LAFARGE EXSHAW CEMENT PLANT
ENVIRONMENTAL PRODUCT DECLARATION

A MEMBER OF HOLCIM

About this EPD

This is a cradle-to-gate environmental product declaration for General Use (GU, Type I/II), High Sulphate (HS, Type V), General Use Limestone (GUL, Type IL), High Sulphate Limestone (HSL, Type IL – HS), High Early (HE, Type III), and Oil Well G (OWG) cements as produced at Lafarge's Exshaw, AB plant. The life cycle assessment was prepared according to ISO 14025:2006, ISO 21930:2017 (the core PCR) and the NSF product category rules for Portland, Blended, Masonry, Mortar and Plastic (stucco) Cements (subcategory PCR). This environmental product declaration (EPD) is intended for business-to-business audiences.

General Summary

EPD Commissioner and Owner	**Lafarge Canada** 6509 Airport Road Mississauga ON, L4V 1S7 www.lafarge.ca
	Lafarge, a member of Holcim, provided both LCI and meta-data for limestone quarrying, clinker production and cement manufacture for reference year 2020. The owner of the declaration is liable for the underlying information and evidence. *For any explanatory material, regarding this EPD, please contact Matt Dalkie (matt.dalkie@lafarge.com).*
Product Group and Name	Cement, UN CPC 3744.
Product Definition	**Portland Cement (GU, Type I/II, HE, Type III, HS, Type V):** a product obtained by pulverizing portland cement clinker consisting essentially of hydraulic calcium silicates, to which the various forms of calcium sulphate, up to 5% limestone, water, and processing additions may be added at the option of the manufacturer (CSA A3000, ASTM C150, ASTM C1157, AASHTO M85). **Portland Limestone Cement (GUL, Type IL, HSL, Type IL – HS):** a product obtained by intergrinding portland cement clinker, to which the various forms of calcium sulphate, between 5 and 15% limestone, water, and processing additions may be added at the option of the manufacturer (CSA A3000, ASTM C595, ASTM C1157, AASHTO M240). **Oil Well Cement (Class G):** a product obtained by pulverizing portland cement clinker consisting essentially of hydraulic calcium silicates, to which the various forms of calcium sulphate and water may be added at the option of the manufacturer (API Spec 10A).
Product Category Rules (PCR)	NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021.
Date of Issue & Validity Period	January 24, 2022 – 5 years
Declared Unit	1 metric tonne of cement

EPD and Project Report Information

Program Operator	ASTM International
Declaration Number	EPD 290 – Lafarge Exshaw Cement Plant
Declaration Type	Cradle-to-gate (modules A1 to A3). Facility and product-specific.
Applicable Countries	Canada and United States
Product Applicability	Cement is the basic ingredient of concrete. Concrete, one of the most widely used construction materials in the world, is formed when Portland cement creates a paste with water that binds with sand and rock to harden.
Content of the Declaration	This declaration follows Section 9; Content of an EPD, NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021.
This EPD was independently verified by ASTM in accordance with ISO 14025 and the reference PCR: Internal External X	Tim Brooke ASTM International 100 Barr Harbor Drive PO Box C700 West Conshohocken PA 19428-2959, USA cert@astm.org
Notes	The LCA results are computed using the N.A. version 3.1 of GCCA Industry EPD tool for Cement and Concrete (https://concrete-epd-tool.org)
LCA report and EPD Prepared by:	Matt Dalkie Lafarge Canada Inc. 7591 No 9 Rd Richmond BC, V6W 0A6

This EPD verified in accordance with ISO 14025, ISO 14040/44, and the reference PCR.

PCR Information

Program Operator	NSF International
Reference PCR	Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021.
PCR review was conducted by:	Thomas P. Gloria, PhD (Chair), Industrial Ecology Consultants, t.gloria@industrial-ecology.com Mr. Jack Geibig, EcoForm Mr. Bill Stough, Sustainable Research Group

Lafarge Cement & Production Facility

Lafarge is a member of Holcim, the global leader in building materials and solutions. As the largest provider of diversified construction materials in Canada Lafarge's ambition is to lead the industry in reducing carbon emissions and shifting towards low-carbon construction.

In Canada, Holcim subsidiary companies include 400 across Canada, employing 6,000 people. Our customers rely on us to help them design and build better communities with innovative solutions that deliver structural integrity and eco-efficiency.

Facility Name: Lafarge Exshaw Cement Plant,
Hwy 1A, Exshaw, AB, T0L 2C0

Set on the edge of the Canadian Rocky Mountains, Lafarge's newly modernized cement plant is a showcase in environmental and economic efficiency. First constructed in 1906, updated facilities operate the latest in cement production technology and greatly improve its capacity to serve markets across western Canada and the Pacific Northwest. Home to 160 proud employees, Lafarge Exshaw is the largest cement plant in Canada and is instrumental in building the communities in which we live, work and play.

Product Description

This EPD reports environmental transparency information for General Use (GU, Type I/II), High Sulphate (HS, Type V), General Use Limestone (GUL, Type IL), High Sulphate Limestone (HSL, Type IL – HS), High Early (HE, Type III), and Oil Well G (OWG) cements produced by Lafarge at its Exshaw, AB plant. Cements are hydraulic binders and are manufactured by grinding cement clinker and other main or minor constituents into a finely ground, usually grey colored mineral powder. When mixed with water, cement acts as a glue to bind together the sand, gravel, or crushed stone to form concrete, one of the most durable, resilient, and widely used construction materials in the world. The Table below sets out each cement type constituents and applicable standards. All Exshaw cements are sold in bulk.

Products and Standards

Inputs	General Use (GU) High Sulphate (HS)	General Use Limestone (GUL) High Sulphate Limestone (HSL)	High Early (HE)	Oil Well (OWG)
Standards	CSA A3001 ASTM C150 ASTM C1157 AASHTO M85	CSA A3001 ASTM C595 ASTM C1157 AASHTO M240	CSA A3001 ASTM C150 ASTM C1157 AASHTO M85	API Spec 10A
Clinker	92%	86%	91%	94%
Gypsum, Limestone	8%	14%	9%	6%
Total	100%	100%	100%	100%

Applicable Standards:
CSA A3000-18 Cementitious Materials Compendium
ASTM C150 / C150M – 21 Standard Specification for Portland Cement
ASTM C595 / C595M – 21 Standard Specification for Blended Hydraulic Cements
ASTM C1157 / C1157M – 20a Standard Performance Specification for Hydraulic Cement
AASHTO M85-20 Standard Specification for Portland Cement

AASHTO M240-20 Standard Specification for Blended Hydraulic Cement
API Spec 10A – Cements and Materials for Well Cementing

Note:
CSA cement type designations have been used throughout this document as the primary identifier. The equivalent types and classes under other standards are shown below. Cements are produced to meet all applicable standards shown.

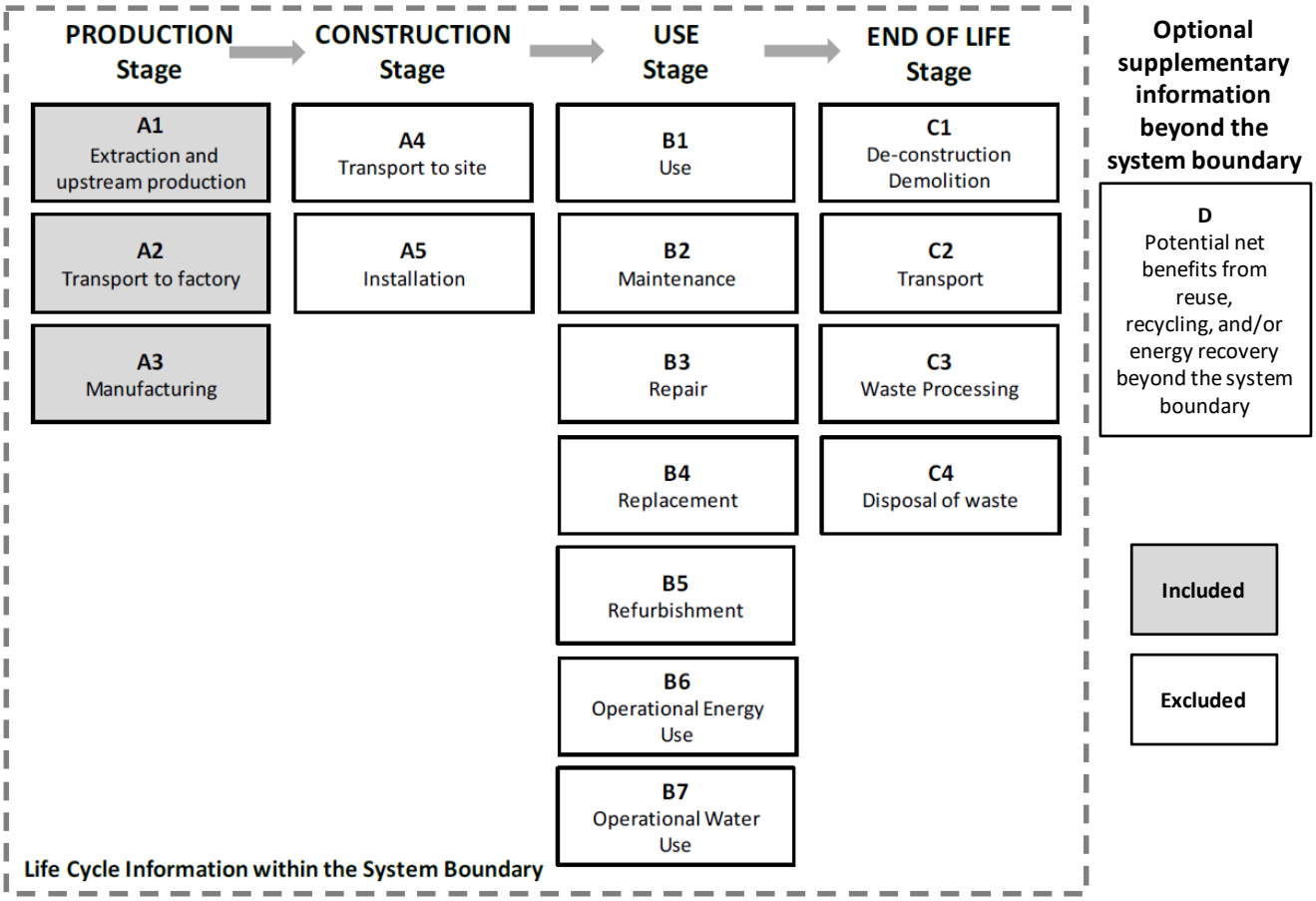
Standard	GU	GUL	HE	HS	HSL	OWG
ASTM C150	Type I/II	N/A	Type III	Type V	N/A	N/A
ASTM C595	N/A	Type IL	N/A	N/A	Type IL – HS	N/A
ASTM C1157	Type GU	Type GU	Type HE	Type HS	Type HS	N/A
AASHTO M85	Type I/II	N/A	Type III	Type V	N/A	N/A
AASHTO M240	N/A	Type IL	N/A	N/A	Type IL – HS	N/A
API Spec 10A	N/A	N/A	N/A	N/A	N/A	Class G

Declared Unit

The declared unit is one metric tonne of cement.

System Boundary

This cradle-to-gate EPD covering the production stage (LCA modules A1-A3) as depicted in the figure below. The production stage includes extraction of raw materials (cradle) through the manufacture of cements ready for shipment (gate). The Exshaw, AB cement plant sources its limestone supply from an adjacent quarry operated by Lafarge.



Items *excluded* from the system boundary include:

- Production, manufacture, and construction of manufacturing capital goods and infrastructure
- Production and manufacture of production equipment, delivery vehicles, and laboratory equipment
- Personnel-related activities (travel, furniture, and office supplies)
- Energy and water use related to company management and sales activities that may be located either within the factory site or at another location

Cut-off Criteria

The cut-off criteria as per NSF PCR, Section 7.1.8 and ISO 21930, 7.1.8 were followed. Per ISO 21930, 7.1.8, all input/output data required were collected and included in the LCI modelling. No substances with hazardous and toxic properties that pose a concern for human health and/or the environment were identified in the framework of this EPD. Any plant specific data gaps for the reference year 2020 e.g. amount of lubricants and refractory were filled in with industry data (secondary data).

Primary Data Collection

Gate-to-gate input/output flow data were collected for the following processes for the reference year 2020:

- Limestone quarry, clinker production and cement manufacture – Exshaw, AB.

Exshaw's direct greenhouse gas (GHG) emissions were calculated in accordance with Canada's Greenhouse Gas Reporting Program (GHGRP) as reported to the Province of Alberta and Government of Canada. Calcination emissions were calculated based on the Cement CO2 and Energy Protocol detailed output method (B2) published by the World Business Council for Sustainable Development (WBCSD) Cement Sustainability Initiative (CSI).

Allocation Rules

Allocation follows the requirements and guidance of ISO 14044 Clause 4.3.4, NSF PCR, and ISO 21930 section 7.2. Recycling and recycled content are modeled using the cut-off rule. The sub-category PCR recognizes fly ash, furnace bottom ash, bypass dust, mill scale, polluted soils, spent catalyst, aluminum oxide waste, silica fume, granulated blast furnace slag, iron rich waste, cement kiln dust (CKD), flue gas desulfurization (FGD) gypsum, and calcium fluoride rich waste as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a cement material input. Further, used tires, plastics, solvents, used oil and oily waste, coal/carbon waste, roofing asphalt, household refuse-derived waste and non-hazardous liquid waste are considered non-renewable and/or renewable secondary fuels. Only the materials, water, energy, emissions, and other elemental flows associated with reprocessing, handling, sorting and transportation from the point of the generating industrial process to their use in the production process are considered. All emissions from combustion at the point of use are considered.

Data Quality Requirements and Assessment

It should be noted that the data quality assessment here covers only the clinker and cement production inventories (i.e., activity data). An evaluation of the quality of data used to model background processes (e.g., electricity generation) has also been carried out, and the results are located in the *LCA core model and database report* of the *U.S. version of GCCA tool for EPDs of concrete and cement.*

Data Quality Requirements	Description
Technology Coverage	Data represents the prevailing technology in use at the Exshaw, AB facility. The Exshaw, AB plant utilizes *pre-calciner kiln technology*. *Technological representativeness is characterized as "high".*
Geographic Coverage	The geographic region considered is Canada. The electricity was modeled based on the AESO 2020 grid mix for AB, consisting of 45.8% gas, 35.1% coal, 10.6% wind, 4.9% oil, 3.5% hydro, and 0.2% solar generation. *Geographical representativeness is characterized as "high".*
Time Coverage	Activity (primary) data are representative of 2020 calendar year (12 months). - Exshaw, AB limestone extraction, - Exshaw, AB clinker production, - Exshaw, AB cement manufacturing, - In-bound/out-bound transportation data - primary data collected for Exshaw, AB quarry site and cement manufacturing plant. - Total carbon dioxide emissions from fuel use and calcination were reported for clinker production as part of the facility data collection. *Temporal representativeness is characterized as "high".*
Completeness	All relevant, specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled to complete production profile for Exshaw cement products.

Consistency	To ensure consistency, the modeling of the production input and output LCI data for the Exshaw cement products of interest used the same LCI modeling structure, which consisted of input material and intermediate products, ancillary and packaging materials (if applicable), energy flows, water resource inputs, product outputs, co-products, by-products, emissions to air, water and soil, and solid and liquid waste disposal. The calculated LCI was subsequently inputted into the N.A. version of GCCA Industry EPD tool for Cement and Concrete (https://concrete-epd-tool.org) Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the facility level and selected process levels to maintain a high level of consistency.
Reproducibility	Internal reproducibility is possible since the data and the models are stored the N.A. version of GCCA Industry EPD tool for Cement and Concrete (https://concrete-epd-tool.org). Key primary (manufacturer specific) and secondary (generic) LCI data sources are also summarized in the GCCA Tool documentation. External reproducibility is not possible as the background report is confidential.
Transparency	Activity and LCI datasets are disclosed in the project report, including all data sources.

Life Cycle Impact Assessment Results: Exshaw, AB Cements

This section summarizes the production stage life cycle impact assessment (LCIA) results including resource use and waste generated metrics based on the cradle-to-gate life cycle inventory inputs and outputs analysis. The results are calculated based on 1 metric tonne of each cement type as produced at the Exshaw, AB plant.
It should be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Further, a number of LCA impact categories and inventory items are still emerging or under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting results for these categories – identified with an "".*

Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products. Environmental declarations from different programs may not be comparable. EPDs are comparable only if they comply with ISO 21930, use the same, sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.
Production Stage EPD Results: Exshaw, AB– per metric tonne

Impact category and inventory indicators	Unit	GU / HS	GUL / HSL	HE	OWG
Global warming potential, GWP 100, AR5	kg CO_2 eq	838	788	858	860
Ozone depletion potential, ODP	kg CFC-11 eq	2.81E-5	2.68E-5	3.12E-5	2.86E-5
Smog formation potential, SFP	kg O_3 eq	36.0	34.0	36.7	36.8
Acidification potential, AP	kg SO_2 eq	2.89	2.73	2.97	2.96
Eutrophication potential, EP	kg N eq	0.832	0.807	1.022	0.849
Abiotic depletion potential for non-fossil mineral resources, ADP elements*	kg Sb eq	1.49E-4	1.47E-4	1.76E-4	1.51E-4
Abiotic depletion potential for fossil resources, ADP fossil	MJ NCV	816	773	844	835
Renewable primary resources used as an energy carrier (fuel), RPRE*	MJ NCV	103	100	128	105
Renewable primary resources with energy content used as material, RPRM *	MJ NCV	0	0	0	0
Non-renewable primary resources used as an energy carrier (fuel), NRPRE*	MJ NCV	5700	5405	6066	5839
Non-renewable primary resources with energy content used as material, NRPRM *	MJ NCV	0	0	0	0
Secondary materials, SM *	kg	104.5	95.6	99.9	104.3
Renewable secondary fuels, RSF *	MJ NCV	0	0	0	0
Non-renewable secondary fuels, NRSF *	MJ NCV	0	0	0	0
Recovered energy, RE *	MJ NCV	0	0	0	0
Consumption of freshwater, FW	m^3	0.985	1.00	1.10	1.00
Hazardous waste disposed, HWD *	kg	1.92E-3	1.86E-3	1.91E-3	1.95E-3
Non-hazardous waste disposed, NHWD*	kg	1.13E-2	1.07E-2	1.12E-2	1.15E-2
High-level radioactive waste, conditioned, to final repository, HLRW *	m^3	x	x	x	x
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW *	m^3	x	x	x	x
Components for re-use, CRU *	kg	0	0	0	0
Materials for recycling, MR *	kg	0.105	0.101	0.104	0.108
Materials for energy recovery, MER *	kg	0	0	0	0
Recovered energy exported from the product system, EE *	MJ NCV	0	0	0	0
Additional Inventory Parameters for Transparency					
Emissions from calcination	kg CO_2 eq	491	459	484	505
Biogenic CO2, reporting the removals and emissions of biogenic carbon within biobased	kg CO_2 eq	0	0	0	0

Table Notes:

1) (x) Not all LCA datasets for upstream materials include these impact categories and thus results may be incomplete.
2) (*) Use caution when interpreting results for these categories.

LCA Interpretation

The Manufacturing module (A3) drives most of the potential environmental impacts. Manufacturing impacts are primarily driven by energy use (electricity and thermal fuels) used during the pyroprocessing of limestone in the production of clinker. Clinker content in cement similarly defines the relative environmental profile of the final cement product. Raw material extraction (A1) is the second largest contributor to the Production stage EPD results, followed by the transportation (A2).

References

1. CSA A3000-18 Cementitious materials compendium
2. ASTM C150/C150M-21, Standard Specification for Portland Cement
3. ASTM C595/C595M-21, Standard Specification for Blended Hydraulic Cements
4. AASTHO M85 - 20, Standard Specification for Portland Cement
5. AAHTO M240M/M240 -20, Standard Specification for Blended Hydraulic Cement
6. API Spec 10A, Cements and Materials for Well Cementing
7. NSF International, Product Category Rule Environmental Product Declarations, PCR for Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021.
8. ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
9. ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework.
10. ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines.
11. ISO 14025:2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.
12. ISO 14021:2016 Environmental labels and declarations -- Self-declared environmental claims (Type II environmental labelling).
13. ASTM General Program Instructions, v8.0, April 29, 2020.
14. GCCA CO_2 and Energy Protocol Version 3.1 of 9 December 2013. (https://www.cement-co2-protocol.org/en/) accessed 08-2021.
15. GCCA Industry EPD tool for Cement and Concrete, N.A. version 3.1 (https://concrete-epd-tool.org) accessed 11-2021
16. GCCA Industry EPD tool for Cement and Concrete (v3.1) LCA Model, North American Version, November 10, 2021