ENVIRONMENTAL
PRODUCT
DECLARATION

GENYK
POLYURETHANE

SPRAY POLYURETHANE FOAM INSULATION

Boreal Nature Elite™, Duraseal™ and Floraseal 50™

Specialized in the development and manufacturing of rigid and flexible polyurethane foam insulation products, Genyk is pleased to present the environmental product declaration (EPD) of three spray polyurethane foams (SPFs): Boreal Nature Elite™, Duraseal™ and Floraseal 50™.

This EPD was developed by CT Consultant in compliance with CAN/CSA-ISO 14025:2006 and has been verified by Marie Bellemare Consulting.

This EPD includes life cycle assessment (LCA) results for the raw material supply, manufacturing, transport, installation, use, and end-of-life stages (i.e., cradle to grave).

For more information about Genyk, visit www.genyk.com

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1| GENERAL INFORMATION

This environmental product declaration (EPD) is in accordance with CAN/CSA-ISO 14025:2006 [1] and the PCRs noted below. ISO 21930:2017 [2] serves as the core PCR along with EN 15804:2012 [3] and the UL Part A PCR [4]. EPDs from different programs may not be comparable.

Program operator	**ASTM International** 100 Barr Harbor Drive West Conshohocken, PA 19428 United States of America (USA) www.astm.org
Product	Boreal Nature Elite™, Duraseal™ and Floraseal 50™ spray polyurethane foam insulation
Functional unit	1 m^2 of insulation foam with a thickness that gives an average thermal resistance of RSI=1 m^2K/W
EPD registration number	EPD 503
EPD recipient organization	**Genyk** 1701 3e Avenue Shawinigan, Quebec Canada G9T 2W6 (844) 404-3695 www.genyk.com info@genyk.com
Reference product category rules (PCR)	PCR Part A: UL Environment Building Related Products and Services. Life cycle assessment calculation rules and report requirements, v3.1. May 2018. Standard 10010 PCR Part B: UL Environment. Building-Related Products and Services. Building Envelope Thermal Insulation EPD Requirements, v3.0. April 2018 – April 2024. UL 1001-1
LCA Software	openLCA v1.11, GreenDelta (2022) [5]
Date of issue	June 14, 2023
Period of validity	June 2023 – May 2028
The PCR review was conducted by:	Thomas Gloria, PhD Industrial Ecology 35 Bracebridge Road, Newton, Massachusetts United States of America (USA) (617) 533-4929 t.gloria@industrial-ecology.com
This EPD and related data were independently verified by an external verifier according to CAN/CSA-ISO 14025:2006, ISO 21930:2017, EN 15804:2012 and UL Part A	☐ INTERNAL ☒ EXTERNAL  Marie Bellemare, Marie Bellemare Consulting

2| PRESENTATION OF GENYK

Genyk is a Canadian company founded in 2012 that is involved in every aspect of development, manufacturing and marketing of rigid and flexible polyurethane foam products. From the manufacturing of specific products for its customers to researching and developing spray polyurethane foam (SPF) to meet specific needs, Genyk is present at every step of the process. Genyk's manufacturing plant is located at 1701, 3e Avenue, Shawinigan, Quebec, Canada.

3| DESCRIPTION OF THE PRODUCTS

3.1. Description and applications of the products

The SPFs consist of two components that react together to produce polyurethane: polyol resin (B-side) manufactured by Genyk and methylene diphenyl diisocyanate (MDI, A-side). These two components are delivered in liquid form in their original packaging to the installation site then mixed and sprayed to form a polyurethane foam. The SPFs provide both thermal insulation and waterproofing.

3.1.1 Boreal Nature Elite™

Boreal Nature Elite™ [6] is a medium-density, closed cell SPF containing a low global warming potential HFO blowing agent. Boreal Nature Elite™ is a superior quality product for residential and commercial buildings that provides an all-in-one barrier against air, vapour and radon. The SPF adheres to most construction materials and can be applied to roofs, walls, foundations, under foundation slabs and more. Thanks to its superior adhesion, the SPF increases the structural strength of the building. Boreal Nature Elite™ is GREENGUARD GOLD certified for low chemical emissions [7]. The Boreal Nature Elite™ has physical properties that meet the requirements of CAN/ULC S705.1-15 (Table 2).

Photo 1: Boreal Nature Elite™ SPF

3.1.2 Duraseal™

Duraseal™ [8] is a high-density, closed cell SPF specially designed for roofing applications and contains a HFO blowing agent with a low global warming potential. Ideally suited for flat roof insulation, this SPF has an exceptional ability to withstand high vertical pressure. Indeed, when properly installed, it is safe to walk on the roof and install equipment such as heat pumps or air conditioning units. This foam must be covered with an adequate membrane to protect it from water infiltration and UV rays.

Photo 2: Duraseal™ SPF

3.1.3 Floraseal 50™

Floraseal 50™ [9] is a semi-rigid, open cell SPF with water as a blowing agent. The water comes from a rainwater recovery system installed at the plant. This low-density SPF has good adhesion to conventional substrates and is used for thermal insulation and soundproofing of residential and commercial buildings. The Floraseal 50™ has physical properties that meet the requirements of CAN/ULC S712.1:2017 (Table 4).

Photo 3: Floraseal 50™ SPF

3.3. Technical specifications

Table 1. Thermal performance test results of the SPFs manufactured by Genyk

SPF	Standard	Result	Verification laboratory
Boreal Nature Elite™	ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus [10]	7.30 ft²°Fhr/Btu/in	Canadian Construction Materials Centre [11]
		0.51 m²K/W/cm	
Duraseal™		5.23 ft²°Fhr/Btu/in	Evonik [12]
		0.36 m²K/W/cm	
Floraseal 50™		3.69 ft²°Fhr/Btu/in	Canadian Construction Materials Centre [13]
		0.26 m²K/W/cm	

Note: The thermal performance test was performed at an average sample temperature of 24°C (75°F).

Table 2. Other physical properties of Boreal Nature Elite™

Physical property	Required values		Standard	Result
	Min.	Max.		
Core density	28 kg/m³	---	ASTM D1622	32.0 kg/m³ (2.0 lb/pi³)
Compressive strength	170 kPa	---	ASTM D1621	228 kPa (33.1 psi)
Tensile strength	200 kPa	---	ASTM D1623	205 kPa (29.7 psi)
Water vapour permeance on a 50mm thickness sample	60 ng/(Pa.s.m²)		ASTM E96 (Procedure A)	34 ng/(Pa.s.m²)
Surface burning (flame spread index)	---	500	CAN/ULC S127-14	285
Fungi resistance	No growth	---	ASTM C1338	No growth
Air permeance	---	0,02	ASTM E2178	0.001 L/(s.m²)
Recommended time to occupancy	1 day	30 days	CAN/ULC S774	25 hours
Open cell content	---	10.0%	ASTM D6226 (Procedure 2)	2.8%
Water absorption (volume)	---	4.0%	ASTM D2842 (Procedure A)	1.6%
Dimensional stability (volume)	-2 -2 -2	+5 +8 +14	ASTM D2126 (28 days) -20 ºC 80 ºC 70 ºC, 97% (RH±3%)	-1% +2% +13%

Table 3. Other physical properties of Duraseal™

Physical property	Standard	Result
Core density	D 1622	44.4 kg/m^3 (2.77 lb/pi^3)
Compressive strength	D 1621	310-344 kPa (45-50 psi)
Dimensional stability (volume)	D2126 (7 days, -25 ºC, ambient R.H.) D2126 (7 days, +80 ºC, ambient R.H.) D2126 (28 days +700 ºC,97% +-3% R.H.)	-0.72% -4.20% +5.35%
Tensile strength	ASTM D1623	> 55psi
Open cell content	ASTM D2856	< 3%
Water vapour permeance	ASTM E96	< 1%

Table 4. Other physical properties of Floraseal 50™

Physical property	Standard	Result
Density	ASTM D1622	8.87 kg/m^3 (0.55 lb/pi^3)
Dimensional stability	ASTM D2126	
	(28 days, -20 ºC, ambient R.H.)	+0.60%
	(28 days, +80 ºC, ambient R.H.)	-2.20%
	(28 days, +70 ºC, 97±3% R.H.)	+0.40%
Air permeance at 75 Pa pressure difference at 100 mm thickness	ASTM E2178	< 0.01 L/(m^2.s)
Water vapour permeance on a 50mm thickness sample	ASTM E96 A	1296 ng/(Pa.s.m^2)
Water absorption (volume)	ASTM D2842 A	48%
Open cell content	ASTM D6226	98.5%
Fungi resistance	ASTM C1338	No growth
Fire resistance properties Flame spread characteristics Smoke-developed classification	CAN/ULC S102 - CAN/ULC S127	30 Flame spread index 230 Smoke-develop index 353 Flame spread index
Volatile organic compounds - time to occupancy	CAN/ULC S774	1 day

3.4. Material composition

The SPFs consist of the B-side (polyol resin) manufactured by Genyk and the A-side (MDI) which is purchased from suppliers (Tables 5 and 6). The A-side consists of diphenylmethylene diisocyanate (MDI) and is the same for the three SPFs. The B-side (polyol resin) consists of polyols, blowing agents (water and HFO), a compatibilizer, catalysts, flame retardants and surfactants in varying proportions depending on the SPF (Table 7). Although some of the ingredients may be classified as hazardous under the Canadian Environmental Protection Act [14], SPF as installed and disposed of when it reaches its end of life is not classified as a hazardous substance, as the hazardous ingredients are rendered chemically inert after installation. In addition, the SPF does not contain any VOC-emitting materials. For more information, please consult the safety data sheets available from Genyk [15][16][17].

Table 5. Composition of the SPFs manufactured by Genyk (volume distribution)

SPF	B-side (polyol resin)	A-side (MDI)	Total
Boreal Nature Elite™	50%	50%	100%
Duraseal™	50%	50%	100%
Floraseal 50™	50%	50%	100%

Table 6. Place of production and transport distances of the raw materials used in the SPFs manufactured by Genyk (B = Boreal Nature Elite™, D = Duraseal™, F = Floraseal 50™)

				Average transport distance (km)		
			Place of production	B	D	F
B-side (polyol resin)	Polyol	Polyester/polyether	North America, Asia	5,069	11,242	15,167
		Mannich	North America	3,182	3,182	-
	Flame retardant		Asia	15,001	15,001	15,001
	Compatibilizer		Asia	-	-	15,001
	Blowing agent	Water	Rainwater collected at Genyk's manufacturing plant	0	0	0
		HFO	North America	2,876	1,655	-
	Catalyst	Amine	North America, Asia	1,527	6,018	7,084
		Metal	North America	727	747	-
	Surfactant (Silicone)		North America	727	727	727
B-side (MDI)			Europe, Asia	13,501	13,501	13,501

Table 7. Material composition of the SPFs manufactured by Genyk (mass distribution)

		Boreal Nature Elite™	Duraseal™	Floraseal 50™
Polyol	Polyester/polyether	< 60%	< 60%	< 35%
	Mannich	< 15%	< 15%	0%
Flame retardant		< 15%	< 15%	< 25%
Compatibilizer		0%	0%	< 15%
Blowing agent	Water	< 3%	< 3%	< 25%
	HFO	< 15%	< 15%	0%
Catalyst	Amine	< 5%	< 5%	< 12%
	Metal	< 1%	< 1%	0%
Surfactant (Silicone)		< 2%	< 2%	< 5%
Total		**100%**	**100%**	**100%**

3.5. Manufacturing of the SPFs

The A-side (MDI) is manufactured by suppliers located in Europe and Asia before being shipped in steel drums or plastic totes to Genyk's various warehouses. The B-side (polyol resin) is manufactured by Genyk at its plant in Shawinigan, Quebec, Canada. For all polyol resins manufactured by Genyk, the manufacturing process comprises three stages: mixing, quality control and packaging (Figure 1). The raw materials are weighed according to the formulation of the polyol resin, then mixed before undergoing quality control. The polyol resin is then packaged in steel drums or plastic totes on wood pallets.

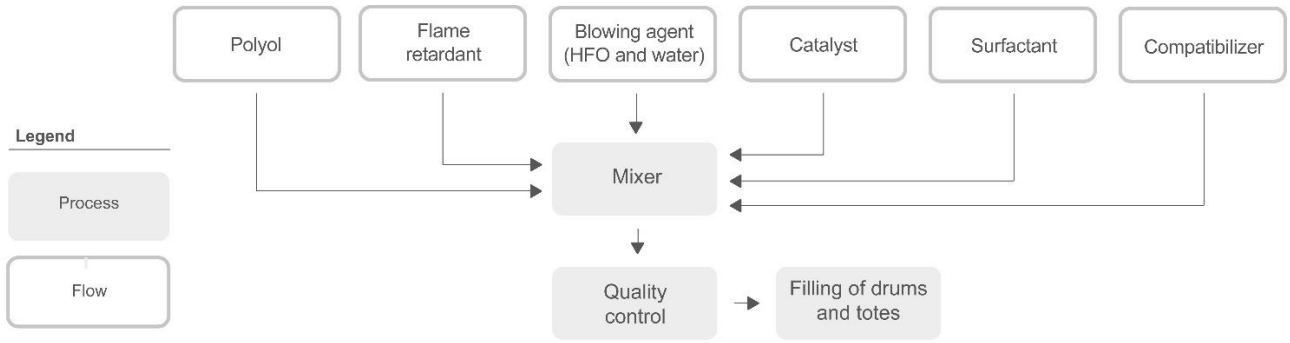

Figure 1. Manufacturing stages of the B-side at Genyk's manufacturing plant, Shawinigan, Quebec, Canada

3.6. Manufacturing losses

Losses of raw materials for the manufacturing of the B-side (raw material stuck to the packaging, the storage tank or the pipe feeding the mixer) are sent to landfill. Polyol resin that is non-compliant is recovered by reintroducing it into the manufacturing process. There are therefore no polyol resin losses during

manufacturing. The MDI is transported to the installation site in its original packaging. It is considered that there are no losses of MDI before the installation of the SPFs.

3.7. Packaging

The A-side and B-side are packaged in steel drums or plastic totes on wood pallets. Each pallet carries four steel drums or one plastic tote.

3.8. Transport

The SPFs are delivered to the user in two shipping scenarios:

- **Scenario 1.** Shipment to the applicator by truck, then to the construction site by cube truck.
- **Scenario 2.** Shipment to the applicator by semi-trailer truck, then to the construction site by cube truck via a warehouse.

The storage of the SPFs in a heated space has been included. The energy required for this heating comes from the electricity grid and natural gas.

3.9. Installation

The installation is carried out by mixing the A-side and B-side using a plural-component pump designed for spraying polyurethane foam. The pump is diesel-powered. The two components are heated and pressurised by the plural-component pump, then sent through heated hoses to a spray gun that mixes them together. The foam created by the chemical reaction of the A-side and the B-side is applied to the desired area with the spray gun. When Boreal Nature Elite™ and Duraseal™ are sprayed, HFO is emitted. CO_2 is also emitted during application for all three SPFs as described in section 4.3. Once sprayed, the polyurethane foam expands and hardens. The excess foam is trimmed and sent to landfill. Packaging for the A-side and B-side is sent to recycling.

Personal protective equipment such as nitrile gloves, safety goggles, protective suits and supplied air respirators are used to protect applicators from exposure to chemicals during the installation of the SPF. Materials to delineate the insulation area are also used, such as adhesive tape and polyethylene film. These ancillary materials (protective equipment and materials for delineating the site) are assumed to be landfilled after use.

3.10. Use

Once sprayed, the SPFs do not require any maintenance, repair, or replacement. HFO diffuses out of Boreal Nature Elite™ and Duraseal™ SPFs during use, as described in section 4.3. Floraseal 50™ SPF does not release any emissions in the air during use.

3.11. Reference service life

The reference service life of the three SPFs is considered equivalent to that of the building, set to 75 years as the default value in the PCR Part B [18].

3.12. End of life of the SPFs

When the building in which the SPF is installed reaches its end of life, it is assumed that it is demolished without any sorting or recycling of materials. Therefore, the SPF will be incorporated into the rest of the demolition waste and sent to a landfill site. HFO diffuses out of Boreal Nature Elite™ and Duraseal™ SPFs at the landfill site, as described in section 4.3.

4 METHODOLOGY USED FOR THE LIFE CYCLE ASSESSMENT

4.1. Functional unit

The LCA results are the life cycle environmental impacts related to the mass of SPF required to achieve the functional unit. The latter is based on the thermal resistance of the SPF, as specified in the PCR Part B [18].

Table 8. Functional unit and key parameters

Parameter	Value		Unit
Functional unit	1 m^2 of insulation material with a thickness that gives an average thermal resistance of RSI=1 m^2K/W (packaging included)		-
Mass	Boreal Nature Elite™	0.682	kg
	Duraseal™	1.323	kg
	Floraseal 50™	0.377	kg
Thickness to achieve the functional unit	Boreal Nature Elite™	0.020	m
	Duraseal™	0.028	m
	Floraseal 50™	0.039	m

4.2. System boundaries

The cradle-to-grave LCA includes the following life cycle stages and modules (EN 15804:2012 and ISO 21930:2017 [3][2]):

- Production (A1 - A3)
- Construction (A4 - A5)
- Use (B1 - B7)
- End of life (C1 - C4)

Although technically possible, the recycling of the SPF at the end-of-life stage was not considered since no product recovery system is currently in place. Thus, module D was not included in the LCA.

Table 9. Life cycle stages and modules included in and excluded from the LCA

PRODUCTION STAGE (A1 - A3)			CONSTRUCTION STAGE (A4 - A5)			USE STAGE (B1 - B7)						END-OF-LIFE STAGE (C1 - C4)				BEYOND SYSTEM BOUNDARIES
Production of raw materials	Transport of raw materials	SPF manufacturing	Transport to construction site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Energy use	Water use	Deconstruction	Transport to 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	X	X	X	X	X	X	X	X	X	X	X	X	X	ME

Legend: X: Module included in the LCA ME: Module excluded from the LCA

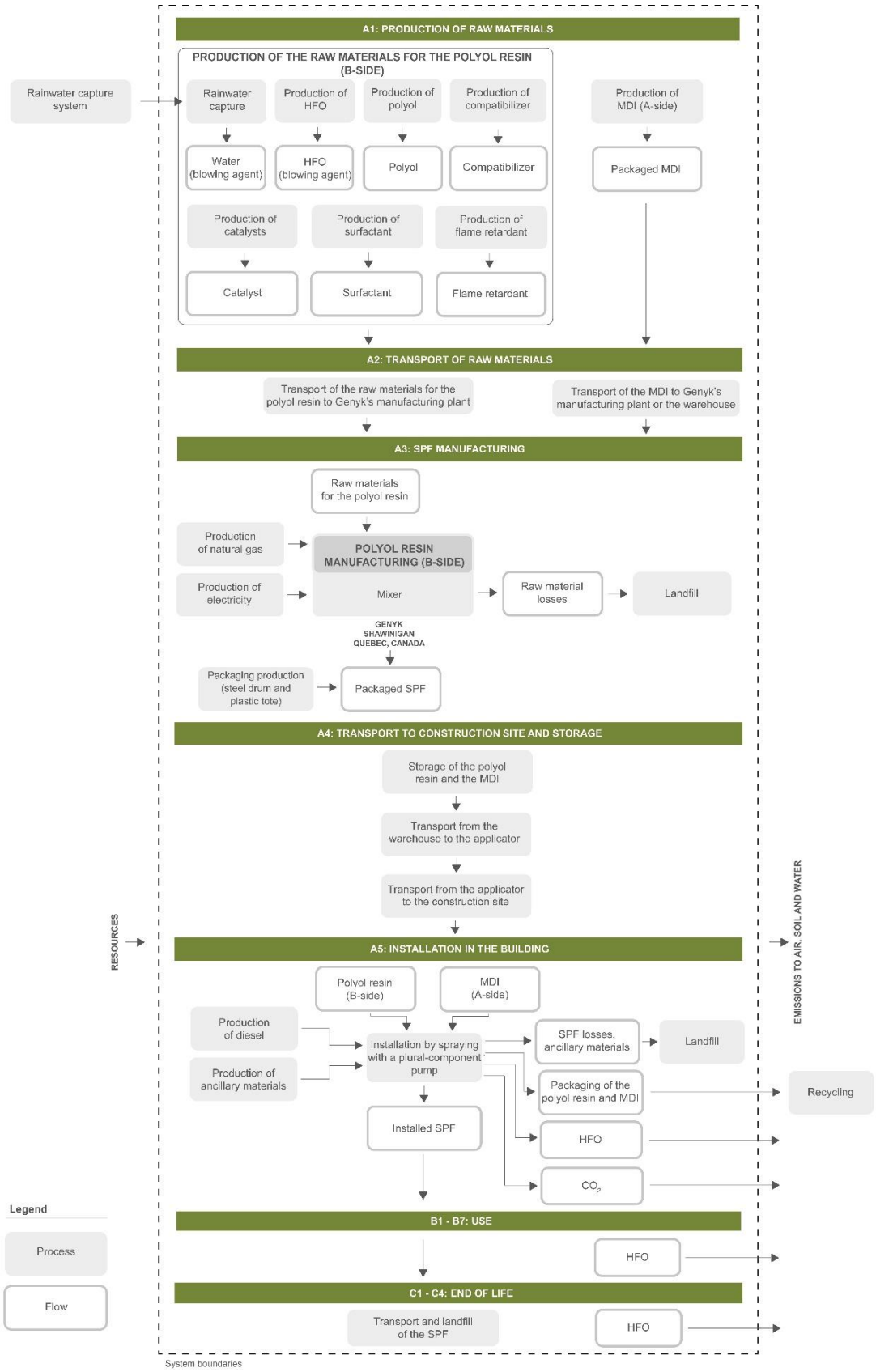

Figure 2. System boundaries – Boreal Nature Elite™, Duraseal™ and Floraseal 50™

4.3. Assumptions

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

- **Transport of raw materials (A2).** Because the exact transport routes between the producers of the raw materials and Genyk's manufacturing plant are not known, these were determined based on conservative assumptions: raw materials from Asia are transported from the production plant to the nearest port by truck, then from the port to Vancouver by ship, and finally delivered to Genyk's plant by train; raw materials from Europe are transported to Montreal by ship and delivered to Genyk's plant by semi-trailer truck; raw materials from North America are delivered to Genyk's plant by semi-trailer truck.
- **Water blowing agent (A5).** Water is used as a blowing agent in Genyk's SPFs. This water is converted into CO_2 when the A-side reacts with the B-side. For Boreal Nature Elite™ and Duraseal ™ SPFs, 100% of the water is converted into CO_2 and emitted to the air when the SPF is installed. For Floraseal 50™ SPF, 75% of the water is transformed into CO_2 and emitted to the air during installation, while the rest of the water remains in the SPF.
- **HFO blowing agent (A5, B, C4).** The HFO used as a blowing agent in Boreal Nature Elite™ and Duraseal™ diffuses out of the polyurethane foam and is emitted to the air during the life cycle of the SPF. It is considered that 10% of the HFO is emitted to the air during the installation of the SPF, 24% during its use in the building, 16% in the landfill and 50% of the HFO remains in the landfilled SPF [19][20].
- **Wood pallets for packaging (A1, A3).** The wood pallets are considered to have been reused 15 times, according to Genyk.

4.4. Cut-off criteria

As defined in ISO 21930:2017 [2], all input and output flows whose mass and/or energy flow account for more than 1% of the total mass and/or cumulative energy were included. Also in line with the standard, at least 95% of all mass and energy flows were included. The packaging of raw materials for the B-side is excluded, as this flow represents less than 1% of the mass of inputs and does not represent a significant environmental impact. The infrastructure and equipment for the production and installation of the SPF (e.g., mixers and plural-component pump) were excluded from this study because they are considered to produce/install a large amount of SPF over their lifetime. Their impact in relation to the functional unit is therefore regarded as negligible. The maintenance of equipment and infrastructure, administrative activities and transport of employees and workers were not included in the LCA model. No known mass or energy flows were deliberately excluded.

4.5. 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 of 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 compliance with ISO 21930 [2]. 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 of materials leaving the system are not included. In this study, no environmental benefits associated with the packaging materials (wood pallets, steels drums, plastic totes) sent for recycling were included.

- **Allocation for multi-functional processes.** No processes in the life cycle of the SPF generate co-products within the boundaries of the system under study. Therefore, there are no multi-functional allocations to be considered in this study.
- **Allocation for 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.

4.6. Reference period

The inventory data is representative of the production year from 1 April 2021 to 31 March 2022.

4.7. Data sources and quality

Table 10. Life cycle inventory data sources for the three SPFs

Data type	Source
Primary data	Primary data was provided by Genyk for the period from 1 April 2021 to 31 March 2022 and included: • measured data on raw materials' quantities and transport, packaging, manufacturing and transport to the client. • data based on realistic assumptions regarding losses and transport of raw materials as well as SPF losses and ancillary materials at the installation stage.
Secondary data	Secondary data was obtained from the following sources: • the Ecoinvent version 3.9.1 "cut-off" database [21] • scientific reports • reference guides

Table 11. Data quality assessment

Criterion	Evaluation
Geographical representativeness	The primary data represents the life cycle stages of the SPFs in the Canadian context. The secondary data was selected so that the geographical context is as representative as possible of Genyk's SPFs. The electricity grid mix and natural gas used to manufacture component B are representative of the Quebec context. Regarding the manufacturing of raw materials and packaging for the A-side and B-side as well as the manufacturing of ancillary materials for installation, data representative of the global or European market was used depending on the source of these materials. The electricity grid mixes used for the storage of the A-side and B-side are representative of the Canadian province where the warehouses are located. The data for the use of natural gas representative of Quebec was chosen as a proxy for all warehouses in Canada. Transportation by semi-trailer truck in Canada and the United States was modelled using global data from Ecoinvent v3.9.1. The geographical representativeness of the primary and secondary data is considered satisfactory.
Temporal representativeness	The primary data is representative of the reference period (1 April 2021 to 31 March 2022). The secondary data comes from recent reports and reference guides, i.e., published less than 10 years ago. The life cycle inventory data is taken from the Ecoinvent version 3.9.1 (2022) database, which is based on version 3.0 (released annually since 2013). It should be noted that some version 3.0 data comes from earlier versions (1991-2012). The primary and secondary data is deemed satisfactory in terms of temporal representativeness.
Technological representativeness	The primary data is based on data measured by Genyk or on realistic assumptions. The secondary data was selected in order to represent the technologies used during the life cycle of the SPFs as accurately as possible. This included the energy and raw materials used in the manufacturing of the B-side and the manufacturing of the A-side and its installation. As there is no data for the manufacturing of the HFO for Boreal Nature Elite™ and Duraseal™ in Ecoinvent, LCA data representing the production of HFO 1234ze was used [22]. This proxy is considered acceptable. Due to the lack of data, the production of metal catalysts was modelled using a generic proxy (chemical production, organic) from the Ecoinvent database. The modelling of ancillary materials is based on realistic assumptions about their composition. The primary and secondary data are considered to have a satisfactory technological representativeness.
Completeness	All flows whose mass and energy flow are above the cut-off threshold (1%) were included in the LCA in accordance with the PCR Part B. No known flow was deliberately excluded. The study is considered to have a satisfactory level of completeness.

4.8. Scenarios used beyond the manufacturing stage

4.8.1 Transport to the construction site (A4)

Table 12. Scenarios for the SPF transport from the manufacturing plant to the construction site (B = Boreal Nature Elite™, D = Duraseal™, F = Floraseal 50™)

Parameter	Value / Specification			Unit
	B	D	F	
Scenario 1 - Shipping to the applicator and the construction site				
Share of the tonnage for this scenario	**18%**	**73%**	**52%**	**-**
Transport step 1 – from Genyk's manufacturing plant to the applicator by truck				
Fuel type	Diesel	Diesel	Diesel	-
Liters of fuel[3]	18 - 25	18 - 25	18 - 25	L/100km
Vehicle type	Truck with a load capacity between 7.5 and 16 tons and 16 to 32 tons	Truck with a load capacity between 7.5 and 16 tons and 16 to 32 tons	Truck with a load capacity between 7.5 and 16 tons and 16 to 32 tons	-
Transport distance	150	150	150	km
Capacity utilization	Unknown[1]	Unknown[1]	Unknown[1]	-
Mass transported	0.13	0.99	0.22	kg/UF
Transport step 2 – from the applicator to the construction site by cube truck				
Fuel type	Diesel	Diesel	Diesel	-
Liters of fuel[3]	13	13	13	L/100km
Vehicle type	Cube truck	Cube truck	Cube truck	-
Transport distance	50	50	50	km
Capacity utilization	Unknown[1]	Unknown[1]	Unknown[1]	-
Mass transported[2]	0.26	2.04	0.43	kg/UF

Parameter	Value / Specification			Unit
	B	D	F	
Scenario 2 - Shipping to the applicator and the construction site via a warehouse				
Share of the tonnage for this scenario	**82%**	**27%**	**48%**	**-**
Transport step 1 - from Genyk's manufacturing plant to the warehouse by semi-trailer truck				
Fuel type	Diesel	Diesel	Diesel	-
Liters of fuel[3]	35	35	35	L/100km
Vehicle type	Semi-trailer truck with a load capacity of 32 tons or more	Semi-trailer truck with a load capacity of 32 tons or more	Semi-trailer truck with a load capacity of 32 tons or more	-
Average transport distance	1 547	1 239	2 621	km
Capacity utilization	Unknown[1]	Unknown[1]	Unknown[1]	-
Mass transported	0.57	0.36	0.20	kg/UF
Transport step 2 - from the warehouse to the applicator by truck				
Fuel type	Diesel	Diesel	Diesel	-
Liters of fuel[3]	18	18	18	L/100km
Vehicle type	Truck with a load capacity between 7.5 and 16 tons	Truck with a load capacity between 7.5 and 16 tons	Truck with a load capacity between 7.5 and 16 tons	-
Transport distance	50	50	50	km
Capacity utilization	Unknown[1]	Unknown[1]	Unknown[1]	-
Mass transported	0.57	0.36	0.20	kg/UF
Transport step 3 - from the applicator to the construction site by cube truck				
Fuel type	Diesel	Diesel	Diesel	-
Liters of fuel[3]	13	13	13	L/100km
Vehicle type	Cube truck	Cube truck	Cube truck	-
Transport distance	50	50	50	km
Capacity utilization	Unknown[1]	Unknown[1]	Unknown[1]	-
Mass transported[2]	1.17	0.74	0.39	kg/UF

[1] Information about the truck's capacity utilization is not available. The information provided in the Ecoinvent v3.9.1 database concerns the total mass of the truck and not the maximum mass that the vehicle can contain, thus it is not possible to determine the capacity utilization.

[2] The mass transported from the applicator to the construction site includes the mass of the plural-component pump used for the installation.

[3] Fuel consumption is calculated considering the average mass transported per vehicle type according to Ecoinvent v3.9.1.

Table 13. Scenario for the heating of the warehouse

Parameter	Value / Specification			Unit
	B	D	F	
Electric heating	0.02	0.04	0.01	kWh/UF
Natural gas heating	0.10	0.19	0.41	MJ/UF

4.8.2 Installation (A5)

Table 14. SPF installation scenario

Parameter		Value / Specification			Unit
		B	D	F	
Diesel for the plural-component pump		0.04	0.08	0.02	L/UF
Ancillary materials	Nitrile gloves	8.56E-5	1.66E-4	4.69E-5	kg/UF
	Cartridges and tube for supplied air respirators	1.36E-3	2.62E-3	7.42E-4	kg/UF
	Protective suits	4.52E-4	8.74E-4	2.47E-4	kg/UF
	Safety goggles	1.33E-5	2.56E-5	7.26E-6	kg/UF
	Adhesive tape	1.90E-4	3.67E-4	1.04E-4	kg/UF
	Roll of polyethylene film	1.77E-3	3.43E-3	9.72E-4	kg/UF
Other resources		-	-	-	-
SPF loss		0.006	0.012	0.007	kg/UF
Packaging waste		0.06	0.12	0.04	kg/UF
Direct emissions of HFO to the air		0.004	0.006	-	kg/UF
Direct emissions of CO_2 to the air		0.012	0.023	0.073	kg/UF
Other emissions to ambient air, soil and water[1]		-	-	-	kg/UF
Volatile organic compound emissions (VOCs)[1]		-	-	-	mg/m^3

[1] No direct emissions are currently measured other than the HFO and CO_2.

Table 15. Transport and end-of-life scenario for packaging waste

Parameter	Value / Specification			Unit
	B	D	F	
Transport to landfill or recycling site				
Transport distance	50	50	50	km
Vehicle type	Truck with a load capacity between 7.5 and 16 tons	Truck with a load capacity between 7.5 and 16 tons	Truck with a load capacity between 7.5 and 16 tons	0
Steel drums, plastic totes and wood pallets				
Recycling rate	100%	100%	100%	-
Landfill rate	0%	0%	0%	-
Biogenic carbon contained in the wood of the pallet	1.70E-3	3.35E-3	1.02E-3	kg/UF
Ancillary materials				
Recycling rate	0%	0%	0%	-
Landfill rate	100%	100%	100%	-

4.8.3 Use (B1 - B7)

During use, Boreal Nature Elite™ and Duraseal™ SPFs emit HFO to the air. No other emissions or use of resources occur during its lifetime. In addition, no maintenance, repair, or replacement processes were included.

Table 16. SPF use scenario

Parameter	Value / Specification			Unit
	B	D	F	
Direct emissions of HFO to the air	9.33E-3	1.39E-2	-	kg/UF
Other emissions to ambient air, soil and water	-	-	-	kg/UF
Volatile organic compound emissions (VOCs)	-	-	-	kg/UF

4.8.4 Reference service life

Table 17. Reference service life of the SPF

Parameter	Value / Specification	Unit
Reference service life	75	years
Declared product properties	Building envelope thermal insulation	-
Design application parameters	The SPFs must be installed using a plural-component pump and personal protective equipment to limit the risk of exposure to certain hazardous chemicals. Please consult the safety data sheets and installation guide available from Genyk. SPF must be installed in accordance with applicable building codes by installers that are certified by UFC in accordance with CAN/ULC S705 2 [23].	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	The SPF meets the specified R-value. The temperature, humidity, equipment, and substrate can affect installation parameters.	-
Outdoor environment	The temperature of the substrate and ambient temperature should be between -10°C and 35°C during installation.	-
Indoor environment	The temperature of the substrate and ambient temperature should be between -10°C and 35°C during installation.	-
Use conditions	The SPF is combustible and must be protected by a thermal barrier.	-
Maintenance	No maintenance required.	-

4.8.5 End of life (C1 - C4)

Table 18. SPF end-of-life scenario

Parameter		Value / Specification			Unit
		B	D	F	
Description of the end-of-life scenario		Considering that the building is demolished without any sorting or recycling of materials when it reaches its end of life, the SPF is assumed to be incorporated into the rest of the demolition waste and sent to a landfill site. HFO from Boreal Nature Elite™ and Duraseal™ SPFs is emitted to the air at the landfill site.			
Transport distance		50	50	50	km
Vehicle type		Truck with a load capacity between 7.5 and 16 tons	Truck with a load capacity between 7.5 and 16 tons	Truck with a load capacity between 7.5 and 16 tons	km
Collection process	Collected separately	-	-	-	kg/UF
	Collected with mixed construction waste	0.62	1.20	0.35	kg/UF
Recovery	Re-use	-	-	-	kg/UF
	Recycling	-	-	-	kg/UF
	Incineration	-	-	-	kg/UF
	Incineration with energy recovery	0.62	1.20	0.35	kg/UF
HFO emissions		6.22E-3	9.27E-3	-	kg/UF

5| ENVIRONMENTAL IMPACTS

5.1. Life cycle impact assessment results

The results of the life cycle impact assessment are reported for 1 m² of SPF giving an average thermal resistance of RSI = 1 m²K/W. The results were calculated for six impact categories using the TRACI 2.1 impact assessment method [24] and are reported for each declared life cycle module [2] [25]. In addition, the results for global warming considering IPCC 2013 (AR5) [26] are also presented as they provide an emissions factor for the HFO blowing agents.

Table 19. Life cycle impacts – Boreal Nature Elite™

INDICATOR		UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
				(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
				A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Global warming potential	TRACI 2.1 (IPCC AR4)	kg CO_2 eq	3.94E+0	3.32E+0	1.82E-1	1.19E-1	1.75E-1	8.22E-2	0.00E+0	0.00E+0	0.00E+0	7.35E-3	0.00E+0	5.92E-2
	IPCC 2013 GWP 100A (AR5)	kg CO_2 eq	4.04E+0	3.38E+0	1.85E-1	1.22E-1	1.78E-1	8.73E-2	9.33E-3	0.00E+0	0.00E+0	7.46E-3	0.00E+0	7.40E-2
Acidification of soil and water sources potential		kg SO_2 eq	1.95E-2	1.54E-2	2.04E-3	5.80E-4	6.60E-4	6.70E-4	0.00E+0	0.00E+0	0.00E+0	2.81E-5	0.00E+0	7.34E-5
Eutrophication potential		kg N eq	1.31E-2	1.14E-2	2.40E-4	3.80E-4	1.90E-4	1.00E-4	0.00E+0	0.00E+0	0.00E+0	6.78E-6	0.00E+0	7.70E-4
Smog formation potential		kg O_3 eq	3.27E-1	2.32E-1	4.89E-2	7.22E-3	1.60E-2	1.97E-2	0.00E+0	0.00E+0	0.00E+0	7.00E-4	0.00E+0	1.59E-3
Ozone depletion potential		kg CFC-11 eq	2.65E-7	2.41E-7	3.06E-9	1.74E-9	2.98E-9	1.55E-8	0.00E+0	0.00E+0	0.00E+0	1.26E-10	0.00E+0	2.28E-10
Abiotic depletion potential (fossil resources)		MJ (LHV)	8.36E+0	7.39E+0	3.26E-1	1.03E-1	3.51E-1	1.45E-1	0.00E+0	0.00E+0	0.00E+0	1.45E-2	0.00E+0	2.42E-2

Table 20. Life cycle impacts – Duraseal™

INDICATOR		UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
				(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
				A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Global warming potential	TRACI 2.1 (IPCC AR4)	kg CO_2 eq	7.59E+0	6.41E+0	3.90E-1	2.81E-1	2.17E-1	1.59E-1	0.00E+0	0.00E+0	0.00E+0	1.43E-2	0.00E+0	1.15E-1
	IPCC 2013 GWP 100A (AR5)	kg CO_2 eq	7.80E+0	6.53E+0	3.96E-1	2.87E-1	2.20E-1	1.73E-1	2.78E-2	0.00E+0	0.00E+0	1.45E-2	0.00E+0	1.50E-1
Acidification of soil and water sources potential		kg SO_2 eq	3.82E-2	2.98E-2	4.76E-3	1.37E-3	7.90E-4	1.30E-3	0.00E+0	0.00E+0	0.00E+0	5.47E-5	0.00E+0	1.40E-4
Eutrophication potential		kg N eq	2.56E-2	2.23E-2	5.40E-4	9.10E-4	2.10E-4	2.00E-4	0.00E+0	0.00E+0	0.00E+0	1.32E-5	0.00E+0	1.50E-3
Smog formation potential		kg O_3 eq	6.46E-1	4.54E-1	1.13E-1	1.71E-2	1.91E-2	3.81E-2	0.00E+0	0.00E+0	0.00E+0	1.35E-3	0.00E+0	3.09E-3
Ozone depletion potential		kg CFC-11 eq	5.12E-7	4.67E-7	6.48E-9	4.12E-9	3.59E-9	3.00E-8	0.00E+0	0.00E+0	0.00E+0	2.45E-10	0.00E+0	4.43E-10
Abiotic depletion potential (fossil resources)		MJ (LHV)	1.59E+1	1.42E+1	6.84E-1	2.32E-1	4.30E-1	2.81E-1	0.00E+0	0.00E+0	0.00E+0	2.82E-2	0.00E+0	4.71E-2

Table 21. Life cycle impacts – Floraseal 50™

INDICATOR		UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
				(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
				A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Global warming potential	TRACI 2.1 (IPCC AR4)	kg CO_2 eq	2.25E+0	1.80E+0	1.21E-1	8.37E-2	1.04E-1	1.12E-1	0.00E+0	0.00E+0	0.00E+0	4.13E-3	0.00E+0	3.33E-2
	IPCC 2013 GWP 100A (AR5)	kg CO_2 eq	2.29E+0	1.82E+0	1.23E-1	8.52E-2	1.06E-1	1.13E-1	0.00E+0	0.00E+0	0.00E+0	4.19E-3	0.00E+0	3.81E-2
Acidification of soil and water sources potential		kg SO_2 eq	1.12E-2	8.43E-3	1.55E-3	4.10E-4	3.90E-4	3.70E-4	0.00E+0	0.00E+0	0.00E+0	1.58E-5	0.00E+0	4.12E-5
Eutrophication potential		kg N eq	7.74E-3	6.69E-3	1.70E-4	2.70E-4	1.10E-4	6.15E-5	0.00E+0	0.00E+0	0.00E+0	3.81E-6	0.00E+0	4.30E-4
Smog formation potential		kg O_3 eq	2.12E-1	1.48E-1	3.69E-2	5.08E-3	9.52E-3	1.08E-2	0.00E+0	0.00E+0	0.00E+0	3.90E-4	0.00E+0	8.90E-4
Ozone depletion potential		kg CFC-11 eq	1.62E-7	1.48E-7	2.00E-9	1.23E-9	1.77E-9	8.51E-9	0.00E+0	0.00E+0	0.00E+0	7.07E-11	0.00E+0	1.28E-10
Abiotic depletion potential (fossil resources)		kg SO_2 eq	4.35E+0	3.76E+0	2.10E-1	6.97E-2	2.09E-1	8.00E-2	0.00E+0	0.00E+0	0.00E+0	8.13E-3	0.00E+0	1.36E-2

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 six 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.

5.2. Life cycle inventory results

5.2.1 Resource use inventory indicators

Table 22. Life cycle inventory results for resource use – Boreal Nature Elite™

INDICATOR	UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
			(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
			A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Renewable primary energy used as energy carrier (fuel)[1]	MJ (LHV)	3.58E+0	3.06E+0	4.75E-2	3.50E-1	8.75E-2	2.16E-2	0.00E+0	0.00E+0	0.00E+0	1.39E-3	0.00E+0	8.56E-3
Renewable primary resources with energy content used as material[1]	MJ (LHV)	1.51E-2	7.30E-3	0.00E+0	7.81E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary resources with energy content[1]	MJ (LHV)	3.60E+0	3.07E+0	4.75E-2	3.58E-1	8.75E-2	2.16E-2	0.00E+0	0.00E+0	0.00E+0	1.39E-3	0.00E+0	8.56E-3
Non-renewable primary resources used as an energy carrier (fuel)[1]	MJ (LHV)	5.15E+1	4.40E+1	2.39E+0	1.41E+0	2.60E+0	8.91E-1	0.00E+0	0.00E+0	0.00E+0	1.03E-1	0.00E+0	1.99E-1
Non-renewable primary resources with energy content used as material[1]	MJ (LHV)	1.33E+1	1.31E+1	0.00E+0	1.88E-2	0.00E+0	1.56E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary resources with energy content[1]	MJ (LHV)	6.48E+1	5.70E+1	2.39E+0	1.43E+0	2.60E+0	1.05E+0	0.00E+0	0.00E+0	0.00E+0	1.03E-1	0.00E+0	1.99E-1
Renewable secondary fuels	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-renewable secondary fuels	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Secondary materials[2]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Recovered energy[3]	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net freshwater resources[4]	m^3	6.30E-2	6.04E-2	3.50E-4	1.28E-3	7.80E-4	4.90E-5	0.00E+0	0.00E+0	0.00E+0	1.24E-5	0.00E+0	1.80E-4

[1] *The results of these indicators were calculated with the CED LHV method* [27] *according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017"* [28].

[2] *The SPFs do not contain any secondary source materials; this inventory indicator is therefore zero.*

[3] *The SPFs are not used for energy recovery; this inventory indicator is therefore zero.*

[4] *The results of this indicator were determined by using the "water consumption" indicator of the ReCiPe 2016 Midpoint (H) impact assessment method* [27].

Table 23. Life cycle inventory results for resource use – Duraseal™

INDICATOR	UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
			(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
			A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Renewable primary energy used as energy carrier (fuel)[1]	MJ (LHV)	7.22E+0	6.05E+0	1.04E-1	8.14E-1	1.86E-1	4.18E-2	0.00E+0	0.00E+0	0.00E+0	2.71E-3	0.00E+0	1.67E-2
Renewable primary resources with energy content used as material[1]	MJ (LHV)	2.98E-2	1.41E-2	0.00E+0	1.57E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary resources with energy content[1]	MJ (LHV)	7.25E+0	6.07E+0	1.04E-1	8.30E-1	1.86E-1	4.18E-2	0.00E+0	0.00E+0	0.00E+0	2.71E-3	0.00E+0	1.67E-2
Non-renewable primary resources used as an energy carrier (fuel)[1]	MJ (LHV)	1.00E+2	8.65E+1	5.05E+0	3.30E+0	3.15E+0	1.73E+0	0.00E+0	0.00E+0	0.00E+0	2.01E-1	0.00E+0	3.88E-1
Non-renewable primary resources with energy content used as material[1]	MJ (LHV)	2.56E+1	2.53E+1	0.00E+0	0.00E+0	0.00E+0	3.02E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary resources with energy content[1]	MJ (LHV)	1.26E+2	1.12E+2	5.05E+0	3.30E+0	3.15E+0	2.03E+0	0.00E+0	0.00E+0	0.00E+0	2.01E-1	0.00E+0	3.88E-1
Renewable secondary fuels	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-renewable secondary fuels	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Secondary materials[2]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Recovered energy[3]	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net freshwater resources[4]	m³	1.24E-1	1.18E-1	7.40E-4	2.95E-3	1.31E-3	9.50E-5	0.00E+0	0.00E+0	0.00E+0	2.42E-5	0.00E+0	3.60E-4

[1] *The results of these indicators were calculated with the CED LHV method* [27] *according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017"* [28].

[2] *The SPFs do not contain any secondary source materials; this inventory indicator is therefore zero.*

[3] *The SPFs are not used for energy recovery; this inventory indicator is therefore zero.*

[4] *The results of this indicator were determined by using the "water consumption" indicator of the ReCiPe 2016 Midpoint (H) impact assessment method* [27].

Table 24. Life cycle inventory results for resource use – Floraseal 50™

INDICATOR	UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
			(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
			A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Renewable primary energy used as energy carrier (fuel)[1]	MJ (LHV)	2.83E+0	2.48E+0	3.34E-2	2.43E-1	5.81E-2	1.19E-2	0.00E+0	0.00E+0	0.00E+0	7.80E-4	0.00E+0	4.81E-3
Renewable primary resources with energy content used as material[1]	MJ (LHV)	9.10E-3	4.25E-3	0.00E+0	4.85E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary resources with energy content[1]	MJ (LHV)	2.84E+0	2.48E+0	3.34E-2	2.48E-1	5.81E-2	1.19E-2	0.00E+0	0.00E+0	0.00E+0	7.80E-4	0.00E+0	4.81E-3
Non-renewable primary resources used as an energy carrier (fuel)[1]	MJ (LHV)	2.69E+1	2.24E+1	1.52E+0	8.75E-1	1.48E+0	4.77E-1	0.00E+0	0.00E+0	0.00E+0	5.74E-2	0.00E+0	1.06E-1
Non-renewable primary resources with energy content used as material[1]	MJ (LHV)	6.36E+0	6.27E+0	0.00E+0	2.83E-3	0.00E+0	8.56E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary resources with energy content[1]	MJ (LHV)	3.33E+1	2.87E+1	1.52E+0	8.78E-1	1.48E+0	5.63E-1	0.00E+0	0.00E+0	0.00E+0	5.74E-2	0.00E+0	1.06E-1
Renewable secondary fuels	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-renewable secondary fuels	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Secondary materials[2]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Recovered energy[3]	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net freshwater resources[4]	m³	3.63E-2	3.46E-2	2.30E-4	8.80E-4	4.40E-4	2.80E-5	0.00E+0	0.00E+0	0.00E+0	6.98E-6	0.00E+0	1.00E-4

[1] *The results of these indicators were calculated with the CED LHV method* [27] *according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017"* [28].

[2] *The SPFs do not contain any secondary source materials; this inventory indicator is therefore zero.*

[3] *The SPFs are not used for energy recovery; this inventory indicator is therefore zero.*

[4] *The results of this indicator were determined by using the "water consumption" indicator of the ReCiPe 2016 Midpoint (H) impact assessment method* [27].

5.2.2 Waste categories and output flows inventory indicators

Table 25. Life cycle inventory results for waste categories and output flows – Boreal Nature Elite™

INDICATOR	UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
			(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
			A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Hazardous waste disposed[1]	kg	4.58E-3	0.00E+0	0.00E+0	7.15E-4	0.00E+0	3.87E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed[1]	kg	6.24E-1	0.00E+0	0.00E+0	8.15E-4	0.00E+0	6.03E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	6.17E-1
High-level radioactive waste[2]	m³	2.31E-9	1.78E-9	3.77E-11	1.37E-10	3.36E-10	1.49E-11	0.00E+0	0.00E+0	0.00E+0	1.18E-12	0.00E+0	8.50E-12
Intermediate- and low-level radioactive waste[2]	m³	1.10E-8	9.57E-9	2.03E-10	6.93E-10	3.70E-10	7.95E-11	0.00E+0	0.00E+0	0.00E+0	5.92E-12	0.00E+0	4.67E-11
Components for reuse[3]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for recycling[1]	kg	4.92E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.92E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for energy recovery[3]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported energy[3]	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

Table 26. Life cycle inventory results for waste categories and output flows – Duraseal™

INDICATOR	UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
			(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
			A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Hazardous waste disposed[1]	kg	9.46E-3	0.00E+0	0.00E+0	1.97E-3	0.00E+0	7.49E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed[1]	kg	1.21E+0	0.00E+0	0.00E+0	1.57E-3	0.00E+0	1.18E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.20E+0
High-level radioactive waste[2]	m³	4.38E-9	3.57E-9	8.16E-11	3.19E-10	3.60E-10	2.88E-11	0.00E+0	0.00E+0	0.00E+0	2.31E-12	0.00E+0	1.65E-11
Intermediate- and low-level radioactive waste[2]	m³	2.20E-8	1.93E-8	4.40E-10	1.62E-9	4.13E-10	1.54E-10	0.00E+0	0.00E+0	0.00E+0	1.15E-11	0.00E+0	9.09E-11
Components for reuse[3]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for recycling[1]	kg	9.91E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	9.91E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for energy recovery[3]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported energy[3]	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

[1] The results of these indicators were calculated according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017" [28] *by using the foreground data provided by the manufacturer.*

[2] The results of these indicators were calculated according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017" [28] *by using the inventory data. It is important to note that the foreground data of this LCA does not include radioactive waste, i.e., the SPF manufacturing process does not directly generate radioactive waste. According to ISO 21930:2017* [2], *radioactive waste, when generated for electricity production, consists mainly of spent fuel from reactors (high-level radioactive waste) and routine maintenance and operation of the facilities (low- and medium-level radioactive waste).*

[3] The SPFs are not recovered or reused. These inventory indicators are therefore zero.

Table 27. Life cycle inventory results for waste categories and output flows – Floraseal 50™

INDICATOR	UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
			(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
			A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Hazardous waste disposed[1]	kg	2.91E-3	0.00E+0	0.00E+0	7.91E-4	0.00E+0	2.12E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed[1]	kg	3.54E-1	0.00E+0	0.00E+0	4.91E-4	0.00E+0	6.87E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.46E-1
High-level radioactive waste[2]	m³	1.49E-9	1.25E-9	2.58E-11	9.51E-11	1.06E-10	8.21E-12	0.00E+0	0.00E+0	0.00E+0	6.65E-13	0.00E+0	4.77E-12
Intermediate- and low-level radioactive waste[2]	m³	7.66E-9	6.81E-9	1.40E-10	4.83E-10	1.53E-10	4.39E-11	0.00E+0	0.00E+0	0.00E+0	3.33E-12	0.00E+0	2.62E-11
Components for reuse[3]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for recycling[1]	kg	3.01E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.01E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for energy recovery[3]	kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported energy[3]	MJ (LHV)	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

[1] The results of these indicators were calculated according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017" [28] *by using the foreground data provided by the manufacturer.*

[2] The results of these indicators were calculated according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017" [28] *by using the inventory data. It is important to note that the foreground data of this LCA does not include radioactive waste, i.e., the SPF manufacturing process does not directly generate radioactive waste. According to ISO 21930:2017* [2]*, radioactive waste, when generated for electricity production, consists mainly of spent fuel from reactors (high-level radioactive waste) and routine maintenance and operation of the facilities (low- and medium-level radioactive waste).*

[3] The SPFs are not recovered or reused. These inventory indicators are therefore zero.

5.2.3 Biogenic carbon emissions and removals inventory indicators

Table 28. Life cycle inventory results for biogenic carbon emissions and removals – Boreal Nature Elite™

INDICATOR	UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
			(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
			A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Biogenic carbon removal from product[1]	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Biogenic carbon emission from product[1]	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Biogenic carbon removal from packaging[1,2]	kg CO_2	0.00E+0	-8.20E-4	0.00E+0	-8.77E-4	0.00E+0	1.70E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Biogenic carbon emission from packaging[1]	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Calcination carbon emissions	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Carbonation carbon removals	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Carbon emissions from combustion of waste from non-renewable sources used in production processes	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Carbon emissions from combustion of waste from renewable sources used in production processes	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

Table 29. Life cycle inventory results for biogenic carbon emissions and removals – Duraseal™

INDICATOR	UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
			(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
			A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Biogenic carbon removal from product[1]	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Biogenic carbon emission from product[1]	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Biogenic carbon removal from packaging[1,2]	kg CO_2	0.00E+0	-1.59E-3	0.00E+0	-1.76E-3	0.00E+0	3.35E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Biogenic carbon emission from packaging[1]	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Calcination carbon emissions	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Carbonation carbon removals	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Carbon emissions from combustion of waste from non-renewable sources used in production processes	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Carbon emissions from combustion of waste from renewable sources used in production processes	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

[1]*The results of these indicators were calculated according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017"* [28].

[2]*The packaging for MDI and polyol resin includes wood pallets that contain biogenic carbon. At their end of life, these pallets are recycled and are therefore modelled as a flow leaving the system. This means that all the biogenic carbon contained in these pallets is considered to be re-emitted to the atmosphere and is counted as a negative absorption* [28].

Table 30. Life cycle inventory results for biogenic carbon emissions and removals – Floraseal 50™

INDICATOR	UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
			(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
			A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Biogenic carbon removal from product[1]	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Biogenic carbon emission from product[1]	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Biogenic carbon removal from packaging[1,2]	kg CO_2	0.00E+0	-4.77E-4	0.00E+0	-5.45E-4	0.00E+0	1.02E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Biogenic carbon emission from packaging[1]	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Calcination carbon emissions	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Carbonation carbon removals	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Carbon emissions from combustion of waste from non-renewable sources used in production processes	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Carbon emissions from combustion of waste from renewable sources used in production processes	kg CO_2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

[1]*The results of these indicators were calculated according to the "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017"* [28].

[2]*The packaging for MDI and polyol resin includes wood pallets that contain biogenic carbon. At their end of life, these pallets are recycled and are therefore modelled as a flow leaving the system. This means that all the biogenic carbon contained in these pallets is considered to be re-emitted to the atmosphere and is counted as a negative absorption* [28].

5.3. Life cycle assessment interpretation

The life cycle impacts are interpreted by means of a contribution analysis. The purpose of the contribution analysis is to determine the share of impacts associated with the different life cycle modules (tables 31 to 33).

Table 31. Share of impacts associated with life cycle modules – Boreal Nature Elite™

INDICATOR		UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
				(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
				A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Global warming potential	TRACI 2.1 (IPCC AR4)	kg CO_2 eq	100.0%	84.1%	4.6%	3.0%	4.4%	2.1%	0.0%	0.0%	0.0%	0.2%	0.0%	1.5%
	IPCC 2013 GWP 100A (AR5)	kg CO_2 eq	100.0%	83.6%	4.6%	3.0%	4.4%	2.2%	0.2%	0.0%	0.0%	0.2%	0.0%	1.8%
Acidification of soil and water sources potential		kg SO_2 eq	100.0%	79.2%	10.5%	3.0%	3.4%	3.4%	0.0%	0.0%	0.0%	0.1%	0.0%	0.4%
Eutrophication potential		kg N eq	100.0%	87.2%	1.8%	2.9%	1.4%	0.8%	0.0%	0.0%	0.0%	0.1%	0.0%	5.9%
Smog formation potential		kg O_3 eq	100.0%	71.2%	15.0%	2.2%	4.9%	6.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.5%
Ozone depletion potential		kg CFC-11 eq	100.0%	91.1%	1.2%	0.7%	1.1%	5.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Abiotic depletion potential (fossil resources)		kg SO_2 eq	100.0%	88.5%	3.9%	1.2%	4.2%	1.7%	0.0%	0.0%	0.0%	0.2%	0.0%	0.3%

Table 32. Share of impacts associated with life cycle modules – Duraseal™

INDICATOR		UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
				(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
				A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Global warming potential	TRACI 2.1 (IPCC AR4)	kg CO_2 eq	100.0%	84.5%	5.1%	3.7%	2.9%	2.1%	0.0%	0.0%	0.0%	0.2%	0.0%	1.5%
	IPCC 2013 GWP 100A (AR5)	kg CO_2 eq	100.0%	83.7%	5.1%	3.7%	2.8%	2.2%	0.4%	0.0%	0.0%	0.2%	0.0%	1.9%
Acidification of soil and water sources potential		kg SO_2 eq	100.0%	78.0%	12.5%	3.6%	2.1%	3.4%	0.0%	0.0%	0.0%	0.1%	0.0%	0.4%
Eutrophication potential		kg N eq	100.0%	86.8%	2.1%	3.6%	0.8%	0.8%	0.0%	0.0%	0.0%	0.1%	0.0%	5.9%
Smog formation potential		kg O_3 eq	100.0%	70.3%	17.5%	2.6%	2.9%	5.9%	0.0%	0.0%	0.0%	0.2%	0.0%	0.5%
Ozone depletion potential		kg CFC-11 eq	100.0%	91.2%	1.3%	0.8%	0.7%	5.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Abiotic depletion potential (fossil resources)		kg SO_2 eq	100.0%	89.3%	4.3%	1.5%	2.7%	1.8%	0.0%	0.0%	0.0%	0.2%	0.0%	0.3%

Table 33. Share of impacts associated with life cycle modules – Floraseal 50™

INDICATOR		UNIT	TOTAL	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE		END-OF-LIFE STAGE			
				(A1 - A3)			(A4 - A5)		(B1 - B7)		(C1 - C4)			
				A1	A2	A3	A4	A5	B1	B2-B7	C1	C2	C3	C4
Global warming potential	TRACI 2.1 (IPCC AR4)	kg CO_2 eq	100.0%	79.7%	5.4%	3.7%	4.6%	5.0%	0.0%	0.0%	0.0%	0.2%	0.0%	1.5%
	IPCC 2013 GWP 100A (AR5)	kg CO_2 eq	100.0%	79.5%	5.4%	3.7%	4.6%	4.9%	0.0%	0.0%	0.0%	0.2%	0.0%	1.7%
Acidification of soil and water sources potential		kg SO_2 eq	100.0%	75.2%	13.8%	3.7%	3.5%	3.3%	0.0%	0.0%	0.0%	0.1%	0.0%	0.4%
Eutrophication potential		kg N eq	100.0%	86.5%	2.2%	3.5%	1.4%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	5.6%
Smog formation potential		kg O_3 eq	100.0%	70.0%	17.4%	2.4%	4.5%	5.1%	0.0%	0.0%	0.0%	0.2%	0.0%	0.4%
Ozone depletion potential		kg CFC-11 eq	100.0%	91.5%	1.2%	0.8%	1.1%	5.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Abiotic depletion potential (fossil resources)		kg SO_2 eq	100.0%	86.4%	4.8%	1.6%	4.8%	1.8%	0.0%	0.0%	0.0%	0.2%	0.0%	0.3%

For the three SPFs, the life cycle module contributing most to the different impact categories is A1 - Production of raw materials (70.0-91.5% of the impacts). A2 - Transport of raw materials is the second module of the three SPFs' life cycle with the most impacts on the *Global warming potential - TRACI 2. 1* and *IPCC 2013* (4.6-5.4%), the *Acidification potential* (10.5-13.8%), the *Smog formation potential* (15.0-17.5%) and the *Abiotic depletion potential* (4.3-4.8%). In the case of Boreal Nature Elite™ SPF, A4 - Transport to the construction site is the second largest contributor to the *Abiotic depletion potential* (4.2%). As for the *Ozone depletion potential* impact category, the life cycle module A5 - Installation represents the second largest contributor to the impacts (5.3-5.9%) for all of Genyk's SPFs. For the *Eutrophication potential* impact category, the life cycle module C4 - Disposal remains the second highest contributor for all three SPFs (5.6-5.9%).

6 ADDITIONAL ENVIRONMENTAL INFORMATION

6.1. Regulated hazardous substances

Although some raw materials may be classified as hazardous under the Canadian Environmental Protection Act [14], the installed SPF is not classified as a hazardous substance as the hazardous components are rendered chemically inert after installation. In addition, the SPF does not contain any VOC-emitting materials. For more information, please consult the safety data sheets available from Genyk [15][16][17].

6.2. Health and environmental quality during product manufacturing and installation

The manufacturing of the SPFs' constituents entails the use of potentially hazardous chemicals and manufacturing processes. Genyk complies with all local, provincial and federal regulations regarding the use and safe disposal of chemicals (e.g., the Quebec Environment Quality Act and the Canadian Environmental Protection Act) as well as safety requirements for the operation of manufacturing processes (e.g., CNESST and CCOHS). The installation of SPF entails potential exposure to certain hazardous chemical substances. The implementation of risk reduction measures during and immediately after the installation of the SPF, such as the use of personal protective equipment (nitrile gloves, safety goggles, protective suits, supplied air respirators and on-site measures (e.g. ventilation of the work area) is therefore necessary. Potential exposure to liquid and airborne isocyanates (sensitizing agent) through contact with the skin, eyes and respiratory system poses the greatest risk to the installer. For more information, please refer to the safety data sheets and installation guide available from Genyk.

6.3. Energy savings during building operation

The use of an insulation material reduces the energy consumption of a building throughout its life cycle, thereby reducing its environmental impact. In the case of this LCA, the environmental benefits provided by Genyk's SPFs associated with the reduction of the energy consumed by the building were not included in the results presented in section 5, in line with the PCR Part B. Carrying out energy simulations considering several building scenarios (building geometry, type of heating, fenestration rate, etc.) would provide an assessment of the energy savings associated with the use of Genyk's SPFs and thus would enable to determine the reductions in environmental impacts.

6.4. Environmental certifications and activities

Boreal Nature Elite™ obtained and maintains the GREENGUARD GOLD certification, issued and validated yearly by UL Environment, demonstrating the SPF's low emissions for interior environments following the guidelines of the UL 2818 standard [29].

Link to the certificate:
https://www.genyk.com/ca/wp-content/uploads/sites/2/2023/05/LEED_Compliance_Certificate.pdf

The use of Genyk's three SPFs can contribute to acquiring green building program certifications such as the U.S. Green Building Council's LEED® rating system.

6.5. Delayed emissions and unexpected adverse events

Fire

Polyurethane foam is a combustible material. The SPFs must therefore be protected by a thermal barrier and installed in accordance with applicable building codes. Unless it is protected by a thermal barrier, SPF can produce flame spread, toxic or flammable gases, dense smoke, and immediate intense heat in the event of a fire. The SPFs contain flame retardants to control ignition, fire spread and smoke development.

Water

Duraseal™ and Boreal Nature Elite™ closed-cell SPFs are materials that are highly resistant to flood damage. These materials can resist cycles of water immersion and drying and be successfully cleaned. Floraseal 50™ open-cell SPF will absorb water and will need to be replaced in the event of flooding.

Mechanical destruction

If the wall or roof in which the SPF is installed must be replaced, the SPF will also have to be replaced.

6.6. Blowing agent (HFO)

Boreal Nature Elite™ and Duraseal™ SPFs use HFO blowing agents with a low global warming potential. The emissions of these blowing agents only represent a small contribution to the impacts (0.5-0.8%) to the *Global warming potential - IPCC 2013 (AR5)* of these two SPFs.

6.7. Further information

Additional information can be found at: www.genyk.com

7| IMPACT AND INVENTORY INDICATORS DEFINITIONS

Table 34. Impact categories used in the study, definition and unit [24]

Indicator Category	Definition	Unit
Global warming potential	This indicator 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 indicator 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 indicator 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 indicator 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 indicator 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
Abiotic depletion potential (fossil resources)	This indicator measures the depletion of abiotic (fossil) energy resources and represents the excess energy required to extract these resources in the future.	MJ (LHV)

Table 35. Inventory categories used in the study, definition and unit [4]

Indicator Category	Definition	Unit
Renewable primary energy used as energy carrier/material	Use of renewable primary energy as a source of energy (hydroelectric, solar, wind) or as a material (wood, paper).	MJ (LHV)
Non-renewable primary energy used as energy carrier/material	Use of non-renewable primary energy (peat, oil, gas, coal) as a source of energy or as a material (plastics).	MJ (LHV)
Hazardous, non-hazardous and radioactive disposed waste	Generation of hazardous (solvents, engine oil, acids), non-hazardous (concrete, plastic, glass) or radioactive (radioactive fuels, products contaminated by radioactive substances) disposed waste.	kg, m^3
Use of freshwater resources	Freshwater that is consumed, i.e., by evaporation (cooling towers), evapotranspiration, freshwater embedded in the product or drainage of water into the ocean.	m^3
Removals and emissions of biogenic carbon	Biogenic carbon input (removal during biomass formation) and output (emissions) related to the product and packaging.	kg CO_2

8| ABBREVIATIONS, ACRONYMS AND CHEMICAL FORMULAE

- B - Boreal Nature Elite™
- CFC - Chlorofluorocarbon
- CFC-11 - Trichlorofluoromethane
- CH_4 - Methane
- CO_2 - Carbon dioxide
- D - Duraseal™
- EPD - Environmental product declaration
- eq - Equivalent
- F - Floraseal 50™
- FU - Functional unit
- HFO - Hydrofluoroolefin
- HFO 1234ze - (1E)-1,3,3,3-Tetrafluoroprop-1-ene
- LCA - Life cycle assessment
- LHV - Lower heating value
- MDI - Methylene diphenyl diisocyanate
- MJ - Megajoules
- N - Nitrogen
- NO_x - Nitrogen oxides
- O_3 - Ozone
- PCR - Product category rules
- SO_2 - Sulfur dioxide
- SPF – Spray polyurethane foam
- VOCs - Volatile organic compounds

9| GLOSSARY

- **A-side:** methylene diphenyl diisocyanate (MDI).
- **B-side:** polyol resin.
- **Biogenic carbon:** carbon derived from biomass produced by living organisms through natural processes, excluding carbon which is fossilized or derived from fossil resources [2].
- **Biomass:** material of biological origin including organic material (both living and dead) above or below ground (trees, crops, animals) and biological waste (manure). Biomass excludes material embedded in geological formations, fossilized material and peat [2].
- **Blowing agent:** substance generating a cell-like structure (foam) from materials that can undergo hardening or phase transition (such as polymers or metals) via a foaming process [30].
- **Co-product:** any of one or more products from the same process which is not the object of the assessment [2].
- **Cut-off criteria:** 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 [2].
- **Ecoinvent:** Life cycle inventory database for materials, chemicals, power generation systems, transport and waste treatment processes [21].
- **Environmental impact:** any negative or beneficial modification of the environment, resulting wholly or in part from environmental aspects [31], that is to say elements of the activities, products or services of an organization that can interact with the environment [32].
- **Environmental product declaration (EPD):** environmental declaration providing quantified environmental data using predetermined parameters based on the ISO 14040:2006 and ISO 14044:2006 standards [2].
- **Functional unit (FU):** quantified performance of a product system intended to be used as a reference unit in a life cycle assessment [32].
- **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 [32].
- **Mannich:** Mannich polyols are a group of amino polyols with aromatic structure which give fire resistance, good thermal and superior physico-mechanical properties to polyurethane foams [33].
- **Product category rules (PCR):** set of specific rules, requirements and guidelines for the development of EPDs [2]. The PCR referenced in this EPD refer to "UL PCR Part B: Building Envelope Thermal Insulation EPD Requirements" and "UL PCR Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report."
- **Reference service life :** Product lifetime selected for the functional unit [2].

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