LAURIER, Monolithic Glass Laminated Glass and Sealed Units

LAURIER GLASS Ltd.

ENVIRONMENTAL PRODUCT DECLARATION

ISO 14025:2006

LAURIER GLASS is pleased to present this environmental product declaration (EPD) for Monolithic Glass, Laminated Glass and Sealed Units. This EPD was developed in compliance with CAN/CSA-ISO 14025 and has been verified by Lindita Bushi from the Athena Sustainable Materials Institute.

This LCA and EPD were prepared by Vertima Inc. The EPD includes cradle-to-gate life cycle assessment (LCA) results.

For more information about LAURIER GLASS products, visit https://www.laurier.net/.

For explanatory materials regarding this EPD, please contact the program operator.

Environmental Product Declaration

CSA Group Registered Based on ISO 14025 and Other Requirements

For more information visit csaregistries.ca/epd

#8939-3810

November 2018 - 2023

1 GENERAL INFORMATION

This EPD was not written to support comparative assertions. Even for similar products, differences in declared units, use and end-of-life stage assumptions and data quality may produce incomparable results. It is not recommended to compare EPDs with another organization, as there may be differences in methodology, assumptions, allocation methods, data quality such as variability in data sets and results of variability in assessment software tools used.

PCR GENERAL INFORMATION			
Reference PCR	PCR Guidance for Building-Related Products and Services – Part B: Processed Glass EPD Requirements UL Environment August 17, 2016 to August 17, 2021		
The PCR review was conducted by:	Thomas P. Gloria Industrial Ecology Consultants *t.gloria@industrial-ecology.com*	Jack Geibig Ecoform *jgeibig@ecoform.com*	Bill Stough Sustainable Research Group *Bstough@sustainableresearch-group.com*

EPD GENERAL INFORMATION		
Program Operator	CSA Group 178 Rexdale Blvd Toronto, ON Canada M9W 1R3 www.csagroup.org	
Product	LAURIER Monolithic Glass, Laminated Glass, and Sealed Units	
EPD Registration Number 8939-3810	EPD Date of Issue November 19, 2018	EPD Period of Validity November 19, 2018 - November 18, 2023
EPD Recipient Organization	LAURIER GLASS 153 Laurier blvd., #300, Laurier-Station, QC Canada G0S 1N0 *http://laurier.net/en/*	
EPD Content	Product System Description LCA Calculation Rules LCA Results and Interpretation Additional environmental information References	

This LCA and EPD were prepared by:	Chantal Lavigne Vertima Inc. www.vertima.ca
This EPD and related data were independently verified, according to CAN/CSA-ISO 14025:2006 and ISO 21930:2007. ☐ Internal ☒ External	Lindita Bushi Lindita Bushi, Ph.D. Athena Sustainable Materials Institute

2 PRODUCT SYSTEM DOCUMENTATION

2.1 Company Description

LAURIER GLASS is a third-generation family business that manufactures processed glass products, including tempered coated and uncoated monolithic glass, tempered laminated glass, and sealed units. Their glass is mostly used in the commercial and institutional construction markets, high-rise buildings and the manufacturing industry. Its manufacturing facility is based in Laurier-Station, (QC), Canada.

2.2 Product description

This EPD is valid for the following processed LAURIER GLASS products:

- **Monolithic Glass:** a coated or uncoated tempered flat glass.
- **Laminated Glass:** a safety glass that will hold together when shattered. Laminated Glass assessed in this EPD is composed of two layers of tempered flat glass bonded together with a polyvinyl butyral (PVB) interlayer as illustrated in Figure 1. The glass can be coated or uncoated.
- **Sealed Units:** a tempered coated or uncoated insulating glass unit available with or without laminated glass. The sealed units are assembled with a spacer bar (three options), a desiccant (one option), a primary sealant (one option), a secondary sealant (two options), and argon gas as illustrated in Figure 1.

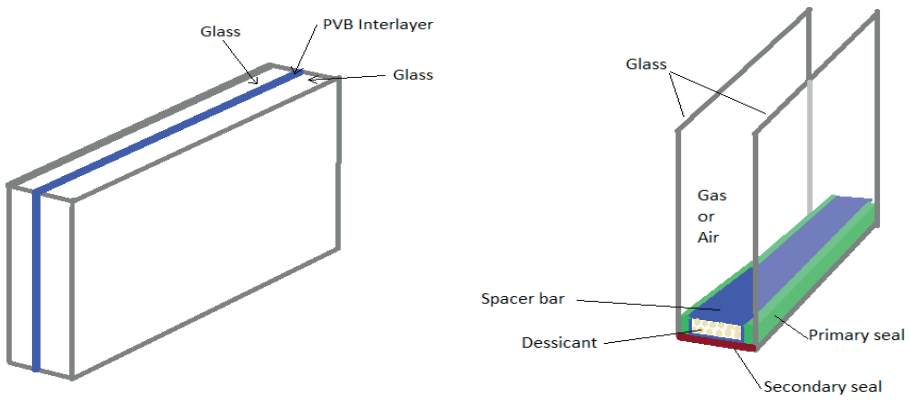

Figure 1: Representation of Laminated Glass (on the left) and Sealed Units (on the right). [Source: Vertima 2018]

All products are produced at the LAURIER GLASS manufacturing plant in Laurier-Station (QC). The weighted average profiles of the different product groups are calculated based on 2017 annual production data (on glass area basis). Average Sealed Unit masses of desiccant, spacer, sealant and gas were calculated as total mass consumption of each material divided by total product glass area produced in 2017. A summary of the values compiled for the different product groups is presented inTable 1.

Please consult http://laurier.net/en/ for more information on these products.

Table 1: Composition of the average Glass used in Monolithic Glass, Laminated Glass, and Sealed Units based on 2017 Production Volumes[1]

	Monolithic Glass	Laminated Glass	Sealed Unit
Weighted average glass thickness (mm)	6.36	10.24	11.40
Range of total glass thickness (mm)	3 - 19	6 - 30	6 -22
Weighted average coating thickness (mm)	0.06	0.01	0.002
Available coatings	Uncoated OPACICOAT TENDANCES CERAFRIT$^{MC/TM}$ CERAPRINT$^{MC/TM}$	Unicoated CERAFRIT$^{MC/TM}$ CERAPRINT$^{MC/T}$	Unicoated CERAFRIT$^{MC/TM}$ CERAPRINT$^{MC/T}$
Weighted average interlayer thickness (mm)	–	1.43	0.08

2.3 Product application

LAURIER GLASS is used in interior and exterior commercial, residential, and technical applications. LAURIER Laminated Glass is a safety glass that will hold together when shattered. In architecture, it is used for fenestration in height and in applications where glass is used as railing. It can also be used for its acoustic properties. LAURIER's double sealed units are used in various exterior applications.

OPACICOAT coated glass is mainly used for spandrels or interior wall cladding applications. TENDANCES coated glass is also used for interior decorating, while CERAFRIT$^{MC/TM}$ and CERAPRINT$^{MC/TM}$ can be used for interior decorating and in architectural projects.

LAURIER GLASS has been used in a multitude of projects, see *http://laurier.net/en/* for examples [1].

2.4 Technical data

Technical data specific to the glazing and configuration of a project are available upon request to LAURIER GLASS' technical team. General technical documents can be found at *http://laurier.net/en/technical-documents/* [2].

[1] *Please note data may not add up to totals due to rounding.*

2.5 Placing on the market / Application rules

LAURIER GLASS products respect the following standards per product type:

Monolithic Glass Products

- ASTM C1036-16 - Standard Specification for Flat Glass [3]
- ASTM C1048-12e1- Standard Specification for Heat-Strengthened and Fully Tempered Glass [4]
- ANSI Z97.1-2015 - American National Standard for Safety Glazing Materials Used in Buildings [5]
- CAN/CGSB 12.3 M91 (R2017) - Canadian Standard - Flat, Clear Float Glass [6]
- CAN/CGSB-12.1-2017 - Canadian Standard - Safety glazing [7]
- DIN EN 14179-1:2016 - Heat-Soaked, Thermally Toughened Soda Lime Silicate Safety Glass [8]

Laminated Glass Products

- ASTM C1172-14 - Laminated Architectural Flat Glass [9]
- CAN/CGSB-12.1-2017 - Canadian Standard - Safety Glazing [7]
- CPSC 16 CFR-1201 (2012) - Safety Standard for Architectural Glazing Materials [10]
- ANSI Z97.1-2015 - American National Standard for Safety Glazing Materials Used in Buildings [5]

Sealed Units

- ASTM E 2190-10 - Standard Specification for Insulating Glass Unit [11]

2.6 Properties of declared product as delivered

Monolithic Glass is tempered and its thickness varies from 3mm to 19mm; its length can be up to 144 inches (3658mm) and height up to 96 inches (2438mm). The available colours are clear, ultra-clear, grey, bronze, green, black, blue, or blue-green, with OPACICOAT, TENDANCES, CERAFRIT$^{MC/TM}$, or CERAPRINT$^{MC/TM}$ coating.

Laminated Glass is made of two pieces of tempered monolithic glass with a PVB interlayer. Its thickness varies from 6mm to 30mm; its length can be up to 118 inches (2997mm) and height up to 68 inches (1727mm). Specific properties in terms of safety, energy performance, aesthetics and acoustics depend on the make-up, i.e. glass thickness. Available coatings are CERAFRIT$^{MC/TM}$ or CERAPRINT$^{MC/TM}$.

Sealed Units are double-sealed and made of tempered Monolithic Glass or Laminated Glass. Thickness varies from 6mm to 22mm; length can be up to 135 inches (3429mm) and height up to 78'' (1981mm). Available coatings are CERAFRIT$^{MC/TM}$ or CERAPRINT$^{MC/TM}$.

Details can be found in LAURIER GLASS' technical documents at *http://laurier.net/en/technical-documents/* [2]

2.7 Base materials / Ancillary materials

The raw materials input for average Monolithic Glass, Laminated Glass and Sealed Units are detailed inTable 2. As for details on material content, refer to the health product declaration (HPD) which can be found at *http://www.hpd-collaborative.org/hpd-public-repository/* [12]

Table 2: Material composition of 1 m² of average Monolithic Glass, Laminated Glass, and Sealed Unit.[2]

Materials/Components		Mass in final product (%)		
		Average Monoilithic Glass	Average Laminated Glass	Average Sealed Units
Flat Glass		99.59%	94.33%	90.10%
Coating		0.41%	0.12%	0.02%
PVB		–	5.55%	0.27%
Desiccant		–	–	0.72%
Spacer	Spacer bar 1	–	–	0.23%
	Spacer bar 2	–	–	2.26%
	Spacer bar 3	–	–	2.63%
Primary sealant		–	–	0.06%
Secondary sealant	Secondary sealant 1	–	–	2.34%
	Secondary sealant 2	–	–	1.13%
Argon gas		–	–	0.25%
TOTAL		**100.00%**	**100.00%**	**100.00%**

2.8 Manufacture

The glass is cut, polished and/or seamed, cleaned and optionally painted with CERAFRIT[MC/TM] or CERAPRINT[MC/TM] before being tempered. Once the glass is tempered, it can be coated with OPACICOAT or TENDANCES. For Laminated Glass, the laminating process takes place after the tempering process. As for sealed units, the glass is prepared as stated above prior to assembly with sealant, desiccant, spacer and gas. The sequence of the different process steps performed at LAURIER GLASS are illustrated in section A3 – Manufacturing of Figure 2.

[2]*The "average" products used in the modeling are production weighted average of products and do not represent specific products manufactured by LAURIER GLASS.*

2.9 Environment and health during manufacturing

LAURIER GLASS is fully committed to the diligent protection of both the environment and the health and safety of its workers. LAURIER GLASS workers have access to the necessary protective equipment, and procedures are set up to ensure that work is performed safely. LAURIER strives to reduce their environmental footprint by offering a selection of energy-efficient and environmentally friendly products, through sound resource management and a waste recycling program:

- LAURIER GLASS recovers the heat loss from their tempering furnaces to heat the inside of their plant.
- LAURIER GLASS has a closed circuit water filtration and recycling system that reduces their water consumption.
- Rather than sending their glass waste to the landfill, it is picked up by an external supplier for use as raw material in the manufacturing of their products.
- LAURIER GLASS uses lead-free inks in their product coatings.

2.10 Product processing / Installation

Products should be processed, stored and installed according to industry standards and the applicable building codes.

2.11 Packaging

Monolithic Glass, Laminated Glass, and Sealed Units are all packaged using felt, cork, and cardboard separators, cardboard strips, plastic and cardboard corners, and cardboard boxes. They are then wrapped in plastic, put in assembled wooden crates, and finally strapped with polyester strapping on wood pallets. Wood pallets can be reused, while cardboard and plastics can be recycled.

2.12 Condition of use

No specific information regarding special product features for the period of use to be reported.

2.13 Environment and health during use

For this EPD, the system boundaries encompass a cradle-to-gate scope. Environmental impacts of product in use phase are excluded from this declaration, per UL Environment PCR Guidance for Building-Related Products and Services – Part B: Processed Glass EPD Requirements [13].

As for cleaning and maintenance, LAURIER GLASS refers to the maintenance and cleaning guide from the *Association de vitrerie et fenestration du Québec (AVFQ)*. The guide is only available in French on LAURIER GLASS' website (*http://laurier.net/documents-techniques/*) [2].

2.14 Extraordinary effects

No extraordinary effects are to be reported.

2.15 Re-use phase

According to the Glass Association of North America (GANA), a wide variety of architectural glass products can be recycled [14]. Annealed, tempered and low-e glass can be recycled with virtually no restrictions, with the exception of the need to separate contaminants. Recycled glass can enter the composition of several products such as fiberglass, glass containers, roadways, highway paint, terrazzo flooring, polishing materials and in landscaping.

2.16 Disposal

Based on the RECYC-QUÉBEC fact sheet on glass [15], glass is recovered at 49% in the province of Quebec. Hence, LAURIER's glass can be recycled at 49% if used in Québec, the rest being landfilled as an inert and non-hazardous waste.

2.17 Further information

Additional information about LAURIER GLASS products is available at *http://laurier.net/en/* [1].

3 LCA CALCULATION RULES

3.1 Declared unit

The selected declared unit (DU) for this EPD is **1 m² of processed glass**. All flat glass used in the products has the same density (2530 kg/m³). Table 3 presents all products targeted by this report and their respective DUs.

Table 3: Declared Unit of studied products, including mass per m² of processed glass, conversion factor to 1 kg and average thicknesses

Item	Unit	Average Monoilithic Glass	Average Laminated Glass	Average Sealed Units
Declared unit	m²	1	1	1
Mass per piece	kg / m²	16.16	27.45	32.00
Conversion factor to 1 kg	m² / kg	0.06	0.04	0.03
Glass thickness (average)	mm	6.36	10.24	11.40
Coating % mass	%	0.41	0.12	0.02
Interlayer % mass	%	0	5.55	0.27
Desiccant % mass	%	0	0	0.72
Spacer % mass	%	0	0	5.12
Sealant % mass	%	0	0	3.53
Argon gas % mass	%	0	0	0.25

The average glass thickness for each product has been calculated using a weighted average based on 2017 glass area production data for each product.

3.2 System boundaries

According to UL Environment's PCR [13], the LCA modelling system boundaries are Cradle-to-Gate, i.e., only covers the Production life cycle stage. Within this life cycle stage, three (3) modules are considered, namely A-1) Raw materials acquisition, A-2) Raw materials transportation to the manufacturing plant and A-3) Manufacturing. Construction (A-4; A-5), use (B-1 to B 7) and end-of-life (C-1 to C-4) stages are not included in the present EPD. Figure 2 presents the process flow diagram for Monolithic Glass, Laminated Glass, and Sealed Units, respectively.

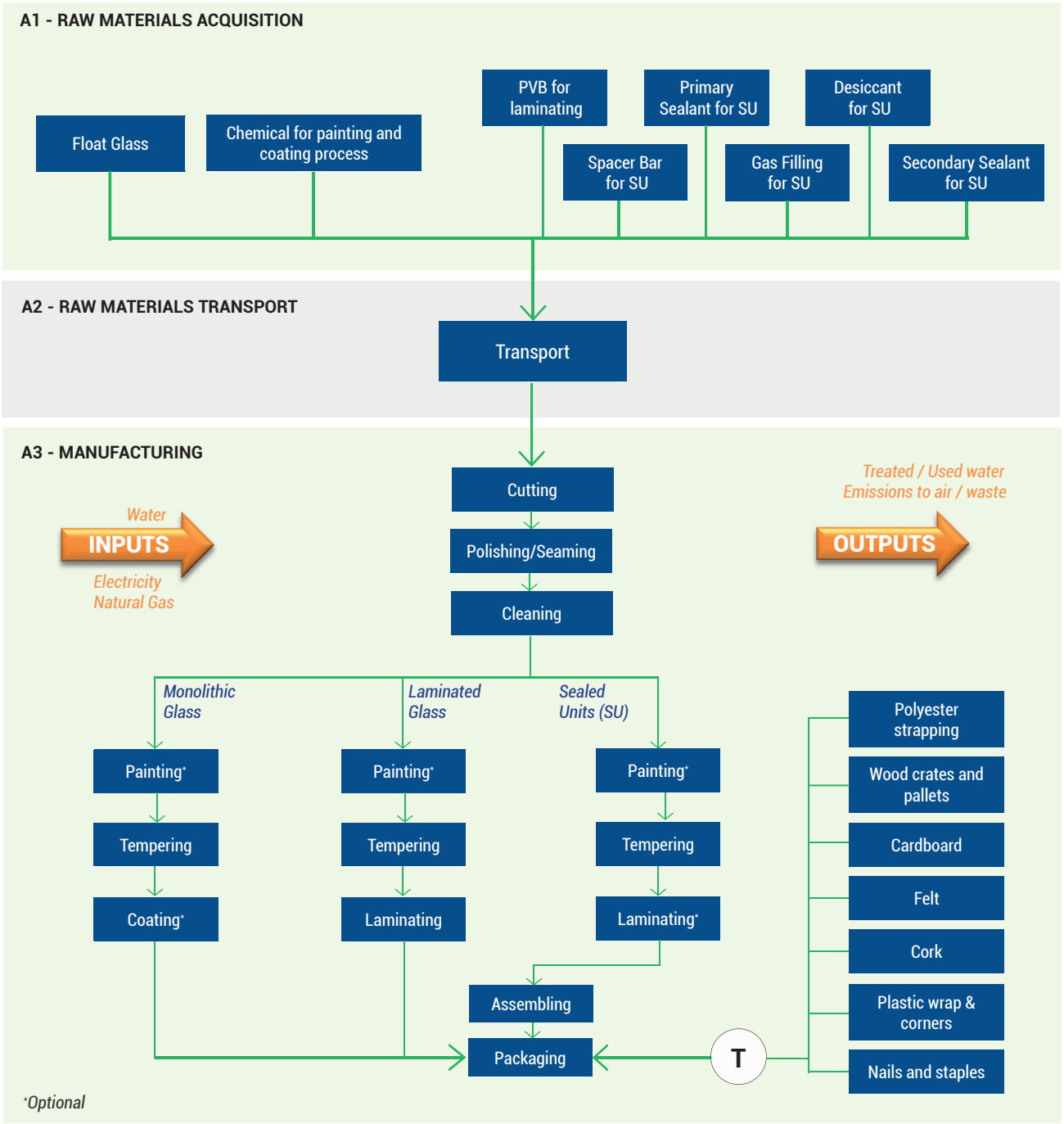

Figure 2: System boundaries of Cradle-to-Gate LCA of LAURIER GLASS Monolithic Glass, Laminated Glass, and Sealed Units. "T" refers to transport.

Raw materials acquisition and transportation:

These modules include the extraction and transformation of raw materials needed to produce flat glass (soda-lime glass), all the chemicals used for the coatings, the PVB for laminating, as well as raw materials to produce the sealed units (SU). Also included is the transport of raw materials from LAURIER GLASS' suppliers to the Laurier Station plant, in Quebec.

Manufacturing:

This module includes water and energy (electricity, natural gas) consumption for manufacturing processes (e.g., painting, tempering, coating, laminating, and assembling) and excludes heating of the building. Emissions to air from the application of coatings and sealants, as well as fuel combustion, have also been considered. No water emissions from the manufacturing plant were reported.

There is an average 30% loss of glass during the processes (e.g., broken, trims) as well as 5% to 7% loss of products (e.g. scrap, defects). These losses have been determined by production weight. Glass waste is sold and used as input in another process (i.e., considered recycled), paper wrapping is sent to a recycling centre, paint and solvent residues are sent to hazardous waste treatment, and other waste types are considered sent to landfill.

Finally, packaging materials to make products ready for shipment, as well as their transport to LAURIER GLASS' manufacturing plant, are covered by this module.

3.3 Estimates and assumptions

Assumptions were made regarding generic data used to model the various coatings, PVB, spacer, sealant, and desiccant. In addition, the resulting ADP – fossil fuels indicator from Vitro EPD was estimated from non-specific EPD results.

The "average" products used in the modeling are calculated production weighted average of products and do not represent specific products manufactured by LAURIER GLASS.

3.4 Cut-off criteria

According to the UL Environment PCR – Part A [16], no known flows are deliberately excluded from this EPD. Any application of cut-off criteria for the exclusion of inputs and outputs shall be documented.

In the present EPD, no primary data (input material, energy consumption) was excluded from the system boundaries.

For this EPD, no data on the construction, maintenance or dismantling of the capital assets, daily transport of the employees, office work, business trips and other activity from LAURIER GLASS' employees was included in the model. The model only takes into account the processes associated with infrastructures that are already included in the ecoinvent unit processes.

3.5 Background data

Manufacturing data representative of the 2017 production year was collected from LAURIER GLASS' manufacturing plant located in Laurier-Station, QC. This data included: total annual mass of products produced at the manufacturing plant, as well as the total annual mass of products under study; amount of raw materials entering the production of Monolithic Glass, Laminated Glass, and Sealed Units; losses of these materials; distances and transportation mode for the supply of raw materials; energy consumption (electricity, natural gas, diesel oil), emissions to the environment, water consumption and waste generation at LAURIER GLASS' manufacturing plant; and materials needed for packaging, as well as distance and mode of transportation.

Data used to model Flat Glass was taken from Vitro Architectural Glass Flat Glass Products EPD [17]. This EPD was chosen because Vitro is a big supplier to process glass companies in North America, and therefore was considered more representative than the actual ecoinvent process for flat glass. EPDs from specific suppliers, when available, did not contain all the required environmental indicators.

When primary data was not available, unit processes were selected either from the ecoinvent v3.3 - cut-off database, one of the most comprehensive LCI databases currently available [18], from the US LCI database [19] that is specific to a North American context, or from published EPDs.

3.6 Data quality

This EPD is specific to a particular manufacturer: LAURIER GLASS. The primary data, obtained from the manufacturer, is representative of the year 2017, of the current technologies and materials used by this company. As primary data was collected directly from plants where processed glass products are manufactured, it can be stated that it is 100% representative of the technologies in use and of geographical areas.

Secondary data was used for upstream and downstream processes. For some processes, the ecoinvent database provided representative data for a Canadian context. These processes were used in priority. When necessary, the grid mix was changed for the grid mix of the province or country where the production takes place.

When ecoinvent processes were not available for a North American context, processes were taken from the US LCI database.

Datasets from the ecoinvent 3.3 database were extrapolated to the year of calculation, i.e., 2016; however, their year of publication is different. A complete data quality assessment was performed in the LCA.

3.7 Allocation

Data relative to energy consumption (electricity, natural gas, and diesel), water consumption, air emissions, waste and packaging was provided for the whole manufacturing plant. According to PCR part B, section 3.8, mass should be used as the primary basis co-product allocation [13]. Allocation methods deemed more appropriate than on the basis of mass may be used when justified. In this EPD, mass allocation was used for input energy flows, water flows, emissions to air, and waste flows. As for packaging, allocation based on surface area was deemed more appropriate as it was evaluated that whether the glass was 4mm or 6 mm thick, for example, it would need the same packing for shipping.

As per PCR part A, section 3.3.1, waste processing of the material flows undergoing recycling processes are included up to the system boundary of the end-of-waste state [20]. In other words, a cut-off approach was used as further processing of the recycled material is part of raw material preparation of another product system (open-loop recycling).

3.8 Comparability

"Environmental declarations from different programs may not be comparable."[21] "Comparison of the environmental performance of processed glass 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 energy use phase as instructed under this PCR."[13]

"Full conformance with the PCR for North American Processed Glass allows EPD comparability only when all stages of the processed glass life cycle have been considered, which is not permitted under this PCR. However, variations and deviations are possible." Example of variations: Different Life Cycle Assessment (LCA) software and background Life Cycle Inventory (LCI) datasets may lead to differences in results upstream or downstream of the life cycle stages declared." [13] Given this EPD is cradle-to-gate in scope, comparisons of EPD data from one product to another are not allowed.

4 LIFE CYCLE ENVIRONMENTAL IMPACT ASSESSMENT RESULTS

According to the PCR, section 5, life cycle impact assessment results are to be presented according to three tables: 1) The North American LCA Environmental Impact Assessment Results for 1 m² of process glass (Table 4); 2) The LCA Results: Resource Use for 1 m² of process glass (Table 5); 3) The LCA Results: Output Flows and Waste Categories for 1 m² of process glass (Table 6). The European and Rest of the World (ROW) Life Cycle Environmental Impact Assessment Results were also elected to be presented in this EPD (Table 4).

Note that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Table 4: LCA results for 1 m² of processed glass

Environmental indicator		Unit	LAURIER GLASS		
			Monolithic Glass (per m²)	Laminated Glass (per m²)	Sealed Units Glass (per m²)
TRACI 2.1 (with the exception of ADP elements)					
AP	Acidification potential	kg SO_2 eq.	2.51E-01	4.28E-01	5.39E-01
EP	Eutrophication potential	kg N eq.	3.08E-02	5.72E-02	7.07E-02
GWP	Global Warming Potential	kg CO_2 eq.	2.67E+01	4.73E+01	6.45E+01
ODP	Stratospheric ozone layer depletion potential	kg CFC-11 eq.	1.87E-07	4.77E-07	9.30E-07
POCP	Photochemical ozone creation potential	kg O_3 eq.	6.76E+00	1.13E+01	1.32E+01
ADP fossil fuels	Abiotic resource depletion potential - fossil fuels	MJ surplus	4.88E+01	9.40E+01	1.17E+02
ADP elements	Abiotic resource depletion potential - minerals (per ReCiPe)	kg Fe eq.	5.10E-01	8.66E-01	1.45E+00
CML 4.4					
AP Air	Acidification potential for air emissions	kg SO_2 eq.	2.17E-01	3.72E-01	4.81E-01
EP	Eutrophication potential	kg $(PO_4)^{3-}$ eq.	4.38E-02	7.56E-02	8.92E-02
GWP	Global warming potential	kg CO_2 eq.	2.67E+01	4.74E+01	6.45E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 eq.	1.69E-07	4.14E-07	7.61E-07
POCP	Formation potential of tropospheric ozone	kg C_2H_4 kg eq.	1.21E-02	2.12E-02	2.75E-02
ADP fossil fuels	Abiotic depletion potential for fossil resources	MJ, LHV	1.01E+03	1.76E+03	2.21E+03
ADP elements	Abiotic depletion potential for non-fossil resources	Kg Sb eq.	8.87E-05	1.59E-04	3.63E-04

Table 5: Resource Use results for 1 m2 of processed glass

Environmental indicator		Unit	LAURIER GLASS		
			Monolithic Glass (per m^2)	Laminated Glass (per m^2)	Sealed Units Glass (per m^2)
Resource use					
PERE	Renewable primary energy as energy carrier	MJ, LHV	7.30E+01	1.19E+02	1.75E+02
PERM	Renewable primary energy as material utilization	MJ, LHV	3.26E+00	4.12E+00	4.33E+00
PERT	Total use of renewable primary energy resources	MJ, LHV	7.63E+01	1.23E+02	1.79E+02
PENRE	Non-renewable primary energy as energy carrier	MJ, LHV	5.78E+02	1.02E+03	1.27E+03
PENRM	Non-renewable primary energy as material utilization	MJ, LHV	2.60E+00	3.86E+01	6.03E+01
PENRT	Total use of non-renewable primary energy resources	MJ, LHV	5.80E+02	1.06E+03	1.33E+03
SM	Use of secondary material	MJ, LHV	-	-	3.81E-01
RSF	Use of renewable secondary fuels	MJ, LHV	-	-	-
NRSF	Use of non-renewable secondary fuels	MJ, LHV	-	-	-
FW	Use of net fresh water	m^3	7.60E+01	1.26E+02	2.60E+02

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;
PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM = Use of non-renewable primary energy resources used as raw materials;
PENRT = Total use of non-renewable primary energy resources;
SM = Use of secondary materials;
FW = Use of net fresh water.

Table 6: Output flows and waste categories results for 1 m2 of processed glass

Environmental indicator		Unit	LAURIER GLASS		
			Monolithic Glass (per m^2)	Laminated Glass (per m^2)	Sealed Units Glass (per m^2)
Output flows and waste categories					
HWD	Hazardous waste disposed	kg	2.35E-03	4.25E-03	1.70E+00
NHWD	Non-hazardous waste disposed	kg	3.87E+00	1.03E+01	1.11E+01
RWD	Radioactive waste disposed	kg	9.42E-03	1.56E-02	2.32E-02
CRU	Components for re-use	kg	-	-	-
MFR	Materials for recycling	kg	7.26E+00	1.17E+01	1.30E+01
MER	Materials for energy recovery	kg	-	-	-
EE	Exported energy	MJ, LHV	-	-	-

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed;
CRU = Components for re-use;
MFR = Materials for recycling;
MER = Materials for energy recovery;
EE = Exported energy.

5 LCA INTERPRETATION

This section details the contribution to the impacts and resource use of the different modules.

Figure 3, Figure 4, and Figure 5 respectively present the environmental impacts and energy consumption of Monolithic Glass, Laminated Glass and Sealed Units. The raw materials acquisition module (A1), for all three (3) products, is a main contributor to all the studied TRACI and ReCiPe impacts categories, as well as for the total use of non-renewable primary energy (PENRT). Flat glass is the main contributor within the raw material module (A1), except for stratospheric ozone layer depletion potential (ODP) where it is coatings for Monolithic Glass, polyvinyl butyral (PVB) and coatings for Laminated Glass, and desiccant and secondary sealant for Sealed Units.

Manufacturing module (A3) only dominates total use of renewable resources (PERT). Manufacturing is the main or the second largest contributor to cradle-to-gate eutrophication potential (EP), stratospheric ozone layer depletion potential (ODP), and abiotic resource depletion potential - minerals (ODP). Within the manufacturing module (A3), it is the treatment of waste at landfill that contributes to eutrophication potential (EP), the use of Quebec electricity mix that contributes to total use of renewable resources (PERT), a mix of fuel use at the waste treatment center and energy production in the electricity mix that contributes to stratospheric ozone layer depletion potential (ODP), and steel nails used in the packaging that contributes to abiotic resource depletion potential – minerals (ADP-elements).

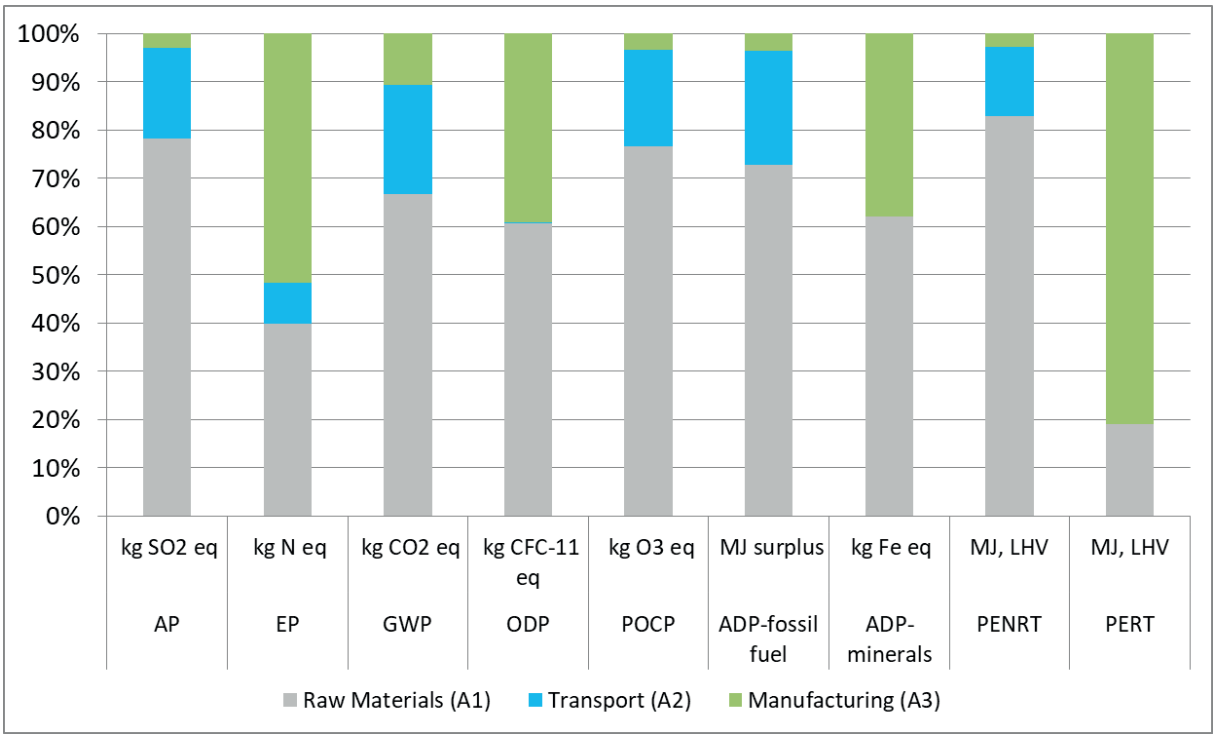

Figure 3: Contribution of Production life cycle stage modules to the environmental impacts of 1m2 of Monolithic Glass – TRACI, ReCiPe & CED indicators.

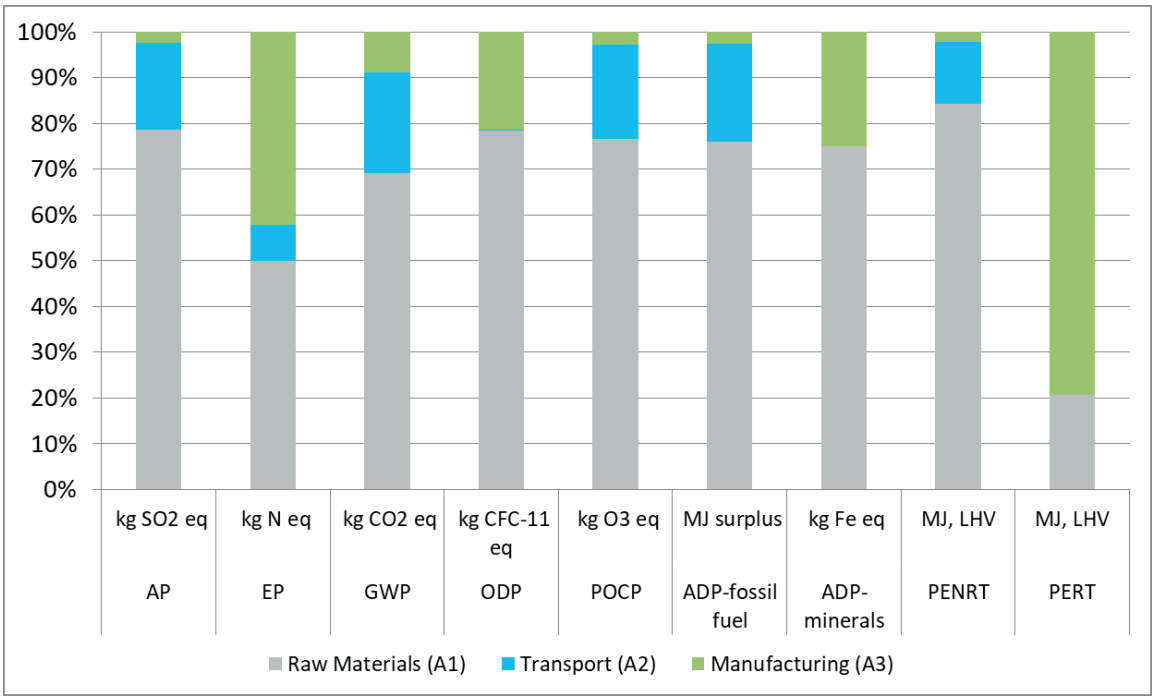

Figure 4: Contribution of Production life cycle stage modules to the environmental impacts of 1m2 of Laminated Glass – TRACI, ReCiPe & CED indicators.

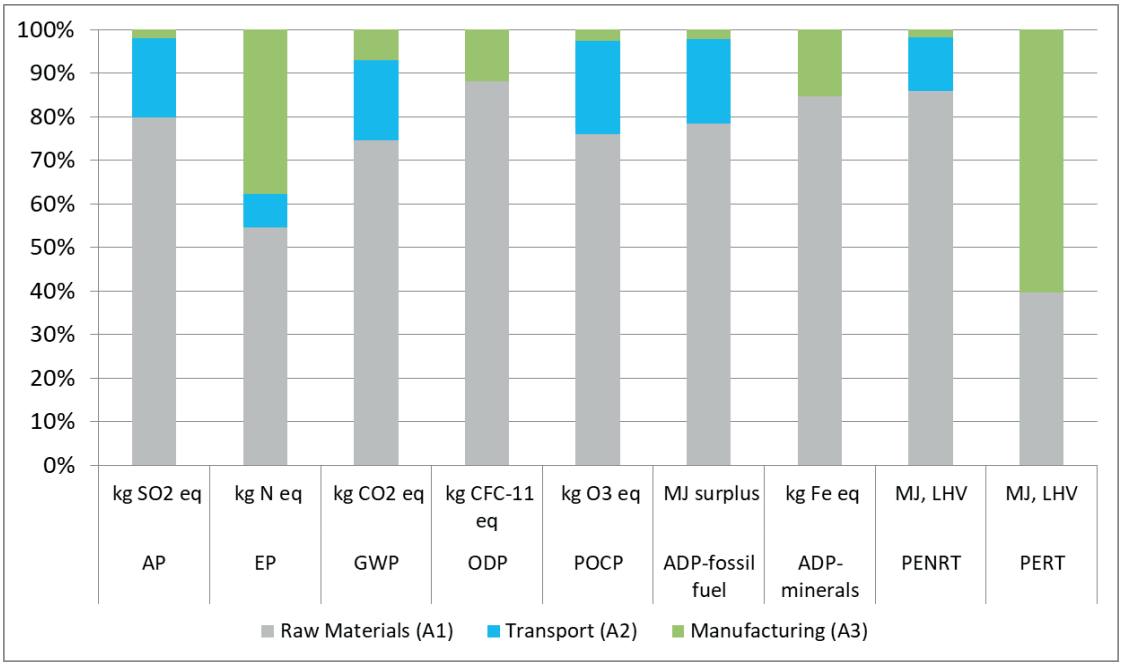

Figure 5: Contribution of Production life cycle stage modules to the environmental impacts of 1m2 of Sealed Units – TRACI, ReCiPe & CED indicators.

8 ADDITIONAL ENVIRONMENTAL INFORMATION

8.1 Validated Eco-Declaration® by Vertima

In addition, LAURIER GLASS has undergone a third-party verification process with Vertima Inc. where LAURIER GLASS products and its entire supply chain were assessed. At the end of the process, they received the Validated Eco-Declaration® Certification summarizing verified environmental claims, as well as Vertima's Environmental Data Sheet©.

8.2 Health Product Declaration® (HPD®)

LAURIER GLASS. has published a Health Product Declaration® for its Monolithic Glass, Laminated Glass and Sealed Units. More details are available on the HPDC public repository: *https://www.hpd-collaborative.org/hpd-public-repository/.*

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