Environmental Product Declaration

Environmental Product Declaration for polyurethane spray foam (SPF) insulation products produced by Elastochem Specialty Chemicals Inc. at their facility in Brantford, ON

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers spray foam products produced by Elastochem Specialty Chemicals Inc. Declared unit: 1 m2 of installed spray polyurethane foam insulation for RSI = 1
Declaration Owner:	Elastochem Specialty Chemicals Inc. 37 Easton Road Brantford, ON www. elastochem.com
Program Operator:	Labeling Sustainability Address, 11670 W Sunset Blvd. City, State, Los Angeles, CA http://labelinsustainability.com/
Product Category Rule:	ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services and Sub Product Category Rule Part B: Building Envelope Thermal Institution EPD Requirements UL 10010-1 PCR Program Operator: UL Environment, Underwriters Laboratories Inc. PCR review was conducted by: Thomas Gloria, PhD
Independent LCA Reviewer and EPD Verifier:	This declaration was independently verified in accordance with ISO 14025:2006 Independent verification of the declaration, according to ISO 14025:2006 Internal ☐ ; External X Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under Labeling Sustainability Program (www.labelingsustainability.com), CSA Group (www.csaregistries.ca)
Date of Issue:	30 January 2023
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COMPANY DESCRIPTION

ELASTOCHEM SPECIALTY CHEMICALS is a family owned and operated Canadian polyurethane manufacturing company located in Ontario Canada. In business for over 35 years and built upon a world-class product portfolio, Elastochem specializes in the manufacturing of outstanding polyurethane and epoxy-based materials for industries including commercial and residential construction, automotive, oil & gas, agriculture and mining and industrial applications.

The largest divisions within the Elastochem portfolio focus on the building envelope with its Insulthane line of Spray Polyurethane Foam and Hygrothane, a leading-edge spray applied waterproofing membrane. In addition to ensuring all products set the bar for quality and performance, Elastochem also engineers their products to be environmentally responsible and are leaders in bringing environmental innovation to the market.

STUDY GOAL

The intended application of this life cycle assessment (LCA) is to comply with the procedures for creating a Type III environmental product declaration (EPD) and publish the EPD for public review on the website, www.labelingsustainability.com This level of study is in accordance with EPD Product Category Rule (PCR) for Spray foam insulation published by UL Environment, entitled "Guidance for Building-Related Products and Services Part B: Building Envelope Thermal Insulation EPD Requirements"; International Standards Organization (ISO) 14025:2006 Environmental labels and declarations, Type III environmental declarations-Principles and procedures; ISO 14044:2006 Environmental management, Life cycle assessment- Requirements and guidelines; and ISO 14040:2006 Environmental management, Life cycle assessment-Principles and framework. The performance of this study and its subsequent publishing is in alignment with the business-to-business (B2B) communication requirements for the environmental assessment of building products. The study does not intend to support comparative assertions and is intended to be disclosed to the public.

This project report was commissioned to differentiate Elastochem Specialty Chemicals Inc from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of Elastochem Specialty Chemicals Inc by continuously measuring, controlling and reducing the environmental impacts of their products; help project facilitators working on Leadership in Energy and Environmental Design (LEED) projects achieve their credit goal; and to strengthen Elastochem Specialty Chemicals Inc's license to operate in the community. The intended audience for this LCA report is Elastochem Specialty Chemicals Inc's employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This LCA report does not include product comparisons from other facilities.

DESCRIPTION OF PRODUCT AND SCOPE

This EPD covers the following Spray Polyurethane Foam (SPF) insulation products manufactured by Elastochem Specialty Chemicals in Brantford, Ontario:

1. **Insulthane® Extreme (2lb ccSPF):**
Insulthane® Extreme is a 2lb HFO-blown insulation with a low global warming impact. Insulthane® Extreme is the first CCMC approved HFO foam system with an ultra-low Global Warming Potential (GWP) of 1. It is an approved air barrier and soil gas barrier that defends against radon and other dangerous gases.
2. **Wrapsulate® Foam Jacket (1lb ocSPF):**
Wrapsulate® Foam Jacket is a first-of-its-kind open-cell spray foam insulation that can be used for exterior applications. Wrapsulate® is a 1lb water-blown spray foam insulation that also functions as an air and water control layer while remaining vapor open, which allows for any accumulated moisture within your building enclosure to dry towards the exterior.
3. **Elastochem® 500 (0.5lb ocSPF):**
Elastochem® 500 is a high-performance spray foam insulation with superior air sealing properties for interior use. It expands up to 120 times its initial volume, leaving no crack or crevice unfilled. While other types of insulation leave gaps that allow air to leak, Elastochem® 500 insulates and air seals in one step to form airtight barrier preventing heat loss during the winter while keeping cool air in during the summer.
4. **Insulthane® 450 NM (0.5lb ocSPF):**
Insulthane® 450 NM is a no-mix two-component open-cell spray polyurethane foam insulation that can be applied in a wide range of temperatures making it suitable for a wide variety of climate conditions. It's no mix processing means less downtime and higher job site efficiency.

Spray polyurethane foam (SPF) is made on the jobsite by combining polymeric methylene-diphenyl diisocyanate (pMDI/MDI or A-side) with an equal volume of a polyol blend (B-side). Sides A and B react and expand at the point of application in the building envelope to form polyurethane foam. The foamed-in-place SPF provides both thermal insulation and air sealing to the building.

Four types of SPF with varying performances and applications are assessed in this declaration. The 2lb closed-cell, or medium density foam, (ccSPF) provides a water-resistant insulation, air-sealing, water vapour control and delivers added structural performance to the building. The 1lb open-cell (ocSPF) foam also provides a water-resistant insulation, air-sealing, while remaining vapour open, which allows for drying through vapour diffusion. The 0.5 lb open-cell (ocSPF) foam provides insulation and air sealing.

SPF can be further categorized based on the type of blowing agent used in the product. Open-cell SPF uses water as the reactive blowing agent. while closed-cell SPF use chemical blowing agents that transform into a gas during installation due to the exothermic foam reaction that occurs. These physical blowing agents can be either hydrofluorocarbons (HFC) or hydrofluoroolefins (HFO). Elastochem closed-cell spray foam only uses HFO as the blowing agent as it has an ultra-low GWP of 1.

All types of spray polyurethane foam provide insulation (R-value) and air sealing (air-impermeable) when installed at a typical thickness in a building enclosure. The high R-value per inch of closed-cell SPF insulation can reduce assembly thickness and framing materials. These factors should be considered when comparing SPF to similar products and are the reason for the functional unit calculations. The functional unit for thermal insulation is one m^2 of installed insulation material with a thickness that gives an average thermal resistance RSI = 1 m^2K/W and with a building service life of 75 years (packaging included). The R-value is the manufacturer's representative value for the material's service life and is determined by ASTM C 518 and ASTM C1303, whichever is applicable. The unit for the functional unit mass is kg.

Table 1: **Summary of Typical Material Performance Requirements for SPF in Construction**

Standard Type	Standard	Types	Insulthane 450NM	Elastochem 500	Insulthane Wrapsulate	Insulthane Extreme
Thermal Performance (R-value)	ASTM C518, C177 or C1363	50mm (90 Days)	R 7.60 RSI 1.33	R 7.1 RSI 1.25	–	R 10.9 RSI 1.92
		25mm (90 Days)	–	–	R 4.3 RSI .75	–
Corner Wall Test	CAN/ULC-S127	–	–	–	–	330
Flame Spread	CAN/ULC-S102 Steiner Tunnel				Flame < 500 Smoke < 500	Flame 5 Smoke 130
Flame Spread	ASTM E84 Class 1				–	<25
Core Density	ASTM D1622	–	0.53 lb/ft^3 or 8.5 kg/m^3	0.48 lb/ft3 7.6 kg/m3	1.07 lb/ft3 17.2 Kg/m3	2.2 lb/ft3 34.5 kg/m3
Open Cell Content	ASTM D2856 or D6226	–	97%	98%	99%	2.5%
Tensile Strength	ASTM D1623	–	–	3.3 psi or 22.752 KPa	13.6 psi or 94 kPa	64.5 psi or 445 kPa
Compressive Strength	ASTM D1621	–	–	–	8.7 Psi 60 kPa	25.4 Psi 175 kPa
Dimensional Stability	ASTM D2126	After 28 Days	@ -20°C, -1.0% @ 80°C, -7.0% @ 70°C & 97% ±3%RH, -6.0%	-20°C, -1% 80°C, -11% 70°C @ 97% RH, -15%	-20°C, .008% 80°C, -9% 70°C @ 97% RH, -2.3%	-20°C, +1.0% 80°C, +1.0% 70°C & 97% ±3%RH, +9.0%
Water Vapor Transmission	ASTM E96	50 mm	9.35 US Perms 535 ng/(Pa·s·m2)	21.64 US Perms 1238 ng/ (Pa·s·m2)	16.69 US Perms 949 ng/ (Pa·s·m2)	0.63 US Perms 36.1 ng/ (Pa·s·m2)
Air Permeance	ASTM D E283 or D2178	–	–	–	0.0005 L/S·m2	0.002 L/S·m2
Water Absorption (% Volume)	ASTM D2842	–	–	34%	1.6%	3.3%

Table 2: **Transport to the building site (A4) assumptions used in this study.**

Name	Unit	Close Cell / Close cell
Outbound distance from the plant to the jobsite	km	1400

Table 3: **Technical Requirements for 1 Functional Unit of Each Elastochem Product**

	Extreme	500	450	Wrapsulate
RSI @ 25MM	0.96	0.61	0.67	0.75
RSI/MM	0.038	0.02	0.03	0.03
RSI = 1 (mm)	26.0	41.0	37.6	33.3
RSI = 1 (Meters)	0.03	0.04	0.04	0.03
Density kg/m3	34.5	6.80	8.50	17.2

Table 4: **Installation (A5) Assumptions used in this study.**

Name	Unit	Insulthane Extreme (closed cell)	Insulthane 450NM/Elastochem 500/Wrapsulate (open cell)
Ancillary materials	kg	0.00436	0.0018
Electricity consumption	KWh	0.0556	0.023
Diesel for construction equipment	MJ	3.68	1.52
Product loss per functional unit	Kg	10% loss at installation	10% loss at installation
Waste materials at the construction site before waste processing, generated by product installation	Kg	Barrels, PPE, and Pallets	Barrels, PPE, and Pallets

This LCA assumes the impacts from products manufactured in accordance with the standards outlined in this report. This LCA is a cradle-to-grave study.

POLYURETHANE SPRAY FOAM INSTALLATION DESIGN SUMMARY

The following tables provide a list of the polyurethane spray foam installation products considered in this EPD along with key performance parameters.

Table 5: **Declared products with All declared products considered in this environmental product declaration.**

Prod#	Unique name/ID	Short description	Product type	Unit	Density, dry kg/Unit	productGroup
1	Insulthane 450 NM	An open-cell, no-mix spray foam insulation.	ocSPF	m2-RSI	8.50	spray foam
2	Elastochem 500	A two component 0.5lb open cell foam with superior air sealing properties.	ocSPF	m2-RSI	6.80	spray foam
3	Insulthane Wrapsulate	A 1lb vapour-permeable exterior spray foam.	ocSPF	m2-RSI	17.20	spray foam

4	Insulthane Extreme	A 2lb HFO-blown insulation with low global warming impact.	ccSPF	m2-RSI	34.50	spray foam

Side "A" of the two-part mixture is defined in this study; Side "B" is covered by intellectual property and therefore the composition is listed as substance role in descending order for each product. The table below is the composition of Side B.

Prod#	Product Name	Ingredients in Descending Order
1	Insulthane 450 NM	Flame Retardant Sucrose Polyol Polyether Polyol Flame Retardant Silicone Surfactant Surfactant Tertiary Amine Water
2	Elastochem 500	Polyether Amine Tertiary Amine Silicone Surfactant Polyether Polyol Flame Retardant Water
3	Insulthane Wrapsulate	Polyether Polyol Sucrose Polyol Flame Retardant Silicone Surfactant Tertiary Amine Polyether Amine Water Metal Catalyst
4	Insulthane Extreme	Polyester Polyol Sucrose Polyol Alcohol Flame Retardant Silicone Surfactant Tertiary Amine Metal Catalyst Surfactant Organic Dye Surfactant Water Blowing Agent

A1 RAW MATERIAL RECYCLED CONTENT AND MATERIAL LOSSES

ELASTOCHEM SPECIALTY CHEMICALS does not use recycled materials as non-linear inputs to their products. Any recycled material in this study follows the "Polluter Pays" principle. A standard 2% material loss was used across all categories.

SYSTEM BOUNDARIES

The following figure depicts the cradle-to-grave system boundary considered in this study:

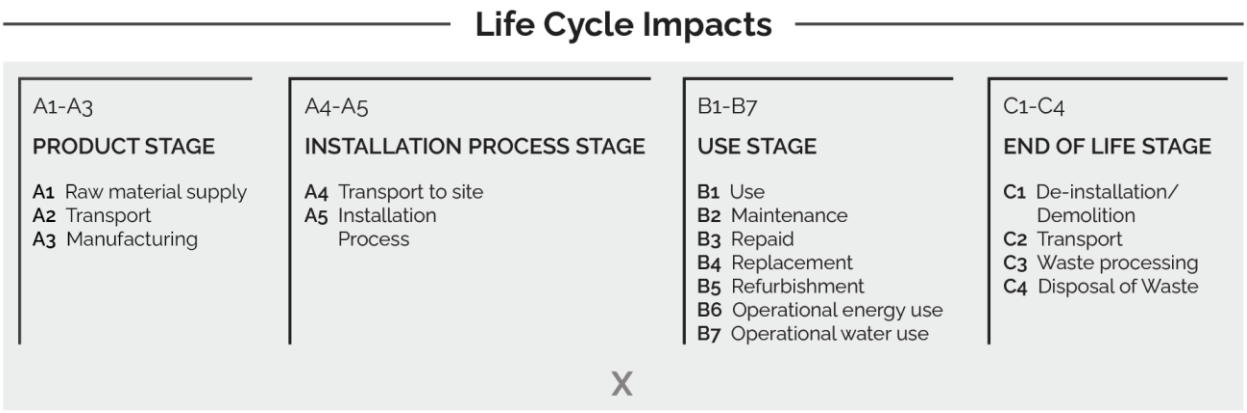

Figure 1: **General life cycle phases for consideration in a construction works system.**

This is a Cradle-to-grave life cycle assessment and the following life cycle stages are included in the study:

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e., A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacturer the declared products and to operate the facility.
- A4: Product plant gate-to-site of use logistics
- A5: Product at-site installation requirements
- B: Product use phase requirements and direct emissions (if applicable)
- C: Product end-of-life requirements

As according to the PCR, the following figure illustrates the general activities and input requirements for producing polyurethane spray foam installation products and is not necessarily exhaustive.
In addition, as according to the relevant PCR, the following requirements are excluded from this study:

- Production, manufacture and construction of A3 building/capital goods and infrastructure.
- Production and manufacture of steel production equipment, steel delivery vehicles, earth-moving equipment, and laboratory equipment;
- Personnel-related activities (travel, furniture, office supplies);
- Energy use related to company management and sales activities.

For this LCA, the manufacturing plant, owned and operated by Elastochem Specialty Chemicals Inc, is located at their Elastochem facility in Brantford, Ontario. All operating data is formulated using the actual data from Elastochem Specialty Chemicals Inc's plant at the above location, including water, energy consumption and waste generation. All inputs for this system boundary are calculated for the plant.

This life cycle inventory was organized in a spreadsheet and was then input into an RStudio environment where pre-calculated LCIA results for relevant products/activities stemming from the ecoinvent v3.8 database and a local EPD database in combination with primary data from Elastochem Specialty Chemicals Inc were utilized. Explanations of the contribution of each data source to this study are outlined in the section 'Data Sources and Quality'. Further LCI details for each declared product are provided in the sections 'Detailed LCI tables' and 'Transport tables' of the detailed LCA report. A parameter uncertainty analysis was also performed where key statistical results (e.g., min/mean/max etc.) are provided in the detailed LCA report.

No known flows are deliberately excluded from this EPD.

CUT-OFF CRITERIA

ISO 14044:2006 and the focus PCR requires the LCA model to contain a minimum of 95% of the total inflows (mass and energy) to the upstream and core modules be included in this study. The cut-off criteria were applied to all other processes unless otherwise noted above as follows. A 1% cut-off is considered for all renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process where the total of the neglected inputs does not exceed 5%.

DATA SOURCES AND DATA QUALITY ASSESSMENT

No recovered on-site energy occurs at this facility.

Table 7: **Reused or recycled components/materials at the A3 facility site**

Component/material for re-use/recycling	Value	Units	Re-used/recycled on-site or off-site
Plastic packaging	402827	kg	Off-site
Cardboard packaging	NA	kg	Off-site
Plastic components	36436	kg	Off-site
Steel components	1546534	kg	Off-site

The following statements explain how the above facility requirements/generation were derived:

Raw material transport: Elastochem Specialty Chemicals provided all raw material data for the reference year 2021. This includes a complete chemical inventory of the products covered in this study to 100 ppm. The transportation was reported using primary Elastochem data and consisted of the distance, mode of transport, and location data in the city, state, and country.

There are three types of transportation modeled in this study. The first is from the manufacturing facility to the distributor in distributor-owned trucks, where the average distance to the distributors was used. Secondly is transportation from the manufacturer to the distributor in contracted trucks. In

this case, the type of truck has been divided between a typical truck and a refrigerated one. The average distance to those distributors has been used from primary Elastochem records. Lastly is the transportation from the distributor to the job site. Elastochem does not have that information since they sell to the distributor. To include the additional transportation, this study uses 25 km as an average distance one-day.

Electricity: Elastochem Specialty Chemicals uses the national grid of their region. Therefore, all primary data was gathered from utility bills and reported using kWh. The products covered in this EPD consist of 99% of the overall product volume; therefore, all electricity was allocated based on that 99% figure.

Process/space heating: Elastochem Specialty Chemicals uses natural gas as supplied to their region. Therefore, all primary data was gathered from utility bills and reported using megajoules (MJ). The products covered in this EPD consist of 99% of the overall product volume; therefore, all electricity was allocated based on that 99% figure.

Fuel required for machinery: Elastochem Specialty Chemicals uses propane to move materials as their facility. Primary data was gathered from the vendor bills for the propane tanks and reported in liters. The products covered in this EPD consist of 99% of the overall product volume; therefore, all electricity was allocated based on that 90% figure.

Waste generation: All waste for A1 was calculated using primary information from Elastochem vendor bills. For hazardous waste the number of barrels was multiplied by the density of the product to get the total kg of disposed material. Transportation defaults were used because the driver's route and ultimate final destination are unknown. Therefore, the exact mileage could not be confirmed by the waste hauler. Transportation for waste in the end-of-life modules also uses default distances set by the PCR.

Recovered energy: No on-site energy is recovered on site.

Recycled/reused material/components: Elastochem buys new barrels and totes for its products. A new barrel consists of 19.1 kg of steel. A tote is made of HPDE and steel. It weighs 58 kg, 90% of that weight being the HPDE and the remaining 10% steel. After installation, the contractors clean out the steel barrels and the plastic/steel totes and resell them. Because they are worth $65+ per barrel and there is a recycling and reselling infrastructure, nearly 100% of the barrels and totes are reused.

Module A1 material losses: Default material losses, 2%, were used.

Direct A3 emissions accounting: Direct emissions at the facility, natural gas, and propane were captured using ecoinvent 3.8 unit processes. Natural gas used the region-specific process for Canada, and the propane used the global unit process, RoW. For additional information on the processes used, see the table outlining A3 processes.

Elastochem eliminated Hydrofluorocarbons (HFCs) in their spray polyurethane foams before 2021. Extreme is formulated without harmful HFCs, resulting in an ultra-low Global Warming Potential (GWP) of 1.0. Compared to closed-cell alternatives that have GWPs ranging from 700-1400, Extreme offers a lower GWP emission value.

A4 Product transport requirements: Elastochem's product arrives at the job site in two ways. The first is by customer's truck. Large commercial installers will pick up the product directly from Elastochem. A total of more than 3,000 barrels were delivered this way, with an average distance to the job site of 600 km. Elastochem also contracts with transport companies to transport their product to distributors. The two types of trucks used are regular semis and refrigerated trucks. The frequency distribution is 75% of the time semis are used while 25% of the time a refrigerated truck is used; the combined average distance to the distributor is 1375 km. Since the distance to the job site varies and Elastochem is one step removed from that information, the same distance of 0.41km/FU was used as it appeared in the industry average LCA/EPD.

A5 Product installation: High-pressure SPF, including open-cell and closed-cell, is installed by professional applicators by on-site mixing of the A-side and B-side chemicals. Side A is purchased and not manufactured at Elastochem. Side B is the proprietary ingredients included in this study and manufactured by Elastochem. The combination of sides A and B makes up the Functional Unit. Protective equipment such as goggles, protective suits, and respirator cartridges is required to protect applicators from chemical exposure during installation. Also needed are disposable materials such as masking tape and drop cloths. All of the PPE and drop cloths are assumed to be landfilled. The amount of waste per functional unit is 0.00308 kg.

Typical equipment components that produce high-pressure SPF foam are unpressurized A-side and B-side liquid drums with transfer pumps connected to the proportioner system for heating and pressuring the chemicals. The chemicals then pass through a heated hose connected to a spray gun for application. This system requires electricity and diesel. The system runs on electricity, but in some spaces, there may not be easy access to electricity, so a diesel generator is used. The values used are 0.04 kWh and 2.9 MJ per functional unit for the electricity and diesel, respectively.

Lastly, this study assumes a 3% waste factor during installation and a stepped release of the blowing agent in the Extreme product. All other products use water as a blowing agent and, therefore, do not release during their lifetime. This study assumes 10% of the blowing agent is released during installation.

B Product use phase: The Reference Service Life (RSL) of the building is 75 years; therefore, there is only one product application. There is no energy used during the use phase of this product. The PCR states that during the lifetime of products using a blowing agent, 24% of the blowing agent is released. This is applicable for Insulthane Extreme only.

C Product end-of-life: At the end of the Service Life of the building, it is assumed that only manual labor is involved to remove the foam. To align with the PCR, the removed foam (waste) is assumed to be transported 48 km to the disposal site. The spray foam is assumed to be landfilled at end-of-life, as is typical for construction and demolition waste. Per the PCR, 16% of the original physical blowing agent (Insulthane Extreme only) is emitted at this stage in the life cycle.

The following tables depict a list of assumed life cycle inventory utilized in the LCA modeling to generate the impact results across the life cycle modules in scope. An assessment of the quality of each LCI activities utilized from various sources is also provided.

Table 8: **LCI inputs assumed for module A1 (i.e. raw material supply)**

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Tertiary Amine 2	Proprietary	ecoinvent v3.8	Kansas	v3.8 in 2021	2	3	2	3	3
Tertiary Amine 3	Proprietary	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	2	3	3
Steel Drums	steel production, electric, low-alloyed/steel, low-alloyed/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3
Tertiary Amine 1	Proprietary	ecoinvent v3.8	Kansas	v3.8 in 2021	2	3	2	3	3
Surfactant 2	Proprietary	ecoinvent v3.8	Ontario	v3.8 in 2021	2	3	2	3	3
Flame Retardant 1	Proprietary	ecoinvent v3.8	Kansas	v3.8 in 2021	2	3	2	3	3
Sucrose Polypol 1	Proprietary	ecoinvent v3.8	West Vergenia	v3.8 in 2021	2	3	2	3	3
Silicone Surfactant 3	Proprietary	ecoinvent v3.8	Ontario	v3.8 in 2021	2	3	2	3	3
Plastic Wrap (HPDE)	extrusion, plastic film/extrusion, plastic film/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3
Sucrose Polyol 1	Proprietary	ecoinvent v3.8	NA	v3.8 in 2021	2	3	2	3	3
Surfactant 1	Proprietary	ecoinvent v3.8	West Vergenia	v3.8 in 2021	2	3	2	3	3
Polyester Polyol 1	Proprietary	ecoinvent v3.8	Texas	v3.8 in 2021	2	3	2	3	3
Sucrose Polyol 2	Proprietary	ecoinvent v3.8	Kansas	v3.8 in 2021	2	3	2	3	3
Chemical, organic	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	2	3	3
Sucrose Polyol 1	Proprietary	ecoinvent v3.8	Kansas	v3.8 in 2021	2	3	2	3	3
Blowing agent	Proprietary	ecoinvent v3.8	Louisanna	v3.8 in 2021	2	3	2	3	3
Tertiary Amine 2	Proprietary	ecoinvent v3.8	Kansas	v3.8 in 2021	2	3	2	3	3
methylene diphenyl diisocyanate Side A	market for methylene diphenyl diisocyanate/methylene diphenyl diisocyanate/RER/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	2	3	3

Polyether Amine 2	Proprietary	ecoinvent v3.8	Texas	v3.8 in 2021	2	3	2	3	3
Pallets	EUR-flat pallet production/EUR-flat pallet/RoW/unit	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3
Surfactant 1	Proprietary	ecoinvent v3.8	Ontario	v3.8 in 2021	2	3	2	3	3
Polyether Polyol 1	Proprietary	ecoinvent v3.8	Kansas	v3.8 in 2021	2	3	2	3	3
heavy fuel oil	Proprietary operation/heavy fuel oil/RoW/kg	ecoinvent v3.8	Texas	v3.8 in 2021	2	3	2	3	3
Blowing Agent	tap water production, underground water without treatment/tap water/Europe without Switzerland/kg	ecoinvent v3.8	Ontario	v3.8 in 2021	2	3	2	3	3
Tertiary Amine 4	Proprietary	ecoinvent v3.8	Kansas	v3.8 in 2021	2	3	2	3	3
Polyether Polyol 1	Proprietary	ecoinvent v3.8	Texas	v3.8 in 2021	2	3	2	3	3

Table 10: **LCI inputs assumed for module A3**

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Bulk Waste	process-specific burdens, inert material landfill/process-specific burdens, inert material landfill/RoW/kg	ecoinvent v3.8	Ontario	v3.8 in 2021	2	3	2	3	3
Electricity	market for electricity, medium voltage/electricity, medium voltage/CA-ON/kWh	ecoinvent v3.8	Ontario	v3.8 in 2021	2	3	2	3	3
Hazardous Waste	process-specific burdens, residual material landfill/process-specific burdens, residual material landfill/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	2	3	3
Natural Gas	heat production, natural gas, at boiler modulating	ecoinvent v3.8	Ontario	v3.8 in 2021	2	3	2	3	3

	>100kW/heat, district or industrial, natural gas/CA-QC/MJ								

Table 11: **LCI inputs assumed across modules A4 to C4 (i.e. from plant gate-to-grave if applicable)**

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
C4. blowing agent release at end of life i.e. 16%	Insulthane Extreme	See A3 inputs	C4 relevant region	See A3 inputs	3	A3	3	A3	A3
A5. blowing agent release at installation	Insulthane Extreme	See A3 inputs	A5 relevant region	See A3 inputs	3	A3	3	A3	A3
B1. blowing agent release During product life 24%	Insulthane Extreme	See A3 inputs	B1 relevant region	See A3 inputs	3	A3	3	A3	A3
A4. Delivery to Jobsite Trucks	Product-to-site transport requirements	See A4 transport requirements	Multiple Regions	2021-01-01 to 2021-12-31	NA	NA	NA	NA	NA
A4. Delivery to Jobsite Trucks-freight transport via Truck	market for transport, freight, lorry 3.5-7.5 metric ton, EURO5/transport, freight, lorry 3.5-7.5 metric ton, EURO5/RoW/tkm	ecoinvent v3.8	see corrsp. product input above	v3.8 in 2021	2	3	1	3	3
A5. Diesel for Installation	diesel, burned in building machine/diesel, burned in building machine/GLO/MJ	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3
A5. Electricity for Installation	market for electricity, medium voltage/electricity, medium voltage/US-NPCC/kWh	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3

A4. HDPE Totes	polyethylene production, high density, granulate/polyethylene, high density, granulate/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	2	3	3
A4. HDPE Totes-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	see corrsp. product input above	v3.8 in 2021	2	3	1	3	3
A4. Outbound to Distributor Refrigerated Trucks	transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO3, R134a refrigerant, cooling/transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO3, R134a refrigerant, cooling/GLO/tkm	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	2	3	3
A4. Outbound to Distributor Trucks	Product-to-site transport requirements	See A4 transport requirements	Multiple Regions	2021-01-01 to 2021-12-31	NA	NA	NA	NA	NA
A4. Outbound to Distributor Trucks-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	see corrsp. product input above	v3.8 in 2021	2	3	1	3	3
C4. Pallet disposal	treatment of waste wood, untreated, municipal incineration/waste wood, untreated/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3
C4. Pallet disposal-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	see corrsp. product input above	v3.8 in 2021	2	3	1	3	3

C4. Plastic wrap landfilled	treatment of waste plastic, mixture, sanitary landfill/waste plastic, mixture/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3
C4. Plastic wrap landfilled-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	see corrsp. product input above	v3.8 in 2021	2	3	1	3	3
A5. PPE Disposal	market for waste textile, soiled/waste textile, soiled/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3
A5. PPE Disposal-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	see corrsp. product input above	v3.8 in 2021	2	3	1	3	3
A5. PPE for installation	textile production, nonwoven polypropylene, spunbond/textile, nonwoven polypropylene/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3
C4. Recycle Drum	treatment of waste reinforcement steel, recycling/waste reinforcement steel/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	1	3	1	3	3
C4. Recycle Drum-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	see corrsp. product input above	v3.8 in 2021	2	3	1	3	3
A4. Steel Totes	steel production, electric, low-alloyed/steel, low-alloyed/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	2	3	3
A4. Steel Totes-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16	ecoinvent v3.8	see corrsp. product input above	v3.8 in 2021	2	3	1	3	3

	metric ton, EURO6/RoW/tkm								
A4. Truck Pickup at Elastochem	Product-to-site transport requirements	See A4 transport requirements	Multiple Regions	2021-01-01 to 2021-12-31	NA	NA	NA	NA	NA
A4. Truck Pickup at Elastochem-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	see corrsp. product input above	v3.8 in 2021	2	3	1	3	3

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its precision (measured, calculated or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision: Through measurement and calculation, the manufacturers collected and provided primary data on their annual production. For accuracy, the LCA practitioner and 3rd Party Verifier validated the plant gate-to-gate data.

Completeness: All relevant specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. The majority of relevant background materials and processes were taken from ecoinvent v3.8 LCI datasets where relatively recent region-specific electricity inputs were utilized. The most relevant EPDs requiring key A1 inputs were also utilized where readily available.

Consistency: To ensure consistency, the same modeling structure across the respective product systems was utilized for all inputs, which consisted of raw material inputs and ancillary material, energy flows, water resource inputs, product, and co-products outputs, returned and recovered Spray foam insulation materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets from the ecoinvent v3.8 database were used across all product systems. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the plant and selected process level to maintain a high level of consistency.

Reproducibility: Internal reproducibility is possible since the data and the models are stored and available in a machine-readable project file for all foreground and background processes, and in Labeling Sustainability's proprietary Spray foam insulation LCA calculator* for all production facility and product-specific calculations. A considerable level of transparency is provided throughout the

detailed LCA report as the specifications and material quantity make-up for the declared products are presented and key primary and secondary LCI data sources are summarized. The provision of more detailed publicly accessible data to allow full external reproducibility was not possible due to reasons of confidentiality.

*Labeling Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Spray foam insulation product designs. The tool auto-calculates results by scaling base-unit technosphere inputs (i.e., 1 kg sand, 1 kWh electricity, etc.) to replicate the reference flow conversions that take place in any typical LCA software like openLCA or SimaPro. The tool was tested against several LCAs performed in openLCA and the tool generated identical results to those realized in openLCA across every impact category and inventory metric (where comparisons could be readily made).

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

- Time related coverage of the manufacturing processes' primary collected data from 2021-01-01 to 2021-12-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent ecoinvent v3.8 database.
- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary data.

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

Per the PCR, this EPD supports the life cycle impact assessment indicators and inventory metrics as listed in the tables below. As specified in the PCR, the most recent US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), impact categories were utilized as they provide a North American context for the mandatory category indicators to be included in the EPD. Additionally, the PCR requires a set of inventory metrics to be reported with the LCIA indicators (see tables below).

Table 12: **Life cycle impact categories and life cycle inventory metrics**

ID	LCIA.indicators	Abbreviations	Units
1	Environmental impact: acidification	AP	moles of H+-Eq
2	Environmental impact: eutrophication	EP	kg N
3	Environmental impact: global warming	GWP	kg CO2-Eq
4	Environmental impact: ozone depletion	ODP	kg CFC-11-Eq
5	Environmental impact: photochemical oxidation	PCOP	kg NOx-Eq
6	Material resources: metals/minerals: abiotic depletion potential (ADP): elements (ultimate reserves)	ADPe	kg Sb-Eq

7	Energy resources: non-renewable: abiotic depletion potential (ADP): fossil fuels	ADPf	MJ, net calorific value
Inventory metrics			
8	Total primary energy	TPE	MJ-Eq
9	Renewable energy	RE	MJ-Eq
10	Non-renewable energy	NRE	MJ-Eq
11	Non-Renewable Resources	NRR	kg
12	Renewable Resources	RR	m3
13	Water depletion: WDP	WDP	m3
14	Land filling: bulk waste	LFW	kg waste
15	Land filling: hazardous waste	LFHW	kg waste

It should be noted that emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in any of the following categories.

- Renewable primary energy resources as energy (fuel);
- Renewable primary resources as material;
- Non-renewable primary resources as energy (fuel);
- Non-renewable primary resources as material;
- Secondary Materials;
- Renewable secondary fuels;
- Non-renewable secondary fuels;
- Recovered energy;
- Abiotic depletion potential for non-fossil mineral resources.
- Land use related impacts, for example on biodiversity and/or soil fertility;
- Toxicological aspects;
- Emissions from land use change [GWP 100 (land-use change)];
- Hazardous waste disposed;
- Non-hazardous waste disposed;
- High-level radioactive waste;
- Intermediate and low-level radioactive waste;
- Components for reuse;
- Materials for recycling;
- Materials for energy recovery;
- Recovered energy exported from the product system.

TOTAL IMPACT SUMMARY

The following table reports the total LCA results for each product produced at the given polyurethane spray foam installation facility on a per 1 m2 of installed spray polyurethane foam insulation for RSI = 1 basis.

Table 14: **Total life cycle (across modules in scope) impact results for All declared products, assuming the geometric mean point values on a per 1 m2 of installed spray polyurethane foam insulation for RSI = 1 basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Insulthane 450 NM	6.20E-01	2.35E-03	1.82E+00	3.58E-07	7.84E-03	7.81E-05	3.87E+01
Elastochem 500	4.41E-01	1.69E-03	1.46E+00	3.30E-07	6.10E-03	2.60E-05	3.07E+01
Insulthane Wrapsulate	8.83E-01	3.50E-03	3.07E+00	6.85E-07	1.17E-02	5.50E-05	6.48E+01
Insulthane Extreme	**1.53E+00**	5.42E-03	4.83E+00	1.06E-06	2.00E-02	1.40E-04	1.04E+02

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**
Insulthane 450 NM	4.16E+01	1.89E+00	3.98E+01	1.06E+00	4.35E-05	8.08E-03	3.37E-01	3.91E-05
Elastochem 500	3.30E+01	1.49E+00	3.15E+01	8.56E-01	3.77E-05	4.71E-03	2.81E-01	3.32E-05
Insulthane Wrapsulate	7.00E+01	3.22E+00	6.71E+01	1.79E+00	9.02E-05	1.03E-02	5.92E-01	6.58E-05
Insulthane Extreme	1.12E+02	5.19E+00	1.06E+02	2.89E+00	1.18E-04	1.59E-02	9.33E-01	1.04E-04

ADDITIONAL ENVIRONMENTAL INFO

No regulated substances of very high concern are utilized on site.

Elastochem is focused on reducing the environmental footprint of its products. Blowing agents are gases needed to expand the foam to its rigid shape. Within the gases, tiny bubbles form to act as insulators. Both XPS rigid panels and spray foam insulation contain blowing agents.

REDUCED GLOBAL WARMING POTENTIAL Elastochem uses Hydrofluorocarbons (HFOs) as the blowing agent in all its closed-cell foam products. Elastochem was the first to develop a CCMC-listed HFO foam in Canada with Insulthane® Extreme. Mandated throughout Canada, HFO provides a GWP of 1. Elastochem's open-cell (low-density) SPF is water-blown with a GWP of 0.

LOW VOC EMISSIONS In addition to lowering the GWP of the product, Elastochem's also focuses on the chemical emissions or off-gassing of the product once it is applied. Elastochem's closed-cell spray foams are GREENGUARD, and GREENGUARD Gold certified. GREENGUARD certification ensures that the insulations are scientifically proven to meet some of the world's most rigorous third-party chemical emissions standards.

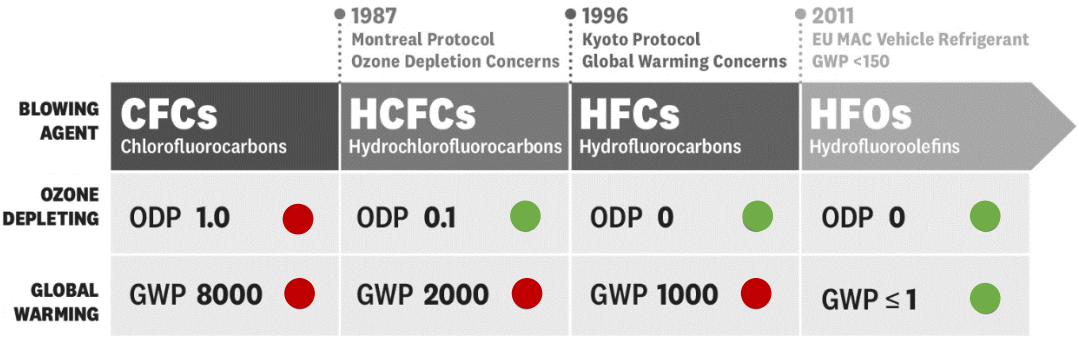

Figure 2: **The evolution of the blowing agents used in spray foam can be see in the diagram below along with their ozone depleting (ODP) and global warming (GWP).**

REFERENCES

ISO Standards:

- ISO 6707-1: 2014 Buildings and Civil Engineering Works - Vocabulary - Part 1: General Terms
- ISO 14021:1999 Environmental Labels and Declarations - Self-declared Environmental Claims (Type II Environmental Labeling)
- ISO 14025:2006 Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures
- ISO 14040:2006 Environmental Management - Life Cycle Assessment - Principles and Framework
- ISO 14044:2006 Environmental Management - Life Cycle Assessment - Requirements and Guidelines
- ISO 14067:2018 Greenhouse Gases – Carbon Footprint of Products – Requirements and Guidelines for Quantification
- ISO 14050:2009 Environmental Management - Vocabulary
- ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

EN Standards:

- EN 16757 Sustainability of construction works - Environmental product declarations – Product Category Rules for concrete and concrete elements
- EN 15804 Sustainability of construction works - Environmental product declarations -Core rules for the product category of construction products

Other References:

- USGBC LEED v4 for Building Design and Construction, 11 Jan 2019 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b
- USGBC PCR Committee Process & Resources: Part B, USGBC, 7 July 2017 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b.
- US EPA (2020) Advancing Sustainable Materials Management: 2018 Fact Sheet, https://www.epa.gov/sites/production/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf