






EverGuard® PVC Roofing Membrane

Smooth Back

Environmental Product Declaration



Program Operator	NSF Certification, LLC 789 N. Dixboro Ann Arbor, MI 48105 www.nsf.org		Certified Environmental Product Declaration www.nsf.org
General Program instructions and Version Number	PCR for Single Ply Roofing Membranes, Version 2, NSF International and ASTM International		
Manufacturer Name and Address	GAF 5080 UT-56 Cedar City, UT 84721		
Declaration Number	EPD10291		
Declared Product and Functional Unit	EverGuard® PVC Smooth Back Membrane 1000 m ² of installed roofing membrane for 75 years, with a thickness of 50 mils (1.27 mm), 60 mils (1.52 mm) or 80 mils (2 mm).		
Facility Included	GAF Cedar City Facility 5080 UT-56 Cedar City, UT 84721		
Reference PCR and Version Number	PCR for Single Ply Roofing Membranes, Version 2, NSF International		
Product's intended Application and Use	Roofing		
Product RSL	25 Years		
Markets of Applicability	North America		
Date of Issue	December 11 th , 2019		
Period of Validity	5 years from date of issue		
EPD Type	Product Specific		
Range of Dataset Variability	N/A		
EPD Scope	Cradle to Grave		
Year of reported manufacturer primary data	2018		
LCA Software and Version Number	GaBi 9.2.0.58		
LCI Database and Version Number	GaBi Database, Service Pack 39		
LCIA Methodology and Version Number	TRACI 2.1 CML 2001-Jan 2016		
The sub-category PCR review was conducted by:	Review Panel chaired by Dr. Thomas Gloria		
This declaration was independently verified in accordance with ISO 14025: 2006 and the reference PCR: PCR for Single Ply Roofing Membranes, Version 2, NSF International and ASTM International ☐ Internal ☐ External	Jenny Oorbeck joorbeck@nsf.org 		
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting, LLC		
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Angela Fisher Aspire Sustainability angela@aspireustainability.com 		
<p>Limitations:</p> <p>Environmental declarations from different programs (ISO 14025) may not be comparable.</p> <p>Comparison of the environmental performance of Single Ply Membranes using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR.</p> <p>Full conformance with the PCR for Single Ply Membranes allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.</p>			



Company Description

Founded in 1886, GAF is the leading roofing manufacturer in North America. As a member of the Standard Industries family of companies, GAF is part of the largest roofing and waterproofing business in the world. The company's products include a comprehensive portfolio of roofing and waterproofing solutions for residential and commercial properties as well as for civil engineering applications. The full GAF portfolio of solutions is supported by an extensive national network of factory-certified contractors. GAF continues to be the leader in quality and offers comprehensive warranty protection on its products and systems. The company's success is driven by a commitment to empowering its people to deliver advanced quality and purposeful innovation. For more information about GAF, visit www.gaf.com.



Product Description

EverGuard® PVC 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. It is made of two layers of polyvinyl chloride (PVC) bonded to a layer of polyester scrim in the middle. This configuration meets all the inherent properties and performance for which PVC is known, including longevity, flexibility and resistance to tears, punctures, chemicals, UV, and ozone.



Application

EverGuard® PVC membrane can be installed using various methods, including mechanically attached, RhinoBond®, or adhesive adhered. Acceptable deck types include steel, wood, structural concrete & gypsum, light weighted insulating concrete, and cementitious wood fiber.

Technical Data

Table 1 Product Performance Properties

Property	Results for 50 mils	Results for 60 mils	Results for 80 mils	ASTM Minimum	Test Method
Product Form	Dual layers of PVC reinforced with a layer of polyester scrim				-
Nominal Thickness	1.27 mm	1.52 mm	2 mm	1.14 mm	ASTM D751
Thickness over Scrim	0.51 mm	0.64 mm	0.76 mm		ASTM D7635
Breaking Strength	>1201.0 N		>1445.7 N	889.6 N (MD & CMD)	ASTM D751
Elongation at Break	25%	25%	25%	15% (MD & CMC)	ASTM D751
Seam Strength	Pass	Pass	Pass	75% (% of tensile or breaking strength)	ASTM D751
Tear Strength	Pass	Pass	Pass	200.2 N (MD & CMD)	ASTM D751
Low Temperature Bend	Pass	Pass	Pass	-40°C	ASTM D2136
Accelerated Weathering	>38360 kJ/m2	>38360 kJ/m2	>38360 kJ/m2	Pass	ASTM G154
Dimensional Stability	0.3%	0.3%	0.5%	=<0.5%	ASTM D1204
Change in Weight after Water Immersion	Pass	Pass	Pass	+/-3%	ASTM D570
Static Puncture Resistance	Pass	Pass	Pass	Pass	ASTM D5602
Dynamic Puncture Resistance	Pass	Pass	Pass	Pass	ASTM D5635
Breaking Strength after Heat Aging	Pass	Pass	Pass	90%	ASTM D3045
Elongation at Break after Heat Aging	Pass	Pass	Pass	90%	ASTM D3045
Solar Reflective Index (SRI) (White)	110	110	110	n/a	ASTM E903
Solar Reflectivity (White) Initial/Aged*	0.87/0.806	0.87/0.806	0.87/0.806	n/a	ASTM C1549
Emissivity (White) Initial/Aged*	0.88/0.89	0.88/0.89	0.88/0.89	n/a	ASTM E903

*White Membrane Only



Delivery Status

EverGuard® PVC membrane is delivered in two dimensions—full roll and half roll. The size of a full roll is 3.05 m x 30.5 m and that of a half roll is 1.52 m x 30.5 m.

Declaration of Methodological Framework

The type of EPD is cradle-to-grave. All LCA modules are included and are summarized in Table 10.

Material Composition

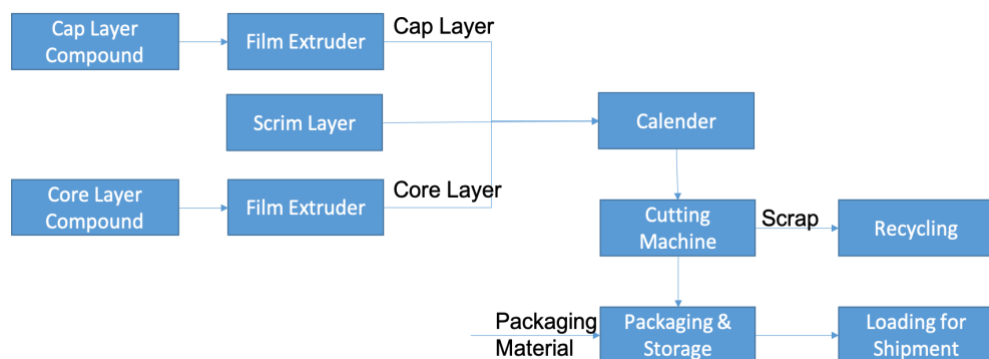
Table 2: Composition

Material	Mass %
PVC Resin	30-60
Phthalate Ester	7-13
Calcium Carbonate	0-30

Manufacturing

This stage includes an aggregation of raw material extraction, supplier processing, delivery, manufacturing and packaging by GAF.

EverGuard® PVC membrane is constructed of three layers. The cap and core layers are made of PVC-based compounds and are processed on site. The scrim is purchased in its ready-to-use form from an off-site supplier. To produce the cap and core layers, pre-mixed compounds are fed into extruders, heated and pressurized and then extruded through a die to form films of a required thickness. The cap layer and core layer will join the scrim layer between a series of heated rollers. In this manner, the layers are bound together to form the final membrane. Once bound, the membrane will go through the cutter where it will be cut into specified dimensions. The finished membrane is reeled to a roll, packaged, labelled and moved into storage until it is shipped to a job site for customer use.



Environment and Health During Manufacturing

During the manufacturing of EverGuard® PVC membrane, all legal regulations regarding emissions to air, wastewater discharge, solid waste disposal, and noise emissions are followed.

Packaging

After manufacturing, the product is prepared for shipment to the customer. The membrane is reeled on a cardboard core and wrapped in plastic film. Additional packaging materials include product labels, a cardboard protective sheet and steel strap. The product is then shipped on wooden pallets to the customer.



Product Installation

There are multiple installation options for EverGuard® PVC membrane. These options include mechanical fasteners, adhesive, and RhinoBond®. All installation options were evaluated during the LCA study. However, this EPD provides an average of the installation options. For additional environmental information regarding the specific installation options for your project, please contact GAF.

Some equipment may be necessary during the installation phase. This includes weld seaming adjacent membranes using a hot-air welder. Such installation equipment is required though not included in the study as these are multi-use tools and the impacts per declared unit are assumed to be negligible. However, electricity used to power this equipment during the installation process was evaluated.

Condition of Use

With professional installation and proper use, the condition and material content of EverGuard® PVC membrane remains unchanged throughout the service life.

Environment and Health During Use

No impacts to the environment or the health of the users during the use phase is expected.

Reference Service Life

For this study, the reference service life is assumed to be 25 years, but may vary based on the method of attachment of the membrane. Therefore, after initial installation on a building with a reference service life of 75 years, there will be two replacements needed for this study. Customers should refer to www.gaf.com or their sales representative for more accurate warranty and lifetime information on the product, based on their specific needs.

Extraordinary Effects Fire

Resistance by the roofing system to fire applied to the exterior roof surface is important. Typically, a UL Class A or B rating is required by building code. Occasionally, depending on the use of the building, special resistance to fire applied from within the building is required. This is normally expressed in the form of hourly ratings, and usually requires the use of a specialized roof assembly. Refer to current EverGuard® listings in the appropriate UL directory to verify roof assembly requirements for specific fire ratings.

Extraordinary Effects Water

No environmental impacts are expected due to water exposure of properly installed EverGuard® PVC membrane.

Extraordinary Effects Mechanical Destruction

EverGuard® PVC membrane has excellent mechanical strength. The breaking strength and elongation at break performance are measured by ASTM D751 and test results confirm Everguard® PVC has a breaking strength of >1201.0 N and an elongation at break of 25%. The ASTM minimums for these properties are 889.6 N (MD & CMD) and 15%, respectively.

Re-Use Phase and Disposal

In general, EverGuard® PVC membrane can be recycled if local recycling facilities are available. Re-use after service is not recommended.

In this EPD, the impacts in landfilling scenario is declared as the most common disposal option.



Functional Unit

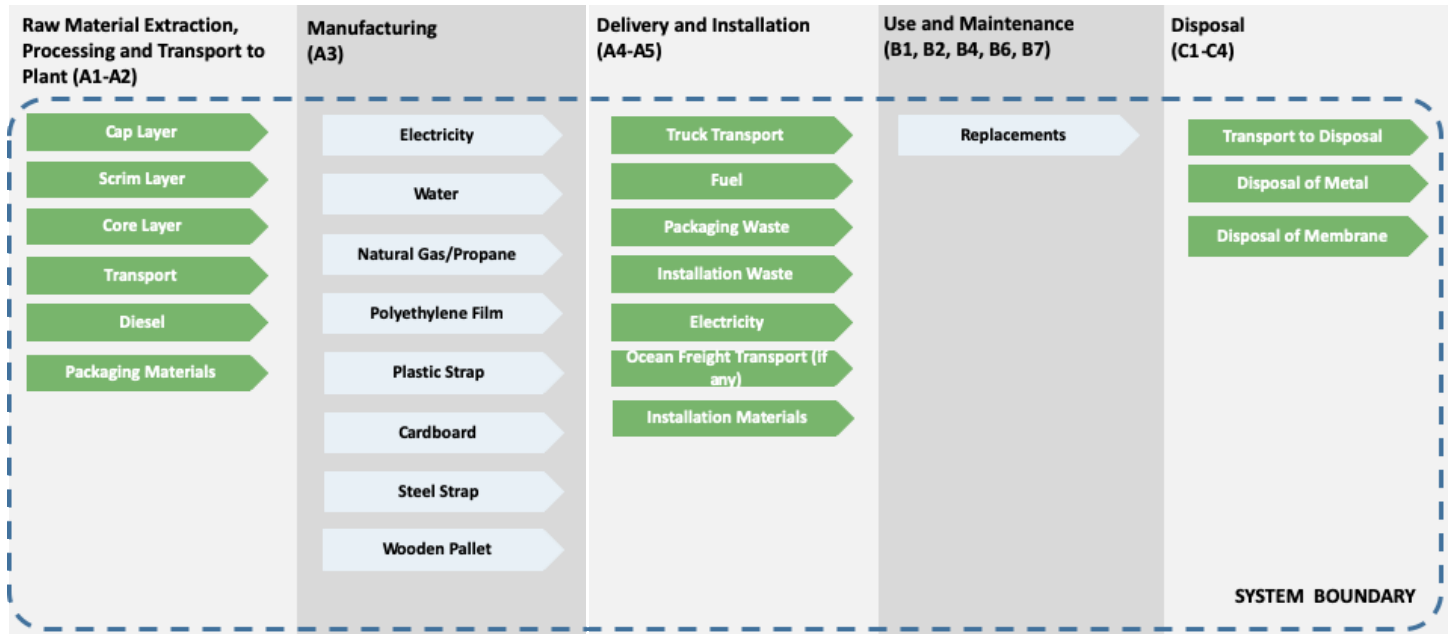
The environmental impacts are declared based on 1000 m² of installed EverGuard® PVC membrane over 75 years.

Table 3: Reference Flow for 75 Years

EverGuard® PVC Smooth Back Membrane			
Functional Unit	1000 m ² of installed roofing membrane for 75 years with a thickness of 50 mils, 60 mils or 80 mils		
Specification	50 mils	60 mils	80 mils
Thickness [mm]	1.27	1.52	2
Installation Option	Average*	Average*	Average*
Mass [kg]	1921.41	2295.50	2971.14
Fasteners [kg]	81.18	81.18	82.51
Adhesive [kg]	192.00	192.00	192.00
* Average indicates that 4 types of installation configurations were considered. These include two mechanical options, an adhered option and a RhinoBond® option.			

System Boundary

The overall system boundary is identified in the flow chart below. This EPD discloses impacts from cradle to grave, including the replacement needed for a use of 75 years.





Cut-Off Rules

All inputs for which data were available were included. Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit. Some raw materials were excluded due to a lack of adequate representative secondary data. However, the excluded materials were significantly below the cut off criteria and include minor additives such as proprietary binders.

Estimates and Assumptions

The compositional data of EverGuard® PVC membrane is based upon typical product performance and is subject to normal manufacturing tolerance and variance. The LCA study is based on nominal values.

Background data

Primary data was collected onsite by GAF associates. This includes electrical and thermal energy, water consumption, waste generation, bill of materials and suppliers. Secondary data was sourced from the GaBi Database, Service Pack 39.

Data Quality

The geographical scope of the manufacturing portion of the life cycle is Cedar City, Utah. All primary data were collected by the manufacturer. The geographic coverage of primary data is considered excellent. The primary data provided by the manufacturer represent all information for calendar year 2018. Using this data meets the PCR requirements. Time coverage of this data is considered good. Primary data provided by the manufacturer is specific to the technology that GAF uses in manufacturing their product. It is site-specific and considered of good quality. It is worth noting that the energy and water used in manufacturing the product includes overhead energy such as lighting, heating and sanitary use of water. Sub-metering would improve the technological coverage of data quality. Data necessary to model cradle-to-gate unit processes was sourced from GaBi LCI datasets.

Period under Review

Data used in this study was representative of production in calendar year 2018.

Allocation

General principles of allocation were based on ISO 14040/44. Where possible, allocation was avoided. When allocation was necessary it was done on a physical mass basis.

Comparability

The user of the EPD should take care when comparing EPDs from different companies. Assumptions, data sources, and assessment tools may all impact the uncertainty of the final results and make comparisons misleading. Even for similar products, differences in use and end-of-life stage assumptions and data quality may produce incomparable results. The user should not compare EPDs unless they are experts in the nuances of Life Cycle Assessment (LCA) practice and methodology and follow comparability best practices.



Scenarios and Additional Technical Information

Transportation to the Construction Site (A4)

Table 4: Transportation Details

Name	Value	Unit
Shipping to Customer	1160.34	km
Shipping to Landfill	32.19	km
Fuel Type	Diesel	-
Liters of Fuel	39.0625	l/100km
Vehicle Type	Truck – Trailer, basic enclosed/45000 lb. payload	
Capacity Utilization	78	%
Gross Density of Products Transported	175.75	Kg/m ³
Weight of Products Transported	20,411.657	Kg
Volume of Products Transported	116.14	M ³
Capacity Utilization Volume Factor	1	-

Installation into the Building (A5)

Table 5: Installation Parameters

Name	Value for Average Installation Option	Unit
Metal Fasteners	81.18 (50 & 60 mils) 82.51 (80 mils)	kg
Water Consumption	0	kg
Adhesive	192.00	kg
Electricity Consumption	7	kWh
Other Energy Carriers	0	MJ
Material Loss	0	kg
Output Substances Following Waste Treatment on Site	0	kg
Dust in the Air	0	kg
Installation Losses	192.14 (50 mils) 229.55 (60 mils) 297.11 (80 mils)	kg
VOC in adhesive	199.4	g/L
Overlap (membrane)	3.70%	%

Table 6 : A5 Product Packaging Waste

Module	Parameter	Unit	Value for 50-mil and 60-mil	Value for 80 mil
A5	Mass of plastic packaging	kg	2.17	2.71
	GWP based in biogenic carbon content of plastic packaging	kg CO ₂ e	0	0
	Mass of cardboard and paper packaging	kg	82.81	103.57
	GWP based in biogenic carbon content of cardboard and paper packaging	kg CO ₂ e	294.66	368.04
	Mass of steel packaging	kg	1.74	2.17
	GWP based in biogenic carbon content of steel packaging	kg CO ₂ e	0	0
	Mass of wood packaging	kg	45.51	56.81
	GWP based in biogenic carbon content of wood packaging	kg CO ₂ e	82.11	102.56



Reference Service Life

Table 7 Product Reference Service Life

Name	Value	Unit
RSL	25	years
Declared product properties (at the gate) and finishes, etc.	See Table 1	-
Design application	Installation per recommendation by manufacturer	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Accepted industry standard	-
Indoor environment (if relevant for indoor applications)	Normal building operating conditions	-
Use conditions, e.g. frequency of use, mechanical exposure	Normal building operating conditions	-

Replacement (B4)

Table 8: Replacement Parameters

Name	Value	Unit
Replacement cycle	0	Number/ RSL
Replacement cycle	2	Number/ ESL
Energy input to power drills and hot-air welders	2.33	kWh/replacement
Net freshwater consumption specified by water source and fate	0	m3/replacement
Adhesive	64	kg/replacement

End-of-Life Stage (C1-C4)

Table 9: Disposal Parameters

Product	Membrane			Fasteners			Unit
	50 Mils	60 Mils	80 Mils	50 Mils	60 Mils	80 Mils	
Reuse*	0			0			kg
Recycling*	0			0			kg
Landfilling	1921.28	2257.94	2866.02	81.18		82.51	kg
Energy Recovery*	0			0			kg

* The products can also be recycled or incinerated for energy recovery, though reusing is not recommended. Here only the most common disposal option is declared.



LCA Results

All results are given per functional unit, which is 1000 m² of installed PVC membrane for 75 years with a thickness of 50 mils (1.27 mm), 60 mils (1.52 mm) or 80 mils (2mm). Environmental impacts were calculated using the GaBi software platform. Impact results have been calculated using both TRACI 2.1 and CML 2001-Jan 2016 characterization factors.

Table 10: Description of the System Boundary

Product Stage			Construction Process Stage		Use Stage							End of Life Stage			
Raw Material Supply	Transportation	Manufacturing	Transportation	Installation	Use	Maintenance	Repair	Refurbishment	Replacement	Operational Energy Use	Operational Water Use	De-construction	Transportation	Waste Processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Impact Category Keys

Table 11: LCIA Indicators

Abbreviation	Parameter	Unit
CML 2001-Jan 2016		
ADP-elements*	Abiotic depletion potential for non-fossil resources	kg Sb eq
ADP-fossil	Abiotic depletion potential for fossil resources	MJ, net calorific value
AP	Acidification potential of soil and water	kg SO ₂ eq
EP	Eutrophication potential	kg Phosphate eq
GWP	Global warming potential	kg CO ₂ eq
ODP	Depletion of stratospheric ozone layer	kg CFC 11 eq
POCP	Photochemical ozone creation potential	kg Ethene eq
TRACI 2.1		
AP	Acidification potential of soil and water	kg N eq
EP	Eutrophication potential	kg SO ₂ eq
GWP	Global warming potential	kg CO ₂ eq
ODP	Depletion of stratospheric ozone layer	kg CFC 11 eq
Resources	Depletion of non-renewable fossil fuels	MJ, surplus energy
POCP	Photochemical ozone creation potential	kg O ₃ eq

Table 12: Life Cycle Inventory Indicators*

Abbreviation	Parameter	Unit
Resource Use Parameters		
RPR _E	Renewable primary energy as energy carrier	MJ, net calorific value
RPR _M	Renewable primary energy resources as material utilization	MJ, net calorific value
RPR _T	Total use of renewable primary energy resources	MJ, net calorific value
NRPR _E	Non-renewable primary energy as energy carrier	MJ, net calorific value
NRPR _M	Non-renewable primary energy as material utilization	MJ, net calorific value
NRPR _T	Total use of non-renewable primary energy resources	MJ, net calorific value
SM	Use of secondary material	kg
RSF	Use of renewable secondary fuels	MJ, net calorific value
NRSF	Use of non-renewable secondary fuels	MJ, net calorific value
RE	Recovered energy	MJ, net calorific value
FW	Use of fresh water	m ³
Output Flows and Waste Parameters		
HWD	Hazardous waste disposed	kg
NHWD	Non-hazardous waste disposed	kg
HLRW	High-level radioactive waste disposed	kg
ILLRW	Intermediate and low-level radioactive waste disposed	kg
CRU	Components for reuse	kg
MFR	Materials for recycling	kg
MER	Materials for energy recovery	kg
EE	Exported energy	MJ

*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 Table 11 and Table 12.



1 EverGuard® PVC 50-mil Smooth Back Membrane

1.1 CML Results

	Product Stage	Construction Stage		Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
ADP-elements [kg Sb eq]	3.05E+01	2.17E-05	3.06E+00	0.00E+00	0.00E+00	0.00E+00	6.71E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.38E-07	0.00E+00	2.73E-05
ADP-fossil fuel [MJ]	1.27E+05	1.61E+03	2.68E+04	0.00E+00	0.00E+00	0.00E+00	3.14E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.94E+01	0.00E+00	1.03E+03
AP [kg SO2 eq]	3.96E+01	4.30E-01	5.39E+00	0.00E+00	0.00E+00	0.00E+00	9.34E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-02	0.00E+00	8.75E-01
EP [kg Phosphate eq]	2.72E+00	1.19E-01	5.59E-01	0.00E+00	0.00E+00	0.00E+00	7.88E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.30E-03	0.00E+00	3.90E-01
GWP [kg CO2 eq]	6.09E+03	1.14E+02	1.36E+03	0.00E+00	0.00E+00	0.00E+00	1.53E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.92E+00	0.00E+00	6.64E+01
ODP [kg CFC 11 eq]	1.63E-07	1.08E-14	2.29E-08	0.00E+00	0.00E+00	0.00E+00	3.72E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.66E-16	0.00E+00	2.41E-13
POCP [kg Ethene eq]	1.96E+00	-1.63E-01	3.95E-01	0.00E+00	0.00E+00	0.00E+00	5.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.95E-03	0.00E+00	3.97E-01

1.2 TRACI Results

	Product Stage	Construction Stage		Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
AP [kg SO2 eq]	4.04E+01	5.86E-01	5.66E+00	0.00E+00	0.00E+00	0.00E+00	9.60E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-02	0.00E+00	1.38E+00
EP [kg N eq]	2.02E+00	4.78E-02	3.60E-01	0.00E+00	0.00E+00	0.00E+00	5.90E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.44E-03	0.00E+00	5.24E-01
GWP [kg CO2 eq]	6.03E+03	1.14E+02	1.34E+03	0.00E+00	0.00E+00	0.00E+00	1.52E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.91E+00	0.00E+00	8.99E+01
ODP [kg CFC 11 eq]	1.63E-07	-6.13E-13	2.34E-08	0.00E+00	0.00E+00	0.00E+00	3.72E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.64E-14	0.00E+00	-4.73E-12
Resources [MJ]	1.66E+04	2.15E+02	3.34E+03	0.00E+00	0.00E+00	0.00E+00	4.06E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.29E+00	0.00E+00	1.81E+02
POCP [kg O3 eq]	3.10E+02	1.34E+01	6.00E+01	0.00E+00	0.00E+00	0.00E+00	7.91E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.47E-01	0.00E+00	1.18E+01



1.3 Resource Use

	Product Stage	Construction Stage			Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
RPR _E [MJ]	8.12E+03	5.00E+01	1.33E+03	0.00E+00	0.00E+00	0.00E+00	1.92E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E+00	0.00E+00	1.10E+02	
RPR _M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
RPR _T [MJ]	8.12E+03	5.00E+01	1.33E+03	0.00E+00	0.00E+00	0.00E+00	1.92E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E+00	0.00E+00	1.10E+02	
NRPR _E [MJ]	1.33E+05	1.62E+03	2.77E+04	0.00E+00	0.00E+00	0.00E+00	3.27E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.98E+01	0.00E+00	1.44E+03	
NRPR _M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
NRPR _T [MJ]	1.33E+05	1.62E+03	2.77E+04	0.00E+00	0.00E+00	0.00E+00	3.27E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.98E+01	0.00E+00	1.44E+03	
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
FW [m3]	5.02E+01	1.94E-01	6.80E+00	0.00E+00	0.00E+00	0.00E+00	1.15E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.37E-03	0.00E+00	1.71E-01	

1.4 Waste

	Product Stage	Construction Stage			Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
HWD [kg]	1.10E-03	1.31E-05	1.21E-04	0.00E+00	0.00E+00	0.00E+00	2.49E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.66E-07	0.00E+00	5.04E-06	
NHWD [kg]	1.42E+02	6.09E-02	2.62E+02	0.00E+00	0.00E+00	0.00E+00	4.89E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.63E-03	0.00E+00	2.04E+03	
HLRW [kg]	2.59E-03	4.32E-06	4.08E-04	0.00E+00	0.00E+00	0.00E+00	6.04E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.86E-07	0.00E+00	1.75E-05	
ILLRW [kg]	2.14E+00	3.58E-03	3.34E-01	0.00E+00	0.00E+00	0.00E+00	4.99E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.54E-04	0.00E+00	1.39E-02	
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
MFR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
EE [MJ]	0.00E+00	0.00E+00	3.03E+01	0.00E+00	0.00E+00	0.00E+00	6.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	



2 EverGuard® PVC 60-mil Smooth Back Membrane

2.1 CML Results

	Product Stage	Construction Stage			Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
ADP-elements [kg Sb eq]	3.71E+01	2.51E-05	3.72E+00	0.00E+00	0.00E+00	0.00E+00	8.16E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-06	0.00E+00	4.25E-05	
ADP-fossil fuel [MJ]	1.48E+05	1.85E+03	2.89E+04	0.00E+00	0.00E+00	0.00E+00	3.60E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.93E+01	0.00E+00	1.60E+03	
AP [kg SO2 eq]	4.78E+01	4.96E-01	6.23E+00	0.00E+00	0.00E+00	0.00E+00	1.12E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-02	0.00E+00	1.38E+00	
EP [kg Phosphate eq]	3.16E+00	1.37E-01	6.13E-01	0.00E+00	0.00E+00	0.00E+00	9.06E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.76E-03	0.00E+00	6.17E-01	
GWP [kg CO2 eq]	7.13E+03	1.32E+02	1.46E+03	0.00E+00	0.00E+00	0.00E+00	1.77E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.62E+00	0.00E+00	1.03E+02	
ODP [kg CFC 11 eq]	1.91E-07	1.25E-14	2.57E-08	0.00E+00	0.00E+00	0.00E+00	4.34E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.32E-16	0.00E+00	3.75E-13	
POCP [kg Ethene eq]	2.34E+00	-1.88E-01	4.38E-01	0.00E+00	0.00E+00	0.00E+00	6.42E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-4.51E-03	0.00E+00	6.29E-01	

2.2 TRACI Results

	Product Stage	Construction Stage			Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
AP [kg SO2 eq]	4.86E+01	6.76E-01	6.51E+00	0.00E+00	0.00E+00	0.00E+00	1.15E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-02	0.00E+00	1.59E+00	
EP [kg N eq]	2.34E+00	5.51E-02	4.00E-01	0.00E+00	0.00E+00	0.00E+00	6.79E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-03	0.00E+00	6.01E-01	
GWP [kg CO2 eq]	7.07E+03	1.32E+02	1.45E+03	0.00E+00	0.00E+00	0.00E+00	1.75E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.61E+00	0.00E+00	1.03E+02	
ODP [kg CFC 11 eq]	1.91E-07	-7.07E-13	2.62E-08	0.00E+00	0.00E+00	0.00E+00	4.34E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.02E-14	0.00E+00	-5.40E-12	
Resources [MJ]	1.92E+04	2.48E+02	3.62E+03	0.00E+00	0.00E+00	0.00E+00	4.66E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+01	0.00E+00	2.06E+02	
POCP [kg O3 eq]	3.62E+02	1.54E+01	6.55E+01	0.00E+00	0.00E+00	0.00E+00	9.13E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.97E-01	0.00E+00	1.35E+01	



2.3 Resource Use

	Product Stage	Construction Stage			Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
RPR _E [MJ]	9.05E+03	5.77E+01	1.43E+03	0.00E+00	0.00E+00	0.00E+00	2.13E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E+00	0.00E+00	1.25E+02	
RPR _M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
RPR _T [MJ]	9.05E+03	5.77E+01	1.43E+03	0.00E+00	0.00E+00	0.00E+00	2.13E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E+00	0.00E+00	1.25E+02	
NRPR _E [MJ]	1.54E+05	1.86E+03	2.99E+04	0.00E+00	0.00E+00	0.00E+00	3.75E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.97E+01	0.00E+00	1.64E+03	
NRPR _M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
NRPR _T [MJ]	1.54E+05	1.86E+03	2.99E+04	0.00E+00	0.00E+00	0.00E+00	3.75E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.97E+01	0.00E+00	1.64E+03	
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
FW [m3]	5.83E+01	2.24E-01	7.61E+00	0.00E+00	0.00E+00	0.00E+00	1.33E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.56E-03	0.00E+00	1.95E-01	

2.4 Waste

	Product Stage	Construction Stage			Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
HWD [kg]	1.29E-03	1.51E-05	1.40E-04	0.00E+00	0.00E+00	0.00E+00	2.91E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.46E-07	0.00E+00	5.75E-06	
NHWD [kg]	1.67E+02	7.03E-02	2.93E+02	0.00E+00	0.00E+00	0.00E+00	5.59E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-03	0.00E+00	2.33E+03	
HLRW [kg]	3.03E-03	4.98E-06	4.52E-04	0.00E+00	0.00E+00	0.00E+00	7.01E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-07	0.00E+00	2.00E-05	
ILLRW [kg]	2.51E+00	4.13E-03	3.70E-01	0.00E+00	0.00E+00	0.00E+00	5.79E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.76E-04	0.00E+00	1.59E-02	
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
MFR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
EE [MJ]	0.00E+00	0.00E+00	3.03E+01	0.00E+00	0.00E+00	0.00E+00	6.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	



3 EverGuard® PVC 80-mil Smooth Back Membrane

3.1 CML Results

	Product Stage	Construction Stage		Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
ADP-elements [kg Sb eq]	4.62E+01	3.24E-05	4.64E+00	0.00E+00	0.00E+00	0.00E+00	1.02E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.35E-06	0.00E+00	5.36E-05
ADP-fossil fuel [MJ]	1.91E+05	2.40E+03	3.33E+04	0.00E+00	0.00E+00	0.00E+00	4.57E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.99E+01	0.00E+00	2.02E+03
AP [kg SO2 eq]	5.99E+01	6.41E-01	7.51E+00	0.00E+00	0.00E+00	0.00E+00	1.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.67E-02	0.00E+00	1.75E+00
EP [kg Phosphate eq]	4.09E+00	1.77E-01	7.34E-01	0.00E+00	0.00E+00	0.00E+00	1.16E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.74E-03	0.00E+00	7.83E-01
GWP [kg CO2 eq]	9.22E+03	1.70E+02	1.70E+03	0.00E+00	0.00E+00	0.00E+00	2.25E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.08E+00	0.00E+00	1.30E+02
ODP [kg CFC 11 eq]	2.51E-07	1.61E-14	3.34E-08	0.00E+00	0.00E+00	0.00E+00	5.69E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.71E-16	0.00E+00	4.73E-13
POCP [kg Ethene eq]	2.94E+00	-2.43E-01	5.16E-01	0.00E+00	0.00E+00	0.00E+00	8.01E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.69E-03	0.00E+00	7.99E-01

3.2 TRACI Results

	Product Stage	Construction Stage		Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
AP [kg SO2 eq]	6.10E+01	8.74E-01	7.84E+00	0.00E+00	0.00E+00	0.00E+00	1.43E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.23E-02	0.00E+00	2.01E+00
EP [kg N eq]	3.04E+00	7.12E-02	4.93E-01	0.00E+00	0.00E+00	0.00E+00	8.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.07E-03	0.00E+00	7.63E-01
GWP [kg CO2 eq]	9.14E+03	1.70E+02	1.68E+03	0.00E+00	0.00E+00	0.00E+00	2.23E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.07E+00	0.00E+00	1.29E+02
ODP [kg CFC 11 eq]	2.50E-07	-9.13E-13	3.40E-08	0.00E+00	0.00E+00	0.00E+00	5.68E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.81E-14	0.00E+00	-6.80E-12
Resources [MJ]	2.49E+04	3.21E+02	4.19E+03	0.00E+00	0.00E+00	0.00E+00	5.93E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E+01	0.00E+00	2.60E+02
POCP [kg O3 eq]	4.67E+02	1.99E+01	7.70E+01	0.00E+00	0.00E+00	0.00E+00	1.16E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.00E-01	0.00E+00	1.71E+01



3.3 Resource Use

	Product Stage	Construction Stage			Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
RPR _E [MJ]	1.16E+04	7.45E+01	1.69E+03	0.00E+00	0.00E+00	0.00E+00	2.71E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E+00	0.00E+00	1.58E+02	
RPR _M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
RPR _T [MJ]	1.16E+04	7.45E+01	1.69E+03	0.00E+00	0.00E+00	0.00E+00	2.71E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E+00	0.00E+00	1.58E+02	
NRPR _E [MJ]	1.99E+05	2.41E+03	3.45E+04	0.00E+00	0.00E+00	0.00E+00	4.77E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+02	0.00E+00	2.07E+03	
NRPR _M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
NRPR _T [MJ]	1.99E+05	2.41E+03	3.45E+04	0.00E+00	0.00E+00	0.00E+00	4.77E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+02	0.00E+00	2.07E+03	
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
FW [m3]	7.52E+01	2.89E-01	9.32E+00	0.00E+00	0.00E+00	0.00E+00	1.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-02	0.00E+00	2.46E-01	

3.4 Waste

	Product Stage	Construction Stage			Use Stage							End of Life Stage			
Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
HWD [kg]	1.69E-03	1.95E-05	1.81E-04	0.00E+00	0.00E+00	0.00E+00	3.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.14E-07	0.00E+00	7.25E-06	
NHWD [kg]	2.12E+02	9.08E-02	3.68E+02	0.00E+00	0.00E+00	0.00E+00	7.04E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-03	0.00E+00	2.94E+03	
HLRW [kg]	3.93E-03	6.44E-06	5.40E-04	0.00E+00	0.00E+00	0.00E+00	9.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.68E-07	0.00E+00	2.52E-05	
ILLRW [kg]	3.25E+00	5.33E-03	4.43E-01	0.00E+00	0.00E+00	0.00E+00	7.44E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.22E-04	0.00E+00	2.00E-02	
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
MFR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
EE [MJ]	0.00E+00	0.00E+00	3.78E+01	0.00E+00	0.00E+00	0.00E+00	7.56E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	



Biogenic Carbon Removals and Emissions

	Parameter	PVC Smooth Back 50 mil	PVC Smooth Back 60 mil	PVC Smooth Back 80 mil	Unit
BCRP	Biogenic Carbon Removal from Product	1.68E+02	1.96E+02	2.57E+02	[kg CO ₂]
BCEP	Biogenic Carbon Emission from Product	1.10E+02	1.29E+02	1.67E+02	[kg CO ₂]
BCRK	Biogenic Carbon Removal from Packaging	3.45E+02	3.46E+02	4.32E+02	[kg CO ₂]
BCEK	Biogenic Carbon Emission from Packaging	1.52E+02	1.53E+02	1.91E+02	[kg CO ₂]



Interpretation

Abiotic Depletion of fossil fuels, Acidification Potential, and Global Warming Potential share a similar pattern because the major ingredient of the product, PVC resin, is a fossil fuel-based material. The extraction of fossil fuel and the production of PVC resin is positively related to fossil fuel depletion, acidification and global warming. This is a consistent finding across all different thickness. From the angle of a 75-year period, the impact from replacement stage (B4) is largest, but in one reference service life of the products, the vast majority of impacts are related to the sourcing, raw material transportation and manufacturing phases of the life cycle of the product. The third largest impactful life cycle stage is the installation of the product and the need for installation materials.

Since the replacement is responsible for the largest portion of the overall impact, product performance and durability are important. By improving the durability and prolong the reference service life, the impact across the building service life will be alleviated.

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