

Participating manufacturers:



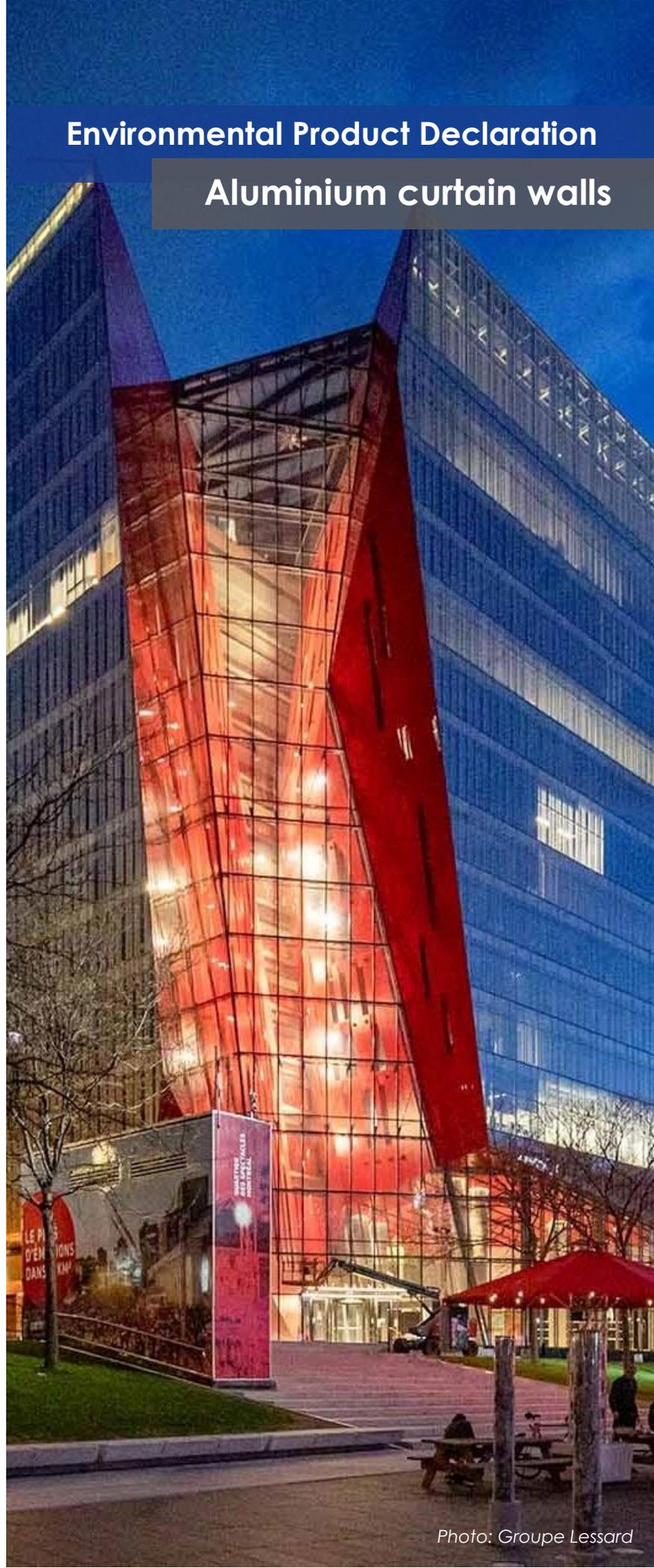
AluQuébec, the Quebec Aluminium Industrial cluster, is pleased to present this **industry-average (sector)** environmental product declaration (EPD) for **aluminium curtain walls manufactured in Quebec, Canada**.

This EPD was developed in compliance with CAN/CSA-ISO 14025 and ISO 21930 by **Groupe AGÉCO** and has been verified by Industrial Ecology Consultants.

This EPD includes life cycle assessment (LCA) results for production stages, end-of-life stages, and potential benefits (cradle to gate with options).

For more information about AluQuébec, please go to www.aluquebec.com.

Issue date: October 4, 2024



This industry-wide (sector) environmental product declaration (EPD) for aluminium curtain walls is in accordance with CAN/CSA-ISO 14025 and ISO 21930, and the PCR noted below. EPDs within the same product category but from different programs may not be comparable. Any EPD comparison must be performed in conformance with ISO 21930. Care should be taken when comparing results since differences in certain assumptions, data quality and datasets are unavoidable, even when using the same product category rules (PCR).

This EPD reports environmental impacts based on established life cycle impact assessment methods. The reported environmental impacts are estimates, and their level of accuracy may differ for a particular product line and reported impact. LCAs do not generally address site-specific environmental issues related to resource extraction or toxic effects of products on human health. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change and habitat destruction. Regulations address some of these issues. EPDs do not report product environmental performance against any benchmark. Also, the EPD and PCR process is informational only and does not warranty performance. The EPD owner has the sole ownership, liability, and responsibility for the EPD.

PROGRAM OPERATOR	CSA Group 178 Rexdale Blvd, Toronto, ON, Canada M9W 1R3 www.csagroup.org
PRODUCT	Aluminium curtain walls
EPD REGISTRATION NUMBER	#4661-4170
EPD RECIPIENT ORGANIZATION	AluQuébec 625 Président-Kennedy Avenue #505, Montreal, Quebec H3A 1K2, Canada www.aluquebec.com
REFERENCE PCR	CEN, EN 15804 and ISO 21930 standards serve as the core PCR. PCR 2019:14 Construction products (version 1.3.2), CPC code: 42120, valid from 2023-12-08, to 2024-12-20 The International EPD® System
DATE OF ISSUE (APPROVAL)	October 4, 2024
PERIOD OF VALIDITY	October 4, 2024 to October 3, 2029
The PCR review was conducted by:	The Technical Committee of the International EPD System. See www.environdec.com for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact or via info@environdec.com .

The LCA was performed by: Groupe AGÉCO
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Independent third-party verification of the declaration and data, according to ISO 14025:2006 and ISO 21930:2017.

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AluQuébec Environmental Product Declaration Summary Sheet

Aluminium curtain walls



Photo: Prévost Architectural

This is a summary of the industry-wide environmental product declaration (EPD) describing the environmental performance of **aluminium curtain walls** manufactured in Quebec, Canada.



EPD commissioner and owner AluQuébec	Period of validity October 4, 2024 to October 3, 2029	Program operator and registration number CSA Group #4661-4170	Product Category Rule PCR 2019:14 Construction products v1.3.2 (2023)	LCA and EPD consultants Groupe AGÉCO
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Product description

Aluminium curtain walls assembled at the construction site or prefabricated, and destined to industrial, commercial, institutional or apartment buildings.

Declared unit

1 m² of curtain wall

Material content (% of total product mass)

Aluminium: 26.4%
Glazing units: 70.3%
Weather strips: 2.1%
Hardware: 0.02%
Gaskets: 0.1%
Adhesives: 1.1%

Life cycle stages included

Cradle-to-gate with options: production (A1-A3), end-of-life (C1-C4), Reuse – Recovery – Recycling potential (D) modules.

What is a Life Cycle Assessment (LCA)?

LCA is a science-based and internationally recognized tool to evaluate the relative potential environmental impacts of products and services throughout their life cycle, beginning with raw material extraction and including all aspects of transportation, production, use, and end-of-life treatment. The method is defined by the International Organization for Standardization (ISO) 14040 and 14044 standards. For EPD development, Product Category Rules (PCR) give additional guidelines on how to conduct the LCA of the product.

Why an Environmental Product Declaration (EPD)?

AluQuébec and its members are seeking to communicate the environmental performance of aluminium products to clients and to position their products through a rigorous and recognized communication tool, the EPD. By selecting products with an EPD, building projects can earn credits towards the Leadership in Energy and Environmental Design (LEED) rating system certification. In LEED v4 and v4.1, points are awarded in the Materials and Resources category.



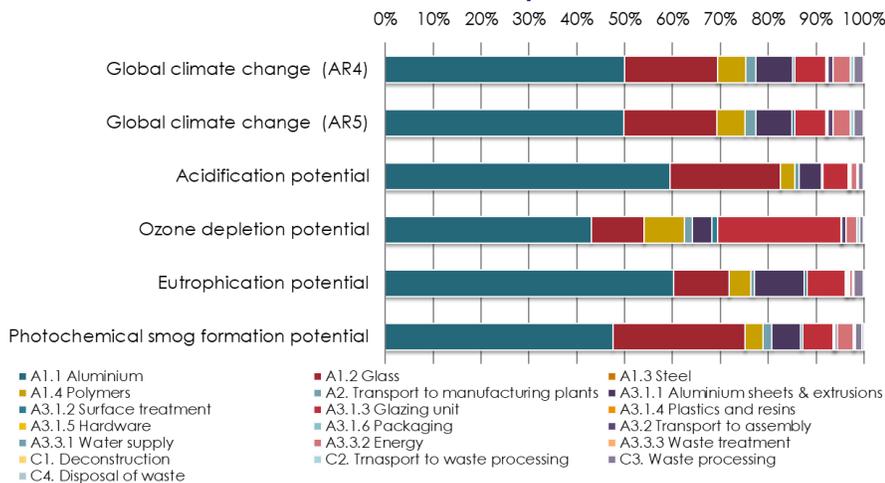
This EPD summary provides an overview of the full ISO 14025 compliant EPD registered with CSA Group.

Environmental impacts

The environmental impacts of 1 square metre of curtain wall over the production stage (A1 to A3 modules), end-of-life stage (C1 to C4 modules) and potential benefits (D module) are summarized below for the main environmental indicators (based on life cycle impact assessment methods TRACI 2.1 and CML baseline 3.09). As per the PCR, it is discouraged to use the results of modules A1-A3 without considering the results of module C. Refer to the LCA report or full EPD for more detailed results. Results on resource use, waste generated, and output flows are also presented in the full EPD.

Indicators	Results for 1 m ² of curtain wall Total (A1-A3, C1-C4)
Global climate change, AR4 (kg CO ₂ eq.)	2.49E+02
Global climate change, AR5 (kg CO ₂ eq.)	2.52E+02
Acidification potential (kg SO ₂ eq.)	1.71E+00
Ozone depletion potential (kg CFC-11 eq.)	5.76E-06
Eutrophication potential (kg N eq.)	6.07E-01
Photochemical smog formation potential (kg O ₃ eq.)	1.73E+01
Abiotic depletion potential of fossil resources (MJ)	2.56E+03

Relative contribution of each life cycle stage to the overall environmental impacts



These results are representative of aluminium curtain wall manufactured in Quebec, Canada. They are based on data provided by 6 manufacturers which represent approximately 53% of the production of curtain walls in the province.

Data was collected from aluminium curtain wall manufacturers for their operations occurring during 12 consecutive months within the period from January 2022 to September 2023.

Additional environmental information

The recyclable content is 26.4% (aluminium content).

For more information: www.aluquebec.com

1. DESCRIPTION OF ALUQUÉBEC

AluQuébec, the “Quebec Aluminium Cluster”, gathers aluminium producers, processors, equipment and specialized suppliers, R&D centres as well as educational institutions associated with the industry in Quebec (Canada). AluQuébec’s role is to act as a lever for Quebec’s aluminium industry by ensuring the consistency and convergence of stakeholders to facilitate and encourage global and promising actions that cater to the industry’s needs with beneficial repercussions in Quebec all while ensuring a worldwide outreach.

As part of this Environmental Product Declaration (EPD) project, AluQuébec aims to support the competitiveness of Quebec’s companies by enabling them to stand out in the industry, to position themselves in the marketplace and to facilitate obtaining a LEED certification, in green building projects.

This industry-wide EPD presents the life cycle environmental impacts of an average aluminium curtain wall manufactured in Quebec. The scope of this EPD is classified as cradle to gate with options. Data for this EPD were collected from six (6) manufacturers operating in the province to determine an average environmental profile for aluminium curtain walls. These manufacturers account for approximately 53% of the total aluminium curtain walls production in Quebec.

Quebec is an important aluminium producer in North America. It does so almost exclusively with hydropower, which makes its aluminium less carbon intensive than when produced with electricity from coal. The use of this low carbon aluminium has therefore a significant influence on the environmental impacts of curtain walls manufactured in Quebec. This particularity is taken into account in this study. For this reason, the results are considered representative to the sector.

This EPD will enable AluQuébec manufacturers to contribute to earning credits towards LEED® (Leadership in Energy and Environmental Design) certifications (i.e. Material and Resource credits), as well as to respond to requests from consultants for data/information on environmental performance.

2. DESCRIPTION OF PRODUCT

2.1. Definition and product classification

Aluminium curtain walls are classified under NAICS 33232. The products covered by this EPD are aluminium curtain walls that are assembled at the construction site or prefabricated. They are destined to industrial, commercial, institutional or apartment buildings, and are manufactured in Quebec (Canada).



Photo: Groupe Lessard

2.2. Material content

A description of the composition of an aluminium curtain wall is provided in Table 1. One square meter of curtain wall weighs about 57.1 kg on average.

Table 1: Materials in an average aluminium curtain wall

Materials	Weight %
Aluminium (primary)	24.3%
Aluminium (secondary)	2.1%
Glazing units	70.3%
Weather strips	2.1%
Adhesives	1.1%
Gaskets	0.1%
Hardware	0.02%

2.3. Production of an aluminium curtain wall

The production of an aluminium curtain wall starts with the extraction and transformation of the raw materials it is composed of, such as aluminium, glass, steel, and polymers. They are then shipped to the curtain wall component manufacturing plants to be transformed into aluminium extrusions and sheets, glazing units and other products. The components are then assembled at the curtain wall manufacturing plant. Aluminium curtain wall components are usually anodized before assembly. At the end of life of the curtain walls, they are dismantled and materials are sorted – they are then either sent to landfills (5%) or recycling (95%) facilities. Aluminium goes to resmelters for recycling. Figure 1 illustrates the cradle-to-gate with options life cycle modules included in this EPD.

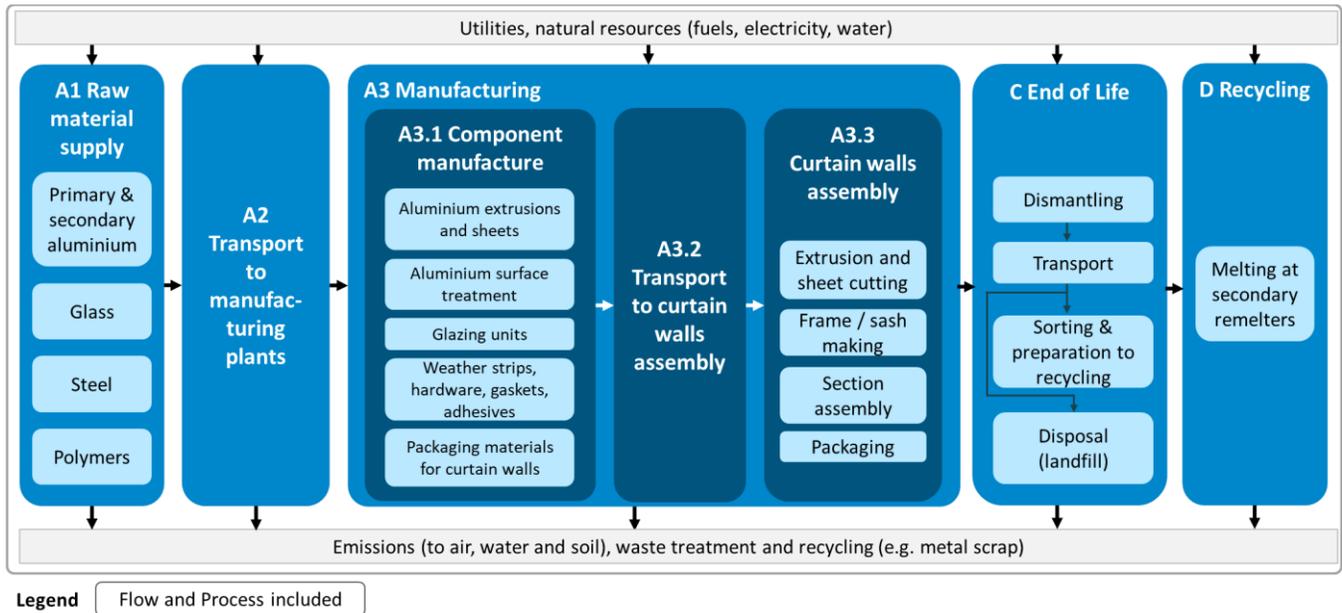


Figure 1: Process flow for the production of an aluminium curtain wall

3. SCOPE OF EPD

3.1. Declared unit

A declared unit is used in lieu of a functional unit since this cradle to gate with options EPD does not include all of the life cycle stages (i.e. the maintenance stage is not considered). It is the reference unit on which the quantities of material inputs, energy inputs, emissions and waste are based for the modelling of the life cycle of an aluminium curtain walls. LCA results are also reported on the basis of this reference unit. The declared unit is defined as follows:

1 m² of aluminium curtain wall

Screens are not included in the declared unit as they are not required for the primary function of the curtain wall, as defined in the PCR.

3.2. System boundaries

The production, end-of-life and potential benefits modules included in this cradle to gate with options EPD are shown in Table 2.

Table 2: Life cycle stages considered according to ISO 21930

Production stage			Construction stage		Use stage							End-of-life stage				Optional
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction, demolition	Transport	Waste processing	Disposal of waste	Potential net benefits from reuse, recycling and/or energy recovery beyond the system boundary
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

Legend: **x** - Considered in the cradle-to-gate with options LCA MND - Module not declared

More precisely, the life cycle stages include the following processes:

A1. RAW MATERIAL SUPPLY

The production of raw materials includes the extraction of resources and their refining into materials that are used during aluminium product manufacturing. They include materials such as aluminium, glass, steel and polymers. The aluminium is mainly supplied from manufacturers located in Quebec.

A2. TRANSPORT OF RAW MATERIALS TO THE MANUFACTURING PLANT

This module includes fuel consumption and emissions related to the transportation of materials to component manufacturing plants.

A3. ALUMINIUM CURTAIN WALL MANUFACTURING

A3.1 – Component manufacture

For all products, electricity and fuel consumption, waste generation and emissions during component and packaging production are included in this sub-module. Curtain wall components include aluminium extrusions and sheets, glazing units, weather strips, hardware, gaskets and adhesives. Capital goods (i.e., manufacturing facility) are also included. Aluminium components undergo a surface treatment (anodization or coating). In some cases, unanodized or uncoated extrusions are delivered to the assembly plant and are sent to a subcontractor for surface treatment before assembly. This surface treatment is included in this module either way. The additional transport is included in the A3.2 module.

A3.2 – Transport to assembly

This module includes fuel consumption and emissions related to the transportation by truck of components and packaging to the assembly plant, as well as to surface treatment for aluminium components when treated in a different plant.

A3.3 – Assembly

Surface treated aluminium extrusions are cut to the desired length. Then, they are assembled with glazing units, weather strips, hardware, and gaskets and sealed with adhesives. The assembled product is packaged with cardboard, PE wrapping and metal strips. Sometimes, glazing units are installed at the construction site, in which case adhesives used for installation were excluded from the study.

This module covers the curtain wall assembly plant and includes the production of electricity and fuels (natural gas, propane, gasoline and diesel). Waste management and emissions from fuel combustion are also included. No water consumption was considered at assembly plants since it is consumed mainly by offices.

C1. DECONSTRUCTION AND DISMANTLING

This module covers deconstruction, including dismantling or demolition of the aluminium product from the final product, including initial on-site sorting of the materials.

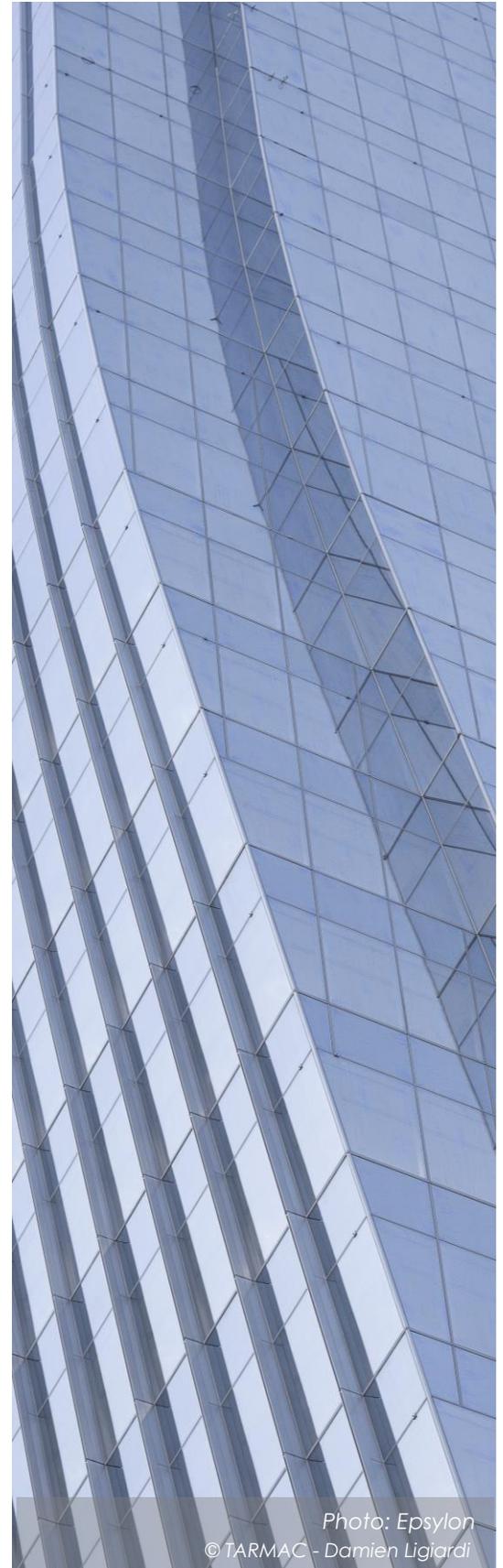


Photo: Epsilon
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C2. TRANSPORT TO WASTE SORTING CENTER OR FINAL DISPOSAL SITE

This module covers the transportation of the discarded aluminium products from the deconstruction to either the waste sorting plant (when recycled) or the final disposal site (when sent to a landfill or to incineration).

C3. WASTE PROCESSING

This module includes the collection and sorting of discarded aluminium products, cleaning and pressing. Only the discarded aluminium resulting in secondary aluminium (i.e. post-consumer aluminium) is considered in this module.

C4. DISPOSAL OF WASTE

This module covers the disposal stage for the discarded aluminium products that will not be sent to recycling (accounted for in module D).

D. POTENTIAL NET BENEFITS FROM RECYCLING BEYOND THE SYSTEM BOUNDARY

This module covers the recycling process and melting of secondary aluminium in secondary smelters. The calculated benefits represent the potential avoided impacts related to the future use of primary aluminium.

3.3. Geographical and temporal boundaries

The geographical boundaries are representative of current equipment and processes associated with aluminium curtain wall manufacturing in Quebec (Canada). Since the data were collected for the years 2022 and 2023, they are considered temporally representative (i.e. less than 5 years old).



4. ENVIRONMENTAL IMPACTS

This cradle-to-gate with options life cycle assessment has been conducted according to ISO 14040 and 14044 standards and the PCR 2019:14 for construction products, version 1.3.2 (2023) (The International EPD® System). Environmental impacts were calculated with the impact assessment method TRACI 2.1 and CML baseline 3.09. The description of these indicators reported are provided in the glossary (section 6).

4.1. Assumptions

The main assumptions included in this LCA were related to transportation parameters (distance and empty haul-back) and water consumption at the assembly plant.

4.2. Criteria for the exclusion of inputs and outputs

Processes or elementary flows may be excluded if the life cycle inventory (LCI) data amounts to a minimum of 95% of total inflows in terms of mass and energy to the upstream and core module. No single flow representing more than 1% of the total inflows were excluded. All product components and production processes are included when the necessary information is readily available, or a reasonable estimate can be made. Based on Groupe AGÉO's experience or the relatively low contribution of the life cycle stages to which they pertain, the following processes were excluded:

- Production, maintenance, and disposal of capital equipment.
- Any secondary packaging (e.g. pallets)
- Personnel impacts (travel to and from work, human emissions).
- Research and development
- Business travel.

Capital goods were included in the impact calculation. The results of the impact categories abiotic depletion of minerals and metals, land use, human toxicity (cancer), human toxicity, non-cancer and ecotoxicity (freshwater) may be highly uncertain in LCAs that include capital goods/infrastructure in generic datasets, in case infrastructure/capital goods contribute greatly to the total results. This is because the LCI data of infrastructure/capital goods used to quantify these indicators in currently available generic datasets sometimes lack temporal, technological and geographical representativeness. Caution should be exercised when using the results of these indicators for decision-making purposes.

4.3. Data quality

Data sources

Table 3 presents the main sources of data used for this EPD. Producer-specific data were collected from six (6) aluminium curtain wall manufacturers for operations occurring between January 2022 and September 2023 (less than 3 years old). Generic data collected for the raw material supply processes, transportation and manufacturing of aluminium were representative of the Canadian context and used technologies.

Table 3: Data sources for the LCA of aluminium curtain walls

Module	Main processes	Data source	Region	Year
A1	Raw material extraction and processing	ecoinvent 3.9	Multiple	2022

Module	Main processes	Data source	Region	Year
A2	Transportation to manufacturing plants	Aluminium: AluQuébec manufacturers' answers to a data collection questionnaire Other: ecoinvent 3.9	Multiple	2022-2023
A3.1	Component manufacture	ecoinvent 3.9	Multiple	2022
A3.2	Transport to curtain wall assembly	AluQuébec manufacturers' answers to a data collection questionnaire	Quebec	2022-2023
A3.3	Curtain wall assembly	AluQuébec manufacturers' answers to a data collection questionnaire	Quebec	2022-2023

The LCA model was developed with the SimaPro 9.5 software using ecoinvent 3.9 database which was released in 2022 (less than 2 years). Since most of the data within ecoinvent is of European origin and represent European industrial conditions and processes, several data were adapted to enhance their representativeness of the products and contexts being examined. ecoinvent is the most complete and recognized internationally LCA database.

Data quality

The overall data quality ratings show that the data used were good. This data quality assessment confirms the sufficient reliability, representativeness (technological, geographical, and time-related), completeness and consistency of the information and data used for this study.

4.4. Allocation

When a process in the life cycle of aluminium curtain walls generated co-products or is directly connected to another system (i.e. the life cycle of another product), the following allocation methods were applied to distribute the impacts between the co-products or linked systems.

Allocation of multi-output processes

As prioritized in the PCR used in this study, allocation for multi-output processes was done on a mass basis. Economic value allocation was not used.

Allocation for end-of-life processes

A recycled content approach (i.e. cut-off approach) was applied when a product is recycled. The impacts associated with the recycling process are thus attributed to the products using these materials. As stated in the PCR, there are no credits allowed for displacement nor system boundary expansion or consequential analysis.

ecoinvent processes with allocation

Many of the processes in the ecoinvent database also provide multiple functions, and allocation is required to provide inventory data per function (or per process). This study accepts the allocation method used by ecoinvent for those processes. The ecoinvent system model used was "Allocation, cut-off by classification". It should be noted that the allocation methods used in ecoinvent for background processes (i.e. processes representing the complete supply chain of a good or service used in the life cycle of aluminium) may be inconsistent with the approach used to model the foreground system (i.e. to model the manufacturing of an aluminium curtain wall with data collected in the literature and from manufacturers). While this allocation is appropriate for foreground processes, continuation of this methodology into the background datasets would add complexity without substantially improving the quality of the study.

4.5. Life cycle impact assessment - results

The results presented in this EPD are representative of an average performance, i.e. a weighted average based on the production volume of the participating manufacturers. Table 4 presents the results for one square metre of aluminium curtain wall over the product stage (A1 to A3), end-of-life stage (C1 to C4 modules) and potential benefits (D module). As per the PCR, it is discouraged to use the results of modules A1-A3 without considering the results of module C.

Table 4: Cradle-to-gate with options results for the production of 1 m² of aluminium curtain wall

Indicators	Units	Total (excl. D)	A1 to A3	C1	C2	C3	C4	D
Potential environmental indicators								
Global climate change (GWP-GHG) (AR4)	kg CO ₂ eq.	2.49E+02	2.42E+02	0.00E+00	1.76E+00	4.81E+00	4.38E-01	-1.10E+02
Global climate change (GWP-GHG) (AR5)	kg CO ₂ eq.	2.52E+02	2.45E+02	0.00E+00	1.79E+00	4.86E+00	4.49E-01	-1.11E+02
Acidification potential	kg SO ₂ eq.	1.71E+00	1.69E+00	0.00E+00	3.78E-03	1.74E-02	2.99E-03	-8.70E-01
Ozone depletion potential	kg CFC-11 eq.	5.76E-06	5.68E-06	0.00E+00	3.09E-08	4.15E-08	1.19E-08	-2.24E-06
Eutrophication potential	kg N eq.	6.07E-01	5.93E-01	0.00E+00	1.46E-03	1.19E-02	6.53E-04	-2.60E-01
Photochemical smog formation potential	kg O ₃ eq.	1.73E+01	1.69E+01	0.00E+00	6.27E-02	2.34E-01	7.67E-02	-7.35E+00
Use of Resources								
Abiotic depletion potential for fossil fuels	MJ, net calorific value (LHV)	2.56E+03	2.50E+03	0.00E+00	2.48E+01	3.04E+01	9.69E+00	-9.45E+02
Renewable primary energy demand	MJ, net calorific value (LHV)	9.80E+02	9.76E+02	0.00E+00	3.24E-01	3.44E+00	1.36E-01	-7.34E+02
Non-renewable primary energy demand	MJ, net calorific value (LHV)	2.53E+03	2.46E+03	0.00E+00	2.51E+01	3.16E+01	9.85E+00	-1.01E+03
Renewable primary material resources	MJ, net calorific value (LHV)	8.48E-01	8.48E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable primary material resources	MJ, net calorific value (LHV)	1.98E+02	1.97E+02	0.00E+00	0.00E+00	6.56E-01	0.00E+00	4.26E-01
Secondary materials	MJ, net calorific value (LHV)	2.49E+01	1.00E+01	0.00E+00	0.00E+00	1.49E+01	0.00E+00	1.38E+01
Renewable secondary fuels	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, net calorific value (LHV)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered energy	MJ, net calorific value (LHV)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water consumption								
Freshwater consumption	m ³	5.55E+00	5.52E+00	0.00E+00	3.61E-03	1.72E-02	1.04E-02	-3.68E+00

Indicators	Units	Total (excl. D)	A1 to A3	C1	C2	C3	C4	D
Waste								
Hazardous waste disposed	kg	2.85E-03	2.85E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	4.02E+01	1.68E-01	0.00E+00	0.00E+00	2.00E-02	4.00E+01	0.00E+00
High-level radioactive waste, conditioned, to final repository	kg	2.35E-07	2.33E-07	0.00E+00	2.81E-10	1.74E-09	1.14E-10	-1.44E-07
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	5.78E-07	5.67E-07	0.00E+00	1.45E-09	8.13E-09	6.15E-10	-2.23E-07
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	3.08E+01	1.59E+01	0.00E+00	0.00E+00	1.49E+01	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy	MJ, net calorific value (LHV)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: values may not add up due to rounding.

The aluminium curtain walls are produced at several facilities; thus, the PCR requires that the variation in GWP-GHG results for modules A1-A3 between the reported result and the results for the underlying sites to be reported in the EPD. For 30% of production sites, the variation is below 10% (i.e., less than 0.03%); for 67% of sites, variation is 15%.

The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.

The climate impact of the Quebec electricity grid mix used in the manufacturing processes is 2.4918E-02 kg CO₂ eq./kWh.

4.6. Life cycle impact assessment - interpretation

Life cycle impacts

Figure 2 shows the contribution of each module and submodule to the impact categories (dominance analysis). For all categories, the raw material supply module (A1) accounts for most of the potential environmental impacts of aluminium curtain walls, dominated by primary and secondary **aluminium production** (A1.1; between 43% and 60%). The aluminium curtain walls under study are mostly made with primary aluminium from Quebec (Canada). **Glass production** (A1.2) is the second-largest contributor to A1 for most impact categories (between 11% and 28%), except for ozone depletion, for which the second largest is **glazing unit** (A3.1.3; 22%).

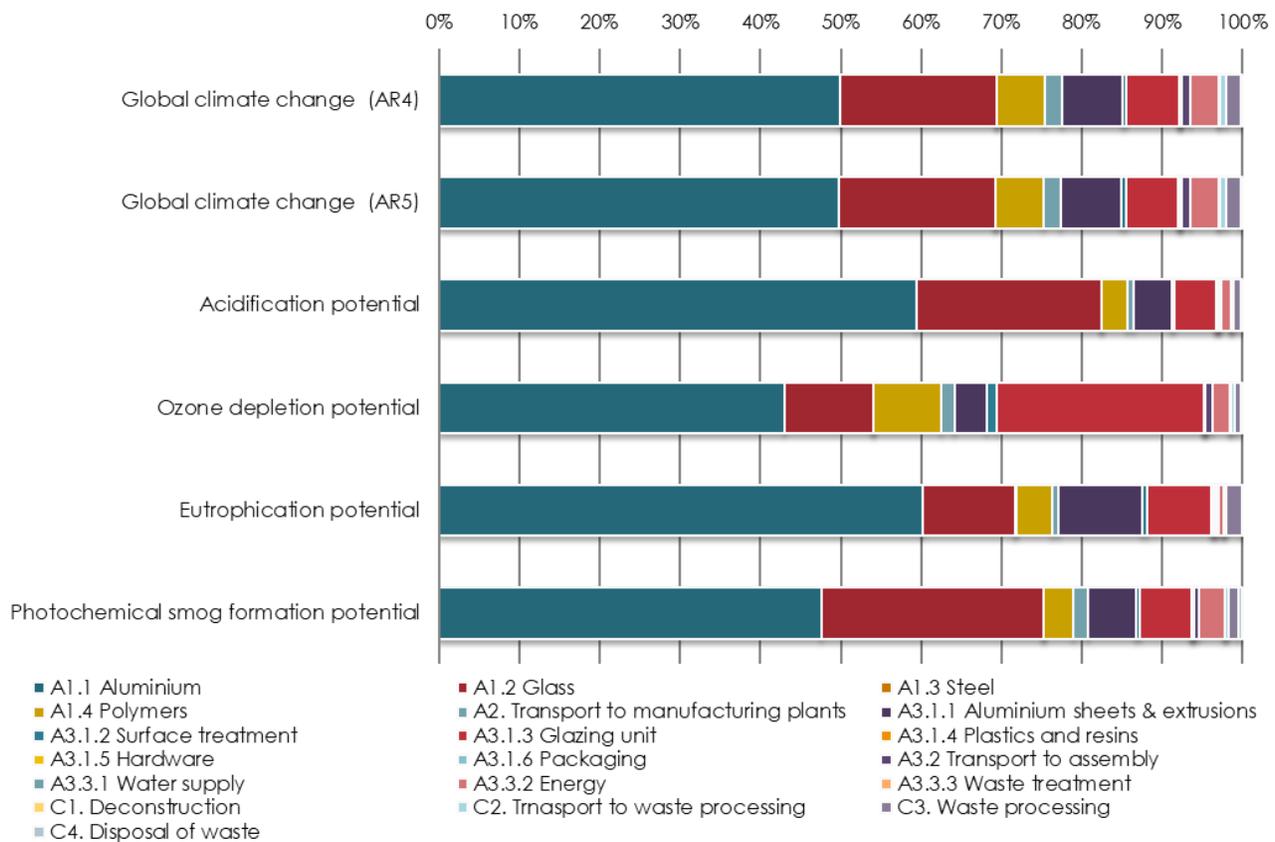


Figure 2: Relative contribution of the main processes in the production of aluminium curtain walls

Use of resources

Aluminium production (A1.1) is the submodule using by far the largest amount of renewable primary energy (81%) because of its high consumption of hydroelectricity. Renewable primary materials with energy content are contained in **packaging (cardboard)**. Ninety percent (90%) of non-renewable primary energy demand is shared between **aluminium production** (A1.1; 45%), **glass production** (A1.2; 20%), **glazing unit manufacturing** (A3.1.3; 7%), **polymer production** (A1.4; 9%) and **aluminium sheets and extrusion production** (A3.1.1; 9%). Ninety-two percent (92%) of non-renewable primary materials resources content are contained in the energy consumed (A3.3.2). Secondary materials are content between **aluminium production** (A1.1; 5%), **aluminium sheets and extrusion** (A3.1.1; 35%) and **waste processing** (C3; 60%). No secondary fuel or recovered energy were used by the manufacturers.

Waste production and water consumption

Waste categories were evaluated for the foreground processes only (A3.1 **aluminium curtain wall assembly**). The disposal of non-hazardous was reported, as well as the disposal of a small amount of waste defined as hazardous according to Canadian laws. No radioactive waste was disposed of. **Aluminium production** (A1.1) is the submodule consuming by far the largest quantity of fresh water (75%) because of its high consumption of hydroelectricity.

5. ADDITIONAL ENVIRONMENTAL INFORMATION

The recyclable content is 26.4% (aluminium content).

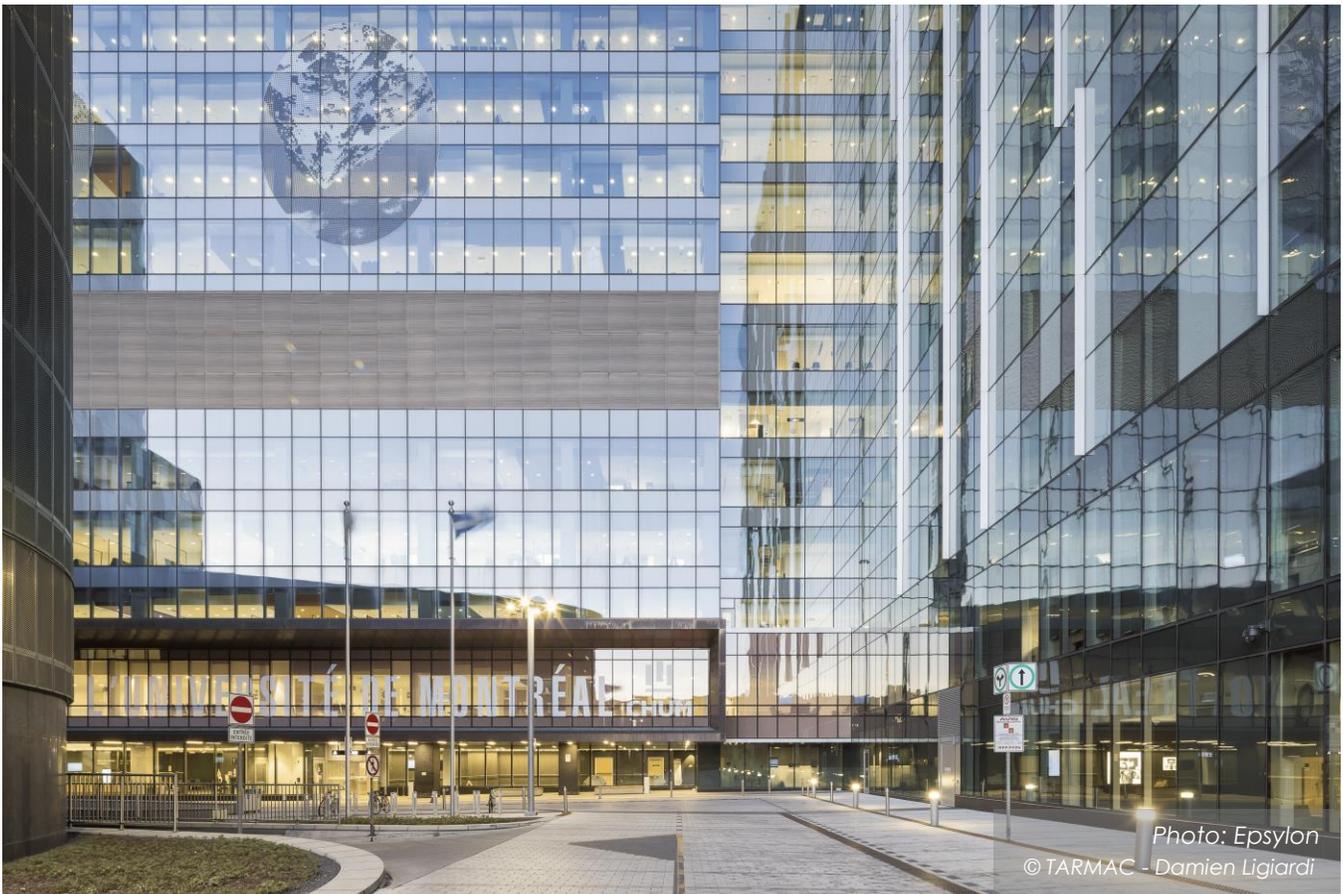


Photo: Epsilon
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6. GLOSSARY

6.1. Acronyms

CSA	Canadian Standards Association
EPD	Environmental Product Declaration
GHG	Greenhouse gas
ISO	International Organization for Standardization
kg CFC-11 eq.	Kilogram of trichlorofluoromethane equivalent
kg CO₂ eq.	Kilogram of carbon dioxide equivalent
kg N eq.	Kilogram of nitrogen equivalent
kg O₃ eq.	Kilogram of ozone equivalent
kg SO₂ eq.	Kilogram of sulfur dioxide equivalent
LCA	Life cycle assessment
LCI	Life cycle inventory
LEED	Leadership in Energy and Environmental Design
LHV	Lower heating value
MJ	Megajoule
m²	Square metre
m³	Cubic metre
NO_x	Nitrogen oxide
PCR	Product category rules
PE	Polyethylene
VOC	Volatile organic compound



6.2. Environmental impact categories and parameters assessed

The **abiotic depletion potential for fossil resources** is an indicator extracted from the CML method using the Lower Heating Value (LHV) of the resource (in MJ/kg) to represent the energy depletion in MJ. Fossil fuels are non-renewable resources. Their extraction therefore contributes to their depletion (**MJ, LHV**).

The **acidification potential** indicator refers to the change in acidity (i.e. reduction in pH) in soil and water due to human activity. The increase in NO_x and SO₂ emissions generated by the transportation, manufacturing and energy sectors are the main causes of this impact category. The acidification of land and water has multiple consequences: degradation of aquatic and terrestrial ecosystems, endangering numerous species and food security. The concentration of the gases responsible for the acidification is expressed in sulphur dioxide equivalents (**kg SO₂ equivalent**).

The **eutrophication potential** indicator measures the enrichment of an aquatic or terrestrial ecosystem due to the release of nutrients (e.g. nitrates, phosphates) resulting from natural or human activity (e.g. the discharge of wastewater into watercourses). In an aquatic environment, this activity results in the growth of algae which consume dissolved oxygen present in water when they degrade and thus affect species sensitive to the concentration of dissolved oxygen. Also, the increase in nutrients in soils makes it difficult for the terrestrial environment to manage the excess of biomass produced. The concentration of nutrients causing this impact is expressed in nitrogen equivalents (**kg N equivalent**).

Freshwater consumption parameter accounts for the imbalance in the natural water cycle created by the water evaporated, consumed by a system or released to a different watershed (i.e. not its original source). This imbalance can cause water scarcity and affect biodiversity. This indicator refers to the waste of the resource rather than its pollution. Also, it does not refer to water that is used but returned to the original source (e.g. water for hydroelectric turbines¹, cooling or river transportation) or lost from a natural system (e.g. due to evaporation of rainwater). The net quantity of freshwater consumed is expressed as a volume of water in cubic metre (**m³ of water consumed**).

The **global warming potential** indicator refers to the impact of a temperature increase on the global climate patterns (e.g. severe flooding and drought events, accelerated melting of glaciers) due to the release of greenhouse gases (GHG) (e.g. carbon dioxide and methane from fossil fuel combustion). GHG emissions contribute to the increase in the absorption of radiation from the sun at the earth's surface. These emissions are expressed in units of kg of carbon dioxide equivalents (**kg CO₂ equivalent**).

The **ozone depletion potential** indicator measures the potential of stratospheric ozone level reduction due to the release of some molecules such as refrigerants used in cooling systems (e.g. chlorofluorocarbons). When they react with ozone (O₃), the ozone concentration in the stratosphere diminishes and is no longer sufficient to absorb ultraviolet (UV) radiation which can cause high risks to human health (e.g. skin cancers and cataracts) and the terrestrial environment. The concentration of molecules that are responsible for ozone depletion is expressed in kilograms of trichlorofluoromethane equivalents (**kg CFC-11 equivalent**).

The **photochemical smog formation potential** indicator covers the emissions of pollutants such as nitrogen oxides and volatile organic compounds (VOCs) into the atmosphere. They are mainly generated by motor vehicles, power plants and industrial facilities. When reacting with the sunlight, these pollutants

¹ Only the water evaporated by hydroelectric reservoirs is considered consumed.

create smog which can affect human health and cause various respiratory problems. The concentration of pollutants causing smog is expressed in kg of ozone equivalents (**kg O₃ equivalent**).

The **secondary materials** parameter represents the quantity of recycled materials used to manufacture a product (**kg**).

The **use of renewable/non-renewable material resources** parameters represent the quantity of material made from renewable resources or non-renewable resources used to manufacture a product, excluding recovered or recycled materials. The quantity of these resources is reported in megajoules (**MJ, LHV**).

The **use of renewable/non-renewable primary energy** parameters refer to the use of energy from renewable resources (e.g., wind, solar, hydro) and non-renewable resources (e.g., natural gas, coal, petroleum). The quantity of primary energy used is expressed in megajoules, on the basis of the net calorific value of the resources (**MJ, LHV**).

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8. PARTICIPATING MANUFACTURERS

All participating manufacturers in this study operate from one manufacturing plant. The addresses shown below are both the headquarters and the manufacturing plants where the activities took place.



1010, Avenue Nordique,
Québec (Québec), G1C 0H9
<https://www.epsylon.ca>



2025, Boulevard Dagenais Ouest,
Laval (Québec), H7L 5V1
<https://www.lessard.ws/>



305, 12e Avenue,
Richelieu (Québec), J3L 3T2
<https://prevost-architectural.com>



Portes, fenêtres et murs-rideaux
en aluminium

4565, Avenue Georges-Bornais,
Shawinigan (Québec), G9N 6T5
<http://shalwin.ca>



668, 5^e Avenue,
Beauceville (Québec), G5X 1L6
<https://stekar.com/en/>



2155, Boulevard Fernand Lafontaine,
Longueuil (Québec), J4G 2J4
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