Johns Manville

JM PVC MEMBRANE

Environmental Product Declaration

JM PVC SD Plus

Built to withstand the test of time, our PVC roofing membranes are made to resist the toughest weather conditions and chemicals.

JM PVC with Dow Elvaloy® KEE and JM PVC SD Plus thermoplastic roofing membranes are manufactured using an ultraviolet-resistant polyvinyl chloride. Utilizing a polyester fabric reinforcement allows for systems to be both mechanically attached and adhered. PVC membranes deliver a pliable and durable sheet with excellent weathering characteristics and resistance to harsh chemicals and industrial pollutants.

An Industry Leader

Johns Manville, a Berkshire Hathaway company (NYSE: BRK.A, BRK.B), is a leading manufacturer and marketer of premium-quality products for building insulation, mechanical insulation, commercial roofing and roof insulation, as well as reinforcement fiberglass and technical nonwovens. JM serves markets that include aerospace, automotive and transportation, air handling, appliance, HVAC, pipe and equipment, air and liquid filtration, waterproofing, building, flooring, interiors and wind energy. In business since 1858, the Denver-based company has annual sales over $4 billion and holds leadership positions in all the key markets that it serves. Johns Manville employs 8,000 people and operates 44 manufacturing facilities in North America and Europe.

As a full-line roofing manufacturer of both single-ply and bituminous membrane systems, Johns Manville manufactures the following:

Thermoplastic Polyolefin membrane (TPO)
Ethylene Propylene Diene Monomer membrane (EPDM)
Polyvinyl Chloride membrane (PVC)
Styrene Butadiene Styrene (SBS)
Atactic Polypropylene (APP)
Built Up Roofing (BUR)
Polyisocyanurate Roof Insulation (ISO)

JM Sustainability Goals

At JM, we are passionate about our ability to succeed in making the company more sustainable. We know that by doing good, we will do well. That is why we've embraced sustainability, working to define what it means to JM and how it benefits our stakeholders. We realize that through these efforts to become more sustainable, we will become more resilient, more innovative, and better positioned to continue serving the changing needs of our customers.



REDUCE our impact on the planet. By 2025, we will:

- Reduce our waste intensity from our 2020 performance by 10%.
- We will use at least 2 billion pounds of external recycle materials in JM products from 2021 through 2025.

EXPAND support of our global workforce.

- Reflect our communities by attracting, promoting and retaining underrepresented groups resulting in an organization that is reflective of the communities where we operate.
- Inspire our employees to volunteer and actively engage in our communities.

INNOVATE a path to a decarbonized future. We will:

- Develop and sell products that increase the net positive benefit to our world by more than 10% by 2025.
- Chart our path to a lower carbon future by:
  - Exploring and implementing alternative renewable energy sources used directly in JM processes
  - Developing a more complete understanding of the impact of our raw material supply chain as the use of fossil fuels phases out
  - Reducing our overall Scope 1&2 GHG emissions by 40% by 2030.

JM Sustainability Highlights *Through 2023*

Guided by our values and commitment to Building a Better Tomorrow, we have generated sustainable outcomes that benefit our planet, communities and customers.

CO_2 REDUCTION

-10%

JM recorded a 10% reduction from our baseline 2017 year as we work towards our 2030 goal of a 40% reduction in Scope 1 & 2 GHG emissions.

WASTE INTENSITY REDUCTION

-12%+

2023 reduction, exceeding our goal of 10% reduction by 2025.

JM Engineered Products (EP) has **12 straight quarters** of reducing waste intensity in progress to our target goal.

EXTERNAL RECYCLED MATERIAL

2 Billion+ lbs

JM is outpacing our 2025 goal of using 2 billion pounds of external recycled material use in products by **1.6% through 2023** – despite a tightening supply of recycled materials.

VOLUNTEER HOURS

completed by JM employees in 2023

4,000+

REDUCTION IN DAYS AWAY FROM WORK

due to workplace injuries & illnesses from 2020-2023

-47%

REDUCTION IN TOTAL CASE INCIDENT RATE

-4%+

vs. 2020 base year

JM continues working toward our goal of zero serious injuries.

BELOW THE INDUSTRY AVERAGE TOTAL CASE INCIDENT RATE

-61%

2023 rate vs. latest available industry average rate (2022).

DONATIONS BY JM EMPLOYEES

$357,000+

Donations for charitable and community impact efforts, including matching donation in 2023.

PRODUCTS CONTRIBUTING TO LEED CREDITS

72

CERTIFICATIONS

SILVER 2023 ecovadis Sustainability Rating

ENERGY STAR

US EPA Certified SmartWay®

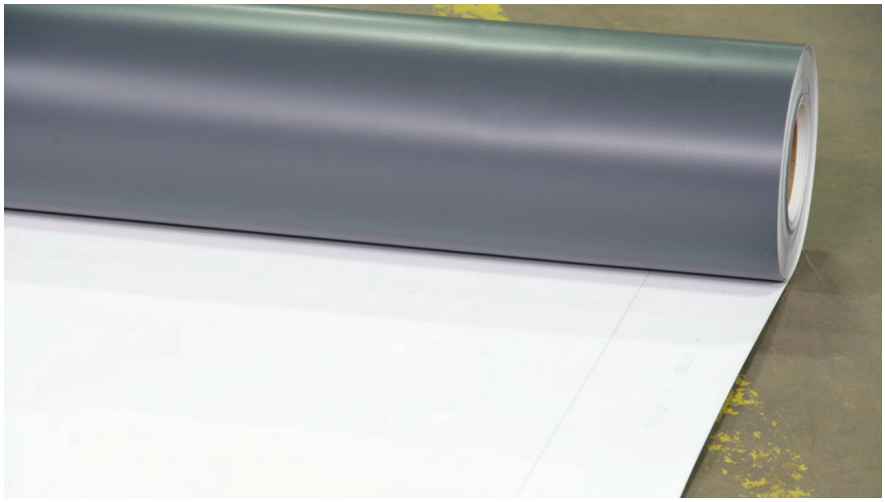
UL ECOLOGO

CERTIFIED INDOOR AIR QUALITY™ SCS GLOBAL SERVICES

Environmental Product Declaration

PVC Single Ply Roofing Membrane

JM PVC SD PLUS



Think JM.

JM PVC SD Plus is a polyester-reinforced, heat weldable thermoplastic polyvinyl chloride available in 50, 60, and 80 mil.

Johns Manville
A Berkshire Hathaway Company

Johns Manville (JM) is a global manufacturer of premium-quality building products for insulation, roofing, fibers and nonwovens for commercial, industrial and residential applications.

We ensure that each of our products not only performs, but also contributes to the health, safety, and sustainability of the environments where they are used.

We strive to ensure that our products meet the rigorous demands of their applications while focusing on finding new ways to reduce our environmental footprint, and we want to provide you with reliable materials that will allow you to do the same.

The use of JM's products improves energy efficiency in homes and buildings as the quickest and most cost-effective way to reduce energy use and lower greenhouse gas emissions.

People ● Passion ● Perform ● Protect

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

Johns Manville
A Berkshire Hathaway Company

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

JM PVC SD PLUS SINGLE PLY ROOFING MEMBRANE
50 MIL, 60 MIL, AND 80 MIL

According to ISO 14025 and ISO21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Solutions 333 Pfingsten Rd, Northbrook IL, 60062 www.ul.com www.spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	Program Operator Rules v 2.7 2022
MANUFACTURER NAME AND ADDRESS	Cooley/Group 350 Esten Avenue Pawtucket, RI 02860
DECLARATION NUMBER	4791527289.102.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	1 m^2 of PVC single ply roofing membrane
REFERENCE PCR AND VERSION NUMBER	Product Category Rule for Preparing an Environmental Product Declaration for Single Ply Roofing Membranes; NSF International, 12-month Extension, December 2024.
DESCRIPTION OF PRODUCT APPLICATION/USE	PVC roofing membrane installed and representative of 50, 60, and 80 mil thicknesses are used as a roofing protective layer for building applications.
PRODUCT RSL DESCRIPTION (IF APPL.)	N/A
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	February 6, 2025
PERIOD OF VALIDITY	5 Years
EPD TYPE	Product-specific
RANGE OF DATASET VARIABILITY	N/A
EPD SCOPE	Cradle-to-gate with options (A1-A3, A4-A5 and C1-C4)
YEAR(S) OF REPORTED PRIMARY DATA	Calendar year 2022
LCA SOFTWARE & VERSION NUMBER	Sphera LCA For Experts v10.9
LCI DATABASE(S) & VERSION NUMBER	Sphera MLC v. 2024.2 database
LCIA METHODOLOGY & VERSION NUMBER	IPCC AR6, TRACI 2.1 and CML v4.2

The PCR review was conducted by:	NSF International PCR Review Panel ncss@nsf.org
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Solutions
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sphera
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

LIMITATIONS

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; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR 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.

Product Definition and Information

Description of Company

For more than 160 years, Johns Manville (JM) has been dedicated to providing products that create stronger buildings, improve energy efficiency, and contribute to the health and comfort of building occupants.

JM manufactures premium-quality building and mechanical insulation, commercial roofing, glass fibers and nonwoven materials for commercial, industrial, and residential applications. JM products are used in a wide variety of industries including building products, aerospace, automotive and transportation, filtration, commercial interiors, waterproofing and wind energy.

JM employs 8,000 people globally and provides products to more than 85 countries. JM operates 44 manufacturing facilities in North America, Europe, and China. Since 1988, JM's global headquarters has been located in downtown Denver, Colorado.

Product Description

Product Identification

This EPD covers JM's polyvinylchloride (PVC) SD Plus roofing membranes available in thicknesses of 50 mil, 60 mil, and 80 mil. JM's PVC SD Plus roofing membranes are manufactured using an ultraviolet-resistant, polyester-reinforced PVC resin. Utilizing a polyester fabric reinforcement allows for the roofing system to be both mechanically attached and adhered. PVC only-based membranes deliver a pliable and durable sheet with excellent weathering characteristics and resistance to harsh chemicals and industrial pollutants. The PVC only-based membranes are typically utilized in mechanically attached commercial roofing systems and provide excellent long term weatherability, hail resistance and repairability. JM PVC only-based membranes provides a cost-effective, yet highly reliable solution for commercial roofing projects. This combination allows extreme pliability, flexibility and weldability. The following JM PVC only-based roofing membrane products are covered by this environmental product declaration:

Product Specification

Table 1 lists the product specifications representative of the PVC only-based membranes covered by this EPD.

Table 1: PVC only-based membrane technical specifications.

Product	Product Properties	Standard	Product Thickness [mil]	Reference Flow [kg/m^2]
JM PVC SD Plus	Polyester-reinforced thermoplastic polyvinyl chloride roofing membrane	ASTM D 4434, Type III	50	1.63
JM PVC SD Plus	Polyester-reinforced thermoplastic polyvinyl chloride roofing membrane	ASTM D 4434, Type III	60	1.81

JM PVC SD Plus	Polyester-reinforced thermoplastic polyvinyl chloride roofing membrane	ASTM D 4434, Type III	80	2.49

Product Specific/Average

This EPD is intended to represent product-specific PVC only-based membranes. The production data used to develop this EPD considers the manufacturing activities during 2022 at two plants owned by Cooley/Group in Pawtucket, RI, and Lancaster, SC. A weighted average production from both facilities was taken into account where the contribution to overall average from each manufacturing site is proportional to its production volume.

Application

PVC only-based single ply roofing membranes are widely used in various applications in building roofing systems due to their durability and performance. PVC only-based roofing membranes are primarily used for flat and low-slope roofs in commercial structures, providing reliable waterproofing and weather resistance. Existing roofs can also be covered with PVC only-based membranes during renovations, providing a new protective layer.

Declaration of Methodological Framework

This EPD is declared under a cradle-to-gate with options system boundary. The system boundary includes the cradle-to-gate stages (A1-A3) with options (A4-A5, C1-C4). More specifically, it encompasses all potential environmental impacts from raw materials extraction, processing, and transport to the manufacturing stage (A1-A3), transport to construction site and installation (A4-A5), and the end-of-life treatment of the product (C1-C4). At the end-of-life, it is assumed that 30% of the product is recycled and the remaining 70% is disposed in a landfill.

Technical Requirements

The technical specification below applies to product considered in this EPD:

ASTM D 4434, Type III – Standard Specification for PVC (Poly Vinyl Chloride) Type III

Properties of Declared Product as Delivered

PVC only-based membranes are typically rolled and placed on wooden pallets. Packaging materials include cardboard and a plastic film to protect the membranes from damage during transportation. Once packaged, they are delivered to the customer.

Material Composition

Table 2 provides the average material content of a PVC only-based single ply roofing membrane.

Table 2: Average PVC only-based membrane material composition.

COMPONENT	CONTENT [% WEIGHT]
PVC resin	38.6%
UV stabilizer	0.1%
Flame retardant	0.7%
Titanium dioxide	6.6%
Fillers and additives	29.7%
Polyester scrim	6.4%
PVC roofing recycle	17.9%

Manufacturing

JM's PVC SD Plus roofing membranes are manufactured off-site by Cooley/Group at two facilities located in Pawtucket, RI, and Lancaster, SC. The primary raw material for this roofing membrane is ultraviolet-resistant PVC resin. These raw materials are mixed with stabilizers, fire retardants, a pigment, filler and additives and pelletized at an off-site manufacturing unit and delivered to Cooley/Group.

The manufacturing processes at involves several steps. Firstly, the process begins with the preparation of yarn packages and beams, which are essential for creating the fabric base of the membrane. This step is followed by the knitting process. The yarn is knitted intro fabric rolls, forming the structural base of the membrane. The knitted fabric rolls are cut to lengths for different membrane sizes. This process is followed by the profile procedures that includes back side extrusion of PVC layer, first calendaring, extrusion of face side, second calendaring, heating of the membrane in an annealing oven. The finished membrane is cut into rolls and inspected. Finally, the product is transferred onto large cardboard rolls and wrapped in plastic film to be shipped to building sites for installation. The final products are packaged using corrugated board, wrapped in plastic film and wooden pallet and shipped to JM's warehouses or installation sites.

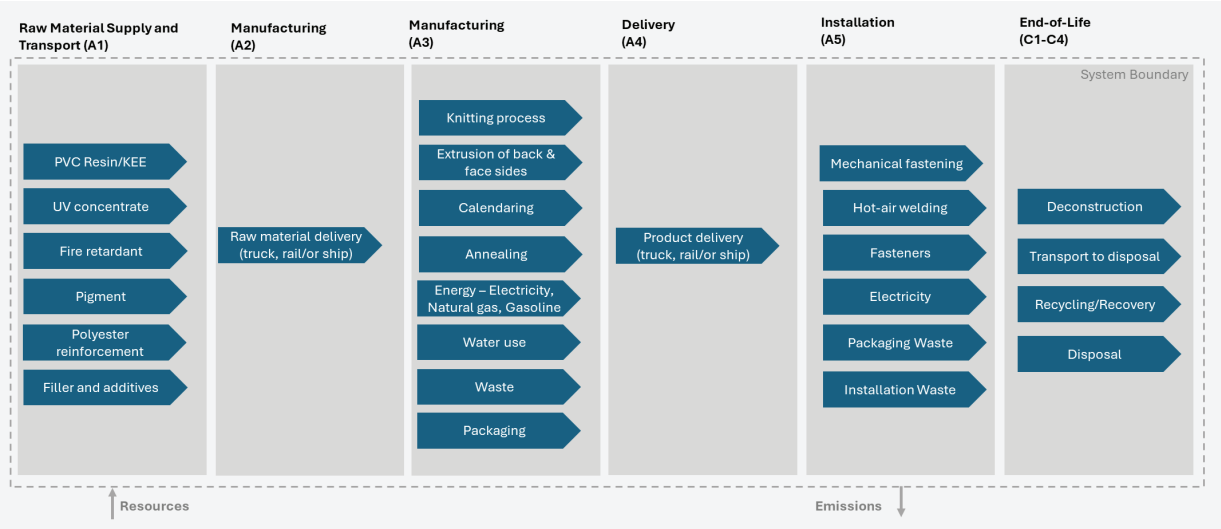


Figure 1: PVC only-based roofing membrane production process schematic.

Packaging

The PVC only-based roofing membranes are bulk packaged using corrugated board and plastic film and delivered on wooden pallets.

Transportation

Primary data from Cooley/Group was used to account for the transportation distances and modes of transport for the supply of raw materials to the production facilities. CFFA's industry average EPD (CFFA, 2020) assumptions on the transport of the finished membrane roofing product to the construction site were considered in this EPD, as defined below:

- Manufacturing site to local distributor: 947 km (588 mi)
- Rail: 47 km (29 mi)
- Local distributor to building site: 25 km (16 mi)

For the transportation of the demolised product at end-of-life, a transport distance of 20 miles (32 km) by road truck from the demolition site to disposal sites is assumed in the study in accordance to CFFA's industry average EPD (CFFA, 2020) assumptions.

Product Installation

PVC only-based roofing membranes are installed using mechanical fastening and hot-air welding. The membrane is secured with screws and seam plates, which are ensured to fasten through the membrane. Material and energy inputs for installation are based on the assumptions proposed by CFFA's Industry average EPD (CFFA , 2020). Therefore, in this study installation requirements per square meter of installed membrane are 0.111 kg of fasteners (screws and seam plates), 0.021 kWh of electricity for seam welding, and 0.015 kWh of electricity for securing screws. An effective

coverage of 10% was determined by JM as a representative installation metric and installation losses were set at 1%.

Waste discarded from bulk packaging materials at installation (e.g., corrugated cartons, polyethylene film, wooden pallets) is included in this module. Typical rates of waste processing routes in the US (e.g., landfill, incineration, recycling) are based on EPA statistics (EPA, 2022) and are assumed for the disposal of packaging materials discarded at installation.

Table 3: Installation systems for PVC SD Plus roofing membrane.

DECLARED MEMBRANE	INSTALLATION	SEAM WELDING
50 mil 60 mil 80 mil	Mechanically fastened	Hot-air welding

Table 4: Installation data for 1 m^2 of installed PVC SD Plus roofing membrane (50 mil, 60 mil, and 80 mil).

TYPE	UNIT	QUANTITY
Fasteners (5” type screws and seam plates)	kg	0.111
Electricity for seam welding	kWh	0.021
Electricity for securing the screws	kWh	0.015
Effective coverage	%	10
Material loss	%	1
Waste transport to landfill (packaging waste) – one way	mi/km	20/32

Use

The use stage is not part of the system boundary of the study.

Recycling and Disposal

The product end-of-life disposal assumptions are based on the ones proposed by CFFA’s Industry average EPD (CFFA

, 2020). At end-of-life, deconstruction of PVC only-based membranes require the use of electricity and diesel. The demolition waste is transported 20 miles (32 km) by truck to the landfill and waste processing site. A fraction of the demolition waste (30%) is sent for recycling, while the rest (70%) is disposed of in a landfill.

Table 5: C1 to C4 Modules, EOL scenario data for 1 m^2 of installed PVC roofing membrane (50 mil, 60 mil, and 80 mil).

EOL Stage	Flow	Units	Quantity
C1	Electricity	kWh	0.0024
	Diesel	MJ	0.421
C2	Discarded PVC membrane	mi/km	20/32
C3	Secondary materials	%	30
C4	Disposal of waste	%	70

Life Cycle Assessment Background Information

Declared Unit

Per the Product Category Rules, the declared unit for this analysis is:

1 m^2 of installed single ply PVC roofing membrane for a stated product thickness.

System Boundary

Table 6 represents the system boundary and scope of the EPD.

Table 6: Description of the system boundary modules

PRODUCT STAGE			CONSTRUCTION PROCESS		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	MND

This study covers the life cycle of the products from cradle to gate with options (A1-A3, A4-A5, and C1-C4). Within these boundaries, the following stages were included as per Figure 2 below:

- **Raw materials acquisition:** Raw material supply (including virgin and recycled materials), inbound transport
- **Manufacturing:** Production of PVC roofing membrane, product packaging, manufacturing waste, releases to environment
- **Distribution:** Distribution of the PVC roofing membrane from the manufacturer to JM warehouses and to the building site for installation
- **End-of-Life:** Deconstruction, transport, recycling and final disposal site (landfill)

Figure 2: Life cycle stages included in system boundary.

Building operational energy and water use are considered to be outside of this study's scope; any beneficial impact that the use of insulation may have on a building's energy consumption is not calculated or incorporated into the analysis.

Estimates and Assumptions

The following assumptions were made on the manufacturing process.

Table 7: Key assumptions for manufacturing stage.

LIFE CYCLE STAGE	ASSUMPTION
A1	Raw material supply • Proxy datasets used in some raw materials where no matching datasets or country-specific data were available (documentation in background report).
A3	• PVC scrap inputs were considered free of upstream environmental burden; however, environmental impact of scrap processing was accounted for. • PVC scrap outputs follow a cut off approach and therefore no environmental credits were assign to them. • All processed water is discharged as wastewater in the municipal sewage; no losses via evaporation or other discharges were considered. • Wood pallets for bulk packaging were assumed to be reused 20 times in their lifetime

The analysis uses the following assumptions based on the CFFA's industry average EPD (CFFA, 2020).

Table 8: Key assumptions at A4-C4 modules, per declared unit.

LIFE CYCLE STAGE	ASSUMPTION
A4	Transport distances to installation site • Manufacturing site to local distributor: 947 km (588 mi) • Rail: 47 km (29 mi) • Local distributor to building site: 25 km (16 mi)
A5	Installation • Mechanically fastened and hot-air welding • Fasteners: 0.111 kg • Electricity for seam welding: 0.021 kWh • Electricity for securing screws: 0.015 kWh • Effective coverage (from JM): 10% • Losses (from JM): 1% • Waste transport to disposal: 32 km (20 mi) by truck

C1	Deconstruction • Electricity: 0.0024 kWh • Diesel: 0.421 MJ
C2	Transport distances of installation waste • Truck: 32 km (20 mi)
C3	• Product's recycling at end-of-life: 30% • Cut-off end-of-life allocation methodology applied (no credits for material/energy recovery)
C4	Product's disposal in the landfill at end-of-life: 70%

Cut-off Criteria

No cut-off criteria are defined for this study. The system boundary was defined based on relevance to the goal of the study. For the processes within the system boundary, all available energy and material flow data have been included in the model. In cases where no matching life cycle inventories are available to represent a flow, proxy data have been applied based on conservative assumptions regarding environmental impacts.

Data Sources

Since the plants manufacture roofing membranes with different thicknesses from the same production line, it was not possible to distinguish the amount of raw materials used to manufacture a specific membrane thickness during the data collection period. In order to resolve this issue, data were collected as a plant totals and later allocated based on the overall production quantities of different products and thicknesses.

The LCA model was created using the LCA For Experts (LCA FE) software system for life cycle engineering, version 10.9, developed by Sphera (Sphera Solutions Inc., 2024). Background life cycle inventory data for raw materials and processes were obtained from the Managed LCA Content v. 2024.2 databases. Cooley/Group provided primary manufacturing data for the calendar year 2022.

Data Quality

As the majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology, precision is considered to be high. Seasonal variations were balanced out by using annual production volume. All background data are sourced from Managed LCA Content databases with the documented precision. Each foreground process was checked for mass balance and completeness of the emission inventory. No data were knowingly omitted. Completeness of foreground unit process data is considered to be high. All background data are sourced from Managed LCA Content databases with the documented completeness.

Period under Review

Primary data collected represent production during the 2022 calendar year. This analysis is therefore intended to represent production primarily in 2022. All secondary data come from the Managed LCA Content database (v. 2024.2) and are representative of the years 2017-2023.

Allocation

Allocation is applied in the foreground system of the study. The PVC only-based roofing membranes covered in this study are produced at two facilities located in Pawtucket, RI and Lancaster, SC. The facility in Pawtucket produces PVC only-based membranes (JM PVC SD Plus), PVC/KEE-based membranes (JM PVC/KEE), and PVC roofing accessories. The Lancaster facility produces only PVC only-based (JM PVC SD Plus) and PVC/KEE-based membranes (JM PVC/KEE). In order to apportion each roofing membrane product with a fraction of the total manufacturing input-output data collected in this study, a mass-based allocation approach is applied. That is, a share of the total manufacturing input-output data was allocated to each product that was proportional to its share of total production per site. Subsequently, a weighted average calculation was carried out with this allocated manufacturing data to obtain product-specific input-output sets of data that encompassed as weighting the production volumes from both manufacturing sites.

Allocation of background data (energy and materials) taken from the MLC v. 2024.2 databases is documented online at https://lcadatabase.sphera.com/

Comparability

Comparisons cannot be made between product-specific or industry average EPDs at the design stage of a project, before a building has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase when product performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted. Any comparison of EPDs shall be subject to the requirements of ISO 21930 or EN 15804. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate, and could lead to erroneous selection of materials or products which are higher-impact, at least in some impact categories.

Life Cycle Assessment Scenarios

Table 9: Transport to the building site (A4).

NAME	50 MIL	60 MIL	80 MIL	UNIT
Fuel type	Diesel	Diesel	Diesel	-
Fuel consumption	Truck: 0.048 Rail: 0.013	Truck: 0.048 Rail: 0.013	Truck: 0.048 Rail: 0.013	l/US ton*mi
Vehicle type	Truck LTL/dry van (EPA SmartWay) & Diesel cargo train	Truck LTL/dry van (EPA SmartWay) & Diesel cargo train	Truck LTL/dry van (EPA SmartWay) & Diesel cargo train	-
Transport distance	Manufacturing site to local distributor: 947 (588.4) Rail: 47 (29.2) Local distributor to building site: 25 (15.5)	Manufacturing site to local distributor: 947 (588.4) Rail: 47 (29.2) Local distributor to building site: 25 (15.5)	Manufacturing site to local distributor: 947 (588.4) Rail: 47 (29.2) Local distributor to building site: 25 (15.5)	km (mi)
Payload capacity	Truck: 22.6 Rail: 726.2	Truck: 22.6 Rail: 726.2	Truck: 22.6 Rail: 726.2	US ton

Gross density of products transported	1.90	2.11	2.90	kg/m^2
Weight of products transported (if gross density not reported)	-	-	-	kg
Volume of products transported (if gross density not reported)	-	-	-	m^3
Capacity utilization volume factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaging products)	<1	<1	<1	-

Table 10: Installation into the building (A5).

NAME	50 MIL	60 MIL	80 MIL	UNIT
Ancillary materials	-	-	-	kg
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	-	-	-	m^3
Other resources: fasteners (screws and seam plates), per declared unit	0.111	0.111	0.111	kg
Electricity consumption, per declared unit	Electricity for seam welding: 0.021 Electricity for securing screws: 0.015	Electricity for seam welding: 0.021 Electricity for securing screws: 0.015	Electricity for seam welding: 0.021 Electricity for securing screws: 0.015	kWh
Other energy carriers, per declared unit	-	-	-	MJ
Product loss, per declared unit	1	1	1	%
Waste materials at the construction site before waste processing, generated by product installation, per declared unit	0.068	0.075	0.103	kg
Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal)	-	-	-	kg
Biogenic carbon contained in packaging	1.64	1.82	2.5	kg CO_2
Direct emissions to ambient air, soil and	-	-	-	kg

water				
VOC content	-	-	-	µg/m³

Table 11: End of life (C1-C4).

NAME		50 MIL	60 MIL	80 MIL	UNIT
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation), per declared unit		Electricity consumption at deconstruction: 0.0024 kWh Diesel consumption at deconstruction: 0.421 MJ	Electricity consumption at deconstruction: 0.0024 kWh Diesel consumption at deconstruction: 0.421 MJ	Electricity consumption at deconstruction: 0.0024 kWh Diesel consumption at deconstruction: 0.421 MJ	
Collection process (specified by type)	Collected separately	-	-	-	kg/declared unit
	Collected with mixed construction waste	-	-	-	kg/declared unit
Recovery (specified by type)	Reuse	-	-	-	kg/declared unit
	Recycling	0.643	0.703	0.927	kg/declared unit
	Landfill	-	-	-	kg/declared unit
	Incineration	-	-	-	kg/declared unit
	Incineration with energy recovery	-	-	-	kg/declared unit
	Energy conversion efficiency rate	-	-	-	kg/declared unit
Disposal (specified by type)	Product or material for final deposition in landfill	1.261	1.399	1.923	kg/declared unit
Removals of biogenic carbon (excluding packaging)		-	-	-	kg CO_2

Life Cycle Assessment Results

These sections describe the potential impacts across the different life cycle stages of PVC SD Plus roofing membrane. The overall results present the environmental impact indicators, resource use indicators, output flows, waste categories and carbon disposal and removal indicators in accordance with ISO 21920. The results cover the life cycle modules considered in the study: A1 to 3, A4, A5, and C1 to C4 modules.

The following results are based on a declared unit of 1 m^2 of installed PVC SD Plus roofing membrane.

Life Cycle Impact Assessment and Inventory Results

PVC SD Plus - 50 mil

Table 12 to Table 15 shows the different environmental impact resutls of 1 m^2 of PVC SD Plus for 50 mil thickness.

Table 12: LCIA impacts 1 m^2 of PVC SD Plus (50 mil).

Parameters	Units	A1-A3	A4	A5	C1	C2	C3	C4
GWP100 excl biogenic CO_2	kg CO_2 eq.	5.18E+00	1.93E-01	4.12E-01	4.43E-02	6.31E-03	0.00E+00	2.72E-02
ODP	kg CFC 11 eq.	2.95E-09	5.69E-16	5.15E-14	2.00E-16	1.86E-17	0.00E+00	1.31E-15
SFP	kg O_3 eq.	2.09E-01	1.17E-02	1.67E-02	1.32E-02	3.33E-04	0.00E+00	2.53E-03
AP	kg SO_2 eq.	2.65E-02	5.04E-04	2.25E-03	3.81E-04	1.47E-05	0.00E+00	1.41E-04
EP	kg P eq.	1.39E-03	5.44E-05	7.02E-05	2.92E-05	1.67E-06	0.00E+00	2.23E-04
ADP_f	MJ	9.02E+01	2.53E+00	4.74E+00	5.81E-01	8.28E-02	0.00E+00	4.01E-01

Table 13: Resource use for 1 m^2 of PVC SD Plus (50 mil).

Resource Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E	MJ	3.22E+01	1.13E-01	1.49E+00	2.88E-02	3.70E-03	0.00E+00	5.12E-02
RPR_M	MJ	1.47E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	8.29E+01	2.55E+00	5.22E+00	5.92E-01	8.36E-02	0.00E+00	4.13E-01

$NRPR_M$	MJ	2.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	kg	3.36E-01	0.00E+00	8.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	-	-	-	-	-	-	-
NRSF	MJ	-	-	-	-	-	-	-
RE	MJ	-	-	-	-	-	-	-
FW	m^3	2.75E-02	3.75E-04	2.13E-03	9.01E-05	1.23E-05	0.00E+00	5.34E-05

Table 14: Output flows and waste for 1 m^2 of PVC SD Plus (50 mil).

INDICATORS	UNITS	A1-A3	A4	A5	C1	C2	C3	C4
HWD	kg	-	-	-	-	-	-	-
NHWD	kg	2.81E-02	0.00E+00	2.71E-02	0.00E+00	0.00E+00	0.00E+00	1.26E+00
HLRW	kg	5.50E-06	9.11E-09	1.73E-07	4.78E-09	2.99E-10	0.00E+00	4.91E-09
ILLRW	kg	4.63E-03	7.68E-06	1.68E-04	4.01E-06	2.52E-07	0.00E+00	4.39E-06
CRU	kg	-	-	-	-	-	-	-
MFR	kg	2.01E-01	0.00E+00	3.02E-02	0.00E+00	0.00E+00	6.43E-01	0.00E+00
MER	kg	0.00E+00	0.00E+00	2.68E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	-	-	-	-	-	-	-

Table 15: Carbon removal and emissions for 1 m^2 of PVC SD Plus (50 mil).

INDICATORS	UNITS	A1-A3	A4	A5	C1	C2	C3	C4
BCRP	kg CO_2 eq.	-	-	-	-	-	-	-
BCEP	kg CO_2 eq.	-	-	-	-	-	-	-
BCRK	kg CO_2 eq.	1.64E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

BCEK	kg CO_2 eq.	0.00E+00	0.00E+00	2.08E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	kg CO_2 eq.	-	-	-	-	-	-	-
CCE	kg CO_2 eq.	-	-	-	-	-	-	-
CCR	kg CO_2 eq.	-	-	-	-	-	-	-
CWNR	kg CO_2 eq.	-	-	-	-	-	-	-

PVC SD Plus - 60 mil

Table 16 to Table 19 shows the different environmental impact resutls of 1 m^2 of PVC SD Plus for 60 mil thickness.

Table 16: LCIA impacts for 1 m^2 of PVC SD Plus (60 mil).

PARAMETERS	UNITS	A1-A3	A4	A5	C1	C2	C3	C4
GWP 100 excl biogenic CO_2	kg CO_2 eq.	5.75E+00	2.14E-01	4.13E-01	4.43E-02	6.97E-03	0.00E+00	3.02E-02
ODP	kg CFC 11 eq.	3.27E-09	6.32E-16	5.15E-14	2.00E-16	2.06E-17	0.00E+00	1.45E-15
SFP	kg O_3 eq.	2.32E-01	1.30E-02	1.67E-02	1.32E-02	3.68E-04	0.00E+00	2.80E-03
AP	kg SO_2 eq.	2.94E-02	5.59E-04	2.25E-03	3.81E-04	1.62E-05	0.00E+00	1.57E-04
EP	kg P eq.	1.55E-03	6.05E-05	7.09E-05	2.92E-05	1.84E-06	0.00E+00	2.48E-04
ADP_f	MJ	1.33E+01	2.81E+00	4.74E+00	5.81E-01	9.15E-02	0.00E+00	4.45E-01

Table 17: Resource use for 1 m^2 of PVC SD Plus (60 mil).

RESOURCE INDICATOR	UNIT	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E	MJ	3.58E+01	1.25E-01	1.49E+00	2.88E-02	4.08E-03	0.00E+00	5.68E-02
RPR_M	MJ	1.64E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	9.21E+01	2.83E+00	5.22E+00	5.92E-01	9.22E-02	0.00E+00	4.58E-01

$NRPR_M$	MJ	2.26E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	kg	3.73E-01	0.00E+00	8.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	-	-	-	-	-	-	-
NRSF	MJ	-	-	-	-	-	-	-
RE	MJ	-	-	-	-	-	-	-
FW	m^3	3.06E-02	4.16E-04	2.13E-03	9.01E-05	1.36E-05	0.00E+00	5.92E-05

Table 18: Output flows and waste for 1 m^2 of PVC SD Plus (60 mil).

INDICATORS	UNITS	A1-A3	A4	A5	C1	C2	C3	C4
HWD	kg	-	-	-	-	-	-	-
NHWD	kg	3.12E-02	0.00E+00	2.99E-02	0.00E+00	0.00E+00	0.00E+00	1.40E+00
HLRW	kg	6.11E-06	1.01E-08	1.73E-07	4.78E-09	3.30E-10	0.00E+00	5.45E-09
ILLRW	kg	5.14E-03	8.53E-06	1.68E-04	4.01E-06	2.78E-07	0.00E+00	4.87E-06
CRU	kg	-	-	-	-	-	-	-
MFR	kg	2.24E-01	0.00E+00	3.32E-02	0.00E+00	0.00E+00	7.03E-01	0.00E+00
MER	kg	0.00E+00	0.00E+00	2.94E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	-	-	-	-	-	-	-

Table 19: Carbon disposal and removal for 1 m^2 of PVC SD Plus (60 mil).

INDICATORS	UNITS	A1-A3	A4	A5	C1	C2	C3	C4
BCRP	kg CO_2 eq.	-	-	-	-	-	-	-
BCEP	kg CO_2 eq.	-	-	-	-	-	-	-
BCRK	kg CO_2 eq.	-	-	-	-	-	-	-
BCEK	kg CO_2 eq.	1.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

BCEW	kg CO_2 eq.	0.00E+00	0.00E+00	2.30E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	kg CO_2 eq.	-	-	-	-	-	-	-
CCR	kg CO_2 eq.	-	-	-	-	-	-	-
CWNR	kg CO_2 eq.	-	-	-	-	-	-	-

PVC SD Plus - 80 mil

Table 20 to Table 23 shows the different environmental impact resutls of 1 m^2 of PVC SD Plus for 80 mil thickness.

Table 20: LCIA impacts for 1 m^2 of PVC SD Plus (80 mil).

	Units	A1-A3	A4	A5	C1	C2	C3	C4
GWP 100 excl biogenic CO2	kg CO_2 eq.	7.92E+00	2.94E-01	4.16E-01	4.43E-02	9.45E-03	0.00E+00	4.15E-02
ODP	kg CFC 11 eq.	4.50E-09	8.70E-16	5.15E-14	2.00E-16	2.79E-17	0.00E+00	1.99E-15
SFP	kg O_3 eq.	3.20E-01	1.80E-02	1.67E-02	1.32E-02	4.99E-04	0.00E+00	3.85E-03
AP	kg SO_2 eq.	4.05E-02	7.69E-04	2.26E-03	3.81E-04	2.20E-05	0.00E+00	2.15E-04
EP	kg P eq.	2.13E-03	8.32E-05	7.36E-05	2.92E-05	2.50E-06	0.00E+00	3.41E-04
ADP_f	MJ	1.83E+01	3.86E+00	4.75E+00	5.81E-01	1.24E-01	0.00E+00	6.11E-01

Table 21: Resource use for 1 m^2 of PVC SD Plus (80 mil).

Resource Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E	MJ	4.92E+01	1.72E-01	1.49E+00	2.88E-02	5.53E-03	0.00E+00	7.81E-02
RPR_M	MJ	2.25E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	1.27E+02	3.90E+00	5.22E+00	5.92E-01	1.25E-01	0.00E+00	6.30E-01
$NRPR_M$	MJ	3.11E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	kg	5.13E-01	0.00E+00	8.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00

RSF	MJ	-	-	-	-	-	-	-
NRSF	MJ	-	-	-	-	-	-	-
RE	MJ	-	-	-	-	-	-	-
FW	m^3	4.21E-02	5.73E-04	2.14E-03	9.01E-05	1.84E-05	0.00E+00	8.14E-05

Table 22: Output flows and waste for 1 m^2 of PVC SD Plus (80 mil).

INDICATOR	UNITS	A1-A3	A4	A5	C1	C2	C3	C4
HWD	kg	-	-	-	-	-	-	-
NHWD	kg	4.29E-02	0.00E+00	4.08E-02	0.00E+00	0.00E+00	0.00E+00	1.92E+00
HLRW	kg	8.40E-06	1.39E-08	1.73E-07	4.78E-09	4.47E-10	0.00E+00	7.49E-09
ILLRW	kg	7.08E-03	1.17E-05	1.68E-04	4.01E-06	3.77E-07	0.00E+00	6.69E-06
CRU	kg	-	-	-	-	-	-	-
MFR	kg	3.08E-01	0.00E+00	4.56E-02	0.00E+00	0.00E+00	9.27E-01	0.00E+00
MER	kg	0.00E+00	0.00E+00	3.96E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	-	-	-	-	-	-	-

Table 23: Carbon disposal and removal for 1 m^2 of PVC SD Plus (80 mil).

INDICATORS	UNITS	A1-A3	A4	A5	C1	C2	C3	C4
BCRP	kg CO_2 eq.	-	-	-	-	-	-	-
BCEP	kg CO_2 eq.	-	-	-	-	-	-	-
BCRK	kg CO_2 eq.	2.50E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	kg CO_2 eq.	0.00E+00	0.00E+00	3.15E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	kg CO_2 eq.	-	-	-	-	-	-	-
CCE	kg CO_2 eq.	-	-	-	-	-	-	-

CCR	kg CO_2 eq.	-	-	-	-	-	-	-
CWNR	kg CO_2 eq.	-	-	-	-	-	-	-

LCA Interpretation

The present EPD evaluates JM's PVC SD Plus single ply roofing membrane's potential environmental impacts, which is sold by JM in thicknesses of 50 mil, 60 mil, and 80 mil. The 80-mil thickness membrane has the highest GWP100 impact, 8.72 kg CO_2e/m^2 of membrane. The 60-mil and 50-mil thicknesses membranes have a GWP100 of 6.46 kg CO_2e and 5.86 kg CO_2e per m^2 of membrane, respectively. As expected, a higher membrane thickness correlates with increased GWP100 given that larger amounts of materials and energy are required to manufacture them. The environmental burden is mostly driven by the manufacturing of the raw materials (A1 module, 71%, 71%, 73% contribution to GWP100 for 50, 60, and 80 mil, respectively). Particularly, the production of the base resin (38%, 38%, 39%), plasticizer (8% across all thicknesses) and other raw materials (22%, 22%, 23%) stand out for module A1. Electricity consumption at the manufacturing site (10% contribution to GWP100 for all thicknesses) is a key driver of module A3 (membranes' manufacturing)'s GWP100. Electricity use at installation (A5) of the PVC roofing membranes (10%, 10%, 8%) are other drivers of GWP100 impact. The production module (A1-A3) is the primary contributor (more than 85%) to environmental impacts across all cate-gories and indicators.

Additional Environmental Information

Environment and Health During Manufacturing

Johns Manville roofing membrane products are designed, manufactured and tested in our own facilities, which are certified and registered to the stringent ISO 9001 (ANSI/ASQC 90) and ISO 14001 quality and environmental standards. These certifications, along with regular, independent third-party auditing for compliance, is your assurance that JM products deliver consistent high quality.

Environment and Health During Installation

More details on installation is available at https://www.jm.com/en/commercial-roofing/PVC-design-and-installation-considerations/.

Building Use Stage Benefits

The lighter-colored JM PVC reflects solar energy to lower the amount of heat absorbed into the building, greatly reducing air-conditioning energy loads and costs.

White JM PVC membrane meets the stringent requirements for both LEED® (Leadership in Energy and Environmental Design) and California Title 24 when tested by the CRRC® (Cool Roof Rating Council).

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Contact Information

Study Commissioner

Johns Manville
717 17th St.
Denver, CO 80202
800-654-3103
www.jm.com

LCA Practitioner

Sphera Solutions, Inc.
130 E Randolph St, #2900
Chicago, IL 60601
https://sphera.com/contact-us/
www.sphera.com

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717 17th St.
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