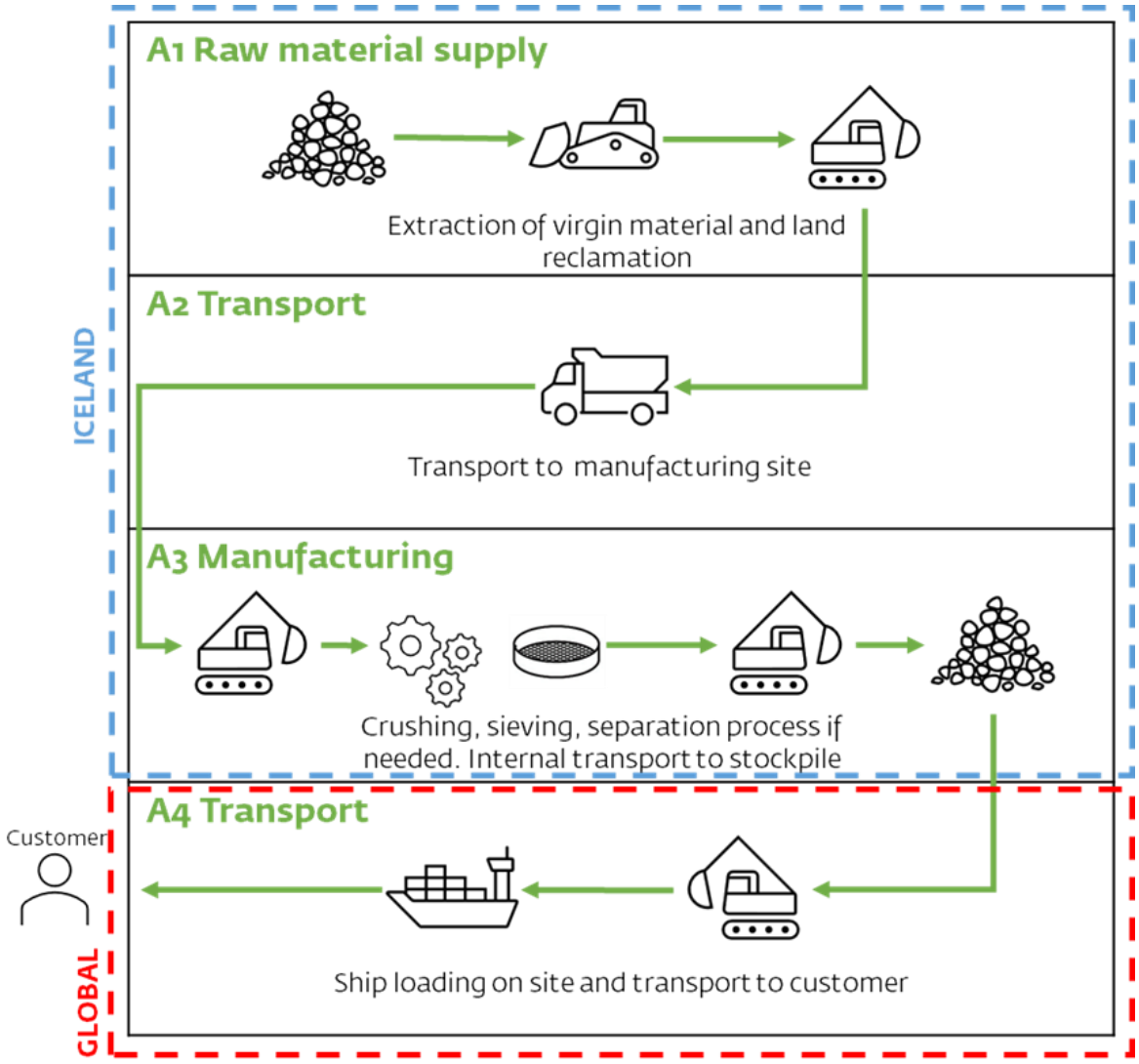

Figure 1. Flow model for the production of pumice and scoria at JEI

The production process begins in the quarries by removing a overburden layer, composed of rocks, sand and pumice. A bulldozer and shovel loader are used to mine the pumice and subsequently backfill the quarry with the overburden layer back to it's original state. The layer of pumice which is mostly between 1 and 3 metres thick, is loaded on to trucks with a shovel loader. The pumice/scoria is trucked by JEI's own trucks, to the processing plant at Þorlákshöfn. In the processing plant at Þorlákshöfn, the pumice is crushed, screened and certain properties are brought out in the process to suit the various products. No additives are used in the grinding/screening process. Some materials are not processed before they are sold, based on customer preferences. The processed stock of pumice/scoria is stored outside, on paved ground. It is moved directly with shovel loaders from the processed stock on to a quay side belt conveyor and from this conveyor to a moveable ship loading conveyor that carries the pumice/scoria directly into the sea vessel used for export. The pumice/scoria is shipped to Europe and to the east coast of North-America in bulk sea ships

LCA: RESULTS

The environmental impacts are declared according to EN 15804:2012+A2:2019 and PCR 2019:14, parameters and units. The environmental impact results refer to 1000 kg of average production product owned and operated by JEI in Iceland. The LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Table 5 and Table 6 show the LCIA results for 1000 kg of pumice/scoria. The product is delivered in bulk, thereof no packaging material is used. Also, the product does not contain any biogenic carbon content.

Table 5. Impact categories and environmental impact of 1000 kg product JEI (2020)

			Module A4					
Parameter	Unit	A1-A3	Dordrecht, NL	Malmö, SE	Surte, SE	Aalborg, DK	Chesapeake, USA	Hargshamn, SE
Parameters describing environmental impacts								
Global warming potential – total (GWP-total)	kg CO_2 eq.	2,78E+01	1,07E+01	1,14E+01	1,04E+01	1,08E+01	2,51E+01	1,53E+01
Global warming potential – fossil (GWP-fossil)	kg CO_2 eq.	2,75E+01	1,07E+01	1,14E+01	1,04E+01	1,08E+01	2,51E+01	1,53E+01
Global warming potential – biogenic (GWP-biogenic)	kg CO_2 eq.	4,86E-02	1,54E-03	1,55E-03	1,53E-03	1,54E-03	1,73E-03	1,60E-03
Global warming potential – luluc (GWP-luluc)	kg CO_2 eq.	1,97E-01	5,15E-03	5,17E-03	5,15E-03	5,16E-03	5,54E-03	5,28E-03
Ozone depletion potential (ODP)	kg CFC11 eq	7,31E-10	7,71E-11	7,82E-11	7,66E-11	7,73E-11	1,02E-10	8,49E-11
Acidification potential for soil and water (AP)	mol H^+ eq.	2,05E-01	4,24E-01	4,50E-01	4,11E-01	4,28E-01	1,02E+00	6,13E-01
Eutrophication aquatic freshwater (EP-freshwater)	kg (PO_4) eq. kg P eq.	1,76E-04 5,39E-04	1,99E-05 6,49E-06	2,03E-05 6,62E-06	1,97E-05 6,43E-06	2,00E-05 6,51E-06	2,85E-05 9,29E-06	2,27E-05 7,38E-06
Eutrophication aquatic marine (EP-marine)	kg N eq.	9,95E-02	1,20E-01	1,27E-01	1,16E-01	1,21E-01	2,85E-01	1,73E-01
Eutrophication terrestrial (EP-terrestrial)	Mol N eq.	1,08E+00	1,31E+00	1,40E+00	1,27E+00	1,33E+00	3,13E+00	1,89E+00
Formation potential of tropospheric ozone (POCP)	kg NMVOC eq.	2,39E-01	3,06E-01	3,25E-01	2,97E-01	3,09E-01	7,27E-01	4,40E-01
Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)[3]	kg Sb eq.	2,14E-03	3,70E-03	3,94E-03	3,59E-03	3,74E-03	8,88E-03	5,35E-03
Abiotic depletion potential for fossil resources (ADP-fossil)[2]	MJ, net calorific	6,56E+02	6,34E+02	6,74E+02	6,15E+02	6,41E+02	1,51E+03	9,14E+02
Water use (WDP)[2]	m^3 world eq deprived	6,87E+00	4,62E-01	4,65E-01	4,61E-01	4,63E-01	5,14E-01	4,79E-01

[3] *The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.*

Table 6. Paramenters describing resource use, primary energy for 1000 kg of product

			Module A4					
Parameter	Unit	A1-A3	Dordrecht, NL	Malmö, SE	Surte, SE	Aalborg, DK	Chesapeake, USA	Hargshamn, SE
Parameters describing resource use, primary energy								
Use of renewable primary energy excluding renewable primary energy used as raw materials (PERE)	MJ	2,65E+01	1,07E+00	1,09E+00	1,06E+00	1,08E+00	1,54E+00	1,22E+00
Use of renewable primary energy resources used as raw materials (PERM)	MJ	-	-	-	-	-	-	-
Total use of renewable primary energy resources (PERT)	MJ	2,65E+01	1,07E+00	1,09E+00	1,06E+00	1,08E+00	1,54E+00	1,22E+00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (PENRE)	MJ	6,56E+02	6,37E+02	6,76E+02	6,17E+02	6,43E+02	1,52E+03	9,17E+02
Use of non-renewable primary energy resources used as raw materials (PENRM)	MJ	-	-	-	-	-	-	-
Total use of non-renewable primary energy resources (PENRT)	MJ	6,56E+02	6,37E+02	6,76E+02	6,17E+02	6,43E+02	1,52E+03	9,17E+02
Parameters describing resource use, secondary materials and fuels, use of water								
Use of secondary material (SM)	kg	-	-	-	-	-	-	-
Use of renewable secondary fuels (RSF)	MJ	-	-	-	-	-	-	-
Use of non-renewable secondary fuels (NRSF)	MJ	-	-	-	-	-	-	-
Net use of fresh water (FW)	m^3	-	-	-	-	-	-	-
Other environmental information describing waste categories								
Hazardous waste disposed (HWD)	kg	-	-	-	-	-	-	-
Non-hazardous waste disposed (NHWD)	kg	-	-	-	-	-	-	-
Radioactive waste disposed (RWD)	kg	3,01E-03	3,81E-04	3,78E-04	3,83E-04	3,81E-04	3,13E-04	3,59E-04
Other environmental information describing outflows								
Components for re-use (CRU)	kg	-	-	-	-	-	-	-
Materials for recycling (MRF)	kg	-	-	-	-	-	-	-
Materials for energy recovery (MER)	kg	-	-	-	-	-	-	-
Exported energy (EE)	MJ per energy carrier	-	-	-	-	-	-	-
Additional indicators								
GWP-GHG	Kg CO_2 eq	2,82E+00	8,44E-01	8,94E-01	8,19E-01	8,52E-01	1,97E+00	1,20E+00

LCA: INTERPRETATION

As seen from this LCA the pumice/scoria produced by JEI in Iceland is an environmentally friendly natural aggregate with a low CO_2 and natural resources deprivation. The goal of JEI is to work in harmony with nature, minimise negative environmental impact and be at the forefront of environmental issues among companies in comparable operations. Most environmental impacts associated with aggregate quarrying are benign. Land use activities, alongside with diesel consumption and electricity are the main contributions to the formation of the environmental impacts. Diesel combustion and use during stages A1-A4 accounts for 83% of the Climate Change – total indicator. Therefore, almost all the total CO2 emissions are attributed to diesel consumption and generation.

REFERENCES

1. **European Commission - Joint Research Centre - Institute for Environment and Sustainability**. International Reference Life Cycle Data System (ILCD) Handbook - general guide for Life Cycle Assessment - Detailed guidance. Luxembourg : Publications Office of the European Union, 2010. Vol. First edition. EUR 24708 EN.

2. **Jarðefnaiðnaður ehf**. Jarðefnaiðnaður ehf. Building material. [Online] 2020. https://jei.is/building-material.html.

3. —. **Jarðefnaiðnaður ehf.** Growing medium. [Online] 2021. https://jei.is/growing-medium.html.

4. **Jarðefnaiðnaður ehf**. Jarðefnaiðnaður ehf. In biotechnology. [Online] 2021. https://jei.is/in-biotechnology.html.

5. **Alþingi.** Lög um náttúruvernd nr. 60. 2013.

6. —. Lög um mat á umhverfisáhrifum nr. 106. 2000.

7. —. Lög um rannsóknir og nýtingu á auðlindum í jörðu nr. 57. 1998.

8. **Umhverfis- og auðlindaráðuneytið**. Námur - efnistaka og frágangur. Reykjavík : Stjórnarráð Íslands, 2002.

9. **Iðnaðarráðuneytið.** Reglugerð um vinnslu og nýtingu vikurs nr. 514/1995. s.l. : Stjórnarráðið, 1995.

10. **Greendelta**. OpenLCA. [Online] 2021. www.openlca.org.

11. **European Commission**. European Platform on Life Cycle Assessment. Developer Environmental Footprint (EF). [Online] https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml.

12. —. International Reference Life Cycle Data System (ILCD) Handbook - Framework and requirements for Life Cycle Impact Assessment models and indicators. European Commission - Joint Research Center - Institute for Environment and Sustainability : Publication Office of the European Union, 2010.

13. —. International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. s.l., European Commission - Joint Research Center - Institute for Environment and Sustainability : Publication Office of the European Union, 2010.

14. **European Committee for Standardization**. EN 15804:2012+A2:2019. Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products. s.l. : CEN, 2019.

15. **EPD International.** PCR 2019:14. Product category rules (PCR) - Construction products. s.l. : EPD International, 2021.

16. —. General Programme Instructions for the International EPD system. s.l. : EPD International, 2021.1.

17. ISO 14025:2010 Environmental labels and declarations - Type III environmental declarations, principles and procedures.

18. ISO 14040:2006 Environmental management. Life cycle assessment. Principles and frameworks.

19. ISO 14044:2006 Environmental management. Life cycle assessment. Requirements and guidelines.

20. ISO 14020:2000 Environmental labels and declarations - General principles.

21. Pumice and scoria LCA background report 26.10.2021