Environmental Product Declaration

Siplast Parasolo® TPX Membrane

Siplast is the industry leader in the development and manufacture of advanced, high-performance roofing and waterproofing systems. For more than 60 years, Siplast has been trusted to protect communities and businesses with innovative solutions and a focus on excellent customer service. Siplast's leadership extends to its commitment to making a positive impact on its communities, industry, and planet. Learn more at www.Siplast.com.

Next-Generation TPO Engineered For Extreme Applications.

NSF Certified Environmental Product Declaration www.nsf.org

Environmental Product Declaration

Siplast Parasolo® TPX Membrane

Single Ply Roofing Membrane (TPO)

According to ISO 14025, ISO 14044, and ISO 21930:2017

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025 and ISO 21930-2017. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g., Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	NSF International, 789 N. Dixboro Rd, Ann Arbor, MI 48105,www.nsf.org
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	NSF Certification Policies for Environmental Product Declarations (EPD): November 1, 2022
MANUFACTURER NAME AND ADDRESS	Siplast 14911 Quorum Drive, Suite 600 Dallas, TX 75254
DECLARATION NUMBER	EPD11022
DECLARED PRODUCT & DECLARED UNIT	Siplast Parasolo® TPX Membrane Declared Unit = 1 m²
REFERENCE PCR AND VERSION NUMBER	NSF International: Product Category Rule for Environmental Product Declarations for Single Ply Roofing Membranes, Version 2, Issued 2019 Valid through July 17, 2024
DESCRIPTION OF PRODUCT APPLICATION/USE	Single Ply Roofing Membrane (TPO)
PRODUCT RSL DESCRIPTION	N/A
MARKETS OF APPLICABILITY	Global
DATE OF ISSUE	02/02/2024 - 02/02/2029
PERIOD OF VALIDITY	5 Years
EPD TYPE	Product Specific
DATASET VARIABILITY	N/A
EPD SCOPE	Cradle-to-Gate w/options
YEAR(S) OF REPORTED PRIMARY DATA	2021
LCA SOFTWARE & VERSION NUMBER	LCA for Experts v. 10.6 GAF EPD Generator Tool Version 1.0
LCI DATABASE(S) & VERSION NUMBER	Sphera database & USLCI v2.0
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1; CML 4.1
The sub-category PCR review was conducted by:	
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v3.2 (Dec 2018), based on ISO 21930:2017, serves as the core PCR, with additional considerations from CEN Norm EN 15804 (2013) and the USGBC/UL Environment Part A Enhancement (2017) ☐ INTERNAL ☒ EXTERNAL	Jack Geibig, EcoForm, LLC jgeibig@ecoform.com
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sustainable Solutions Corporation
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jack Geibig, EcoForm, LLC jgeibig@ecoform.com

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

Comparison of the environmental performance using EPD information shall consider all relevant information modules over the full life cycle of the products within the building.

This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. It should be noted that different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

General Information

Description of Company/Organization

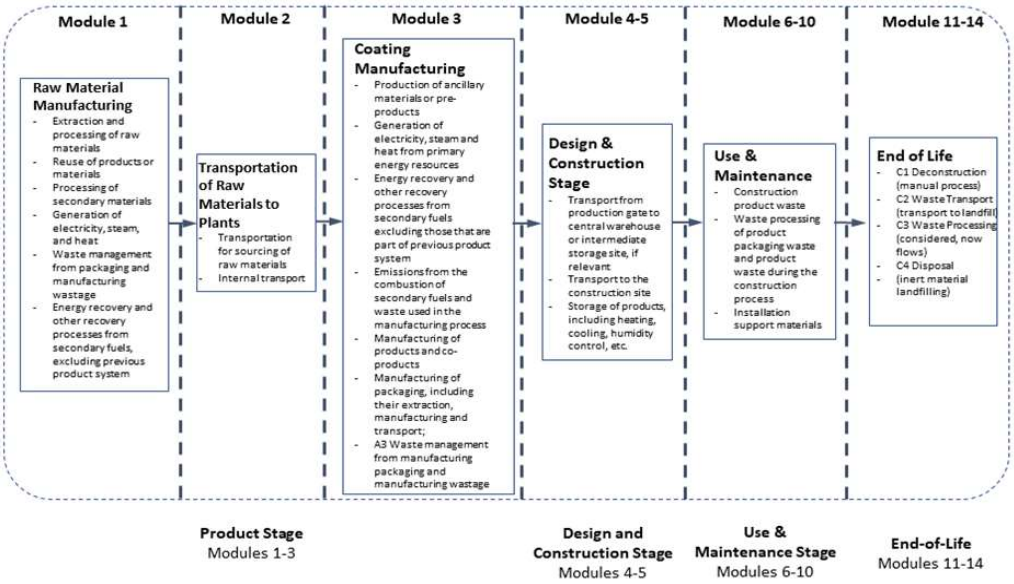
Siplast is the industry leader in the development and manufacture of advanced, high-performance roofing and waterproofing systems. In the 1960s, working with Shell Chemical of Europe, Siplast developed SBS-modified bitumens in response to the changing requirements of modern construction. We have always understood that certain times and unique situations call for different and evolving solutions. That's why we also offer PMMA liquid resin products, single-ply systems, vegetated and reflective white roof systems, reroofable lightweight insulating concrete roof insulation, and a host of other systems. Siplast is with you every step of the way to ensure your project vision fulfills the positive ways you want your work to impact the world. For more information about Siplast, visit www.Siplast.com.

Product Description

Parasolo® TPX Membrane is a single-ply roofing product and is designed to be used as an outer roof layer, either in new construction or re-covering applications. Benefits of Parasolo® TPX Membrane include:
- Great Value: Superior performance at a cost-effective price.
- Excellent Seam Strength: Heat-welded seams provide greater seam strength to taped seams.
- Long-term Weathering: Excellent long-term heat and UV resistance.
- Highly Reflective: Can help reduce rooftop temperatures.

The products included in this EPD are:
- Parasolo® TPX 50-mil Membrane
- Parasolo® TPX 60-mil Membrane
- Parasolo® TPX 80-mil Membrane

Flow Diagram



Manufacturer Specific EPD

This product-specific EPD was developed based on the cradle-to-gate with options (modules A1-A5, C1-C4) Life Cycle Assessment. The EPD accounts for raw material extraction and processing, transport, product manufacturing, distribution, installation, and disposal. Manufacturing data were gathered directly from company personnel. For any product group EPDs, an impact assessment was completed for each product. Product grouping was considered appropriate if the individual product impacts differed by no more than ±10% in any impact category. Average product representations were determined by conducting a weighted average of the manufacturing inventory based on total production in the reference year. Product formulations are consistent between different thicknesses of a product group and across various manufacturing sites.

Application

Single-Ply Roofing Membrane for roofing applications

Material Composition

The primary product components and/or materials must be indicated as a percentage mass to enable the user of the EPD to understand the composition of the product in delivery status.

The average composition of a Parasolo® TPX Membrane Single Ply Roofing Membrane (TPO) is as follows:

	Percentage in mass (%)
Material	**Value**
TPO Resin	60-75%
Polyester Scrim	5-10%
UV Weathering Agent	1-10%
Filler	20-35%
Pigment	1-10%
Total	**100.00%**

***The Siplast product modelled in this study contains no substances that are required to be reported as hazardous, nor are any such substances utilized in its production.*

Technical Data

This product-specific EPD was developed based on the cradle-to-gate with options (modules A1-A5, C1-C4) Life Cycle Assessment. The EPD accounts for raw material extraction and processing, transport, product manufacturing, distribution, installation, and disposal. Manufacturing data were gathered directly from company personnel. For any product group EPDs, an impact assessment was completed for each product. Product grouping was considered appropriate if the individual product impacts differed by no more than ±10% in any impact category. Average product representations were determined by conducting a weighted average of the manufacturing inventory based on total production in the reference year. Product formulations are consistent between different thicknesses of a product group and across various manufacturing sites.

Physical Properties	ASTM Test Method	ASTM D6878 Minimum	Parasolo® Typical Test Data*
Nominal Thickness	ASTM D751	0.039" (min.) (0.99 mm)	0.060" (1.52 mm)
Breaking Strength	ASTM D751 Grab Method	220 lbf/in. (38.5 kn/m)	400 lbf x 360 lbf (596 x 536 kg/m)
Factory Seam Strength	ASTM D751	66 lbf (98.34 kg/m)	145 lbf (membrane failure) (216 kg/m)
Elongation at Break	ASTM D751	15%	30%
Heat Aging	ASTM D573	90% Retention of Breaking Strength and	100%
Tear Strength	ASTM D751 8" x 8" (203 x 203 mm) Sample	55 lbf (81.95 kg/m)	70 lbf x 130 lbf (104 x 194 kg/m)
Puncture Resistance	FTM 101C Method 2031	Not Established	>380 lb. (172 kg)
Cold Brittleness	ASTM D2137	-40°C	-40°C
Permeance	ASTM E96	Not Established	<0.08 Perms
Dimensional Change	ASTM D1204 @158°F (70°C), 6 hrs.	+/- 1%	0.40%
Water Absorption	ASTM D471 @158°F (70°C), 1 week	+/- 3.0% (top coating only)	0.12%
Hydrostatic Resistance	ASTM D751 Method D	Not Established	430 psi
Ozone Resistance	ASTM D1149	No cracks @ 7 x magnification	No visible deterioration @ 7 x magnification
SRI (Solar Reflectance Index) Initial/Aged	N/A	N/A	94/81 83 Aged Title 24
Reflectivity (white) Initial/Aged	ASTM C1549 ASTM E903	N/A N/A	0.76/0.68 81.9% Reflectance
Emissivity (white) Initial/Aged	ASTM C1371 ASTM E403	N/A N/A	0.90/0.83
Weather Resistance	ASTM G155/D6878	10,080 KJ/($m^2 \cdot$ nm) at 340 nm	>25,000 KJ/($m^2 \cdot$ nm) at 340 nm
Heat Aging	ASTM D573	≤1.5% Weight change after 8 Weeks @ 275°	Pass
Thickness Above Scrim	ASTM D7635	0.015"	24.1 mil (Nominal)

*Values stated are approximate and subject to normal manufacturing variation. These values are not guaranteed and are provided solely as a guide.

The standards that can be applied for Parasolo® TPX Membrane are:
- ASTM D751
- ASTM D573
- ASTM D2137
- ASTM E96
- ASTM D1204
- ASTM D6878

Properties of Declared Product as Shipped

After manufacturing, the product is packaged for shipment to the customer. Packaging includes a plastic film referred to as Hooder that wraps around the entire product. Additional packaging includes the pallets that the final product is shipped on. However, Siplast utilizes waste insulation board as the foundation to their pallets. As such, there are no additional packaging inputs required for the pallets.

Methodological Framework

Declared Unit

The declaration refers to the declared unit of 1 m² as specified in the PCR.

Name	Value			Units
Declared unit	1 m²			
Weight per declared unit	1.43	1.69	2.29	kg
Thickness to achieve Declared Unit	50	60	80	mm

System Boundary

This is a cradle-to-gate with options Environmental Product Declaration intended for Business-to-Business (B2B) purposes. The following life cycle phases were considered:

Product Stage			Construction Process Stage		Use Stage							End-of-Life Stage*				Benefits and Loads Beyond the System Boundaries
Raw material supply	Transport	Manufacturing	Transport from gate to the site	Construction/ installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction /demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	MND

Description of the System Boundary Stages Corresponding to the PCR

(X = Included; MND = Module Not Declared)

*This includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues.

Reference Service Life

The reference service life of Siplast Parasolo® TPX Membrane is not declared due to the exclusion of the use-phase.

Allocation

Co-product allocation was determined on a mass basis.

Cut-off Criteria

Processes whose total contribution to the final result, with respect to their mass and in relation to all considered impact categories, is less than 1% can be neglected. The sum of the neglected processes may not exceed 5% by mass of the considered impact categories. For that a documented assumption is admissible.

For Hazardous Substances the following requirements apply:

- The Life Cycle Inventory (LCI) of hazardous substances will be included, if the inventory is available.
- If the LCI for a hazardous substance is not available, the substance will appear as an input in the LCI of the product.
- If the LCI of a hazardous substance is approximated by modeling another substance, documentation will be provided.

This EPD is in compliance with the cut-off criteria. No processes were neglected or excluded. Capital items for the production processes (machine, buildings, etc.) were not taken into consideration.

Data Sources

Primary data were collected for every process in the product system under the control of Siplast. Secondary data from the Sphera (GaBi Content Version 2022.1) and USLCI databases, 2012, were utilized when necessary. These data were evaluated and have temporal, geographic, and technical coverage appropriate to the scope of the product category.

Data Quality

The data sources used are complete and representative of global systems in terms of the geographic and technological coverage and are a recent vintage (i.e., less than ten years old). The data used for primary data are based on direct information sources of the manufacturers. Secondary data sets were used for raw materials extraction and processing, end of life, transportation, and energy production flows. Wherever secondary data is used, the study adopts critically reviewed data for consistency, precision, and reproducibility to limit uncertainty. When a material is not available in the available LCI databases, another chemical which has similar manufacturing and environmental impacts may be used as a proxy, representing the actual chemical.

Important data quality factors include precision (measured, calculated, or estimated), completeness (e.g., unreported emissions or excluded flows), consistency (uniformity of the applied methodology throughout the study), and reproducibility (ability for another researcher reproduce the results based on the methodological information provided). Each dataset has an overall rating from one to four, one being “very good” and four being “poor.” The individual datasets were scored and aggregated to determine the data has an overall average rating of 2.1.

Period Under Review

The period under review is the full calendar year of 2021.

Treatment of Biogenic Carbon

The uptake and release of biogenic carbon throughout the product life cycle follows ISO 21930:2017 Section 7.2.7.

Comparability and Benchmarking

A comparison or an evaluation of EPD data is only possible if all data sets to be compared were created according to ISO 21930 and the building context, respectively the product-specific characteristics of performance, are taken into account. Environmental declarations from different programs may not be comparable. Full conformance with the PCR allows for EPD comparability only when all stages of a product's life cycle have been considered, and the same sub-category PCR, when applicable. Additionally, the functional/declared unit must also be comparable. However, variations and deviations are possible. In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers as the EPD results may.

Units

The LCA results within this EPD are reported in SI units.

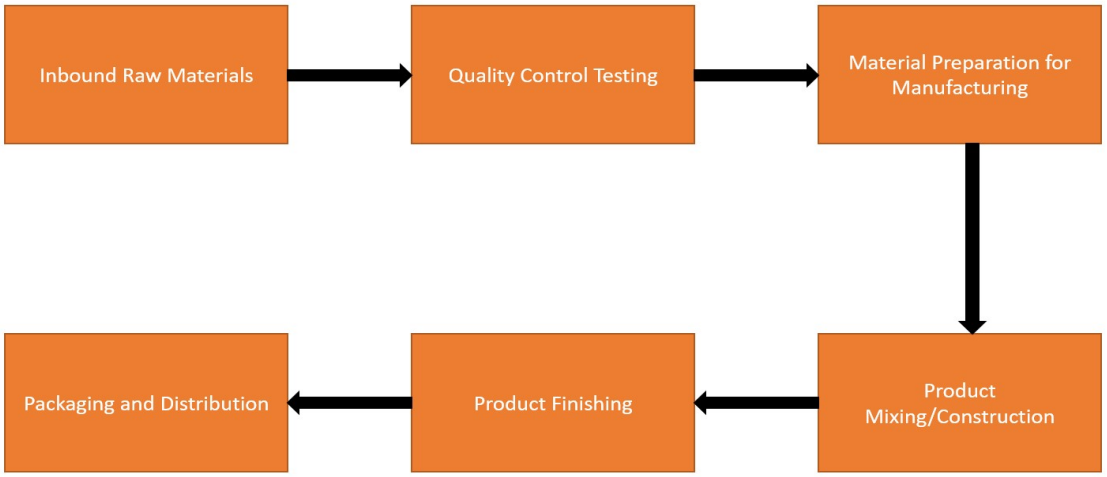
Life Cycle Inventory and Scenarios

Background data

For life cycle modeling of the considered products, the LCA for Experts v. 10.6 Software System for Life Cycle Engineering, developed by Sphera, is used. The Sphera and USLCI databases contain consistent and documented datasets which are documented online. To ensure comparability of results in the LCA, the basic data of the Sphera database were used for energy, transportation, and auxiliary materials.

Manufacturing

Single Ply Roofing Membrane (TPO) is manufactured in Cedar City, Utah; Gainesville, Texas; New Columbia, Pennsylvania; Mt. Vernon, IN and begins with the inbound reception of raw materials. The process begins with adding polymers, performance enhancing ingredients, and other option ingredients to a mixer. The inputs are blended, heated, and then extruded onto the top and bottom of a scrim to form laminated layers. The membrane is then cooled by passing through a series of rollers, wound into rolls or cut to size, and packaged for shipment. The table below describes which facility(ies) produce the product of the study. If multiple facilties produced the product, then a weighted average of total production was used to produce an average life cycle inventory from those facilities.



Product Type	Manufacturing location
TPO	Cedar City, UT
	Gainesville, TX
	Mount Vernon, IN
	New Columbia, PA

Packaging

The packaging material is composed primarily of plastic materials. Single ply roofing products are shipped on pallets and wrapped in plastic film.

	Quantity (% By Weight)
Material	**Value**
Cardboard	1.10%
Wood	23.34%
Paper	2.51%
Plastic	73.04%
Total	**100.00%**

Transportation

Transport to Building Site (A4)		
Name	**Value**	**Unit**
Fuel type	Diesel	
Liters of fuel	38	l/100km
Transport distance	970	km
Capacity utilization (including empty runs)	90	%
Gross density of products transported	29 / 28 / 29	kg/m^3
Weight of products transported	-	kg
Volume of products transported	-	m^3
Capacity utilization volume factor	-	-

Product Installation

Parasolo® TPX membrane can be installed using various methods, including mechanically attached or adhesive adhered. Acceptable deck types include steel, wood, structural concrete & gypsum, light weighted insulating concrete and cementitious wood fiber. Note: Compliance with model building codes does not always ensure compliance with state or local building codes, which may be amended versions of these model codes. Always check with local building code officials to confirm compliance.

Installation Into the Building (A5)		
Name	**Value**	**Unit**
Auxiliary materials	-	kg
Water consumption	-	m^3
Other resources	-	kg
Electricity consumption	-	kWh
Other energy carriers	0.00	MJ
Product loss per declared unit	-	kg
Waste materials at construction site	0.26	kg
Output substance (recycle)	-	kg
Output substance (landfill)	1.43 / 1.69 / 2.29	kg
Output substance (incineration)	-	kg
Packaging waste (recycle)	0.08	kg
Packaging waste (landfill)	0.14	kg
Packaging waste (incineration)	0.04	kg
Biogenic carbon content of packaging	0.12	kg CO_2eq
Direct emissions to ambient air*, soil, and water	0.12	kg
VOC emissions	-	µg/m3

*CO2 emissions to air from disposal of packaging

Disposal

The product is assumed to be 100% landfilled in the end-of-life disposal, in accordance with the PCR.

End of life (C1-C4)		
Name	**Value**	**Unit**
Collected separately	0.00	kg
Collected as mixed construction waste	1.43 / 1.69 / 2.29	kg
Reuse	0.00	kg
Recycling	0.00	kg
Landfilling	1.43 / 1.69 / 2.29	kg
Incineration with energy recovery	0.00	kg
Energy conversion	-	%
Removals of biogenic carbon	-	kg

LCA Results for 50-mil

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

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	4.07E+00	1.28E-01	1.18E+00	0.00E+00	2.13E-02	0.00E+00	4.97E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	2.72E-12	4.84E-12	3.93E-10	0.00E+00	8.07E-13	0.00E+00	1.92E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.12E-02	7.69E-04	9.70E-05	0.00E+00	1.28E-04	0.00E+00	3.62E-03
EP	Eutrophication potential	kg N-Eq.	7.17E-04	4.26E-05	-5.22E-04	0.00E+00	7.10E-06	0.00E+00	1.38E-03
SP	Smog formation potential	kg O_3-Eq.	1.73E-01	2.12E-02	3.21E-02	0.00E+00	3.53E-03	0.00E+00	9.70E-03
FFD	Fossil Fuel Depletion	MJ-surplus	1.22E+01	2.26E-01	2.67E+00	0.00E+00	3.77E-02	0.00E+00	1.15E-01

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	3.98E+00	1.28E-01	1.19E+00	0.00E+00	2.14E-02	0.00E+00	6.86E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	5.36E-12	4.83E-12	3.94E-10	0.00E+00	8.05E-13	0.00E+00	1.12E-13
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.09E-02	6.31E-04	1.75E-03	0.00E+00	1.05E-04	0.00E+00	1.34E-03
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.28E-03	1.12E-04	1.33E-04	0.00E+00	1.87E-05	0.00E+00	1.67E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.23E-03	7.37E-05	2.84E-04	0.00E+00	1.23E-05	0.00E+00	3.31E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	8.91E-06	5.32E-11	3.23E-06	0.00E+00	8.86E-12	0.00E+00	2.69E-08
ADPF	Abiotic depletion potential for fossil resources	MJ	9.46E+01	1.63E+00	2.15E+01	0.00E+00	2.72E-01	0.00E+00	8.86E-01

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the resource use throughout the life cycle of the product.

Resource Use

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E	Renewable primary energy as energy carrier	MJ	3.93E+00	0.00E+00	8.34E-01	0.00E+00	0.00E+00	0.00E+00	8.56E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	1.12E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	6.17E+01	1.65E+00	2.24E+01	0.00E+00	2.74E-01	0.00E+00	9.07E-01
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	3.79E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m^3	5.26E-02	0.00E+00	5.28E-03	0.00E+00	0.00E+00	0.00E+00	2.02E-04

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the output flows and wastes throughout the life cycle of the product.

Output Flows and Waste Categories									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	5.90E-06	0.00E+00	9.76E-10	0.00E+00	0.00E+00	0.00E+00	3.37E-11
NHWD	Non-hazardous waste disposed	kg	3.77E-01	0.00E+00	5.29E-02	0.00E+00	0.00E+00	0.00E+00	1.25E+00
HLRW	High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg	1.95E-03	0.00E+00	3.45E-04	0.00E+00	0.00E+00	0.00E+00	7.92E-06
CRU	Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	Materials for recycling	kg	4.23E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

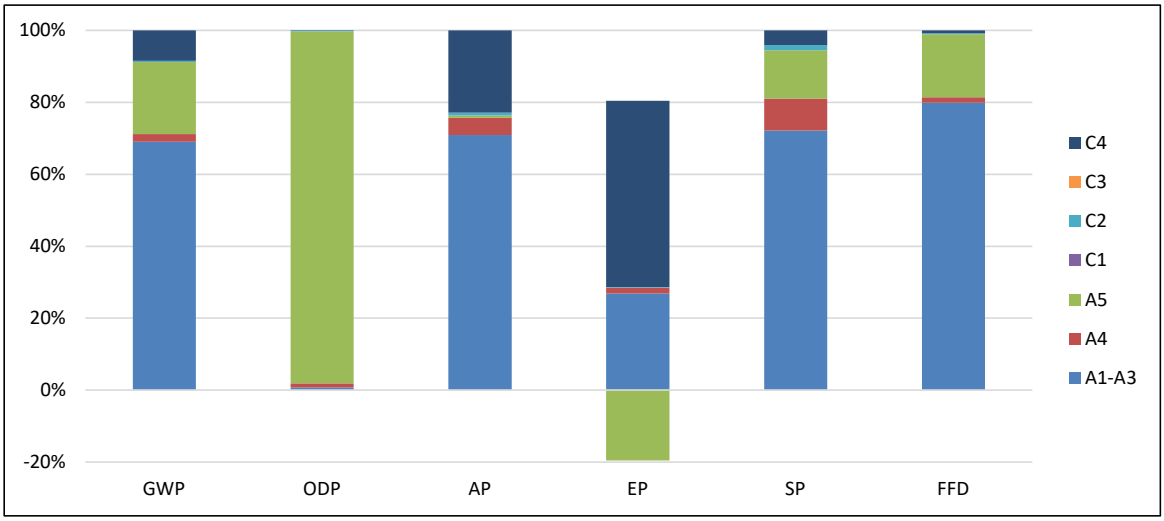
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	1.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	1.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation for 50-mil

The production life cycle stage (A1-A3) dominates the impacts across all impact categories. This is due to the upstream production of materials used in the product, along with natural gas use in the manufacturing of the product. The end-of-life disposal stage (C4) has significant impact in global warming potential, acidification, and eutrophication due to the 100% landfill assumption.



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 these categories:
— renewable primary energy resources as energy (fuel), (RPRE);
— renewable primary resources as material, (RPRM);
— non-renewable primary resources as energy (fuel) ,(NRPRE);
— non-renewable primary resources as material (NRPRM);
— secondary materials (SM);
— renewable secondary fuels (RSF);
— non-renewable secondary fuels (NRSF);
— recovered energy (RE);
— abiotic depletion potential for non-fossil mineral resources (ADPelements).
— 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; and
— recovered energy exported from the product system.

LCA Results for 60-mil

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

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	4.54E+00	1.37E-01	1.59E+00	0.00E+00	2.28E-02	0.00E+00	5.01E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	2.95E-12	5.19E-12	3.93E-10	0.00E+00	8.63E-13	0.00E+00	1.58E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.16E-02	8.24E-04	7.60E-04	0.00E+00	1.37E-04	0.00E+00	3.06E-03
EP	Eutrophication potential	kg N-Eq.	7.75E-04	4.57E-05	-4.48E-04	0.00E+00	7.59E-06	0.00E+00	1.02E-03
SP	Smog formation potential	kg O_3-Eq.	1.94E-01	2.27E-02	3.98E-02	0.00E+00	3.77E-03	0.00E+00	8.52E-03
FFD	Fossil Fuel Depletion	MJ-surplus	1.33E+01	2.43E-01	3.08E+00	0.00E+00	4.03E-02	0.00E+00	6.40E-02

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	4.46E+00	1.38E-01	1.62E+00	0.00E+00	2.29E-02	0.00E+00	7.02E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	5.91E-12	5.18E-12	3.95E-10	0.00E+00	8.61E-13	0.00E+00	9.33E-14
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.09E-02	6.77E-04	2.45E-03	0.00E+00	1.13E-04	0.00E+00	1.34E-03
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.35E-03	1.21E-04	1.55E-04	0.00E+00	2.00E-05	0.00E+00	1.58E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.14E-03	7.91E-05	3.27E-04	0.00E+00	1.31E-05	0.00E+00	3.64E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	7.54E-06	5.70E-11	4.49E-06	0.00E+00	9.48E-12	0.00E+00	1.06E-08
ADPF	Abiotic depletion potential for fossil resources	MJ	1.01E+02	1.75E+00	2.58E+01	0.00E+00	2.91E-01	0.00E+00	4.79E-01

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the resource use throughout the life cycle of the product.

Resource Use									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
RPR_E	Renewable primary energy as energy carrier	MJ	5.47E+00	0.00E+00	1.48E+00	0.00E+00	0.00E+00	0.00E+00	6.18E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	1.07E+02	1.77E+00	2.73E+01	0.00E+00	2.94E-01	0.00E+00	4.94E-01
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m^3	6.35E-02	0.00E+00	6.97E-03	0.00E+00	0.00E+00	0.00E+00	1.40E-04

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the output flows and wastes throughout the life cycle of the product.

Output Flows and Waste Categories									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	7.36E-06	0.00E+00	4.78E-09	0.00E+00	0.00E+00	0.00E+00	1.23E-10
NHWD	Non-hazardous waste disposed	kg	1.34E+00	0.00E+00	6.56E-02	0.00E+00	0.00E+00	0.00E+00	1.33E+00
HLRW	High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg	2.06E-03	0.00E+00	5.29E-04	0.00E+00	0.00E+00	0.00E+00	5.24E-06
CRU	Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

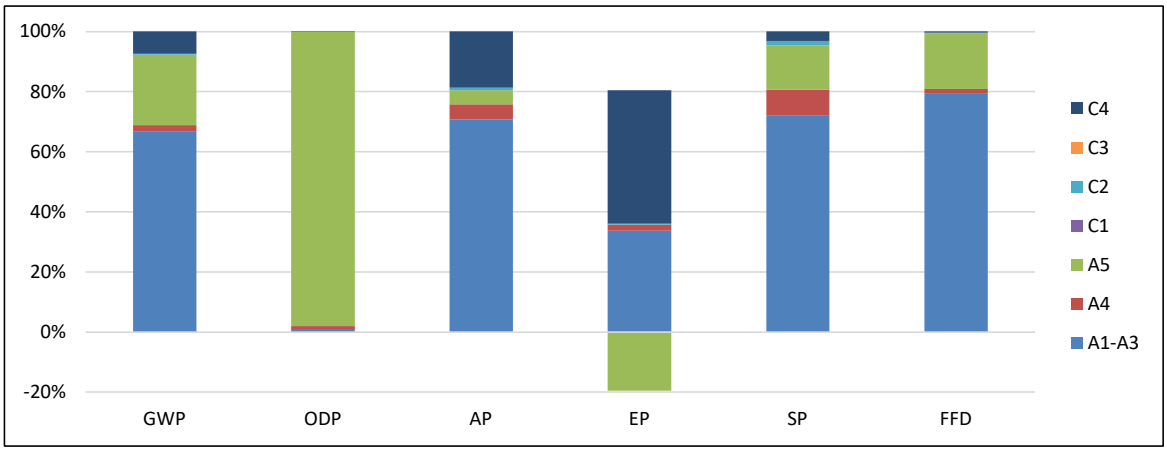
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	1.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	1.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation for 60-mil

The production life cycle stage (A1-A3) dominates the impacts across all impact categories. This is due to the upstream production of materials used in the product, along with natural gas use in the manufacturing of the product. The end-of-life disposal stage (C4) has significant impact in global warming potential, acidification, and eutrophication due to the 100% landfill assumption.



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— renewable primary resources as material, (RPRM);
— non-renewable primary resources as energy (fuel) ,(NRPRE);
— non-renewable primary resources as material (NRPRM);
— secondary materials (SM);
— renewable secondary fuels (RSF);
— non-renewable secondary fuels (NRSF);
— recovered energy (RE);
— abiotic depletion potential for non-fossil mineral resources (ADPelements).
— 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; and
— recovered energy exported from the product system.

LCA Results for 80-mil

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

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	6.70E+00	2.06E-01	1.59E+00	0.00E+00	3.41E-02	0.00E+00	7.50E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.12E-12	7.79E-12	3.93E-10	0.00E+00	1.29E-12	0.00E+00	2.36E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.66E-02	1.24E-03	7.60E-04	0.00E+00	2.05E-04	0.00E+00	4.57E-03
EP	Eutrophication potential	kg N-Eq.	1.13E-03	6.85E-05	-4.48E-04	0.00E+00	1.14E-05	0.00E+00	1.52E-03
SP	Smog formation potential	kg O_3-Eq.	2.81E-01	3.40E-02	3.98E-02	0.00E+00	5.64E-03	0.00E+00	1.28E-02
FFD	Fossil Fuel Depletion	MJ-surplus	1.97E+01	3.64E-01	3.08E+00	0.00E+00	6.03E-02	0.00E+00	9.58E-02

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	6.65E+00	2.06E-01	1.62E+00	0.00E+00	3.42E-02	0.00E+00	1.05E+00
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	9.04E-12	7.77E-12	3.95E-10	0.00E+00	1.29E-12	0.00E+00	1.40E-13
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.56E-02	1.02E-03	2.45E-03	0.00E+00	1.68E-04	0.00E+00	2.01E-03
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.95E-03	1.81E-04	1.55E-04	0.00E+00	3.00E-05	0.00E+00	2.37E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.73E-03	1.19E-04	3.27E-04	0.00E+00	1.97E-05	0.00E+00	5.45E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	1.26E-05	8.55E-11	4.49E-06	0.00E+00	1.42E-11	0.00E+00	1.59E-08
ADPF	Abiotic depletion potential for fossil resources	MJ	1.49E+02	2.63E+00	2.58E+01	0.00E+00	4.35E-01	0.00E+00	7.17E-01

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the resource use throughout the life cycle of the product.

Resource Use									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
RPR_E	Renewable primary energy as energy carrier	MJ	7.75E+00	0.00E+00	1.48E+00	0.00E+00	0.00E+00	0.00E+00	9.25E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	1.58E+02	2.65E+00	2.73E+01	0.00E+00	4.39E-01	0.00E+00	7.39E-01
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m^3	8.91E-02	0.00E+00	6.97E-03	0.00E+00	0.00E+00	0.00E+00	2.09E-04

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the output flows and wastes throughout the life cycle of the product.

Output Flows and Waste Categories									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	1.00E-05	0.00E+00	4.78E-09	0.00E+00	0.00E+00	0.00E+00	1.84E-10
NHWD	Non-hazardous waste disposed	kg	1.89E+00	0.00E+00	6.56E-02	0.00E+00	0.00E+00	0.00E+00	1.99E+00
HLRW	High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg	3.02E-03	0.00E+00	5.29E-04	0.00E+00	0.00E+00	0.00E+00	7.84E-06
CRU	Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

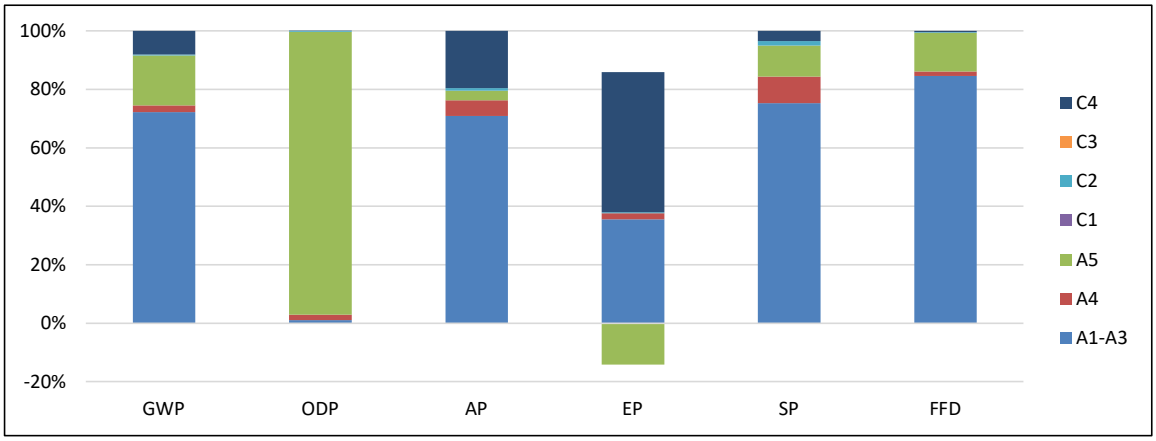
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	1.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	1.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation for 80-mil

The production life cycle stage (A1-A3) dominates the impacts across all impact categories. This is due to the upstream production of materials used in the product, along with natural gas use in the manufacturing of the product. The end-of-life disposal stage (C4) has significant impact in global warming potential, acidification, and eutrophication due to the 100% landfill assumption.



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— renewable primary resources as material, (RPRM);
— non-renewable primary resources as energy (fuel) ,(NRPRE);
— non-renewable primary resources as material (NRPRM);
— secondary materials (SM);
— renewable secondary fuels (RSF);
— non-renewable secondary fuels (NRSF);
— recovered energy (RE);
— abiotic depletion potential for non-fossil mineral resources (ADPelements).
— 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; and
— recovered energy exported from the product system.

Additional Environmental Information

Environmental and Health During Manufacturing

During the manufacturing of Parasolo® TPX Membrane, all legal regulations regarding emissions to air, wastewater discharge, solid waste disposal and noise emissions are followed.

Environmental and Health During Installation

There is no harmful emissive potential. No damage to health or impairment is expected under normal use corresponding to the intended use of the product.

Extraordinary Effects

Fire
Resistance by the roofing system to fire applied to the exterior roof surface is important. Typically, a UL Class B or C rating is required by building code. Also, depending on the use and size of the building and the construction type, fire resistance to fire originating from within the building may be required. This is normally expressed in the form of hourly ratings, and usually requires the use of a specialized roof assembly. Refer to current Parasolo® listings in the appropriate UL directory to verify roof assembly requirements for specific fire ratings.

Water
No environmental impacts are expected due to water exposure of properly installed Parasolo® TPX membrane.

Mechanical Destruction
Parasolo® TPX membrane has excellent mechanical strength. The breaking strength and elongation at break performance are measured by ASTM D751.

Delayed Emissions

Global warming potential is calculated using the TRACI 2.1 and CML 4.1 impact assessment methodologies. Delayed emissions are not considered.

Environmental Activities and Certifications

N/A

Further Information

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- ISO 14044 — ISO 14044:2006-10, Environmental management — Life cycle assessment — Requirements and guidelines.
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