Environmental Product Declaration

PVC WINDOWS

This environmental product declaration (EPD) covers six types of PVC windows with PVC profiles manufactured by Thermoplast Nextrusions. The EPD was prepared by CT Consultant in accordance with CAN/CSA-ISO 14025:2006 and ISO 21930:2017 and verified by Marie Bellemare Consulting.

This EPD includes the results of the life cycle assessment (LCA) for the raw material supply and manufacturing stages (i.e., cradle to gate).

For more information on Thermoplast Nextrusions, please visit www.thermoplast.com

Date of publication: 27 October 2025

ASTM INTERNATIONAL

EPD SUMMARY SHEET

PVC WINDOWS

Goal of the summary sheet

This summary sheet aims to present the company, the product, the main methodological aspects and the results of the environmental product declaration (EPD) for PVC windows made with the profiles manufactured by Thermoplast Nextrusions.

Presentation of the company

Thermoplast Nextrusions is Quebec's largest extruder of PVC profiles for the door and window industry.

Product description

The PVC windows made with the profiles manufactured by Thermoplast Nextrusions are intended for the residential and light commercial building markets. The EPD includes six types of windows: awning, casement, sliding, double-hung, panoramic and fixed.

Product composition

The PVC windows are made up of PVC profiles, sealed units (double glazing) and hardware (stainless steel components).

Administrative information

- **Validity period**

  October 2025 – October 2030

- **Product category rules**

  NSF 1102-23 Product Category Rule for Environmental Product Declarations: Fenestration Assemblies. 2024 - 2028

- **EPD development**

  CT Consultant

- **EPD verification**

  Marie Bellemare Consulting

Methodological aspects

- **Declared unit**

  1 m^2 of window (frame and glazing) corresponding to the categories presented in the ANSI/NFRC 100 standard

- **System boundaries**

  Cradle to gate (A1 – A3)

- **Impact assessment method**

  TRACI 2.1

Certifications

EPD SUMMARY SHEET

PVC WINDOWS

Environmental life cycle impacts - 1 m^2 of PVC window

IMPACT CATEGORY	INDICATOR	AWNING	CASEMENT	SLIDING	DOUBLE-HUNG	PANORAMIC	FIXED
Global warming potential	kg CO_2 eq	6.64E+1	6.64E+1	4.89E+1	5.27E+1	4.25E+1	4.12E+1
Acidification of soil and water sources potential	kg SO_2 eq	3.46E-1	3.46E-1	2.74E-1	2.91E-1	2.55E-1	2.44E-1
Eutrophication potential	kg N eq	3.61E-2	3.61E-2	2.57E-2	2.78E-2	2.16E-2	2.11E-2
Smog formation potential	kg O_3 eq	4.95E+0	4.95E+0	3.96E+0	4.19E+0	3.68E+0	3.52E+0
Ozone depletion potential	kg CFC-11 eq	1.38E-5	1.38E-5	1.07E-5	1.07E-5	7.88E-6	8.02E-6

Contribution analysis

The contribution analysis showed that frame manufacturing is the primary contributor to impacts across all impact categories for the awning and casement windows (54.5% to 88.9% of the total impacts). For other types of windows containing less or no stainless steel, glazing manufacturing is the primary contributor (51.5 to 77.0% of the total impacts), with a few exceptions. In the *Ozone Depletion* category, the frame contributes most to the impacts of all window types (between 73.4% and 88.9% of the impacts in this category). In the *Eutrophication* category, the frame is the primary contributor to the impacts of the sliding and double-hung windows (54.3% and 57.8%, respectively). Finally, in the *Global Warming* category, the frame remains the main contributor to the impacts of the double-hung window (52.2% of the impacts in this category).

Additional environmental information

Thermoplast Nextrusions holds the two following recognitions:

- "Performance +" rating from Recyc-Québec's ICI on recycle + program for the 2022-2025 period;
- Carbon Care® certification from Enviro-Acces for the 2022-2023 period.

Contact details

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Laval, Quebec
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1 800 361-9261
www.thermoplast.com

1 | GENERAL INFORMATION

Product name and description	PVC windows. Description in section 3.1 of the EPD.
Manufacturer name and address	Thermoplast Nextrusions 3035 Le Corbusier Boulevard Laval, Quebec, Canada H7L 4C3 1 800 361-9261 www.thermoplast.com
Program operator	ASTM International 100 Barr Harbor Drive, West Conshohocken, PA 19428 United States www.astm.org
General program instructions	ASTM International (2024) Environmental Product Declarations https://www.astm.org/products-services/certification/environmental-product-declarations/epd-pcr.html
Declaration number	EPD 1067
Declared unit	1 m² of PVC window
Product Category Rules (PCR) used	NSF 1102-23 Product Category Rule for Environmental Product Declarations: Fenestration Assemblies. 2024 - 2028 [1]
Product's intended application and use	Residential and light commercial buildings
Bill of materials (BOM)	Presented in section 3.4 of the EPD
Markets of applicability	North America
Date of issue	27 October 2025
Period of validity	October 2025 – October 2030
Type of EPD and scope of application	Specific cradle-to-gate EPD
Reference year	2021
Assumptions	Presented in section 4.4 of the EPD
Cut-off criteria	Presented in sections 4.4 and 4.5 of the EPD
Allocation rules	Presented in section 4.6 of the EPD
Data quality	Presented in section 4.7 of the EPD
LCA software	OpenLCA v2.02 [2]
Database	Ecoinvent v3.9.1 [3]
Impact assessment method	TRACI 2.1 [4]
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by	CT Consultant www.ctconsultant.ca
The PCR review was conducted by	Thomas Gloria, Ph.D. Industrial Ecology Consultants 35 Bracebridge Road, Newton, Massachusetts, United States t.gloria@industrial-ecology.com
This declaration was independently verified in accordance with ISO 14025:2006. ISO 21930:2017 serves as the core PCR and NSF 1102-23 Product Category Rule for Environmental Product Declarations: Fenestration Assemblies is used as the specific PCR. **☐ Internal ☒ External**	Marie Bellemare, Marie Bellemare Consulting
Further information may be obtained from:	Thermoplast Nextrusions www.thermoplast.com

Comparability of EPDs

This environmental product declaration (EPD) complies with CAN/CSA-ISO 14025:2006 [5] as well as the above-mentioned PCR. This EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers or programs, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at building or infrastructure level per ISO 21930:2017 guidelines [6]. The results presented in this EPD reflect an average performance of the product and its actual impacts may vary on a case-by-case basis.

2 | PRESENTATION OF THERMOPLAST NEXTRUSIONS

A key player in Canada's door and window industry, Thermoplast Nextrusions stands out as a leader among PVC profile manufacturers, specifically targeting the Quebec and Maritime markets. Thermoplast Nextrusions PVC profiles are used for several types of windows: awning, casement, sliding, double-hung, panoramic and fixed. The company has facilities to respond to market demands and customize its products to meet specific customer requirements. This LCA focuses on the production activities of Thermoplast Nextrusions' manufacturing plant located at 3035 Le Corbusier Boulevard in Laval (Quebec, Canada).

3 | PRODUCT DESCRIPTION

3.1 | Summary description of the product and applications

The PVC windows made with the profiles manufactured by Thermoplast Nextrusions are intended for the residential and light commercial building markets. This EPD includes six types of windows: awning, casement, sliding, double-hung, panoramic and fixed. The PVC windows consist of three constituents: PVC profiles, sealed units (double glazing) and hardware (stainless steel components) (Figure 1). The PVC profiles are manufactured using virgin and recycled raw materials. The PVC profiles emit no VOCs over their service life. The sealed units consist of two 3 mm-thick glass panes separated by an air space.

Figure 1 : Cross-section of a PVC window

3.2 | Products covered by the EPD

This EPD covers six types of PVC windows made with profiles manufactured by Thermoplast Nextrusions (Figure 2).

Awning window

Casement window

Sliding window

Double-hung window

Panoramic window

Fixed window

Figure 2 : PVC windows included in the EPD

3.3 | Technical specifications of the PVC windows

The PVC windows meet the performance standards listed in Table 1 [1].

Table 1: Standards met by the PVC windows

STANDARD ABBREVIATION	NAME OF STANDARD
AAMA/WDMA/CSA 101/I.S.2/A440	North American window standard
CSA A440S1	Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440
CSA A440.4	Window installation
CSA A440.2	Energy efficiency of fenestration systems
ANSI/NFRC100	Procedure for determining the fenestration U-factors
ASTM D4726	Rigid PVC exterior profile extrusion for assembled windows
AAMA 303	Voluntary specification for rigid polyvinyl chloride (PVC) exterior profile

PVC windows are recognized by window system certifications from the AAMA (American Architectural Manufacturers Association), which has become the FGIA (Fenestration & Glazing Industry Alliance), the NFRC (National Fenestration Rating Council) and Energy Star [7].

Thermoplast Nextrusions guarantees that door and window profiles will be free from manufacturing defects that could cause rotting, cracking, curling, pitting, corrosion, peeling, blistering or non-uniform colour for a period of 20 years from the date of purchase [8].

3.4 | Composition of PVC windows

The six types of PVC windows are made up of PVC profiles, double glazing and hardware (stainless steel components). The mass composition of the windows is presented at Table 2.

Table 2: Mass of constituents per 1 m² of PVC window

COMPONENT		DOUBLE GLAZING	PVC PROFILES	STAINLESS STEEL COMPONENTS	TOTAL
MASS (KG)	AWNING	10.03	9.22	1.74	21.00
	CASEMENT	10.03	9.22	1.74	21.00
	SLIDING	11.04	6.77	0.25	18.06
	DOUBLE-HUNG	11.06	6.73	0.72	18.51
	PANORAMIC	12.37	4.41	0.00	16.77
	FIXED	11.50	4.59	0.00	16.09
SHARE OF TOTAL WINDOW MASS	AWNING	47.8%	43.9%	8.3%	100.0%
	CASEMENT	47.8%	43.9%	8.3%	100.0%
	SLIDING	61.1%	37.5%	1.4%	100.0%
	DOUBLE-HUNG	59.8%	36.3%	3.9%	100.0%
	PANORAMIC	73.7%	26.3%	0.0%	100.0%
	FIXED	71.5%	28.5%	0.0%	100.0%

3.5 | PVC windows manufacturing

The PVC used to manufacture profiles at the Thermoplast Nextrusions plant contains a portion of virgin material and a portion of recycled material. The virgin PVC (primary) is mainly sourced from two suppliers, one located in Concord (Ontario, Canada) and the other in Westlake (Texas, USA). The recycled PVC (secondary material) comes from manufacturing losses (scrap) of fenestration products. These manufacturing losses are recovered by a recycler who transforms them into granules using a granulator and an extruder. Finally, Thermoplast Nextrusions manufactures its own equipment for the extrusion process.

PVC profiles are produced via an extrusion process (Figure 3). The PVC granules are heated and pressurized to pass through a customized die to form a profile which can be used to make a window frame. The material is extracted from the die using a haul-off machine to obtain a profile with constant dimensions. The scraps generated by the extrusion process are reprocessed and reintroduced into the extrusion process. The extrusion scraps that cannot be reused are sent to a recycler. The resulting profiles are then cut with a saw and packaged. The waste cardboard, metal and wood are sent for recycling. Saw shavings, contaminated cardboard and office waste from the Thermoplast Nextrusions plant are sent to landfill.

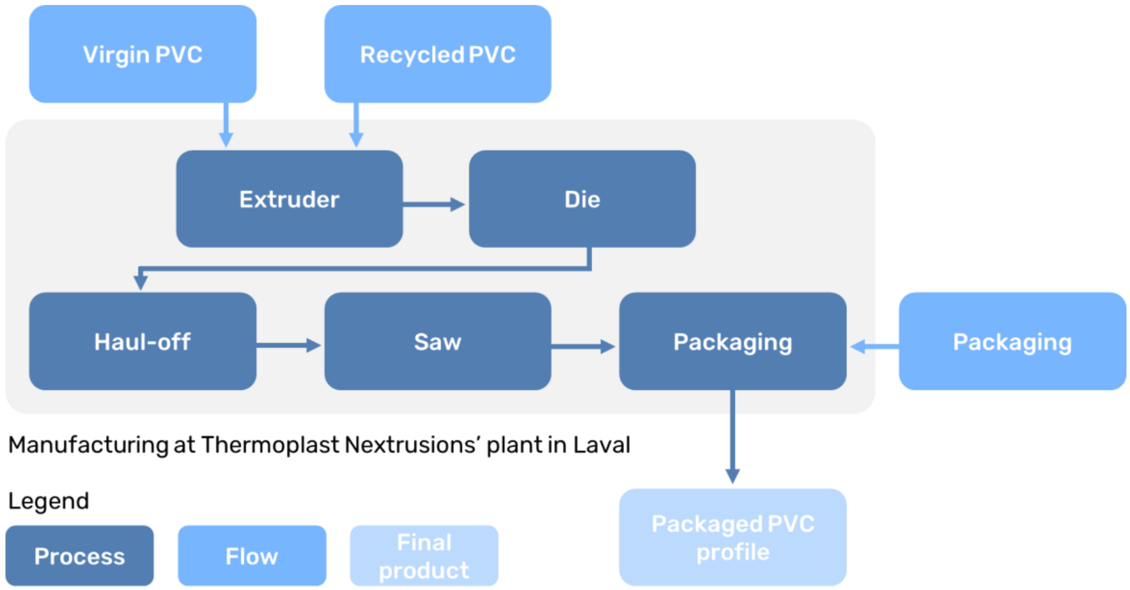

Figure 3: Production stages of the PVC profiles at the Thermoplast Nextrusions plant (Laval, Quebec, Canada)

The PVC profiles manufactured at the Thermoplast Nextrusions plant, available in different sizes according to the requirements of window manufacturers, are shipped by truck to window manufacturing plants. The window manufacturing process consists of assembling the three constituents: PVC profiles, sealed units (double glazing) and hardware (stainless steel components) (Figure 4). It should be noted that only Thermoplast Nextrusions provided primary data for this LCA.

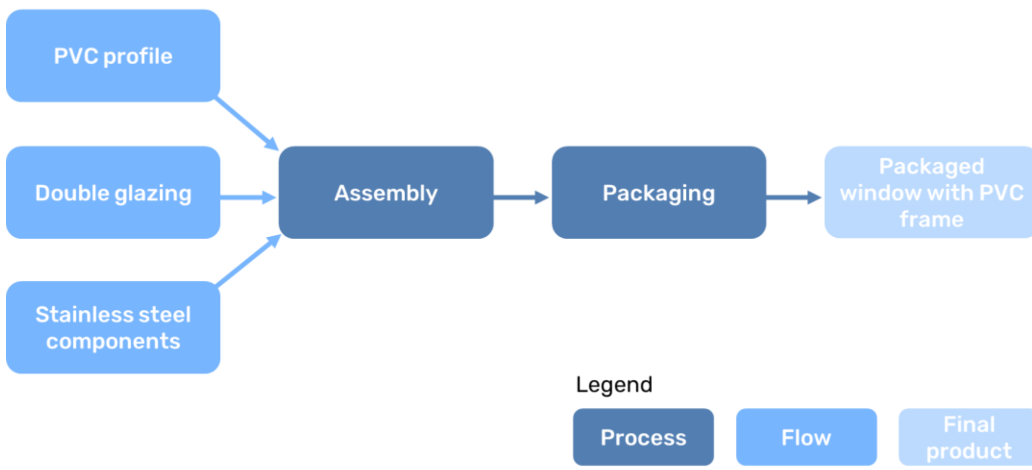

Figure 4 : Manufacturing stages of the PVC windows at the window assembly plant

3.6 | Packaging

Before shipping, the profiles are packaged with cardboard, plastic film and bags, nylon straps, polypropylene tape and newspaper. The windows are packaged with cardboard wedges and plastic film for transport to the point of sale.

4 | METHODOLOGY USED FOR THE LIFE CYCLE ASSESSMENT

4.1 | Declared unit

The declared unit is defined according to the PCR [1] as follows:

"1 m² of window (frame and glazing) corresponding to the categories presented in the ANSI/NFRC 100 standard." [1]

The declared unit refers to the finished products (windows with PVC frames and double glazing) and their packaging (Table 3). The mass of the windows were calculated based on the standard dimensions from the PCR [1] then standardised to 1 m² (Table 4).

Table 3: Names and categories of the six types of PVC windows

NAME OF THE PVC WINDOW	WINDOW TYPE ACCORDING TO TABLE 1 OF THE PCR	WINDOW DIMENSIONS (WIDTH X HEIGHT)	SOURCE
Awning	Projecting (Awning – single)	1500 x 600 mm	NSF PCR for Fenestration Assemblies [1]
Casement	Casement – single	600 x 1500 mm	
Sliding	Horizontal slider	1500 x 1200 mm	
Double-hung	Vertical slider	1200 x 1500 mm	
Panoramic	Fixed	1200 x 1500 mm	
Fixed	Fixed	1200 x 1500 mm	

Table 4: Key parameters of the PVC windows' declared unit

PARAMETER		VALUE	UNIT
Declared unit	1 m² of window (frame and glazing) corresponding to the categories presented in the ANSI/NFRC 100 standard		
Window mass	Awning	21.00	kg
	Casement	21.00	kg
	Sliding	18.06	kg
	Double-hung	18.51	kg
	Panoramic	16.77	kg
	Fixed	16.09	kg
Packaging mass	Awning	0.13	kg
	Casement	0.13	kg
	Sliding	0.13	kg
	Double-hung	0.13	kg
	Panoramic	0.13	kg
	Fixed	0.13	kg

4.2 | System boundaries

The cradle-to-gate LCA includes the production stage of PVC windows comprising life cycle modules A1, A2 and A3 (EN 15804:2019 and ISO 21930:2017 [6,9]). Thus, the other life cycle modules as identified by these standards are excluded from the assessed system.

Table 5: Life cycle modules included and excluded from the LCA

PRODUCTION STAGE (A1-A3)			CONSTRUCTION STAGE (A4-A5)		USE STAGE (B1-B7)							END-OF-LIFE STAGE (C1-C4)				BEYOND THE LIFE CYCLE (D)
Production of raw materials	Transport of raw materials	Product manufacturing	Transport to the construction site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Energy use	Water use	Deconstruction	Transport to the waste treatment site	Waste treatment	Disposal	Benefits associated with reuse / recycling / energy recovery
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	ME	ME	ME	ME	ME	ME	ME	ME	ME	ME	ME	ME	ME	ME

Legend

X: Life cycle module included in the LCA

ME: Life cycle module excluded from the LCA

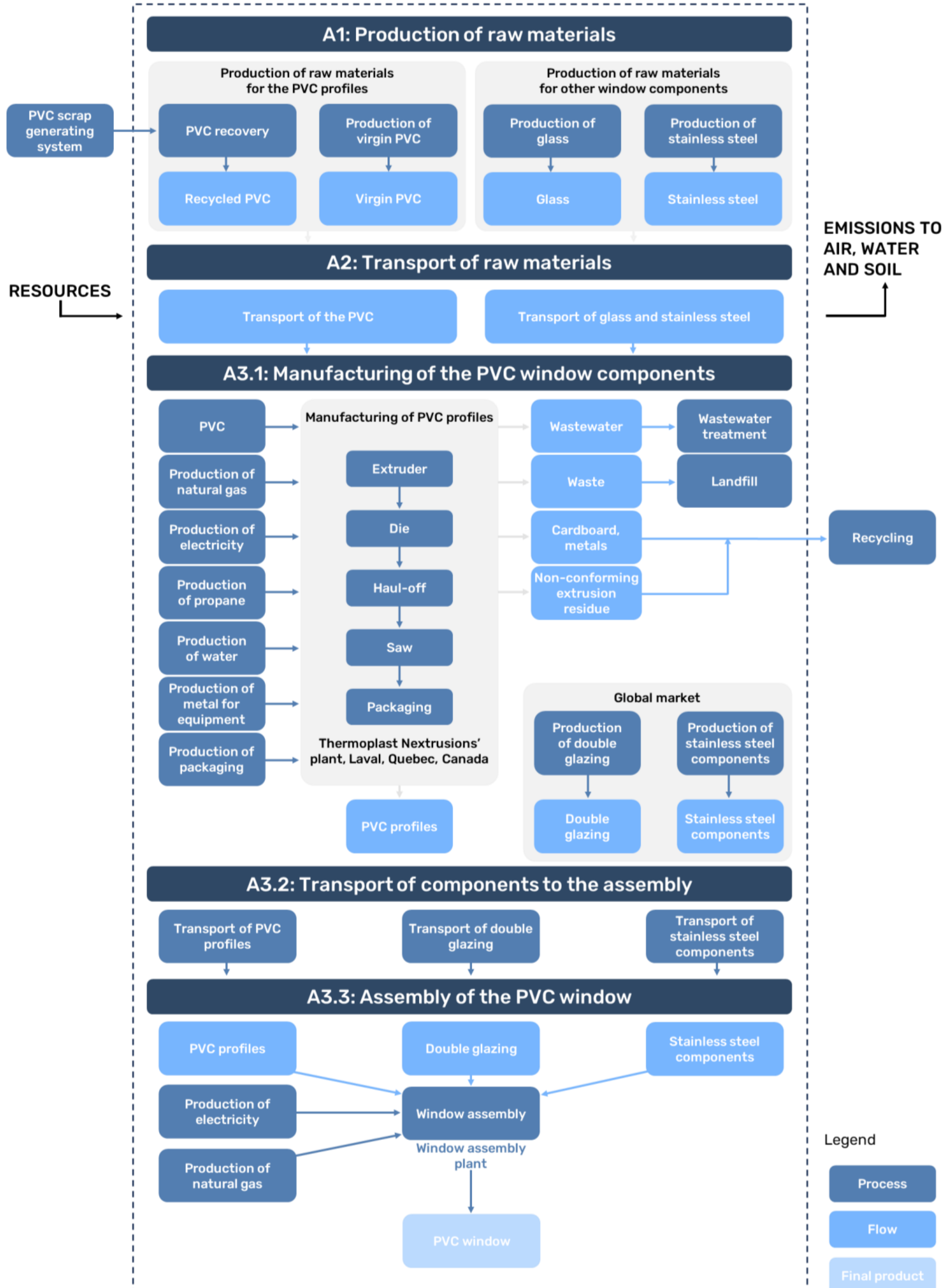

Figure 5 : System boundary – PVC window

4.3 | Reference period

The reference period considered is the calendar year 2021 (from 1 January 2021 to 31 December 2021).

4.4 | Assumptions

Carrying out an LCA involves making assumptions when data is incomplete or missing. The following assumptions were applied with respect to the present LCA:

- **Modelling of double glazing (A1 - A3.1)**. The data from the Ecoinvent database "market for glazing, double, U<1.1 W/m^{2}K | Cutoff, S - GLO" used to model the glazing considers a mass of 20 kg of glazing for 1 m^2 of double glazing. An extrapolation was carried out to model the impacts corresponding to the mass of glazing in the windows under study [3].
- **Separation of the double-glazing impacts (A1 - A3.1).** The impacts of "market for glazing, double, U<1.1 W/m^2 K | Cutoff, S - GLO" were separated to respect the division of the life cycle modules: A1 - Production of raw materials (impacts of glass production only) and A3.1 - Manufacturing of PVC window components (impacts of glazing production, i.e. processing only, excluding the impacts of glass production) [6].
- **Transport of raw materials to glazing and steel component manufacturers (A2).** The distances and transport modes were taken from the PCR as these transports stages are not known by Thermoplast Nextrusions [1].
- **Transport of profiles, glazing and steel components to the assembly plant (A3.2).** The distances and modes of transport were taken from the PCR as these transport stages are not under the control of Thermoplast Nextrusions [1].
- **Transport by truck (A1 – A3).** In line with the PCR, transport by truck includes empty returns [1].
- **Assembly losses (A3.3).** In line with the PCR, material losses during assembly are considered to be landfilled [1].

4.5 | Cut-off criteria

In accordance with ISO 21930:2017 [6] and the PCR "NSF Product Category Rule for Environmental Product Declarations: Fenestration Assemblies" [1], all input and output flows whose mass and/or energy and/or environmental impacts account for more than 1% of the total cumulative mass and/or energy and/or impacts have been included. Also in accordance with the standard, at least 95% of mass, energy and environmental impact flows were considered. Equipment and infrastructure maintenance, administrative activities and employee transportation were not included in the LCA model. No known mass or energy flows were deliberately excluded.

4.6 | Allocation

When a process in the life cycle of a product generates several outputs (multifunctional processes) or is linked to another system (life cycle of a product outside the boundaries of the system under study), the environmental impact of the process must be allocated to the different products, co-products and systems. The allocation methods considered for this study are:

- **Allocation for end-of-life processes.** The cut-off approach was chosen in accordance with ISO 21930:2017 [6]. This approach specifies that the impacts associated with secondary materials entering the system are to be attributed to the system that generated them, and that the benefits associated with the recycling materials leaving the system are not included. In this study, the recycled PVC used for the manufacturing of the profiles and the recycled newspaper used to package the profiles have zero impact. Using the same principle, no environmental benefits associated with the materials sent for recycling (cardboard, metals and extrusion scraps) were accounted for.
- **Allocation approach in Ecoinvent data.** The Ecoinvent data used is "Allocation, cut-off by classification" which attributes the impacts of secondary materials entering the system to those that generated them and excludes the benefits associated with recycling materials. This is in line with the cut-off rule specified in ISO 21930:2017.

- **Allocation for multifunctional processes.** During the window assembly process, three constituents (PVC profiles, glazing and hardware) are combined to manufacture the windows. Thus, the impacts of electricity and natural gas consumption associated with the assembly process must be allocated between these different constituents in order to present the impacts distributed between the frame and the glazing [1]. Based on the ISO 21930:2017 standard, the impacts were distributed according to mass allocation (Figure 3) [6]. As window manufacturing does not generate any co-products, no other allocation of this type is considered in relation to window manufacturing.

4.7 | Data sources and quality

Table 6: Sources of inventory data for window manufacturing

TYPE OF DATA	SOURCE
Foreground data	Primary foreground data was provided by Thermoplast Nextrusions between October 2022 and November 2023 for the year 2021. This includes measured data concerning: • the manufacturing of PVC profiles used for window frames and their packaging; • the composition of PVC windows and their packaging.
	Secondary background data comes from the following sources: • scientific reports (window assembly energy); • PCR (distance and modes of transport of window constituents) [1].
Background data	Background data comes exclusively from the Ecoinvent v3.9.1 database [3].

Table 7: Qualitative assessment of inventory data quality

CRITERION	EVALUATION
Geographical representativeness	The primary foreground data related to the production stages of PVC profiles represents the specific context of Thermoplast Nextrusions and therefore has a high geographical representativeness. The secondary foreground data from the PCR are representative of North America and thus are considered to have a satisfactory representativeness. The secondary foreground data from the scientific report (window assembly energy) relates to the Spanish context and is considered to be acceptable in terms of representativeness. The geographical representativeness of the main background data (Ecoinvent) is considered satisfactory for the PVC profiles and window packaging cardboard and the electricity grid mix and natural gas production; sufficient for transport, for virgin PVC and glass production; and usable for stainless steel and plastic packaging production. The foreground and background data are considered to have a sufficient geographical representativeness to meet the objective of the study.
Temporal representativeness	The primary foreground data supplied by Thermoplast Nextrusions is representative of the reference period (year 2021) which is considered to be satisfactorily representative. Secondary foreground data comes from recent reports, i.e. published less than 5 years ago and deemed satisfactory. The background data comes mainly from the Ecoinvent database version 3.9.1 (2022). This version is based on version 3.0, released annually since 2013. It should be noted that some of the data in version 3.0 comes from earlier versions (1991-2012), but the data are considered to be sufficiently representative. The foreground and background data are considered to have a satisfactory temporal representativeness to meet the objective of the study.

CRITERION	EVALUATION
Technological representativeness	The primary foreground data regarding the production of PVC profiles and the composition of the windows are based on measurements carried out by Thermoplast Nextrusions and are therefore considered to be satisfactory in their level of technological representativeness. The secondary foreground data regarding the electricity and natural gas consumption for window assembly are taken from a scientific report [10] and are deemed to be satisfactory in terms of technological representativeness. The technological representativeness of the main background data (Ecoinvent) is also considered to be satisfactory for PVC, packaging and electricity and natural gas production, and sufficient for steel and glass production and transport. The foreground and background data are considered to have a satisfactory technological representativeness to reach the objective of the study.
Precision	The primary data are the results of calculations, realistic estimates and measured data and are considered to be sufficiently accurate. For the secondary data used for the production of raw materials, energy and transport, the precision is deemed to be sufficient. The level of precision for the primary and secondary data is considered sufficient to reach the objective of the study.
Completeness	All processes whose mass, energy or environmental impacts are above the cut-off threshold (1%) have been included in the LCA in accordance with the PCR "NSF Product Category Rule for Environmental Product Declarations: Fenestration Assemblies" [1]. No known flows were deliberately excluded. The study is considered to have a satisfactory level of completeness.
Consistency	For the methodological aspects of the LCA (e.g. assumptions, allocation methods, impact assessment method, data sources and modelling approaches), the aim was to achieve maximum consistency. The only methodological inconsistency observed, although justified by an improvement in technological and geographical representativeness, is that surrounding the use of two types of life cycle inventory data for window assembly (Ecoinvent and a report estimating the energy consumption associated with window manufacturing) [10]. The study is considered to have a satisfactory level of consistency.
Reproducibility	Information on the method, main assumptions, data references, quantities and processes used is provided in the LCA report [11]. The reproducibility is considered satisfactory for the purpose of the study.
Reliability	The primary data are considered to have a low uncertainty as they are based on measured data from Thermoplast Nextrusions. The secondary data are considered to have a sufficiently low uncertainty to meet the objective of the study. This assessment of data quality considers that reliability is high and uncertainty low.

5 | ENVIRONMENTAL IMPACTS AND INVENTORY RESULTS

5.1 | Environmental impact assessment and life cycle inventory indicators

The environmental life cycle impacts and the inventory results are expressed on the basis of the declared unit, i.e. "*1 m² of window (frame and glazing) corresponding to the categories presented in the ANSI/NFRC 100 standard*". The environmental impacts of the six types of windows were expressed according to five impact categories of the TRACI 2.1 assessment method. The environmental impacts are also presented for the three life cycle modules selected for the LCA: A1 – Production of raw materials; A2 - Transport of raw materials; and A3 - Product manufacturing [4,12].

Table 8: Environmental impacts and inventory results - Manufacturing of 1 m² of PVC awning window

CATEGORY	INDICATOR	TOTAL	A1	A2	A3
ENVIRONMENTAL IMPACT					
Global warming potential	kg CO_2 eq	6.64E+1	4.13E+1	3.03E+0	2.21E+1
Acidification of soil and water sources potential	kg SO_2 eq	3.46E-1	2.16E-1	1.76E-2	1.12E-1
Eutrophication potential	kg N eq	3.61E-2	2.11E-2	1.40E-3	1.35E-2
Smog formation potential	kg O_3 eq	4.95E+0	2.67E+0	4.57E-1	1.82E+0
Ozone depletion potential	kg CFC-11 eq	1.38E-5	1.01E-5	5.23E-8	3.68E-6
RESOURCE USE[1]					
Renewable primary resources used as energy[2]	MJ	1.25E+2	4.67E+1	6.66E-1	7.72E+1
Renewable primary resources used as raw materials[3]	MJ	7.47E+0	0.00E+0	0.00E+0	7.47E+0
Total renewable primary resources[3]	MJ	1.32E+2	4.67E+1	6.66E-1	8.47E+1
Non-renewable primary resources used as energy [3]	MJ	8.06E+2	4.91E+2	4.27E+1	2.73E+2
Non-renewable primary resources used as raw materials[3]	MJ	2.11E+2	1.97E+2	0.00E+0	1.39E+1
Total non-renewable primary resources[4]	MJ	1.02E+3	6.87E+2	4.27E+1	2.87E+2
Use of renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of secondary materials	kg	1.72E-1	1.72E-1	0.00E+0	0.00E+0
Recovered energy[5]	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Depletion of non-renewable material resources[6]	kg	3.59E+0	2.04E+0	9.77E-2	1.46E+0
Use of renewable material resources[7]	kg	2.07E+0	8.66E-1	1.39E-2	1.19E+0
Freshwater consumption[8]	m^3	7.88E-1	3.71E-1	6.01E-3	4.11E-1
WASTE					
Hazardous waste disposed[9,10]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed[9,10]	kg	7.94E-1	0.00E+0	0.00E+0	7.94E-1
Radioactive waste - high level[10,11]	kg	2.70E-4	1.45E-4	3.05E-6	1.23E-4
Radioactive waste – low and medium level[10,11]	kg	5.49E-4	3.41E-4	7.43E-6	2.00E-4

Legend: A1 – Production of raw materials; A2 - Transport of raw materials; A3 - Product manufacturing
For table footnotes 1 to 11, refer to the notes on inventory calculation methods presented after the results tables.

Table 9: Environmental impacts and inventory results - Manufacturing of 1 m² of PVC casement window

CATEGORY	INDICATOR	TOTAL	A1	A2	A3
ENVIRONMENTAL IMPACT					
Global warming potential	kg CO_2 eq	6.64E+1	4.13E+1	3.03E+0	2.21E+1
Acidification of soil and water sources potential	kg SO_2 eq	3.46E-1	2.16E-1	1.76E-2	1.12E-1
Eutrophication potential	kg N eq	3.61E-2	2.11E-2	1.40E-3	1.35E-2
Smog formation potential	kg O_3 eq	4.95E+0	2.67E+0	4.57E-1	1.82E+0
Ozone depletion potential	kg CFC-11 eq	1.38E-5	1.01E-5	5.23E-8	3.68E-6
RESOURCE USE[1]					
Renewable primary resources used as energy[2]	MJ	1.25E+2	4.67E+1	6.66E-1	7.72E+1
Renewable primary resources used as raw materials[3]	MJ	7.47E+0	0.00E+0	0.00E+0	7.47E+0
Total renewable primary resources[3]	MJ	1.32E+2	4.67E+1	6.66E-1	8.47E+1
Non-renewable primary resources used as energy [3]	MJ	8.06E+2	4.91E+2	4.27E+1	2.73E+2
Non-renewable primary resources used as raw materials[3]	MJ	2.11E+2	1.97E+2	0.00E+0	1.39E+1
Total non-renewable primary resources[4]	MJ	1.02E+3	6.87E+2	4.27E+1	2.87E+2
Use of renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of secondary materials	kg	1.72E-1	1.72E-1	0.00E+0	0.00E+0
Recovered energy[5]	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Depletion of non-renewable material resources[6]	kg	3.59E+0	2.04E+0	9.77E-2	1.46E+0
Use of renewable material resources[7]	kg	2.07E+0	8.66E-1	1.39E-2	1.19E+0
Freshwater consumption[8]	m^3	7.88E-1	3.71E-1	6.01E-3	4.11E-1
WASTE					
Hazardous waste disposed[9,10]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed[9,10]	kg	7.94E-1	0.00E+0	0.00E+0	7.94E-1
Radioactive waste - high level[10,11]	kg	2.70E-4	1.45E-4	3.05E-6	1.23E-4
Radioactive waste – low and medium level[10,11]	kg	5.49E-4	3.41E-4	7.43E-6	2.00E-4

Legend: A1 – Production of raw materials; A2 - Transport of raw materials; A3 - Product manufacturing
For table footnotes 1 to 11, refer to the notes on inventory calculation methods presented after the results tables.

Table 10: Environmental impacts and inventory results - Manufacturing of 1 m² of PVC sliding window

CATEGORY	INDICATOR	TOTAL	A1	A2	A3
ENVIRONMENTAL IMPACT					
Global warming potential	kg CO_2 eq	4.89E+1	2.91E+1	2.66E+0	1.71E+1
Acidification of soil and water sources potential	kg SO_2 eq	2.74E-1	1.66E-1	1.60E-2	9.20E-2
Eutrophication potential	kg N eq	2.57E-2	1.47E-2	1.26E-3	9.78E-3
Smog formation potential	kg O_3 eq	3.96E+0	2.05E+0	4.14E-1	1.49E+0
Ozone depletion potential	kg CFC-11 eq	1.07E-5	7.37E-6	4.57E-8	3.25E-6
RESOURCE USE[1]					
Renewable primary resources used as energy[2]	MJ	8.21E+1	2.30E+1	5.94E-1	5.85E+1
Renewable primary resources used as raw materials[3]	MJ	5.63E+0	0.00E+0	0.00E+0	5.63E+0
Total renewable primary resources[3]	MJ	8.77E+1	2.30E+1	5.94E-1	6.41E+1
Non-renewable primary resources used as energy [3]	MJ	5.96E+2	3.45E+2	3.74E+1	2.14E+2
Non-renewable primary resources used as raw materials[3]	MJ	1.55E+2	1.44E+2	0.00E+0	1.07E+1
Total non-renewable primary resources[4]	MJ	7.52E+2	4.89E+2	3.74E+1	2.25E+2
Use of renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of secondary materials	kg	1.26E-1	1.26E-1	0.00E+	0.00E+0
Recovered energy[5]	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Depletion of non-renewable material resources[6]	kg	1.75E+0	1.10E+0	8.72E-2	5.69E-1
Use of renewable material resources[7]	kg	1.51E+0	5.54E-1	1.25E-2	9.42E-1
Freshwater consumption[8]	m^3	6.02E-1	2.54E-1	5.28E-3	3.42E-1
WASTE					
Hazardous waste disposed[9,10]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed[9,10]	kg	6.09E-1	0.00E+0	0.00E+0	6.09E-1
Radioactive waste - high level[10,11]	kg	1.83E-4	8.77E-5	2.71E-6	9.25E-5
Radioactive waste – low and medium level[10,11]	kg	3.78E-4	2.15E-4	6.59E-6	1.57E-4

Legend: A1 – Production of raw materials; A2 - Transport of raw materials; A3 - Product manufacturing
For table footnotes 1 to 11, refer to the notes on inventory calculation methods presented after the results tables.

Table 11: Environmental impacts and inventory results - Manufacturing of 1 m^2 of PVC double-hung window

CATEGORY	INDICATOR	TOTAL	A1	A2	A3
ENVIRONMENTAL IMPACT					
Global warming potential	kg CO_2 eq	5.27E+1	3.14E+1	2.73E+0	1.86E+1
Acidification of soil and water sources potential	kg SO_2 eq	2.91E-1	1.77E-1	1.65E-2	9.82E-2
Eutrophication potential	kg N eq	2.78E-2	1.57E-2	1.29E-3	1.08E-2
Smog formation potential	kg O_3 eq	4.19E+0	2.18E+0	4.27E-1	1.58E+0
Ozone depletion potential	kg CFC-11 eq	1.07E-5	7.36E-6	4.69E-8	3.31E-6
RESOURCE USE[1]					
Renewable primary resources used as energy[2]	MJ	9.04E+1	2.92E+1	6.11E-1	6.06E+1
Renewable primary resources used as raw materials[3]	MJ	5.60E+0	0.00E+0	0.00E+0	5.60E+0
Total renewable primary resources[3]	MJ	9.60E+1	2.92E+1	6.11E-1	6.62E+1
Non-renewable primary resources used as energy [3]	MJ	6.39E+2	3.69E+2	3.83E+1	2.32E+2
Non-renewable primary resources used as raw materials[3]	MJ	1.54E+2	1.44E+2	0.00E+0	1.07E+1
Total non-renewable primary resources[4]	MJ	7.94E+2	5.13E+2	3.83E+1	2.42E+2
Use of renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of secondary materials	kg	1.25E-1	1.25E-1	0.00E+	0.00E
Recovered energy[5]	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Depletion of non-renewable material resources[6]	kg	2.32E+0	1.01E+0	8.97E-2	1.21E+0
Use of renewable material resources[7]	kg	1.62E+0	6.33E-1	1.29E-2	9.72E-1
Freshwater consumption[8]	m^3	6.22E-1	2.72E-1	5.42E-3	3.44E-1
WASTE					
Hazardous waste disposed[9,10]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed[9,10]	kg	6.11E-1	0.00E+0	0.00E+0	6.11E-1
Radioactive waste - high level[10,11]	kg	2.01E-4	9.90E-5	2.78E-6	9.91E-5
Radioactive waste – low and medium level[10,11]	kg	4.17E-4	2.39E-4	6.78E-6	1.71E-4

Legend: A1 – Production of raw materials; A2 - Transport of raw materials; A3 - Product manufacturing
For table footnotes 1 to 11, refer to the notes on the methods used to calculate the inventory results presented after the results tables.

Table 12: Environmental impacts and inventory results - Manufacturing of 1 m² of PVC panoramic window

CATEGORY	INDICATOR	TOTAL	A1	A2	A3
ENVIRONMENTAL IMPACT					
Global warming potential	kg CO_2 eq	4.25E+1	2.36E+1	2.54E+0	1.63E+1
Acidification of soil and water sources potential	kg SO_2 eq	2.55E-1	1.49E-1	1.60E-2	8.97E-2
Eutrophication potential	kg N eq	2.16E-2	1.14E-2	1.24E-3	8.98E-3
Smog formation potential	kg O_3 eq	3.68E+0	1.83E+0	4.16E-1	1.43E+0
Ozone depletion potential	kg CFC-11 eq	7.88E-6	4.88E-6	4.34E-8	2.96E-6
RESOURCE USE[1]					
Renewable primary resources used as energy[2]	MJ	6.31E+1	1.60E+1	5.82E-1	4.65E+1
Renewable primary resources used as raw materials[3]	MJ	3.87E+0	0.00E+0	0.00E+0	3.87E+0
Total renewable primary resources[3]	MJ	6.70E+1	1.60E+1	5.82E-1	5.04E+1
Non-renewable primary resources used as energy [3]	MJ	5.14E+2	2.73E+2	3.55E+1	2.05E+2
Non-renewable primary resources used as raw materials[3]	MJ	1.02E+2	9.40E+1	0.00E+0	7.72E+0
Total non-renewable primary resources[4]	MJ	6.16E+2	3.67E+2	3.55E+1	2.13E+2
Use of renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of secondary materials	kg	8.19E-2	8.19E-2	0.00E+	0.00E
Recovered energy[5]	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Depletion of non-renewable material resources[6]	kg	1.43E+0	1.05E+0	8.56E-2	2.89E-1
Use of renewable material resources[7]	kg	1.27E+0	4.64E-1	1.25E-2	7.89E-1
Freshwater consumption[8]	m^3	4.82E-1	1.90E-1	5.04E-3	2.87E-1
WASTE					
Hazardous waste disposed[9,10]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed[9,10]	kg	4.47E-1	0.00E+0	0.00E+0	4.47E-1
Radioactive waste - high level[10,11]	kg	1.47E-4	6.28E-5	2.63E-6	8.16E-5
Radioactive waste – low and medium level[10,11]	kg	3.19E-4	1.58E-4	6.41E-6	1.55E-4

Legend: A1 – Production of raw materials; A2 - Transport of raw materials; A3 - Product manufacturing
For table footnotes 1 to 11, refer to the notes on the methods used to calculate the inventory results presented after the results tables.

Table 13: Environmental impacts and inventory results - Manufacturing of 1 m^2 of PVC fixed window

CATEGORY	INDICATOR	TOTAL	A1	A2	A3
ENVIRONMENTAL IMPACT					
Global warming potential	kg CO_2 eq	4.12E+1	2.31E+1	2.43E+0	1.56E+1
Acidification of soil and water sources potential	kg SO_2 eq	2.44E-1	1.43E-1	1.51E-2	8.57E-2
Eutrophication potential	kg N eq	2.11E-2	1.12E-2	1.18E-3	8.63E-3
Smog formation potential	kg O_3 eq	3.52E+0	1.76E+0	3.93E-1	1.37E+0
Ozone depletion potential	kg CFC-11 eq	8.02E-6	5.06E-6	4.15E-8	2.92E-6
RESOURCE USE[1]					
Renewable primary resources used as energy[2]	MJ	6.31E+1	1.58E+1	5.52E-1	4.67E+1
Renewable primary resources used as raw materials[3]	MJ	4.00E+0	0.00E+0	0.00E+0	4.00E+0
Total renewable primary resources[3]	MJ	6.71E+1	1.58E+1	5.52E-1	5.07E+1
Non-renewable primary resources used as energy[3]	MJ	4.99E+2	2.69E+2	3.39E+1	1.97E+2
Non-renewable primary resources used as raw materials[3]	MJ	1.06E+2	9.79E+1	0.00E+0	7.96E+0
Total non-renewable primary resources[4]	MJ	6.05E+2	3.67E+2	3.39E+1	2.05E+2
Use of renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of secondary materials	kg	8.54E-2	8.54E-2	0.00E+	0.00E
Recovered energy[5]	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Depletion of non-renewable material resources[6]	kg	1.37E+0	9.99E-1	8.12E-2	2.88E-1
Use of renewable material resources[7]	kg	1.25E+0	4.48E-1	1.18E-2	7.90E-1
Fresh water consumption[8]	m^3	4.79E-1	1.90E-1	4.81E-3	2.84E-1
WASTE					
Hazardous waste disposed[9,10]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed[9,10]	kg	4.52E-1	0.00E+0	0.00E+0	4.52E-1
Radioactive waste - high level[10,11]	kg	1.45E-4	6.28E-5	2.50E-6	7.94E-5
Radioactive waste – low and medium level[10,11]	kg	3.10E-4	1.57E-4	6.09E-6	1.47E-4

Legend: A1 – Production of raw materials; A2 - Transport of raw materials; A3 - Product manufacturing
For table footnotes 1 to 11, refer to the notes on inventory calculation methods presented after the results tables.

It should be noted that the life cycle impact assessment results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. These five impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, EPD users should not use additional measures for comparative purposes.

The term "potential" means that the impact scores do not represent actual measured impacts but are the results of theoretical modelling using an impact assessment method such as TRACI 2.1. To lighten the text, the term "potential" will not be used in the rest of the EPD.

Notes on the methods used to calculate inventory results

[1] The resource use categories represented based on energy (MJ) refer to the lower heating value (LHV).

[2] Category meeting the requirements of ISO 21930:2017 and the PCR. The results of this indicator were calculated using the "Renewable, biomass", "Renewable, water" and "Renewable, wind, solar, geothermal" from the Cumulative Energy Demand (LHV) method [13] following the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017" [14].

[3] Categories meeting the requirements of ISO 21930:2017. The results of these inventory categories were calculated with the CED LHV method following the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017" [14].

[4] Category meeting the requirements of ISO 21930:2017 and the PCR. The results of this indicator were calculated using the "Non-renewable, fossil", "Non-renewable, biomass" and "Non-renewable, nuclear" indicators from the Cumulative Energy Demand (LHV) method [13].

[5] Category meeting the requirements of ISO 21930:2017. The PVC windows are not recovered for energy purposes, so this inventory category is zero.

[6] Category meeting the PCR requirements. The results of this indicator were calculated using the ADP-Elements (Abiotic depletion) indicator of the CML-IA baseline method [13].

[7] Category meeting the PCR requirements. The results for this indicator were calculated by adding up the masses of biotic materials listed in the inventory flows.

[8] Category meeting the requirements of ISO 21930:2017 and the PCR. The results of this indicator were calculated using the "Water consumption" indicator from the ReCiPe 2016 Midpoint (H) impact assessment method [13].

[9] The results of these indicators were calculated according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017" [14] using foreground data provided by the manufacturer.

[10] The life cycle inventory data used to generate waste indicators for life cycle assessments and environmental product declarations currently have significant limitations. The waste indicators were calculated by following the requirements of ISO 21930:2017 [6] but these results represent rough estimates and are for informational purposes only. As such, no decisions regarding actual cradle-gate waste performance between products should be derived from these reported values.

[11] The results of these indicators were calculated according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017" [14] using background inventory data. It is important to note that the foreground data in this LCA does not include radioactive waste, i.e. the window manufacturing process does not directly generate radioactive waste.

5.2 | Interpretation of life cycle impacts

A contribution analysis was carried out to identify the contribution to the impacts of the two components of the PVC window:

1. The **frame** includes PVC profiles, stainless steel components and their respective packaging, transport and waste;
2. The **glazing** includes the double glazing as well as its packaging, transport and waste.

The following tables show the environmental impacts of the frame and glazing in absolute values (impact score) and relative values (%) of the total impacts for the six types of windows.

Table 14: Share of environmental impacts related to the frame and glazing - Manufacturing of 1 m² of PVC awning window

IMPACT CATEGORY	INDICATOR	WINDOW (FRAME + GLAZING)	FRAME		GLAZING	
Global warming potential	kg CO_2 eq	6.64E+1	4.37E+1	65.8%	2.27E+1	34.2%
Acidification of soil and water sources potential	kg SO_2 eq	3.46E-1	1.88E-1	54.5%	1.57E-1	45.5%
Eutrophication potential	kg N eq	3.61E-2	2.55E-2	70.7%	1.06E-2	29.3%
Smog formation potential	kg O_3 eq	4.95E+0	2.70E+0	54.5%	2.25E+0	45.5%
Ozone depletion potential	kg CFC-11 eq	1.38E-5	1.23E-5	88.9%	1.53E-6	11.1%

Table 15: Share of environmental impacts related to frames and glazing - Manufacturing of 1 m² of PVC casement window

IMPACT CATEGORY	INDICATOR	WINDOW (FRAME + GLAZING)	FRAME		GLAZING	
Global warming potential	kg CO_2 eq	6.64E+1	4.37E+1	65.8%	2.27E+1	34.2%
Acidification of soil and water sources potential	kg SO_2 eq	3.46E-1	1.88E-1	54.5%	1.57E-1	45.5%
Eutrophication potential	kg N eq	3.61E-2	2.55E-2	70.7%	1.06E-2	29.3%
Smog formation potential	kg O_3 eq	4.95E+0	2.70E+0	54.5%	2.25E+0	45.5%
Ozone depletion potential	kg CFC-11 eq	1.38E-5	1.23E-5	88.9%	1.53E-6	11.1%

Table 16: Share of environmental impacts related to frames and glazing - Manufacturing of 1 m² of PVC sliding window

IMPACT CATEGORY	INDICATOR	WINDOW (FRAME + GLAZING)	FRAME		GLAZING	
Global warming potential	kg CO_2 eq	4.89E+1	2.37E+1	48.5%	2.52E+1	51.5%
Acidification of soil and water sources potential	kg SO_2 eq	2.74E-1	9.92E-2	36.3%	1.74E-1	63.7%
Eutrophication potential	kg N eq	2.57E-2	1.39E-2	54.3%	1.18E-2	45.7%
Smog formation potential	kg O_3 eq	3.96E+0	1.46E+0	36.8%	2.50E+0	63.2%
Ozone depletion potential	kg CFC-11 eq	1.07E-5	8.88E-6	83.3%	1.78E-6	16.7%

Table 17: Share of environmental impacts related to frames and glazing - Manufacturing of 1 m² of PVC double-hung window

IMPACT CATEGORY	INDICATOR	WINDOW (FRAME + GLAZING)	FRAME		GLAZING	
Global warming potential	kg CO_2 eq	5.27E+1	2.75E+1	52.2%	2.52E+1	47.8%
Acidification of soil and water sources potential	kg SO_2 eq	2.91E-1	1.17E-1	40.1%	1.74E-1	59.9%
Eutrophication potential	kg N eq	2.78E-2	1.61E-2	57.8%	1.18E-2	42.2%
Smog formation potential	kg O_3 eq	4.19E+0	1.69E+0	40.4%	2.50E+0	59.6%
Ozone depletion potential	kg CFC-11 eq	1.07E-5	8.92E-6	83.2%	1.80E-6	16.8%

Table 18: Share of environmental impacts related to frames and glazing - Manufacturing of 1 m² of PVC panoramic window

IMPACT CATEGORY	INDICATOR	WINDOW (FRAME + GLAZING)	FRAME		GLAZING	
Global warming potential	kg CO_2 eq	4.25E+1	1.41E+1	33.3%	2.83E+1	66.7%
Acidification of soil and water sources potential	kg SO_2 eq	2.55E-1	5.86E-2	23.0%	1.96E-1	77.0%
Eutrophication potential	kg N eq	2.16E-2	8.34E-3	38.7%	1.32E-2	61.3%
Smog formation potential	kg O_3 eq	3.68E+0	8.68E-1	23.6%	2.81E+0	76.4%
Ozone depletion potential	kg CFC-11 eq	7.88E-6	5.78E-6	73.4%	2.09E-6	26.6%

Table 19: Share of environmental impacts related to frames and glazing - Manufacturing of 1 m² of PVC fixed window

IMPACT CATEGORY	INDICATOR	WINDOW (FRAME + GLAZING)	FRAME		GLAZING	
Global warming potential	kg CO_2 eq	4.12E+1	1.48E+1	35.9%	2.64E+1	64.1%
Acidification of soil and water sources potential	kg SO_2 eq	2.44E-1	6.12E-2	25.1%	1.83E-1	74.9%
Eutrophication potential	kg N eq	2.11E-2	8.71E-3	41.3%	1.23E-2	58.7%
Smog formation potential	kg O_3 eq	3.52E+0	9.06E-1	25.7%	2.62E+0	74.3%
Ozone depletion potential	kg CFC-11 eq	8.02E-6	6.04E-6	75.3%	1.98E-6	24.7%

The contribution analysis shows that the manufacturing of the frame is the main process contributing to the impacts for all the impact categories for the awning and casement windows (54.5% to 88.9% of the total impacts). For the other types of windows containing less or no stainless steel, the manufacturing of the glazing is the main contributing process (51.5 to 77.0% of the total impacts), with a few exceptions. In the *Ozone Depletion* category, the frame contributes most to the impacts of all window types (between 73.4% and 88.9% of the impacts in this category). In the *Eutrophication* category, the frame remains the primary contributor to the impacts of sliding and double-hung windows (54.3% and 57.8%, respectively). Finally, in the *Global Warming* category, the frame is the dominant contributor to the impacts of the double-hung window (52.2% of the impacts in this category).

6 | ADDITIONAL ENVIRONMENTAL INFORMATION

6.1 | Regulated hazardous substances

The windows contain PVC, glass and stainless steel. These materials are not on Canada's list of hazardous substances [15]. Therefore, no regulated hazardous substances are associated with the manufacturing of the product.

6.2 | Health and environment during manufacturing

As the manufacturing of PVC profiles may involve a risk of injury or splashes to the arms or face during certain maintenance processes or production start-up tasks, workers are provided with personal protective equipment (visor, gloves, helmet). In addition, safety glasses must be worn at the Thermoplast Nextrusions plant. As the extrusion operations do not emit any dust, no respiratory protection is provided.

6.3 | Delayed emissions and unexpected adverse effects

No delayed emissions are expected from the product. There are no unexpected adverse effects resulting from combustion, degradation by water or mechanical alteration of the product.

6.4 | Participation in environmental programs

Thermoplast Nextrusions' commitment to the environment is also reflected in the establishment of its *Solution Zéro Déchet* recovery and recycling program, leading to the award of the "*Performance +*" rating under Recyc-Québec's *ICI on recycle +* recognition program [16,17]. The company also holds the Carbon Care® certification from Enviro-Access for 2022-2023 [18,19].

6.5 | Additional information

Further information can be obtained at the following link: https://www.thermoplast.com/

7 | DEFINITION OF IMPACT AND INVENTORY CATEGORIES

Table 20: Impact categories used in the study, definitions, units [4]

IMPACT CATEGORY	DEFINITION	UNIT
Global warming potential	This impact category measures the impact of an increase in global average temperature caused by greenhouse gas emissions on the world's climate. The main greenhouse gases are CO_2, CH_4, and N_2O.	kg CO_2 eq
Acidification of soil and water sources potential	This category measures the impact of an increase in the concentration of hydrogen ions (H^+) in soil or water environments caused by emissions of acidifying substances (for example, sulfuric acid).	kg SO_2 eq
Eutrophication potential	This impact category measures the consequences of an enrichment of water by nutrients (nitrates and phosphates), thus increasing the growth of algae that deteriorate the aquatic ecosystem.	kg N eq
Smog formation potential	This impact category measures the formation of smog (ground-level ozone (O_3)), which is a pollutant that impacts the respiratory system. Smog is produced by the exposure of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) to solar radiation.	kg O_3 eq
Ozone depletion potential	This category measures the impact of the depletion of the ozone layer, which protects living organisms from solar radiation. Ozone depletion is mainly caused by chlorofluorocarbon (CFC) and halon emissions.	kg CFC-11 eq

Table 21: Inventory category used in the study, definition and units

INVENTORY CATEGORY	DEFINITION	UNIT
Renewable primary resources used as energy /material	Use of renewable resources as a source of energy (hydroelectric, solar, wind) or as a material (wood, hemp).	MJ
Non-renewable primary resources used as energy /material	Use of fossil resources (peat, oil, gas, coal) as a source of energy or as a material (plastics).	MJ
Freshwater consumption	Freshwater that is consumed, i.e. by evaporation (cooling towers), evapotranspiration, the freshwater contained in the product or water flowing into the ocean.	m^3
Depletion of non-renewable material resources	Use of mineral resources as a material.	kg
Use of renewable material resources	Use of renewable resources (biotic materials).	kg
Hazardous, non-hazardous and radioactive waste disposed	Generation of hazardous (solvents, engine oil, acids), non-hazardous (concrete, plastic, glass) or radioactive (radioactive fuels, products contaminated by radioactive substances) disposed waste.	kg or m^3

8 | ABBREVIATIONS, ACRONYMS AND RAW FORMULAS

- CFC Chlorofluorocarbon
- CFC-11 Trichlorofluoromethane
- CH_4 Methane
- CO_2 Carbon dioxide
- EPD Environmental product declaration
- eq Equivalent
- LCA Life cycle assessment
- LHV Lower heating value
- N Nitrogen
- NO_x Nitrogen oxides
- O_3 Ozone
- PCR Product category rules
- PVC Polyvinyl chloride
- SO_2 Sulphur dioxide
- VOCs Volatile organic compounds

9 | GLOSSARY

- **Cut-off threshold.** Criteria for excluding inputs and outputs based on their contribution (%) to the total mass and energy. If this contribution is lower than a certain threshold (cut-off), these flows can be ignored [6].
- **Declared unit.** Quantity of construction product used as a reference unit for presenting environmental information by life cycle module. The term “declared unit” is used instead of “functional unit” when the performance of the product in use is not known [1].
- **Ecoinvent.** Life cycle inventory database for materials, chemicals, power generation systems, transport and waste treatment processes [3].
- **Environmental impact.** Any negative or beneficial modification of the environment, resulting wholly or in part from environmental aspects [20] that is to say elements of the activities, products or services of an organization that can interact with the environment [21].
- **Environmental Product Declaration (EPD).** Environmental declaration providing quantified environmental data using predetermined parameters based on the ISO 14040:2006 and ISO 14044:2006 standards [6,21,22].
- **Life cycle assessment (LCA).** Compilation and evaluation of the inputs and outputs (inventory) as well as the assessment of potential environmental impacts of a product during its life cycle [21].
- **Product Category Rules (PCR).** A set of specific rules, requirements and guidelines for the development of EPDs [6]. The PCR referenced in this EPD is based on the PCR "NSF Product Category Rule for Environmental Product Declarations: Fenestration Assemblies".
- **Reference flow.** Quantity of process outputs in a given product system required to fulfill the function as expressed by the declared unit [21].

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