ASH GROVE

A CRH COMPANY

Ash Grove Mississauga Cement Plant

An Environmental Product Declaration

ASTM INTERNATIONAL
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An Environmental Product Declaration

In accordance with ISO 14025 and 21930

About this EPD

This is a Type III environmental product declaration (EPD) for cements produced by Ash Grove at its plant located in Mississauga, ON. The results of the underlying LCA are computed using the North American (N.A.) version of the Global Cement and Concrete Association (GCCA) Industry EPD Tool for cement and concrete, V4.2 [1]. This tool and the underlying LCA model and database [2] have been previously verified to conform to the prevailing sub-product category rule (PCR) [3], ISO 21930:2017 (the core PCR) [4] as well as ISO 14020:2000 [5] and ISO 14040/44:2006 LCA standards [7], [8].

This EPD is certified by ASTM to conform to the sub-Product Category Rule (PCR) referenced above [3], as well as to the requirements of ISO 14020, ISO 14025 [6], ISO 21930 and ASTM International's General Program Instructions [9]. This EPD is intended for business-to-business audiences.

General Summary

EPD Commissioner and Owner	**Ash Grove, a CRH Company** Mississauga Cement Plant 2391 Lakeshore Rd West Mississauga, ON L5J 1K1 https://www.ashgrove.com/ Ash Grove company personnel provided LCI and meta data for limestone extraction, clinker production, and cement manufacture for the 2023 reference year in support of this EPD. *The owner of the declaration is liable for the underlying information and evidence.*
Product Group and Name	*Cement, UN CPC 3744.*
Product Definition	***Portland cement*** is defined as a hydraulic cement produced by pulverizing clinker, consisting essentially of crystalline hydraulic calcium silicates, and usually containing one or more of the following: water, calcium sulfate, up to 5% limestone, and processing additions (ASTM C150, AASTHO M 85, CSA A3001). • Portland Cement *Type I (GU)* — For use when the special properties specified for any other type are not required. • Portland Cement *Type II (MS/MH)* — For general use, more especially when moderate sulfate resistance is desired. • Portland Cement *Type III (HE)* — For use when high early strength is desired. Some cements are designated with a combined type classification, such as Type I/II, indicating that the cement meets the requirements of the indicated types and is being offered as suitable for use when either type is desired. ***Blended cement*** is a hydraulic cement consisting of two or more inorganic constituents (at least one of which is not portland cement or portland cement clinker) which separately or in combination contribute to the strength gaining properties of the cement, (made with or without other constituents, processing additions and functional additions, by intergrinding or other blending). • Type IL GUL (ASTM C595, AASHTO M 240, CSA A3001) — is a portland-limestone cement (PLC) and is a hydraulic cement in which the limestone content is more than 5% but less than or equal to 15% by mass of the blended cement.

	Masonry cement is hydraulic cement manufactured for use in mortars for masonry construction or in plasters, or both, which contains a plasticizing material and, possibly, other performance-enhancing addition(s). • Types N, S, M (ASTM C91, CSA A3002)
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 [3].
Date of Issue & Validity Period	July 15th, 2024 – 5 years
Declared Unit	1 metric ton of cement

EPD and Project Report Information

Program Operator	ASTM International
Declaration Number	EPD 746
Declaration Type	Cradle-to-gate (modules A1 to A3). Facility and product-specific.
Applicable Countries	Canada and United States
Product Applicability	Portland 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 [3].
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 Thomas P. Gloria, Ph. D. Industrial Ecology Consultants 35 Bracebridge Road Newton, MA 02459-1728
Notes	The EPD results reported herein are computed using the N.A. GCCA Industry EPD tool for Cement and Concrete, v4.2 (https://concrete-epd-tool.org) [1].
EPD Prepared by: Athena Sustainable Materials Institute	Athena Sustainable Materials Institute 280 Albert Street, Suite 404 Ottawa, Ontario, Canada K1P 5G8 info@athenasmi.org www.athenasmi.org

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 [3].
PCR review was conducted by:	Thomas P. Gloria, PhD (Chair), Industrial Ecology Consultants, Mr. Jack Geibig, EcoForm Mr. Bill Stough, Sustainable Research Group

Ash Grove Cement & Production Facilities

Ash Grove Cement Company, a CRH Company, is a leader and pioneer in the cement industry. For over 137 years, we have provided portland and masonry cements to construct the highways, bridges, commercial and industrial complexes, and single- and multi-family homes fundamental to America's economic vitality and quality of life. In 2018, Ash Grove shipped 8.3 million tons of cement from eight cement plants and its network of terminals located throughout the Midwest, Texas and Western United States as well as Florida, the US Great Lakes and Canada. Ash Grove is known for quality, reliability and a commitment to safety.

Facility Name: **Mississauga Cement Plant** 2391 Lakeshore Rd West, Mississauga, ON L5J 1K1

Product Description

This EPD reports environmental transparency information for various cements produced by Ash Grove Cement Company at its Mississauga ON 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.

Products and Standards

Inputs	Type GU / I	Type GUL / IL	Type HE / III	Type HSF GUb-SF	Masonry Types N&S
Clinker	90%	80%	92%	76%	57%
Gypsum	7%	7%	5%	9%	3%
Limestone	3%	13%	3%	0%	40%
Silica Fume	0%	0%	0%	14%	0%
Other	<1%	<1%	<1%	<1%	<1%
Total	100%	100%	100%	100%	100%

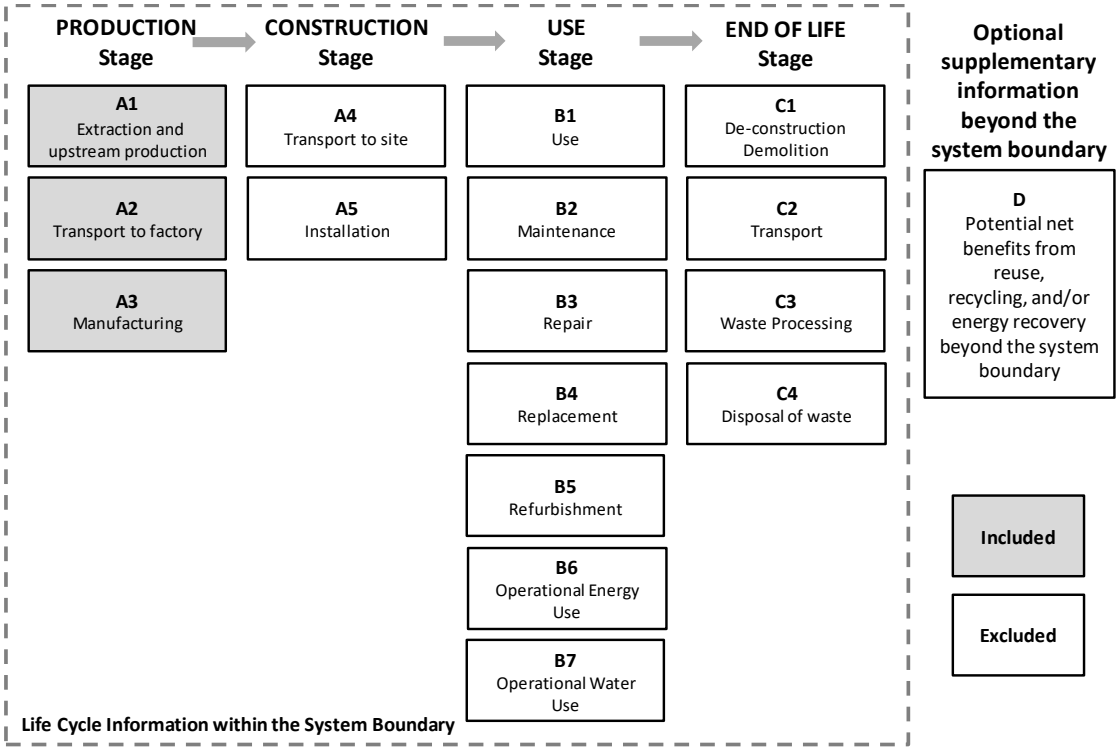
Applicable Standards:
ASTM C150 / C150M, AASHTO M 85, CSA A3001 –Standard Specification for Portland Cement [11], [14] and [16].
ASTM C595 / C595M, AASHTO M 85, CSA A3001– Standard Specification for Blended Hydraulic Cement [12], [14], and [16].
ASTM C91, CSA A3002 – Standard Specification for Masonry Cement [13] and [15].

Declared Unit

The declared unit is one metric ton of cement.

System Boundary

This EPD is a cradle-to-gate EPD covering the production stage (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 Mississauga cement plant barges its limestone supply from a quarry 160km away. The plant's cement products are sold in bulk.



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 per NSF PCR, Section 7.1.8 [3] and ISO 21930, 7.1.8 [4] 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

Data Collection

Gate-to-gate input/output flow data was collected for the following processes for the reference year 2023:

- Limestone quarry operations, clinker production and cement manufacture.

Allocation Rules

Allocation of inventory flows and subsequent environmental impact is relevant when assets are shared between product systems. The allocation method prescribed by the PCR [3] is applied in the underlying LCA model. 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, calcium fluoride rich waste and postconsumer gypsum 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, non-hazardous liquid waste, industrial sludge, and agricultural 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. For co-products, no credit is considered, and no allocation is applied. See the LCA model and LCA database reports of GCCA's Industry Tool for EPDs of cement and concrete for more information [1], [2].

Data Quality Requirements and Assessment

Data Quality Requirements	Description
Technology Coverage	LCI data represents the prevailing technology in use at the Mississauga facility. The Mississauga plant operates using efficient *dry with preheater and precalciner kiln technology*. *Technological representativeness is characterized as "high".*
Geographic Coverage	The geographic region considered is Canada and the U.S. *Geographical representativeness is characterized as "high".*
Time Coverage	Activity (primary) data are representative of 2023 calendar year (12 months) covering - Mississauga limestone extraction, - Mississauga clinker production, - Mississauga cement manufacturing, - In-bound/ out-bound transportation data - primary data collected for Mississauga site. *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 Mississauga cement products. Mississauga operates a continuous emissions monitoring system and performs fuel and raw kiln feed material analysis to determine their emissions. These emissions are reported to the National Pollution Release Inventory and the Government of Ontario's Emission Performance Standards. These data for 2023 were drawn on in the completion of this EPD. The completeness of the foreground process chain in terms of process steps is rigorously assessed.
Consistency	To ensure consistency, cross checks of the energy demand and the calculated raw meal to clinker ratio against ranges reported in the WBCSD Cement Sustainability Initiative, Cement CO2 and Energy Protocol, v3.1 December, 2013 were conducted [16]. The LCA team conducted mass and energy balances at the facility level and selected process levels to maintain a high level of consistency.

Reproducibility	External reproducibility is not possible as the background report is confidential.
Transparency	Activity datasets are disclosed in the project LCI compilation, and the background reports generated by the GCCA Tool.
Uncertainty	A *sensitivity check* was conducted relative to the CAC industry average [18]. The variation for significant inputs was found to be well within the expected range and hence, there is a high degree of confidence in the results.

Life Cycle Impact Assessment Results: Ash Grove Mississauga Cement Plant

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 ton of each cement type as produced at the Mississauga 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 [4], [8]. Further, many 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 "*" [3].

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 [3]. Environmental declarations from different programs may not be comparable [6]. 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 [3] [4].

Production Stage EPD Results: Mississauga Plant – per Metric Ton

Impact category and inventory indicators	Unit	Type GU	Type GUL	Type HE	Type GUb-SF	Masonry Types N &S
Global warming potential, GWP 100, AR5	kg CO_2 eq	**813**	**721**	**837**	**712**	**518**
Ozone depletion potential, ODP	kg CFC-11 eq	**8.63E-06**	**7.75E-06**	**8.83E-06**	**9.46E-06**	**6.12E-06**
Smog formation potential, SFP	kg O_3 eq	**47.83**	**42.82**	**49.21**	**42.17**	**31.64**
Acidification potential, AP	kg SO_2 eq	**2.87**	**2.56**	**2.95**	**2.53**	**1.88**
Eutrophication potential, EP	kg N eq	**0.54**	**0.48**	**0.56**	**0.5**	**0.36**
Abiotic depletion potential for non-fossil, mineral resources ADP elements*	kg Sb eq	**1.34E-04**	**1.15E-04**	**1.39E-04**	**1.75E-04**	**1.16E-04**
Abiotic depletion potential for fossil resources, ADP fossil*	MJ LHV	**4158**	**3657**	**4298**	**4115**	**3146**
Renewable primary resources used as an energy carrier (fuel), RPRE*	MJ LHV	**245**	**213**	**254**	**256**	**224**
Renewable primary resources with energy content used as material, RPRM*	MJ LHV	**0**	**0**	**0**	**0**	**0**
Non-renewable primary resources used as an energy carrier (fuel), NRPRE*	MJ LHV	**4158**	**3657**	**4298**	**4115**	**3146**
Non-renewable primary resources with energy content used as material, NRPRM*	MJ LHV	**0**	**0**	**0**	**0**	**0**
Secondary materials, SM*	kg	**0**	**0**	**0**	**136**	**0**
Renewable secondary fuels, RSF *	MJ LHV	**0**	**0**	**0**	**0**	**0**
Non-renewable secondary fuels, NRSF *	MJ LHV	**1285**	**1140**	**1324**	**1096**	**810**
Consumption of freshwater, FW*	m^3	**6.36**	**5.56**	**6.59**	**6.29**	**5.38**
Hazardous waste disposed, HWD*	kg	**0.16**	**0.14**	**0.16**	**0.13**	**0.1**
Non-hazardous waste disposed, NHWD *	kg	**1.72**	**1.53**	**1.78**	**1.47**	**1.09**
High-level radioactive waste, conditioned, to final repository, HLRW*	kg	**x[1])**	**x[1])**	**x[1])**	**x[1])**	**x[1])**
Intermediate and low-level radioactive waste, conditioned, to final repository, ILLRW*	kg	**x[1])**	**x[1])**	**x[1])**	**x[1])**	**x[1])**
Components for re-use, CRU*	kg	**12.14**	**10.77**	**12.51**	**10.35**	**7.65**
Materials for recycling, MFR*	kg	**1.22**	**1.09**	**1.26**	**1.04**	**0.77**
Materials for energy recovery, MER*	kg	**0**	**0**	**0**	**0**	**0**
Recovered energy exported from the product system, EE*	MJ LHV	**0**	**0**	**0**	**0**	**0**
Additional Indicators:						
Global warming potential - biogenic, GWP-bio*	kg CO_2 eq	**0.34**	**0.29**	**0.35**	**0.37**	**0.31**
Emissions from calcination*	kg CO_2 eq	**488**	**433**	**503**	**416**	**307**
Emissions from combustion of waste from non-renewable sources*	kg CO_2 eq	**109**	**97**	**113**	**93**	**69**

Table Notes:
x[1)] – The GCCA EPD Tool does not support these indicators.
* 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) and process calcination emissions 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 Transportation (A2).

Additional Environmental Information

Environmental Protection Manufacture and Equipment:
Ash Grove's Mississauga, ON plant is both ISO 9001 and 14001 certified.

Air pollution abatement equipment used at Ash Grove Cement Company's Mississauga plant consist of high temperature baghouses, bin vents, water sprinklers for dust control, selective non-catalytic reduction and dry scrubber.

References

[1] Global Cement and Concrete Association (GCCA) and Portland Cement Association (PCA), GCCA Industry EPD Tool for Cement and Concrete (V4.2), User's Manual, North American version, Prepared by Quantis, December 2023. https://concrete-epd-tool.org/

[2] Global Cement and Concrete Association (GCCA) LCA Database, North American version (V4.2), Prepared by Quantis, December 2023. https://concrete-epd-tool.org/assets/GCCA_EPD-Tool_LCA-Database-v4.2_2023-12-18.xlsx

[3] NSF International, Product Category Rule Environmental Product Declarations, PCR for Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021.

[4] ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

[5] ISO 14020:2000 Environmental labels and declarations — General principles

[6] ISO 14025:2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.

[7] ISO 14040:2006/Amd1:2020 Environmental management - Life cycle assessment - Principles and framework.

[8] ISO 14044:2006/Amd1:2017/Amd2:2020 Environmental management - Life cycle assessment - Requirements and guidelines.

[9] ASTM General Program Instructions. V.8.0, April 29, 2020.

[10] NSF International, Product Category Rule Environmental Product Declarations, PCR for Concrete, V2.1, August 2021.

[11] ASTM C150 / C150M – 20 Standard Specification for Portland Cement.

[12] ASTM C595 / C595M - 21 Standard Specification for Blended Hydraulic Cements

[13] ASTM C91 – Standard Specification for Masonry Cement

[14] CSA A3001 – Cementitious Materials for Use in Concrete

[15] CSA A3002 – Masonry and Mortar Cements

[16] AASHTO M 85-21 Standard Specification for Portland Cement (ASTM Designation: C150/C150M-21)

[17] WBCSD CSI 2013: CO_2 and Energy Protocol Version 3.1. December 9, 2013. https://www.cement-co2-protocol.org/en/

[18] Cement Association of Canada Environmental Product Declaration – GU & GUL Cement, ASTM International, April 21, 2023. https://pcr-epd.s3.us-east-2.amazonaws.com/919.CAC_General_Use_(GU)_and_Portland-Limestone_(GUL)_Cements.pdf