



## EverGuard® PVC Roofing Membrane

Smooth

Environmental Product Declaration



Program Operator	NSF Certification, LLC 789 N. Dixboro Ann Arbor, MI 48105 www.nsf.org		
General Program instructions and Version Number	Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report, Institut Bauen und Umwelt e.V., V, 2018		
Manufacturer Name and Address	GAF 5080 UT-56 Cedar City, UT 84721		
Declaration Number	EPD10254		
Declared Product and Functional Unit	EverGuard® PVC Membrane Smooth 1 m <sup>2</sup> of installed roofing membrane, with a thickness of 50 mils (1.27 mm), 60 mils (1.52 mm) or 80 mils (2 mm).		
Included Products	EverGuard® PVC Membrane Smooth in 50, 60 or 80 mil thicknesses and all color options. Product can be manufactured at several of GAF's facilities. Products manufactured at any of these locations are included.		
Reference PCR and Version Number	Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report V1.7, IBU Part B: Requirements on the EPD for Plastic and Elastomer Roofing and Sealing Sheet Systems		
Product's intended Application and Use	Roofing		
Product RSL	Not Declared		
Markets of Applicability	North America, Europe		
Date of Issue	07/17/2019		
Period of Validity	5 years from date of issue		
EPD Type	Product Specific		
Range of Dataset Variability	N/A		
EPD Scope	Cradle to gate with options (A1-A5, B1, B2, B7, C1-C4 and D)		
Year of reported manufacturer primary data	2017		
LCA Software and Version Number	GaBi 8.6.0.20		
LCI Database and Version Number	GaBi Database Version 8.7, Service Pack 35		
LCIA Methodology and Version Number	TRACI 2.1 CML 2001-Jan 2016		
The sub-category PCR review was conducted by:	IBU - Institut Bauen und Umwelt e.V.		
This declaration was independently verified in accordance with ISO 14025: 2006 and the reference PCR: Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report V1.7, IBU Part B: Requirements on the EPD for Plastic and Elastomer Roofing and Sealing Sheet Systems. <input type="checkbox"/> Internal <input checked="" type="checkbox"/> 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:	Jack Geibig - EcoForm jgeibig@ecoform.com 		
<p>Limitations:</p> <p>Environmental declarations from different programs (ISO 14025) may not be comparable.</p> <p>Comparison of the environmental performance of Plastic and Elastomer Roofing and Sealing Sheet Systems 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 Plastic and Elastomer Roofing and Sealing Sheet Systems 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](http://www.gaf.com).



## Product Description

EverGuard® PVC membrane is a single-ply roofing style 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 polyvinyl acetate (PVA) scrim in the middle. This configuration meets all the inherent properties and performance which PVC is known for, including longevity, flexibility and resistance to tears, punctures, chemicals, UV, and ozone.

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.



## Application

EverGuard® PVC membrane is a single-ply roofing style product and is designed to be used as an outer roof layer, either in new construction or re-covering applications. The membrane can be mechanically fastened or adhered to the roof deck.

## Technical Data

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 PVA 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	>402 kg/m	>402 kg/m	>484 kg/m	298 kg/m (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	67 kg/m (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



**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.

**Material Composition**

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

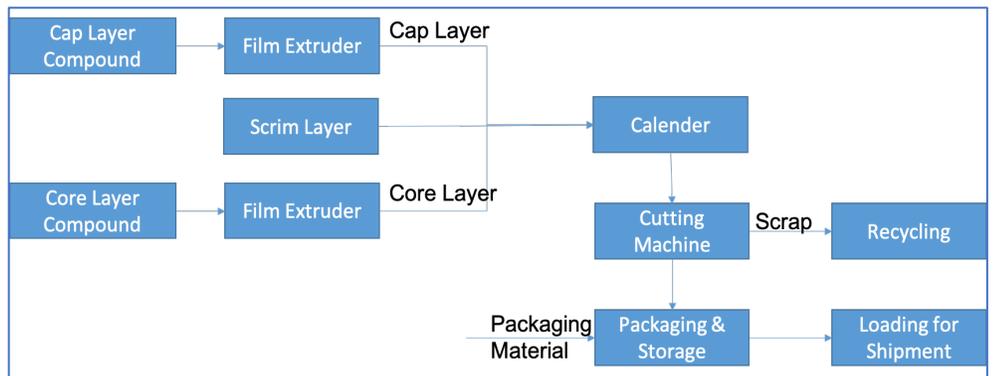
This product contains one substance (CAS number considered confidential) that is listed on the Candidate List of Substances of Very High Concern for Authorization (Date: 17/12/2014) exceeding 0.1 percentage by mass.

**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, as shown in the table above. 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 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**

Use phase modules are not included in this assessment. Thus a reference service life (RSL) is not necessary.

### **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 >270 lbf (402 kg/m) and an elongation at break of 25%. The ASTM minimums for these properties are 200 lbf (298 kg/m) and 15%, respectively.

### **Re-Use Phase**

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

### **Disposal**

At end of life, 100% of the membrane and 15% of the metal fasteners are conservatively assumed to be landfilled. The remaining 85% of the metal fasteners are assumed to be recycled. This assumption is based off of accepted LCA practice.



**Further information**

More information about GAF and its products can be found at [www.gaf.com](http://www.gaf.com).

**Declared Unit**

The environmental impacts are declared based on 1 m<sup>2</sup> of installed EverGuard® PVC membrane.

EverGuard® PVC Smooth Back Membrane			
Functional Unit	1 m <sup>2</sup> of installed roofing membrane 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]	1.78	2.07	2.68
Fasteners [kg]	0.082	0.082	0.082
Adhesive [kg]	0.187	0.187	0.187
* 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 for the required cradle-to-gate lifecycle modules and the optional end of life modules. The optional use phase modules are not declared due to the uncertainty around the product service life and the number of replacement cycles.

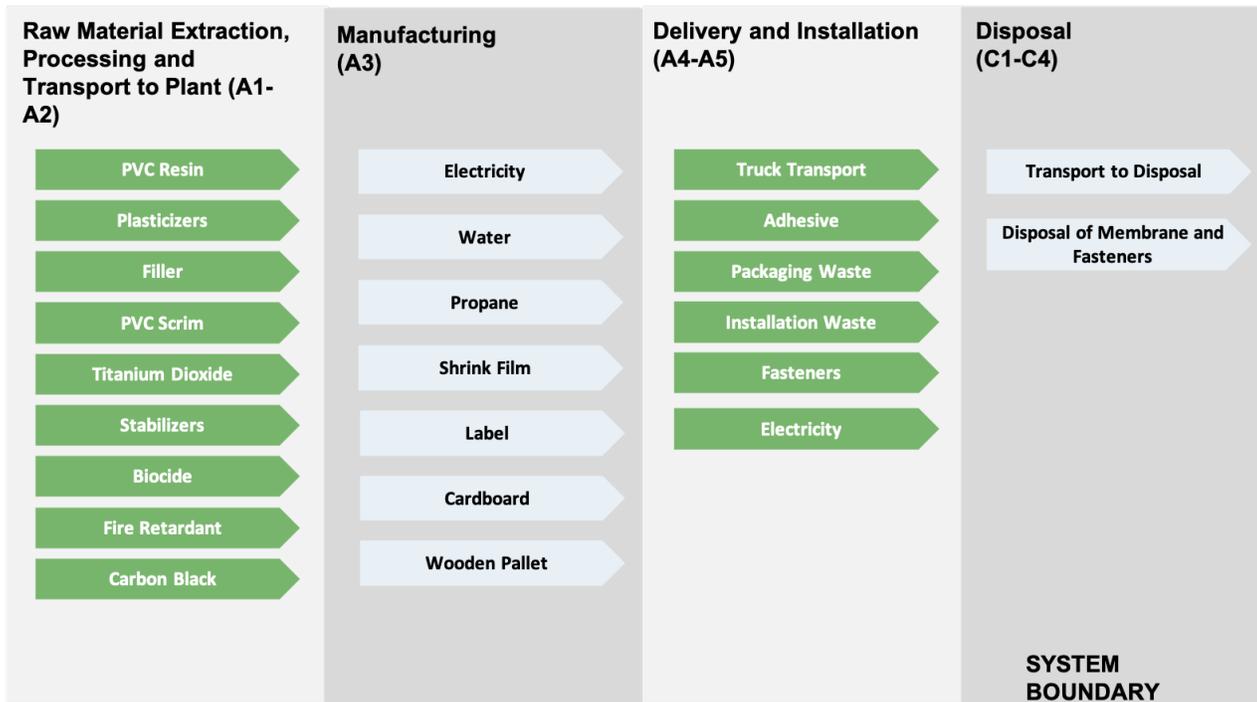


Figure 1: System Boundary



### **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. This was due to lack of adequate representative secondary data within GaBi. 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 GaBi Database Version 8.7, Service Pack 35.

### **Data Quality**

The geographical scope of the manufacturing portion of the life cycle is Cedar City, Utah. This plant served as the example data for manufacturing at all locations because it was of the highest quality. This is permissible under LCA practice and EverGuard® PVC Smooth product from all plants are included in this EPD. 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)

Name	Value	Unit
Shipping to Customer	805	km
Shipping to Landfill	161	km
Fuel Type	Diesel	-
Liters of Fuel	39.0625	l/100km
Vehicle Type	Truck – Trailer, basic enclosed/45000 lb. payload	
Capacity Utilization	0.78	%
Gross Density of Products Transported	175.75	Kg/m <sup>3</sup>
Weight of Products Transported	20,411.657	Kg
Volume of Products Transported	116.14	M <sup>3</sup>
Capacity Utilization Volume Factor	1	-

### Installation into the Building (A5)

Name	Value for Average Installation Option	Unit
Metal Fasteners	0.0825	kg
Water Consumption	0	kg
Adhesive	0.187	kg
Electricity Consumption	6.83E-03	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	0	kg
VOC in the air	-	kg
Overlap (membrane)	3.97	%

### End-of-Life Stage (C1-C4)

Name	50 Mils,	60 Mils	80 Mils	Unit
Collected Separately by Waste Type	0.0701	0.0701	0.0701	kg
Collected as Mixed Construction Waste	1.97	2.57	2.87	kg
Reuse	0	0	0	kg
Recycling	0.0701	0.0701	0.0701	kg
Energy Recovery	0	0	0	kg
Landfilling	1.97	2.57	2.87	kg
* All values above are for the average installation method.				



### LCA Results

All results are given per functional unit, which is 1 m<sup>2</sup> of installed PVC membrane 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.

#### Description of the System Boundary

Product Stage			Construction Process Stage		Use Stage*							End of Life Stage				Benefits and Loads Beyond the System Boundaries
Raw Material Supply	Transportation	Manufacturing	Transportation	Installation	Use	Maintenance	Repair	Refurbishment	Replacement	Operational Energy Use	Operational Water Use	De-construction	Transportation	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	MNR***	MNR	MNR	MND	MND	X	X	X	X	MND

\*Modules marked as MND and MNR are not shown in the following result forms, \*MND=Module not declared, \*\*MNR=Module not relevant



## Impact Category Keys

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 <sub>2</sub> eq
EP	Eutrophication potential	kg Phosphate eq
GWP	Global warming potential	kg CO <sub>2</sub> eq
OPD	Depletion of stratospheric ozone layer	kg CFC 11 eq
POCP	Photochemical ozone creation potential	kg Ethane eq
TRACI 2.1		
AP	Acidification potential of soil and water	kg N eq
EP	Eutrophication potential	kg SO <sub>2</sub> eq
GWP	Global warming potential	kg CO <sub>2</sub> 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 <sub>3</sub> eq

Abbrv.	Parameter (Unit)
Resource Use Parameters	
PERE	Renewable primary energy as energy carrier (MJ, net calorific value)
PERM	Renewable primary energy resources as material utilization (MJ, net calorific value)
PERT	Total use of renewable primary energy resources (MJ, net calorific value)
PENRE	Non-renewable primary energy as energy carrier (MJ, net calorific value)
PENRM	Non-renewable primary energy as material utilization (MJ, net calorific value)
PENRT	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)
FW	Use of fresh water (m <sup>3</sup> )
Output Flows and Waste Parameters	
HWD	Hazardous waste disposed (kg)
NHWD	Non-hazardous waste disposed (kg)
RWD	Radioactive waste disposed (kg)
CRU	Components for reuse (kg)
MFR	Materials for recycling (kg)
MER	Materials for energy recovery (kg)
EEE	Exported electrical energy (MJ)
EET	Exported thermal energy (MJ)



## 1 EverGuard® PVC 50-mil Smooth Back Membrane—Average Installation

### 1.1 EU - CML Results

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
ADP-elements [kg Sb eq]	3.05E-02	2.09E-08	1.57E-05	0.00E+00	4.51E-09	0.00E+00	3.77E-08
ADP-fossil fuel [MJ]	1.26E+02	1.61E+00	1.38E+01	0.00E+00	3.48E-01	0.00E+00	1.36E+00
AP [kg SO <sub>2</sub> eq]	4.00E-02	3.94E-04	1.40E-03	0.00E+00	8.51E-05	0.00E+00	3.71E-04
EP [kg Phosphate eq]	2.55E-03	1.06E-04	2.79E-04	0.00E+00	2.28E-05	0.00E+00	4.82E-05
GWP [kg CO <sub>2</sub> eq]	6.00E+00	1.15E-01	7.19E-01	0.00E+00	2.47E-02	0.00E+00	8.75E-02
ODP [kg CFC 11 eq]	1.52E-10	3.92E-15	5.46E-12	0.00E+00	8.47E-16	0.00E+00	1.60E-14
POCP [kg Ethene eq]	3.51E-03	3.96E-05	2.13E-04	0.00E+00	8.55E-06	0.00E+00	3.13E-05

### 1.2 North America - TRACI Results

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
AP [kg SO <sub>2</sub> eq]	4.04E-02	5.30E-04	1.68E-03	0.00E+00	1.14E-04	0.00E+00	4.03E-04
EP [kg N eq]	1.94E-03	4.31E-05	1.62E-04	0.00E+00	9.31E-06	0.00E+00	2.06E-05
GWP [kg CO <sub>2</sub> eq]	5.95E+00	1.14E-01	7.09E-01	0.00E+00	2.47E-02	0.00E+00	8.70E-02
ODP [kg CFC 11 eq]	1.48E-10	3.92E-15	5.94E-12	0.00E+00	8.47E-16	0.00E+00	1.60E-14
Resources [MJ]	1.63E+01	2.16E-01	1.64E+00	0.00E+00	4.67E-02	0.00E+00	1.74E-01
POCP [kg O <sub>3</sub> eq]	3.39E-01	1.75E-02	2.64E-02	0.00E+00	3.78E-03	0.00E+00	7.99E-03



### 1.3 Resource Use

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
PERE [MJ]	8.63E+00	4.01E-02	4.86E-01	0.00E+00	8.66E-03	0.00E+00	9.84E-02
PERM [MJ]	0.00E+00						
PERT [MJ]	8.63E+00	4.01E-02	4.86E-01	0.00E+00	8.66E-03	0.00E+00	9.84E-02
PENRE [MJ]	1.31E+02	1.62E+00	1.42E+01	0.00E+00	3.50E-01	0.00E+00	1.39E+00
PENRM [MJ]	0.00E+00						
PENRT [MJ]	1.31E+02	1.62E+00	1.42E+01	0.00E+00	3.50E-01	0.00E+00	1.39E+00
SM [kg]	0.00E+00						
RSF [MJ]	0.00E+00						
NRSF [MJ]	0.00E+00						
FW [m <sup>3</sup> ]	4.93E-02	1.95E-04	1.81E-03	0.00E+00	4.21E-05	0.00E+00	1.69E-04

### 1.4 Waste

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
HWD [kg]	1.10E-06	1.26E-08	8.35E-09	0.00E+00	2.72E-09	0.00E+00	4.80E-09
NHWD [kg]	1.33E-01	6.10E-05	4.66E-02	0.00E+00	1.32E-05	0.00E+00	1.98E+00
RWD [kg]	1.79E-03	3.57E-06	1.33E-04	0.00E+00	7.70E-07	0.00E+00	1.43E-05
CRU [kg]	0.00E+00						
MFR [kg]	0.00E+00						
MER [kg]	0.00E+00						
EEE [MJ]	0.00E+00						
EET [MJ]	0.00E+00						



## 2 EverGuard® PVC 60-mil Smooth Back Membrane—Average Installation

### 2.1 EU - CML Results

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
ADP-elements [kg Sb eq]	3.71E-02	2.41E-08	1.57E-05	0.00E+00	5.15E-09	0.00E+00	4.33E-08
ADP-fossil fuel [MJ]	1.47E+02	1.86E+00	1.38E+01	0.00E+00	3.98E-01	0.00E+00	1.56E+00
AP [kg SO <sub>2</sub> eq]	4.82E-02	4.55E-04	1.40E-03	0.00E+00	9.72E-05	0.00E+00	4.26E-04
EP [kg Phosphate eq]	2.95E-03	1.22E-04	2.79E-04	0.00E+00	2.61E-05	0.00E+00	5.53E-05
GWP [kg CO <sub>2</sub> eq]	7.03E+00	1.32E-01	7.19E-01	0.00E+00	2.83E-02	0.00E+00	1.00E-01
ODP [kg CFC 11 eq]	1.80E-10	4.53E-15	5.46E-12	0.00E+00	9.67E-16	0.00E+00	1.84E-14
POCP [kg Ethene eq]	4.14E-03	4.57E-05	2.13E-04	0.00E+00	9.76E-06	0.00E+00	3.59E-05

### 2.2 North America - TRACI Results

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
AP [kg SO <sub>2</sub> eq]	4.86E-02	6.11E-04	1.68E-03	0.00E+00	1.31E-04	0.00E+00	4.62E-04
EP [kg N eq]	2.25E-03	4.97E-05	1.62E-04	0.00E+00	1.06E-05	0.00E+00	2.36E-05
GWP [kg CO <sub>2</sub> eq]	6.97E+00	1.32E-01	7.09E-01	0.00E+00	2.82E-02	0.00E+00	9.98E-02
ODP [kg CFC 11 eq]	1.77E-10	4.53E-15	5.94E-12	0.00E+00	9.67E-16	0.00E+00	1.84E-14
Resources [MJ]	1.89E+01	2.50E-01	1.64E+00	0.00E+00	5.33E-02	0.00E+00	2.00E-01
POCP [kg O <sub>3</sub> eq]	3.96E-01	2.02E-02	2.64E-02	0.00E+00	4.31E-03	0.00E+00	9.16E-03



### 2.3 Resource Use

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
PERE [MJ]	9.64E+00	4.63E-02	4.86E-01	0.00E+00	9.89E-03	0.00E+00	1.13E-01
PERM [MJ]	0.00E+00						
PERT [MJ]	9.64E+00	4.63E-02	4.86E-01	0.00E+00	9.89E-03	0.00E+00	1.13E-01
PENRE [MJ]	1.52E+02	1.87E+00	1.42E+01	0.00E+00	4.00E-01	0.00E+00	1.60E+00
PENRM [MJ]	0.00E+00						
PENRT [MJ]	1.52E+02	1.87E+00	1.42E+01	0.00E+00	4.00E-01	0.00E+00	1.60E+00
SM [kg]	0.00E+00						
RSF [MJ]	0.00E+00						
NRSF [MJ]	0.00E+00						
FW [m <sup>3</sup> ]	5.72E-02	2.25E-04	1.81E-03	0.00E+00	4.81E-05	0.00E+00	1.94E-04

### 2.4 Waste

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
HWD [kg]	1.29E-06	1.46E-08	8.35E-09	0.00E+00	3.11E-09	0.00E+00	5.51E-09
NHWD [kg]	1.57E-01	7.03E-05	4.66E-02	0.00E+00	1.50E-05	0.00E+00	2.28E+00
RWD [kg]	2.09E-03	4.12E-06	1.33E-04	0.00E+00	8.80E-07	0.00E+00	1.64E-05
CRU [kg]	0.00E+00						
MFR [kg]	0.00E+00						
MER [kg]	0.00E+00						
EEE [MJ]	0.00E+00						
EET [MJ]	0.00E+00						



### 3 EverGuard® PVC 80-mil Smooth Back Membrane—Average Installation

#### 3.1 EU - CML Results

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
ADP-elements [kg Sb eq]	4.62E-02	3.11E-08	1.57E-05	0.00E+00	6.49E-09	0.00E+00	5.49E-08
ADP-fossil fuel [MJ]	1.90E+02	2.40E+00	1.39E+01	0.00E+00	5.01E-01	0.00E+00	1.98E+00
AP [kg SO <sub>2</sub> eq]	6.04E-02	5.88E-04	1.43E-03	0.00E+00	1.23E-04	0.00E+00	5.40E-04
EP [kg Phosphate eq]	3.83E-03	1.58E-04	3.03E-04	0.00E+00	3.29E-05	0.00E+00	7.01E-05
GWP [kg CO <sub>2</sub> eq]	9.09E+00	1.71E-01	7.37E-01	0.00E+00	3.56E-02	0.00E+00	1.27E-01
ODP [kg CFC 11 eq]	2.37E-10	5.85E-15	6.79E-12	0.00E+00	1.22E-15	0.00E+00	2.33E-14
POCP [kg Ethene eq]	5.28E-03	5.90E-05	2.22E-04	0.00E+00	1.23E-05	0.00E+00	4.55E-05

#### 3.2 North America - TRACI Results

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
AP [kg SO <sub>2</sub> eq]	6.10E-02	7.90E-04	1.76E-03	0.00E+00	1.65E-04	0.00E+00	5.86E-04
EP [kg N eq]	2.93E-03	6.43E-05	1.83E-04	0.00E+00	1.34E-05	0.00E+00	2.99E-05
GWP [kg CO <sub>2</sub> eq]	9.02E+00	1.70E-01	7.26E-01	0.00E+00	3.55E-02	0.00E+00	1.27E-01
ODP [kg CFC 11 eq]	2.33E-10	5.85E-15	7.39E-12	0.00E+00	1.22E-15	0.00E+00	2.33E-14
Resources [MJ]	2.45E+01	3.22E-01	1.64E+00	0.00E+00	6.72E-02	0.00E+00	2.54E-01
POCP [kg O <sub>3</sub> eq]	5.12E-01	2.61E-02	2.66E-02	0.00E+00	5.44E-03	0.00E+00	1.16E-02



### 3.3 Resource Use

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
PERE [MJ]	1.24E+01	5.98E-02	4.86E-01	0.00E+00	1.25E-02	0.00E+00	1.43E-01
PERM [MJ]	0.00E+00						
PERT [MJ]	1.24E+01	5.98E-02	4.86E-01	0.00E+00	1.25E-02	0.00E+00	1.43E-01
PENRE [MJ]	1.97E+02	2.42E+00	1.42E+01	0.00E+00	5.04E-01	0.00E+00	2.03E+00
PENRM [MJ]	0.00E+00						
PENRT [MJ]	1.97E+02	2.42E+00	1.42E+01	0.00E+00	5.04E-01	0.00E+00	2.03E+00
SM [kg]	0.00E+00						
RSF [MJ]	0.00E+00						
NRSF [MJ]	0.00E+00						
FW [m <sup>3</sup> ]	7.38E-02	2.91E-04	1.82E-03	0.00E+00	6.07E-05	0.00E+00	2.46E-04

### 3.4 Waste

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
HWD [kg]	1.69E-06	1.88E-08	8.42E-09	0.00E+00	3.92E-09	0.00E+00	6.99E-09
NHWD [kg]	1.98E-01	9.09E-05	5.67E-02	0.00E+00	1.89E-05	0.00E+00	2.89E+00
RWD [kg]	2.72E-03	5.32E-06	1.32E-04	0.00E+00	1.11E-06	0.00E+00	2.08E-05
CRU [kg]	0.00E+00						
MFR [kg]	0.00E+00						
MER [kg]	0.00E+00						
EEE [MJ]	0.00E+00						
EET [MJ]	0.00E+00						



## Interpretation

Overall for GAF's EverGuard® PVC product, for all different thickness, Abiotic Depletion of fossil fuels, Acidification Potential, and Global Warming Potential are seen to be the largest impact categories. These impact categories 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. Within the impact categories, 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.

Regarding installation, the decision of which installation method to utilize has a major role in determining the environmental impacts of sourcing, manufacturing and installation relative to the overall impact. The installation method that has the highest impact is the adhered installation method. This method can lead to significantly higher environmental impacts due the sourcing and manufacturing of the raw materials needed for the manufacture the adhesive glue. However, the mechanical option is not without environmental issues. For proper installation, the mechanical method does require more overlap of the PVC membrane edges during installation, which leads to more product being manufactured. Overall, the net increase to the total calculated life cycle impacts of the PVC membrane is calculated to be 2-3% higher for the adhered installation over the mechanical option.

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