Environmental Product Declaration

ASTM INTERNATIONAL

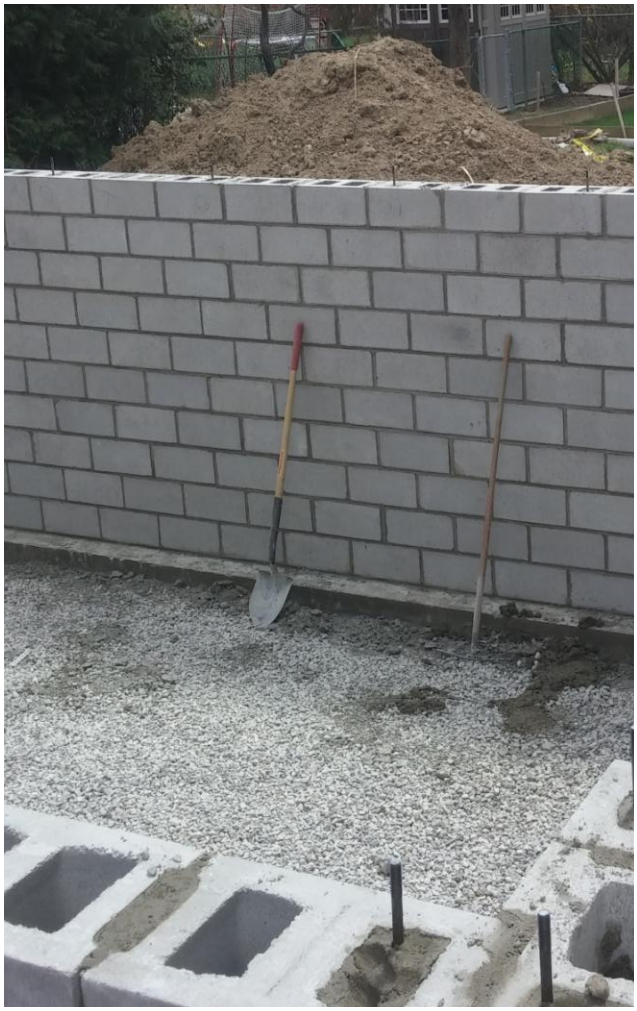
A cradle-to-gate EPD according to ISO 14025 and ISO 21930

Normal-weight and Light-weight Concrete Masonry Units as Manufactured by Members of the Canadian Concrete Masonry Producers Association (CCMPA)

CCMPA

About The CCMPA

For five decades, the CCMPA worked on behalf of Ontario's concrete masonry producers to build an industry as strong and as enduring as the products it manufactures. Now, as a Canada-wide body with national membership, we're making our industry stronger.



Today, technology and innovation are presenting our industry with great opportunities — and considerable challenges. As CCMPA, we will provide the inclusive representation and strong voice necessary to ensure that we meet those challenges, and that our products remain the building material of choice.

ASTM International Certified EPD

This is a Canadian industry-average business-to-business Type III environmental product declaration (EPD) for concrete masonry unit (CMU) products as manufactured by Canadian Concrete Masonry Producers Association (CCMPA) members. This declaration has been prepared in accordance with ISO 14025 and ISO 21930, and the ASTM product category rules (PCR) and EPD program operator rules.

The intent of this document is to further the development of environmentally compatible and more sustainable construction products by providing comprehensive environmental information related to potential impacts of CMU available in Canada in accordance with international standards.

Program Operator

ASTM International
Environmental Product Declarations
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Owner of the EPD

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CCMPA Member-company Corporate Address & Facility Locations Applicable to this EPD

Basalite Concrete Products
8650 130th Street
Surrey, British Columbia
V3W 1G1
www.basalite.com

locations: Surrey, British Columbia

Boehmers
1038 Rife Road
Cambridge, Ontario
N1R 5S3
www.boehmerblock.com

locations: Kitchener, Ontario

Brampton Brick Limited
225 Wanless Drive
Brampton, Ontario
L7A 1E9
www.bramptonbrick.com

locations: Brampton, Ontario; Brockville, Ontario

Brown's Concrete Products Ltd.
3075 Herold Drive
Sudbury, Ontario
P3E 6K9
www.brownsconcrete.com

locations: Sudbury, Ontario

Canal Block
3562 Nugent Road
Port Colborne, Ontario
L3K 5V5
www.canalblock.com

locations: Port Colborne, Ontario

Casey Concrete Ltd
96 Park Street
Amherst, Nova Scotia
B4H 2M8
www.caseyltd.ca

locations: Amherst, Nova Scotia

Century Concrete Products Ltd 2016
4170 Midland Ave
Scarborough, Ontario
M1V 4S6
www.centuryconcrete.ca

locations: Scarborough, Ontario

Cindercrete Products Ltd.
P.O. Box 306
Hwy #1 East
Regina, Saskatchewan
S4P 3A1
www.cindercrete.com

locations: Saskatoon, Saskatchewan

Concrete Products
260 East White Hills Road
P.O. Box 8056 STN 'A'
St. John's, Newfoundland
A1B 3M7
www.newcrete.ca

locations: St. John's, Newfoundland

Day & Campbell Limited
1074 Upper Wellington Street
Hamilton, Ontario
L9A 3S6
www.daycampbell.com

locations: Hamilton, Ontario

Eastway Concrete and Block Inc.
192 Biesenthal Rd
Pembroke, Ontario
K8A 6W7
www.alliedconcretecanada.com

locations: Pembroke, Ontario

Expocrete, an Oldcastle company
#38, 53016 HWY 60
Acheson, Alberta
T7X 5A7
www.expocrete.com

locations: Acheson, Alberta; Edmonton, Alberta; Winnipeg, Manitoba

Lafarge Canada Inc.
#300 115 Quarry Park Road SE
Calgary, Alberta
T2C 5G9
www.lafarge-na.com

locations: Lethbridge, Alberta

Newtonbrook Block
2665 Aurora Road
P.O. Box 69
Gormley, Ontario
L0H 1G0
www.newtonbrook.com

locations: Whitchurch-Stouffville, Ontario

Niagara Block Inc.
5000 Montrose Road
Niagara Falls, Ontario
L2H 1K5
www.niagarablock.com

locations: Niagara Falls, Ontario

Permacon
8145, Bombardier St.
Ville D'Anjou, Quebec
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locations: Anjou, Quebec; Milton, Ontario; Quebec City, Quebec; Sherbrooke, Quebec, Stittsville, Ontario, Trois Rivieres, Quebec

Richvale-York Block Inc. 1298 Clarke Road London, Ontario N5V 3B5 www.richvaleyork.com **locations:** Gormley, Ontario; London, Ontario	**Santerra Stonecraft** 5115 Rhodes Drive Windsor, Ontario N8N 2M1 www.santerrastonecraft.com **locations:** Windsor, Ontario
Shaw Brick 1 Shaw Dr P.O. Box 2130 Lantz, Nova Scotia B2S 3G4 www.shawbrick.com **locations:** Fredericton, New Brunswick; Lantz, Nova Scotia	**Simcoe Block (1979) Ltd.** 207 Tiffin Street Barrie, Ontario L4M 4T2 www.simcoeblock.com **locations:** Barrie, Ontario
Tristar Brick & Block Ltd. Unit 3A -33790 Industrial Avenue Abbotsford, British Columbia V2S 7T9 www.tristarblock.com **locations:** Abbotsford, British Columbia	**VJ Rice Concrete Limited** 1 Rice Road Bridgetown, Nova Scotia B0S 1C0 http://www.riceconcrete.ca/ **locations:** Bridgetown, Nova Scotia

EPD Information

Product Names Normal-weight & light-weight concrete masonry unit (CMU)	**Product Definition** Manufactured masonry unit made of concrete in which the binder is a combination of water and cementitious materials
Declared Unit 1 m^3 CMU	**Declaration Number** EPD- TBD

Declaration Type

A "cradle-to-gate" EPD for normal-weight and light-weight concrete masonry units manufactured by CCMPA members across Canada. Activity stages or information modules covered include production (modules A1 to A3). The declaration is intended for use in Business-to-Business (B-to-B) communication. This EPD of CMU (UN CPC 3755) is an average product EPD, as an average from several CCMPA manufacturers' facilities as listed under "CCMPA Member-company Corporate Address & Facility Locations Applicable to this EPD" – see pg. 2.

Content of the Declaration

The declaration follows Section 11, Content of the EPD, ASTM International, Product Category Rules For Preparing an Environmental Product Declaration For Manufactured Concrete and Concrete Masonry Products.

Declaration Comparability Limitation Statement

The following ISO statement indicates the EPD comparability limitations and intent to avoid any market distortions or misinterpretation of EPDs based on the ASTM's PCR: 2014:

- EPDs from different programs (using different PCR) may not be comparable.
- Declarations based on the ASTM PCR are not comparative assertions; that is, no claim of environmental superiority may be inferred or implied.

Applicable Countries	Date of Issue	Period of Validity
Canada	XX.XX.2016	5 years

EPD Prepared by 	Matt Bowick Athena Sustainable Materials Institute 119 Ross Avenue, Suite 100 Ottawa, Ontario, K1Y 0N6, Canada matt.bowick@athenasmi.org
This EPD was independently verified by ASTM in accordance with ISO 14025: Internal — External X	Signature of third-party reviewer Name and contact information for representative

EPD Project Report Information

EPD Project Report

A Canadian Industry-Average Cradle-to-Gate Life Cycle Assessment of Two Concrete Masonry Unit Products, August 2016. The report is available upon request at *cert@astm.org*.

EPD Project Prepared by 	Matt Bowick Athena Sustainable Materials Institute 119 Ross Avenue, Suite 100 Ottawa, Ontario, K1Y 0N6, Canada matt.bowick@athenasmi.org
This EPD project report was independently verified by in accordance with ISO 14025 and the reference PCR:	Signature of third-party reviewer Name and contact information for representative

PCR Information

Reference PCR	ASTM International, Product Category Rules For Preparing an Environmental Product Declaration For Manufactured Concrete and Concrete Masonry Products
Date of Issue	December 2014
PCR review was conducted by:	Nicholas Santero, PE International (Chairperson) Christine Subasic, Consulting Architectural Engineer Juan Tejeda, ORCO Block Company Contact information available upon request at *cert@astm.org*.

1. PRODUCT IDENTIFICATION

This EPD reports industry-average environmental information for products broadly called either "normal-weight" or "light-weight" concrete masonry unit (CMU), produced by CCMPA members at their facilities located across Canada. See Figure 1 for a visual representation of a typical CMU.

Figure 1: Concrete Masonry Unit

CMUs are typically used in load-bearing and partition wall construction. The blocks are laid in horizontal rows; successive rows are bound by mortar beds and optionally reinforced with steel reinforcing and/or concrete grout. CMUs are also used in masonry columns and beam construction.

The applicable Canadian product standard for CMUs (UN CPC 3755) is ***CSA A165.1-04 - Concrete block masonry units.***

CMUs typically have a length of 390 mm, a height of 190 mm, and a gross thickness of either 90 mm, 140 mm, 190 mm, 240 mm, or 290 mm[1].

Table 1 below summarizes the specifications for CMU products that are applicable to this EPD, according to the CSA A165.1-04 "Four Facet" system.

[1] The noted thicknesses correspond to size codes 10, 15, 20, 25, and 30. The size code refers to the nominal thickness of the block in centimetres.

Table 1: CMU Products Applicable to this EPD

Facet	Specification Identification		Comments
	Normal-weight CMU	Light-weight CMU	
First: Identifies the percentage content of the unit.	H, S, or Sc		The symbols H, S and Sc indicate less than 75%, greater than 75% but less than 100%, and 100% solid content respectively.
Second: Identifies the minimum concrete material strength, in MPa.	15	15	The specified strength of the unit is based on test results of three units with a minimum strength as noted.
Third: identifies oven dry concrete density and the allowable absorption maximum as a percentage of concrete density.	A	B	A and B refer to CMUs with oven dry densities of >2,000 and 1,800-2,000 kg/m^3, and absorption maximums of 175 and 200 kg/m^3, respectively.
Fourth: identifies the maximum moisture, expressed as a percentage of actual absorption as it relates to relative humidity and linear shrinkage of the concrete unit.	M, O		M refers to a known moisture content maximum (See CSA A165.1-04 for further information). O refers to no limits on moisture content maximum.

2. DECLARED UNIT

The declared unit is 1 m^3 of CMU. Data is additionally presented per yd^3 of CMU.

3. REFERENCE SERVICE LIFE

The reference service life of CMU is dependent on its end-use and therefore not declared herein.

4. MATERIAL CONTENT

Table 2 below presents the industry-average material content by input material for the two CMU products, as derived by the CCMPA and the Athena Institute.

Table 2: Weighted-average Material Content of CMU Products

Material	kg/m³ CMU		lbs/yd³ CMU	
	Normal-weight	Light-weight	Normal-weight	Light-weight
Portland Cement	137	140	231	236
Blended Cement	33.9	51.9	57.2	87.6
Slag Cement (GGBFS)	5.27	0	8.88	0
Fly Ash	0.851	0	1.43	0
Crushed Coarse Aggregate	758	185	1,278	312
Natural Coarse Aggregate	104	8	175	14
Crushed Fine Aggregate	157	0	264	0
Natural Fine Aggregate	979	140	1,650	236
Expanded Slag	0	1,207	0	2,035
Pumice	0	4.94	0	8.32
Silica Flour	17.6	20.4	29.6	34.4
Water Reducing Admixture (plasticizer)	0.106	0.0537	0.178	0.0905
Water Repellant/Effloresence Control Admixture	0.0919	0.0108	0.155	0.0183
Air Entraining Admixture	0.00684	0.00529	0.0115	0.00892
Batch Water	57.5	67.2	97.0	113
Total	2,250	1,825	3,792	3,076

5. SYSTEM BOUNDARY

As per the ASTM PCR, the system boundary is the product stage, which includes the following modules:

A1 Raw material supply;
A2 Transport (to the manufacturer); and
A3 Manufacturing.

Figure 2 shows the production stage system boundary for CMU.

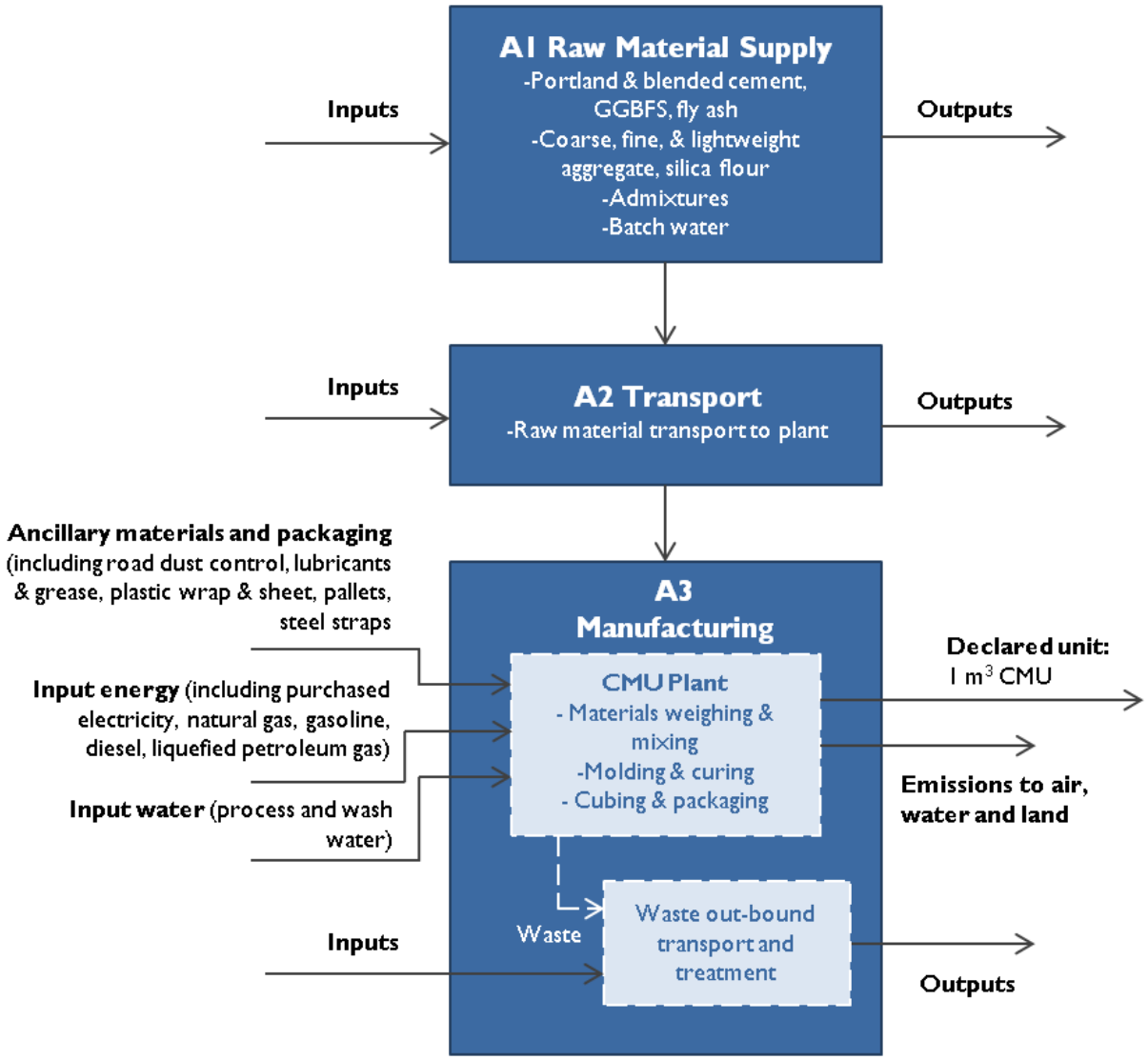

Figure 2: Product Stage (module A1 to A3) System Boundary

6. LIFE CYCLE INVENTORY

6.1. Primary LCI Data

Primary data is based on 18 surveys of CMU facilities deemed representative of CCMPA member-companies, taking into consideration regional production, and plant size and type.

The following primary data was obtained from CCMPA member-companies, for either 2015 calendar year or 2015 fiscal year:

- CMU and other product production amounts, and average concrete batch wastage;
- Inbound transportation distances and modes for raw materials, and ancillary and packaging materials;
- Facility electricity and fuel consumption, and process and wash water use;
- Ancillary and packaging material use;
- Process air emissions;
- Waste outputs and outbound transportation distances and modes.

In instances where plant data were missing for a particular parameter of interest, that plant's data was removed from the horizontal averaging for that parameter.

6.2. Secondary LCI Data

See Table 4 for a summary of secondary LCI data sources used to complete a production stage LCA model for the two CMU products.

Table 3: Secondary LCI Data Sources Summary

Item	Source
A1 - Raw Material Supply	
▪ Portland cement, blended cement, slag cement, expanded slag, silica flour	Athena LCI database
▪ Crushed and natural aggregates, pumice, batch water	Ecoinvent 3.1 database
▪ Admixtures	European Federation of Concrete Admixtures Associations
A2 - Transport	
▪ Truck, rail, barge, ocean freighter	US LCI database
A3 - Manufacturing	
▪ Ancillary materials, including road dust contrrol chemicals, oil and lubricants, grease	Ecoinvent 3.1 database
▪ Packaging materials, including plastic wrap, plastic bags and top sheets, and steel straps	Ecoinvent 3.1 database
▪ Wood pallets	Athena LCI database
▪ Purchased electricity	Athena LCI database
▪ Natural gas, diesel, gasoline, liqufied petroleum products	US LCI database
▪ Water discharges	Quantis Water Database
▪ Outbound waste transport (truck)	US LCI database
▪ Non-hazardous waste to landfill, hazardous waste to incinerator	Ecoinvent 3.1 database

6.3. Cut-off and Allocation

All input/output flow data reported by the facility were included in the LCI modelling.

Allocation procedures observed the requirements and guidance of ISO 14044:2006, clause 4.3. and those specified in ASTM PCR for cement, Section 7.5. CMU plant LCI environmental flows (inputs and outputs) were allocated to the two products on a per-m3 CMU basis.

6.4. Data Quality

Data quality requirements, as specified in ASTM PCR: 2014, Section 7.3, were observed. This section describes the achieved data quality relative to the ISO 14044:2006 requirements.

Precision: CCMPA members, through measurement and calculation, collected primary data on their production of CMU. For accuracy the LCA team individually validated these plant gate-to-gate input and output data.

Completeness: All relevant, specific processes, including inputs (raw materials, energy, and ancillary and packaging materials) and outputs (emissions and production volume) were considered. The relevant background materials and processes were generally taken from the Athena LCI Database, US LCI Database (adjusted for known data placeholders known as "dummy"[2]), and Ecoinvent v3.1 LCI database, and modeled in SimaPro software v.8.1.1.16, August 2016.

Consistency: System boundaries, and allocation and cutoff rules have been uniformly applied across the product life cycles and the two CMU products. The study predominantly relies on two sources of secondary data (US LCI and Ecoinvent databases); adjustments were uniformly applied to all US LCI electricity, fuel, and transport processes. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted.

Reproducibility: Internal reproducibility is possible since the data and the models are stored and available in Athena LCI database developed in SimaPro, 2016. A high level of transparency is provided throughout the report as the LCI profile is presented for the declared product.

Representativeness: The representativeness of the data is summarized as follows:

- Time related coverage: *primary* collected data for the CMU manufacturing process: 2015; all *secondary* data has been validated within the past 8 years.
- Geographical coverage: the geographical coverage is Canada.
- Technological coverage: typical or average.

[2] "Dummy" is a term used by US LCI database that refers to "empty" LCI data sets (technosphere processes).

7. LIFE CYCLE ASSESSMENT

This section summarizes the results of the life cycle impact assessment (LCIA) based on the cradle-to-gate life cycle inventory inputs and outputs analysis. The results are calculated on the basis of 1 m^3 CMU (Tables 4 and 5), but are also provided for 1 yd^3 CMU (Tables 6 and 7). The CMU production results are delineated by information modules A1 through A3.

As per the ASTM PCR, Section 8, US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI, version 2.1) impact categories are used as they provide a North American context for the mandatory category indicators to be included in this EPD. These are relative expressions only and do not predict category impact end-points, the exceeding of thresholds, safety margins or risks. Total primary and sub-set energy consumption was compiled using a cumulative energy demand model. Material resource consumption and generated waste reflect cumulative life cycle inventory flow information.

Table 4: LCA results – Normal-weight CMU, per m^3

Environmental Indicator	Unit	A1 Raw Material Supply	A2 Transport	A3 Manu-facturing	Total
TRACI 2.1 impact categories					
Global warming potential	kg CO_2 eq.	170	27	63	260
Acidification potential	kg SO_2 eq.	0.722	0.181	0.479	1.38
Eutrophication potential	kg N eq.	0.0780	0.0102	0.0130	0.101
Smog creation potential	kg O_3 eq.	11.9	4.93	2.15	19.0
Ozone depletion potential	kg CFC-11 eq.	2.53E-06	1.13E-09	1.41E-07	2.68E-06
Total primary energy consumption					
Non-renewable fossil	MJ (HHV)	1,041	408	1,089	2,538
Non-renewable nuclear	MJ (HHV)	128	4.27	156	289
Renewable (non-biomass)	MJ (HHV)	75.7	0.939	54.0	131
Renewable (biomass)	MJ (HHV)	82.8	0	35.0	118
Material resources consumption					
Non-renewable material resources	kg	2,386	0	0.331	2,387
Renewable material resources	kg	3.94	0	14.9	18.9
Net fresh water	l	842	0.0860	198	1,040
Waste generated					
Non-hazardous waste generated	kg	0.318	0.315	61.3	61.9
Hazardous waste generated	kg	0.00458	0	0.111	0.115

Table 5: LCA results – Light-weight CMU, per m^3

Environmental Indicator	Unit	A1 Raw Material Supply	A2 Transport	A3 Manu-facturing	Total
TRACI 2.1 impact categories					
Global warming potential	kg CO_2 eq.	184	22	63	270
Acidification potential	kg SO_2 eq.	1.00	0.154	0.479	1.64
Eutrophication potential	kg N eq.	0.0899	0.0087	0.0130	0.112
Smog creation potential	kg O_3 eq.	12.6	4.20	2.15	18.9
Ozone depletion potential	kg CFC-11 eq.	2.18E-06	9.47E-10	1.41E-07	2.33E-06
Total primary energy consumption					
Non-renewable fossil	MJ (HHV)	1,089	342	1,089	2,519
Non-renewable nuclear	MJ (HHV)	167	3.57	156	327
Renewable (non-biomass)	MJ (HHV)	65.4	0.784	54.0	120
Renewable (biomass)	MJ (HHV)	92.7	0	35.0	128
Material resources consumption					
Non-renewable material resources	kg	648	0	0.331	648
Renewable material resources	kg	4.36	0	14.9	19.3
Net fresh water	l	545	0.0719	198	743
Waste generated					
Non-hazardous waste generated	kg	0.363	0.263	61.3	61.9
Hazardous waste generated	kg	0.00500	0	0.111	0.116

Table 6: LCA results –Normal-weight CMU, per yd^3

Environmental Indicator	Unit	A1 Raw Material Supply	A2 Transport	A3 Manu-facturing	Total
TRACI 2.1 impact categories					
Global warming potential	kg CO_2 eq.	130	21	48	198
Acidification potential	kg SO_2 eq.	0.552	0.138	0.367	1.06
Eutrophication potential	kg N eq.	0.0596	0.00784	0.00991	0.07737
Smog creation potential	kg O_3 eq.	9.10	3.77	1.64	14.5
Ozone depletion potential	kg CFC-11 eq.	1.94E-06	8.65E-10	1.08E-07	2.05E-06
Total primary energy consumption					
Non-renewable fossil	MJ (HHV)	796	312	833	1,941
Non-renewable nuclear	MJ (HHV)	98	3.26	120	221
Renewable (non-biomass)	MJ (HHV)	57.9	0.718	41.3	100
Renewable (biomass)	MJ (HHV)	63.3	0	26.8	90
Material resources consumption					
Non-renewable material resources	kg	1,824	0	0.253	1,825
Renewable material resources	kg	3.01	0	11.4	14.4
Net fresh water	l	644	0.0657	151	795
Waste generated					
Non-hazardous waste generated	kg	0.243	0.241	46.8	47.3
Hazardous waste generated	kg	0.00350	0	0.0845	0.0880

Table 7: LCA results – Light-weight CMU, per yd^3

Environmental Indicator	Unit	A1 Raw Material Supply	A2 Transport	A3 Manu-facturing	Total
TRACI 2.1 impact categories					
Global warming potential	kg CO_2 eq.	141	17	48	206
Acidification potential	kg SO_2 eq.	0.77	0.118	0.367	1.25
Eutrophication potential	kg N eq.	0.0687	0.0067	0.0099	0.085
Smog creation potential	kg O_3 eq.	9.6	3.21	1.64	14.5
Ozone depletion potential	kg CFC-11 eq.	1.67E-06	7.24E-10	1.08E-07	1.78E-06
Total primary energy consumption					
Non-renewable fossil	MJ (HHV)	832	261	833	1,926
Non-renewable nuclear	MJ (HHV)	128	2.73	120	250
Renewable (non-biomass)	MJ (HHV)	50.0	0.600	41.3	92
Renewable (biomass)	MJ (HHV)	70.9	0	26.8	98
Material resources consumption					
Non-renewable material resources	kg	495	0	0.253	496
Renewable material resources	kg	3.33	0	11.4	14.7
Net fresh water	l	417	0.0550	151	568
Waste generated					
Non-hazardous waste generated	kg	0.278	0.201	46.8	47.3
Hazardous waste generated	kg	0.00382	0	0.0845	0.0883

8. ADDITIONAL ENVIRONMENTAL INFORMATION

Table 8 reports two additional environmental indicators:

- *Recovered materials* sums the mass of recovered materials used in the CMU formulations (i.e. the mass after processing has occurred);
- *Respiratory effects* is a TRACI 2.1 impact category.

Table 8: Additional Cradle-to-gate Environmental Indicator Results

Environmental Indicator	Unit	Normal-weight CMU	Light-weight CMU
Recovered materials	kg	28.8	1,265
Respiratory effects	kg PM2.5 eq.	0.107	0.252

9. REFERENCES

ASTM International, Product Category Rules For Preparing an Environmental Product Declaration For Manufactured Concrete and Concrete Masonry Products, December 2014.

ISO 21930: 2007 Building construction – Sustainability in building construction – Environmental declaration of building products.

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

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

ISO 14040: 2006 Environmental management - Life cycle assessment - Principles and framework.

ISO 14021:1999 Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling)

CSA A165.1-04 - Concrete block masonry units

Quantis Water Database Technical Report version 1, 2012