Environmental Product Declaration

Aluminium exterior cladding

Participating manufacturers:

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Architectural façades

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STEKAR

AluQuébec, the Quebec Aluminium Industrial cluster, is pleased to present this **industry-average (sector)** environmental product declaration EPD for **aluminium exterior cladding manufactured in Québec, 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 raw material supply, transport and manufacturing modules (cradle-to-gate). The LCA was performed by **Groupe AGÉCO**.

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

Issue date: October 4, 2024

Environmental Product Declaration

CSA Group Registered Based on ISO 14025 and Other Requirements
For more information visit
csaregistries.ca/epd

3434-0731
October 2024-October 2029

Photo: Panfab

This environmental product declaration (EPD) is in accordance with CAN/CSA-ISO 14025 and the PCR noted below.

General information

PROGRAM OPERATOR	CSA Group 178 Rexdale Blvd, Toronto, ON, Canada M9W 1R3 www.csagroup.ca
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	CSA Group Environmental Product Declaration (EPD) Program Requirements, version 2013-07
LOCATION OF EXPLANATORY MATERIAL	www.aluquebec.com
DECLARATION HOLDER	AluQuébec 625 Président-Kennedy Avenue #505, Montréal, Québec H3A 1K2, Canada www.aluquebec.com
DECLARATION NUMBER	#3434-0731
DECLARED PRODUCT AND DECLARED UNIT	Aluminium exterior cladding 100 m^2 of aluminium exterior cladding covering a flat surface
PRODUCT DEFINITION	Aluminium cladding for exterior applications on buildings
REFERENCE PCR	ISO 21930 standard serve as the core PCR Product Category Rule (PCR) Guidance for Building-Related Products and Services. Part A: Life Cycle Assessment Calculation Rules and Report Requirements, v.4 (UL 10010), valid from 2022-03-28, to 2027-03-28. Part B: Insulated Metal Panels, Metal Composite Panels, and Metal Cladding: Roof and Wall Panels, v 2.0 (UL 10010-5), valid from 2022-06-12, to 2024-12-31. UL Environment
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE (APPROVAL)	October 4, 2024
PERIOD OF VALIDITY	October 4, 2024 to October 3, 2029
EPD TYPE	Industry average
EPD SCOPE	Cradle to gate
YEAR OF REPORTED MANUFACTURER PRIMARY DATA	2022-2023
LCA SOFTWARE	SimaPro 9.5
LCI DATABASE	ecoinvent 3.9

LCIA METHODOLOGY	TRACI 2.1 and CML 3.09
Applicable green building certification schema	LEED certifications
The PCR review was conducted by the following critical review panel:	Lindita Bushi, PhD, Chair Athena Sustainable Materials Institute lindita.bushi@athenasmi.org Hugues Imbeault-Tétreault, Eng., M.A.Sc. Groupe AGÉCO hugues.i-tetreault@groupeageco.ca Jack Geibig Ecoform jgeibig@ecoform.com
The Part B was reviewed by the following:	Thomas Gloria, PhD (chair) Industrial Ecology Consultants t.gloria@industrial-ecology.com Lindita Bushi, PhD Athena Sustainable Materials Institute lindita.bushi@athenasmi.org Bob Zabcik, P.E., LEED AP BD+C NCI Building Systems BobZ@ncigroup.com
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v4 (March 2022), based on ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017).	__ Internal **x External** Thomas Gloria Tom P. Gloria, Ph.D. Industrial Ecology Consultants 35 Bracebridge Rd., Newton, MA 02459-1728, USA www.industrial-ecology.com
This life cycle assessment was conducted in accordance with ISO 14044:2006 and the reference PCR by:	Groupe AGÉCO www.groupeageco.ca | ageco@groupeageco.ca

	__ Internal **x External**
This life cycle assessment was independently verified in accordance with ISO 14044:2006 and the reference PCR by:	Thomas Gloria Tom P. Gloria, Ph.D. Industrial Ecology Consultants 35 Bracebridge Rd., Newton, MA 02459-1728, USA www.industrial-ecology.com

LIMITATIONS

Environmental declarations from different programs (ISO 14025) may not be comparable.

Comparison of the environmental performance of metal panel and cladding products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building use phase as instructed under this PCR.

Full conformance with the PCR for metal panels and cladding allows EPD comparability only when all stages of a life cycle have been considered when they comply with all referenced standards, use the same sub-category PCR, and use equivalent scenarios with respect to construction works. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

AluQuébec
Environmental Product
Declaration
Summary Sheet

Aluminium exterior cladding

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

EPD commissioner and owner	Period of validity	Program operator and registration number	Product Category Rule	LCA and EPD consultants
AluQuebec	October 4, 2024 to October 3, 2029	CSA Group #3434-0731	PCR for Building-Related Products and Services. Part B: Insulated Metal Panels, Metal Composite Panels, and Metal Cladding: Roof and Wall Panels. v 2.0 (2022)	Groupe AGÉCO

Product description

Aluminium exterior cladding destined to industrial, commercial, institutional or apartment buildings.

Declared unit

100 m^2 of aluminium exterior cladding covering a flat surface

Material content (% of total product mass)

Aluminium: 99.6%
Hardware: 0.1%
Adhesives: 0.3%

Life cycle stages included:

Cradle-to-gate: Extraction and upstream production (A1), transport to factory (A2), manufacturing (A3) 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

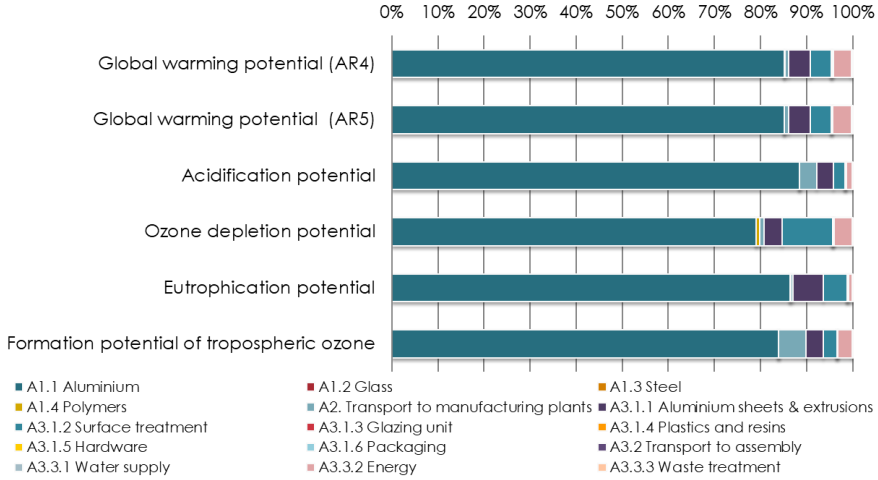
Aluminium exterior cladding

Environmental impacts

The environmental impacts of 100 square metre of aluminium exterior cladding over the production stage (A1 to A3 modules) are summarized below for the main environmental indicators (based on life cycle impact assessment methods TRACI 2.1 and CML baseline 3.09). Refer to the LCA report or full EPD for more detailed results. Results on resource use, generated waste and output flows are also presented in the full EPD.

Indicators	Results for 100 m² of aluminium exterior cladding Total (A1-A3)
Global warming potential (GWP 100, AR4) (kg CO_2 eq.)	1.75E+04
Global warming potential (GWP 100, AR5) (kg CO_2 eq.)	1.78E+04
Acidification potential (kg SO_2 eq.)	1.00E+02
Ozone depletion potential (kg CFC-11 eq.)	2.71E-04
Eutrophication potential (kg N eq.)	3.79E+01
Formation potential of tropospheric (ground level) ozone (kg O_3 eq.)	1.20E+03
Abiotic depletion potential (fossil) (MJ)	1.79E+05

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



These results are representative of aluminium exterior cladding manufactured in Quebec, Canada. They are based on data provided by 7 manufacturers which represent approximately 23% of the Québec aluminium exterior cladding production.

Data was collected from aluminium exterior cladding 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 99.6% (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. AluQuébec's role is to act as a lever for Québec'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 Québec 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 cradle-to-gate life cycle environmental impacts of average aluminium exterior cladding manufactured in Quebec. Data for this EPD were collected from 7 manufacturers operating in the province to determine an average environmental profile for aluminium exterior cladding. These manufacturers account for approximately 23% of the total aluminium exterior cladding production in Quebec. This EPD takes into account the fact that rolled aluminium for exterior cladding manufactured in Quebec is imported from outside the province. Since aluminium production contributes to most to the environmental impacts of this product category, the EPD is considered representative.

This EPD will enable AluQuébec manufacturers to contribute to earning credits towards a LEED® v4 or v4.1 (Leadership in Energy and Environmental Design) certification (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. Product identification and specification

Aluminium exterior cladding is classified under UNSPSC Code 4299. The products covered by this EPD are aluminum exterior cladding. These covered products are destined to industrial, commercial, institutional or apartment buildings, and are manufactured in Quebec (Canada).

Figure 1: Example of an aluminium exterior cladding

The main production processes are presented in Figure 2.

2.2. Application

The aluminium exterior cladding referenced in this EPD can be used for exterior wall and wall covering applications.

2.3. Technical data

Refer to the manufacturer for technical data (see section 8 for contact information).

2.4. Properties of the declared product

Aluminium exterior panels are delivered in a variety of sizes and thicknesses.

2.5. Material composition

A description of the composition of an aluminium exterior cladding is provided in Table 1. One hundred square meters of cladding weigh about 946.6 kg on average.

Table 1: Materials in an average aluminium exterior cladding

Materials	Weight (% by mass)
Aluminium (primary)	67.0%
Aluminium (secondary)	32.6%
Hardware	0.05%
Adhesives	0.3%

2.6. Manufacturing of aluminium exterior cladding

The production of aluminium exterior cladding starts with the extraction and transformation of the raw materials it is composed of, such as aluminium, steel and polymers. They are then shipped to the cladding component manufacturing plants to be transformed into aluminium sheets, aluminium extrusions, and other products. The components are then assembled at the cladding manufacturing plant. Aluminium cladding components are surface treated (anodized or painted) either before or after assembly. Figure 2 illustrates the cradle-to-gate life cycle modules included in this EPD.

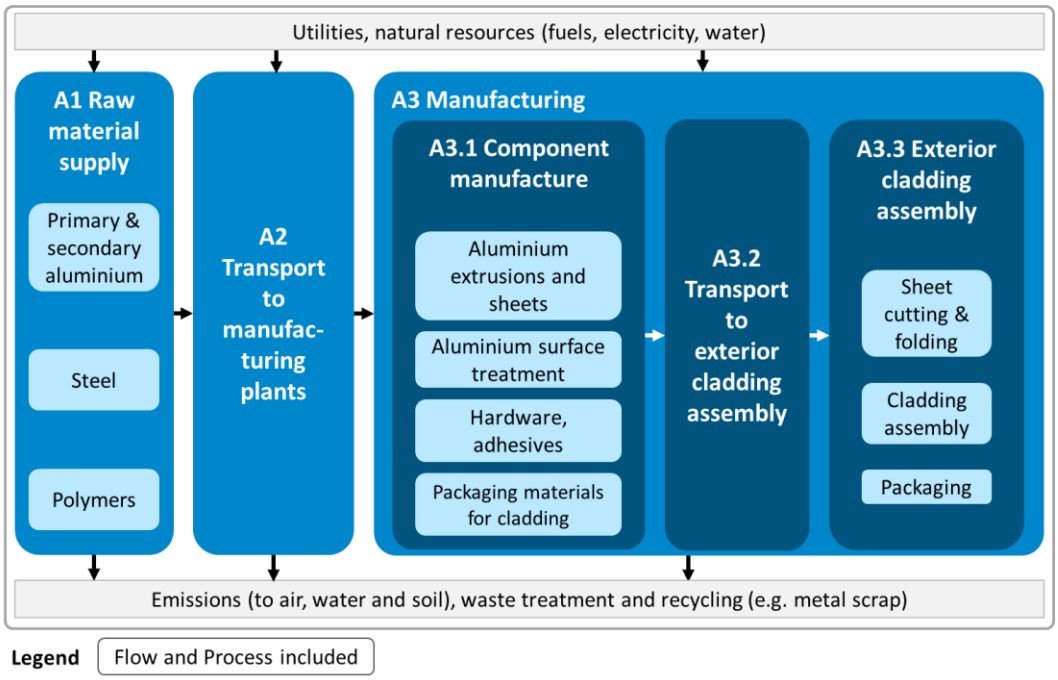


Figure 2: Process flow for the production of aluminium exterior cladding

2.7. Packaging

Aluminium exterior cladding is packaged with expanded polystyrene (EPS), cardboard, polyethylene (PE) wrapping, metal and plastic strips and wood.

3. SCOPE OF EPD

3.1. Declared unit

As per the PCR, the declared unit (i.e. 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 aluminum exterior cladding) is defined as follows:

100 m² (1076.4 ft²) of aluminium exterior cladding covering a flat area

3.2. System boundary

The production modules included in this cradle-to-gate 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	MND	MND	MND	MND	MND

Legend: **x** - Considered in the cradle-to-gate 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, steel and polymers. The aluminium is supplied from manufacturers located in Quebec (Canada).

A2. Transport of raw materials to the manufacturing plant

This module includes fuel consumption, emissions and the infrastructure related to the transportation of materials to component manufacturing plants by train and container ship.

A3. Aluminium exterior cladding manufacturing


Photo: Panfab

A3.1 – Component manufacture

For all products, electricity and fuel consumption, waste generation and emissions during component, ancillary material and packaging production are included in this sub-module. Exterior cladding components include aluminium extrusions and sheets, hardware, 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 either before or after assembly. This surface treatment is included in this module either way. The additional transport is included in the A3.2 module.

No substances required to be reported as hazardous are associated with the production of this product.

A3.2 – Transport to assembly

This module includes fuel consumption, emissions and the infrastructure 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 sheets are cut and folded. Then, they are assembled with hardware and sealed with adhesives. The assembled product is packaged with wood, EPS, PE wrapping, cardboard, and metal strips. Capital goods were also included.

This module covers the exterior cladding 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.

Geographical and temporal boundaries

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

3.3. Estimates and 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.

3.4. Cut-off criteria

As per the PCR, no known flows are deliberately excluded from this assessment. No single flow representing more than 1% of the total inflows was excluded and the total excluded input flows did not exceed a maximum of 5% of energy usage and mass. Based on Groupe AGÉCO's experience or the

relatively low contribution of the life cycle stages to which they pertain, the following processes were excluded: Personnel impacts (travel to and from work, human emissions) and business travel.

3.5. Data sources

Table 1 presents the main sources of data used for this EPD. Producer-specific data were collected from seven (7) aluminium exterior cladding 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 exterior cladding

Module	Main processes	Data source	Region	Year
A1	Raw material extraction and processing	ecoinvent 3.9	Multiple	2022
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 exterior cladding assembly	AluQuébec manufacturers' answers to a data collection questionnaire	Quebec	2022-2023
A3.3	Exterior cladding 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.

3.6. 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.

3.7. Allocation

When a process in the life cycle of aluminium exterior cladding 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 aluminum exterior cladding 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.

3.8. Comparability

As per the PCR: "Comparison of the environmental performance of metal panel and cladding products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building use phase as instructed under this PCR.

Full conformance with the PCR for metal panels and cladding allows EPD comparability only when all stages of a life cycle have been considered when they comply with all referenced standards, use the same sub-category PCR, and use equivalent scenarios with respect to construction works. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared."

Photo: Clermont Ltee

4. ENVIRONMENTAL IMPACTS

The results presented in this cradle-to-gate 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 100 square metres of aluminium exterior cladding over the product stage (A1 to A3). Environmental impacts were calculated with the impact assessment method TRACI 2.1. The description of these indicators reported is provided in the glossary (section 6).

Table 4: Cradle-to-gate results for the production of 100 m² of aluminium exterior cladding

Indicators	Units	Total (A1 to A3)
Impact Categories		
Global warming potential (GWP 100) (AR4)	kg CO_2 eq.	**1.75E+04**
Global warming potential (GWP 100) (AR5)	kg CO_2 eq.	**1.78E+04**
Acidification potential	kg SO_2 eq.	**1.00E+02**
Ozone depletion potential	kg CFC-11 eq.	**2.71E-04**
Eutrophication potential	kg N eq.	**3.79E+01**
Formation potential of tropospheric (ground level) ozone	kg O_3 eq.	**1.20E+03**
Resource use		
Abiotic depletion potential for fossil resources	MJ, net calorific value (LHV)	**1.79E+05**
Renewable primary energy demand	MJ, net calorific value (LHV)	**3.06E+04**
Non-renewable primary energy demand	MJ, net calorific value (LHV)	**1.62E+05**
Renewable primary material resources	MJ, net calorific value (LHV)	**3.35E+01**
Non-renewable primary material resources	MJ, net calorific value (LHV)	**2.26E+04**
Secondary materials	kg	**1.08E+03**
Renewable secondary fuels	MJ, net calorific value (LHV)	**0.00E+00**
Non-renewable secondary fuels	MJ, net calorific value (LHV)	**0.00E+00**
Recovered energy	MJ, net calorific value (LHV)	**0.00E+00**
Water consumption		
Freshwater consumption	m^3	**1.33E+02**
Output flows and waste categories		
Hazardous waste disposed	kg	**1.30E+01**
Non-hazardous waste disposed	kg	**1.07E-01**
High-level radioactive waste, conditioned, to final repository	kg	**6.26E-06**
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	**2.71E-05**
Components for re-use	kg	**0.00E+00**
Materials for recycling	kg	**1.22E+03**
Materials for energy recovery	kg	**0.00E+00**
Exported energy	MJ, net calorific value (LHV)	**0.00E+00**

The aluminium exterior claddings 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 35% of production sites, the variation is below 10%; for 65% of sites, variation is 15%.

4.1. LCA interpretation

Impact categories

Figure 3 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 cladding, dominated by primary and secondary **aluminium production** (A1.1; between 79% and 88%). The aluminium panels under study are mostly made with aluminium from China, Russia and Quebec (Canada). Outside module A1, the three most important submodules are **surface treatment** (A3.1.2; between 3% and 11%), **manufacturing of aluminium sheets and extrusions** (A3.1.1; between 4% and 6%) and **energy consumption** (A3.3.2; between 1% and 4%).

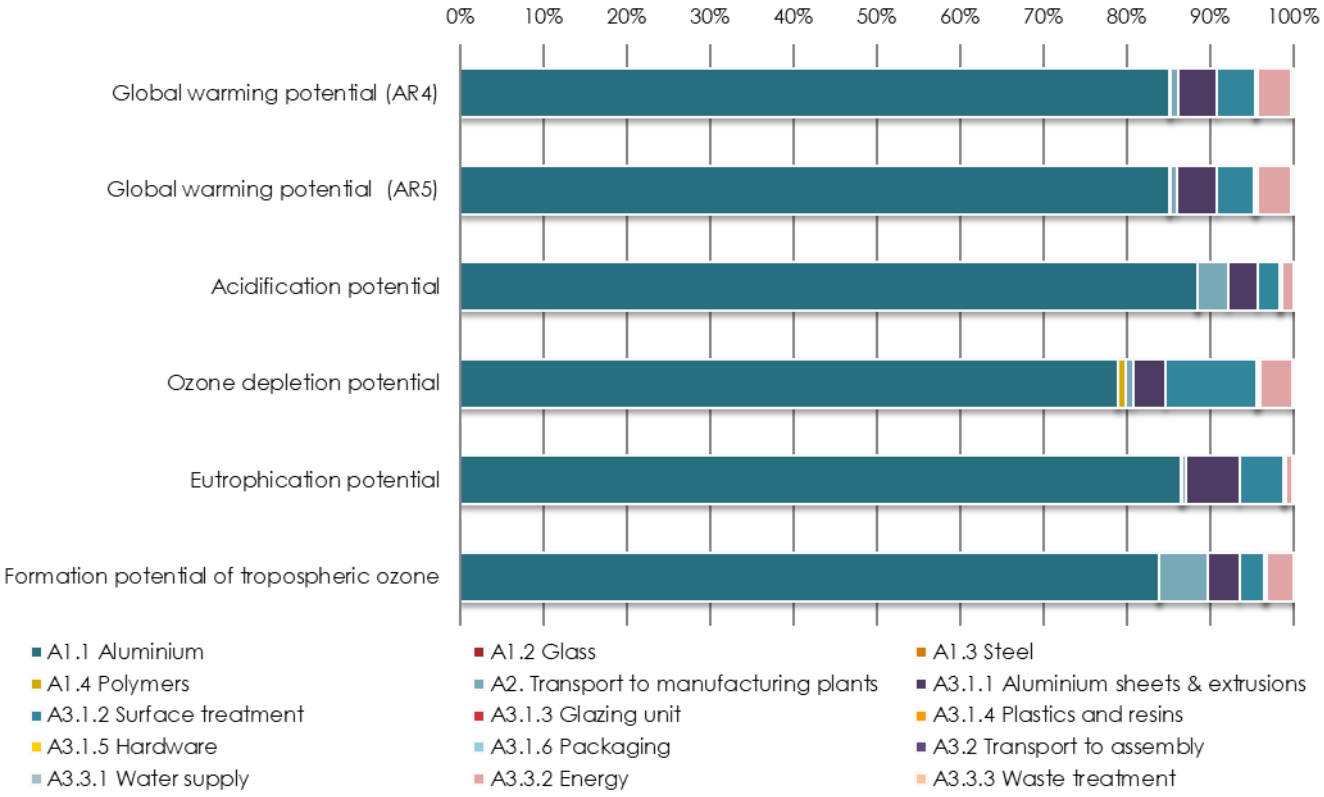


Figure 3: Relative contribution of the main processes in the production of aluminium exterior cladding

Resource use

Aluminium production (A1.1) is the submodule using by far the largest amount of renewable primary energy (63%) because of its high consumption of hydroelectricity. Renewable primary materials with energy content are contained in **packaging**. Eighty-four percent (84%) of non-renewable primary energy is used during **aluminium production** (A1.1). Non-renewable primary materials with energy content are contained in the energy (A3.3.2; 97%). Secondary materials are used during **aluminium production** (A1.1; 41%) and **aluminium sheets and extrusions production** (A3.1.1; 59%). No secondary fuel or recovered energy were used by the manufacturers.

Output flows and waste categories

These output flows and waste categories were evaluated for the foreground processes only (A3.1 aluminium cladding assembly). Most waste generated is **materials for recycling** (aluminium scrap

generated at the plant). The rest is non-hazardous waste disposed as well as the disposal of a small amount of waste defined as hazardous according to Canadian laws. No radioactive waste, components for re-use, materials for energy recovery or exported energy were neither used, disposed of nor produced. **Energy consumption** (A3.1.2) and **aluminium production** (A1.1) are the submodules consuming by far the largest net quantity of fresh water (35% and 56%, respectively).

5. ADDITIONAL ENVIRONMENTAL INFORMATION

The recyclable content is 99.6% (aluminium content).

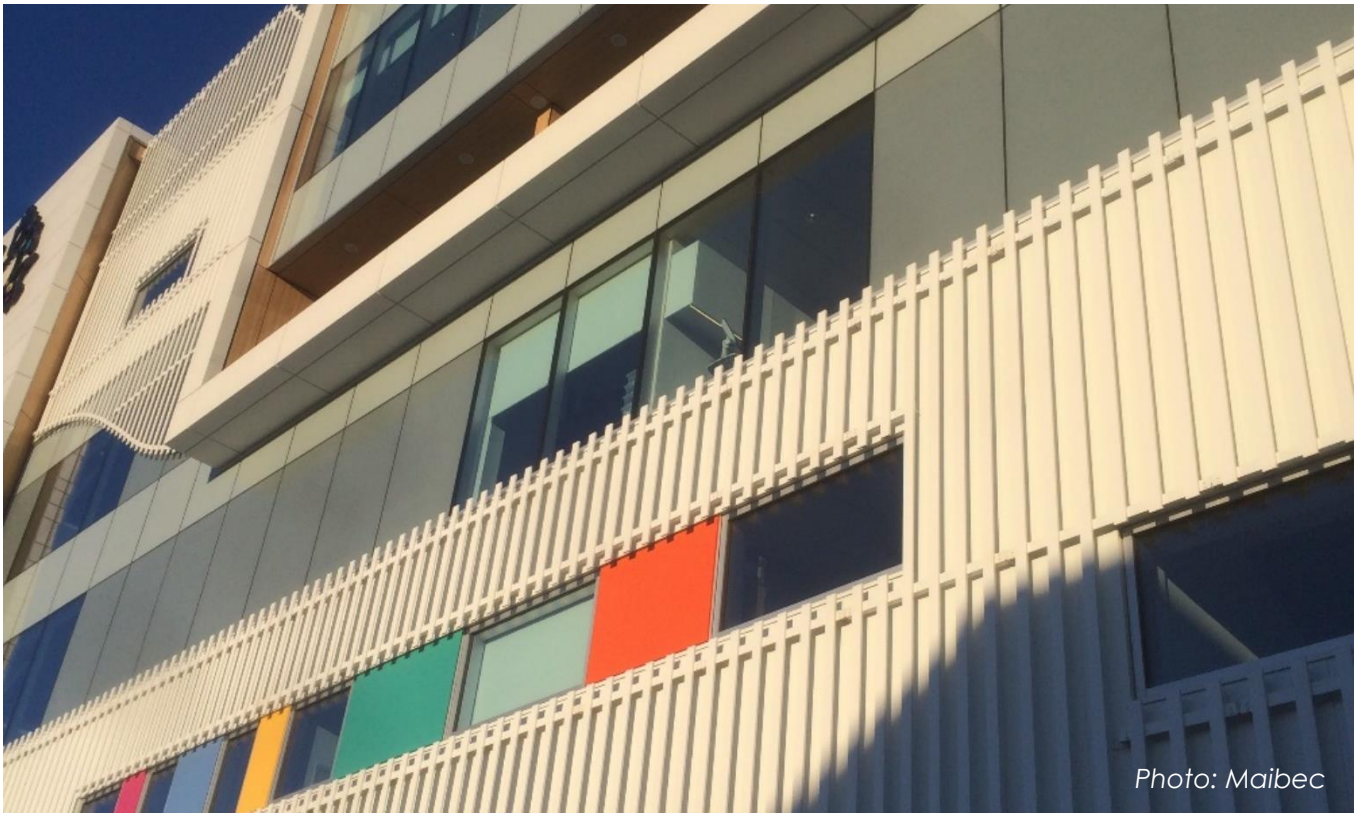


Photo: Maibec

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 CO_2 eq.	Kilogram of carbon dioxide equivalent
kg N eq.	Kilogram of nitrogen equivalent
kg O_3 eq.	Kilogram of ozone equivalent
kg SO_2 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
m^2	Square metre
m^3	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 SO_2 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 SO_2 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 turbines[1], 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 (**m^3 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 CO_2 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 (O_3), 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 O_3 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**).

7. REFERENCES

CSA Group (2013). CSA Group Environmental Product Declaration (EPD) Program. Program Requirements. Retrieved from http://www.csaregistries.ca/assets/pdf/EPD_Registry_Program_Requirements.pdf

CSA (2009). CAN/CSA-ISO 14020:99 Environmental labels and declarations — General principles

CSA (2007). CAN/CSA-ISO 14025:07. Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

ecoinvent (2022). ecoinvent 3.9. https://ecoinvent.org/the-ecoinvent-database/

Groupe AGÉCO (2024). Life cycle assessment of aluminium doors, windows, curtain walls and exterior cladding for environmental product declaration.

ISO (2006a). ISO 14040. Environmental management – life cycle assessment – principles and framework. International Standard Organization, Geneva, Switzerland.

ISO (2006b). ISO 14044. Environmental management – life cycle assessment – requirements and guidelines. International Standard Organization, Geneva, Switzerland.

ISO (2018). ISO 14067. Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification. International Standard Organization. Geneva, Switzerland.

ISO (2017). ISO 21930. Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services. International Standard Organization, Geneva, Switzerland.

UL Environment (2022). Product Category Rule (PCR) Guidance for Building-Related Products and Services. Part A: Life Cycle Assessment Calculation Rules and Report Requirements, version 4 (UL 10010).

UL Environment (2022). Product Category Rule (PCR) Guidance for Building-Related Products and Services. Part B: Insulated Metal Panels, Metal Composite Panels, and Metal Cladding: Roof and Wall Panels. version 2.0 (UL 10010-5).

[US EPA] United States Environmental Protection Agency (2012). Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI) User's Manual. Retrieved from http://nepis.epa.gov/Adobe/PDF/P100HN53.pdf

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.

CLERMONT

270, Boulevard Industriel,
Châteauguay (Québec), J6J 4Z2
https://clermontltee.com/

EPSYLON
Façades architecturales
Architectural façades

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

maibec

1984 5e Rue #202,
Lévis, (Québec), G6W 5M6,
https://maibec.com/fr/

LES INDUSTRIES PANFAB INC.

49, Boulevard de la Seigneurie Est,
Blainville (Québec), J7C 4G6
http://www.panfab.com

3D PANNEAUX

755, Rue Boucher,
St-Jean-sur-Richelieu (Québec), J3B 8P4
https://panneaux3d.com

Shalwin
Portes, fenêtres et murs rideaux en aluminium

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

STEKAR

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