Declaration Owner

Milliken
920 Milliken Road
Spartanburg, SC 29303
United States
+1-800-241-4826 | https://floors.milliken.com.

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

Product
2.5mm PVC Free: En Plein Air

(UNSPSC Class Code 30161700/CSI Code 09 65 00)

Functional Unit
The functional unit is one square meter of flooring over a 75-year period

EPD Number and Period of Validity
SCS-EPD-10665
EPD Valid August 7, 2026 through August 6, 2031

Product Category Rule
PCR for Building-Related Products and Services - Part A: LCA Calculation Rules and Report Requirements, UL 10010, UL v.4.0, March 2022.
PCR Guidance for Building-Related Products and Services - Flooring EPD Requirements, UL 10010-7, v.2.0, valid until 30.09.2026.

Program Operator
SCS Global Services
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Declaration Owner:	Milliken
Address:	920 Milliken Road, Spartanburg SC 29303
Declaration Number:	SCS-EPD-10665
Declaration Validity Period:	EPD Valid August 7, 2026 through August 6, 2031
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Gerard Mansell, Ph.D., SCS Consulting Services
LCA Software and LCI database:	OpenLCA v2.5 software and the Ecoinvent v3.12 database
Product RSL:	22 years
Markets of Applicability:	North America
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Grave
LCIA Method and Version:	TRACI 2.2, IPCC 2021, CMIL-IA v4.8 2016
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Lindita Bushi, Ph.D., Athena Sustainable Materials Institute
Part A Product Category Rule:	PCR for Building-Related Products and Services - Part A: LCA Calculation Rules and Report Requirements, UL 10010, UL v.4.0, March 2022
Part A PCR Review conducted by:	Lindita Bushi, PhD (Chair); Hugues Imbeault-Tétreault, ing., M.Sc.A.; Jack Geibig
Part B Product Category Rule:	PCR Guidance for Building-Related Products and Services - Flooring EPD Requirements, UL 10010-7, v.2.0, valid until 30.09.2026
Part B PCR Review conducted by:	Jack Geibig (chair), Ecoform; Thomas Gloria, Industrial Ecology Consultants; Thaddeus Owen
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Lindita Bushi, Ph.D., Athena Sustainable Materials Institute
Declaration Contents:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and 21930.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works. The owner of the declaration shall be liable for the underlying information and evidence; SCS shall not be liable with respect to manufacturer information, life cycle assessment data, and evidence supplied or made available to SCS.

1. Milliken

Milliken is a leading supplier of floor coverings, with a rich history or delivering dynamic carpet and luxury vinyl tile collections from its award winning design studios and manufacturing facilities around the globe. Combining global insight with national expertise and proprietary technologies, Milliken is at the forefront of innovation and design, offering high-performance, expertly-engineered products. Founded in 1865, Milliken has achieved an amazing 150 years in the textiles business and is now one of the largest privately owned companies in the world, providing expert solutions across a range of disciplines, including specialty chemicals, floor coverings, and performance materials. With over 100 years of environmental stewardship, the Milliken family of companies is one of the world's more responsible manufacturers.

Designing innovative products and solutions for our customers is of the utmost importance. Through meaningful design, deep science and unique insights, we advance product development to the next level, while supporting Milliken's efforts to increase sustainable results and minimize environmental impact of all products. Milliken's holistic approach to innovation encompasses all stages of the life cycle - from material sourcing and manufacturing practices to end-of-life management. Our commitment to transparency, health, safety, quality and sustainability allows us to put our customers, associates, and communities first. In 2020, Milliken was named one of the World's Most Ethical Companies by the Ethisphere Institute for the fourteenth year running.

2. Product

2.1 PRODUCT DESCRIPTION

Product Name	Representative Thickness (mm)	Description
2.5mm PVC Free: En Plein Air	2.5 mm	The En Plein Air collection is designed with both people and the planet in mind. As our third PVC-Free collection, it reflects our commitment to creating healthier indoor environments without compromising on design. Inspired by the fluid, expressive nature of outdoor painting, these designs bring a sense of movement, tranquility and connection to any space. Combining well-being with artistic influence, this collection proves that great design can be both beautiful and responsible.

2.2 PRODUCT FLOW DIAGRAM

A flow diagram illustrating the production processes and life cycle phases included in the scope of the EPD is provided below.

2.3 APPLICATION

The products provide the primary function of flooring for interior applications. The flooring products are used in various residential and commercial applications including retail, healthcare, education, and hospitality.

2.4 DECLARATION OF METHODOLOGICAL FRAMEWORK

The scope of the EPD is cradle-to-grave, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal. The life cycle phases included in the product system boundary are shown below.

Cut-off and allocation procedures are described below and conform to the PCR and ISO standards.

Table 1. *Life cycle phases included in the product system boundary.*

Product			Construction Process		Use							End-of-life				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 extraction and processing	Transport to manufacturer	Manufacturing	Transport	Construction – installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery and/or recycling potential
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	MND

X = Included in system boundary
MND = Module not declared

2.5 TECHNICAL DATA

Technical specifications for the flooring products are summarized in Table 2.

Table 2. *Product characteristics for the* **2.5mm PVC Free: En Plein Air** *flooring product*

Characteristic			Description			
Sustainable certifications			ISO 9001, CE, FloorScore®			
VOC emissions test method			CDPH/EHLB Standard Method, ISO 16000			
Characteristic			**Average Value**	**Unit**	**Min Value**	**Max Value**
Product thickness			2.50 (0.098)	mm (in)	2.50 (0.098)	2.50 (0.098)
Wear layer thickness (where applicable)			0.51 (0.020)	mm (in)	0.51 (0.020)	0.51 (0.020)
Product weight			3,770 (12.35)	g/m^2 (oz/ft^2)	3,770 (12.35)	3,770 (12.35)
Product Form	Tiles	Width	152.0 (5.98)	mm (in)	152.0 (5.98)	152.0 (5.98)
		Length	1,219 (48.0)	mm (in)	1,219 (48.0)	1,219 (48.0)

2.6 MARKET PLACEMENT/APPLICATION RULES

Technical specifications of the flooring products are summarized above. Detailed product performance results can be found on the manufacturer's website https://floors.milliken.com.

2.7 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

The flooring products are delivered for installation in the form of tiles of various dimensions.

2.8 MATERIAL COMPOSITION

The Luxury flooring products (UNSPSC Class Code 30161700/CSI Code 09 65 00) are manufactured at the production facility in South Korea. The primary materials include polymer resins, plasticizers, fillers and stabilizers.

Table 3. *Material content for the flooring products in kg per square meter and percent of total mass.*

Component	Renewable	Recycled Content (%)	2.5mm PVC Free: En Plein Air	
Filler	No	0%	2.33	62%
Polymer resin	No	0%	0.770	20%
Polyethylene	No	0%	0.487	13%
Polypropylene	No	0%	0.114	3%
Pigment	No	0%	1.00×10^{-2}	0.27%
Additives	No	0%	6.10×10^{-2}	1.6%
Total Product			**3.77**	**100%**

In conformance with the PCR, product materials were reviewed for the presence of any toxic or hazardous chemicals. Based on a review of the product components provided by the manufacturer, no regulated chemicals, i.e., substances of Very High Concern (SVHC) or substances on the REACH Candidate List, were identified in the product or product components.

2.9 MANUFACTURING

The products are manufactured at the production facility in South Korea. The manufacturer provided primary data for their annual production, resource use and electricity consumption and waste generation at the facility. Electricity consumption is modeled using Ecoinvent datasets for the regional electricity grid resource mix on the market. No green power sources or CO_2 certificates are included in the present study.

2.10 PACKAGING

The products are packaged for shipment using plastic wrap, corrugated board and wooden pallets.

Table 4. *Material content for the flooring product packaging in kg per square meter of flooring.*

Component	Renewable	Recycled Content (%)	2.5mm PVC Free: En Plein Air	
Corrugate/Paper	Yes	0%	7.17×10^{-2}	27%
Plastic	No	0%	2.50×10^{-3}	0.96%
Wood	Yes	0%	0.187	72%
Total Packaging			**0.261**	**100%**

2.11 PRODUCT INSTALLATION

Installation of the product is accomplished using hand tools with negligible impacts. The impacts associated with packaging disposal are included with the installation phase as per PCR requirements.

2.12 USE CONDITIONS

No special conditions of use are noted.

2.13 REFERENCE SERVICE LIFE

The Reference Service Life (RSL) of the flooring products is based on the manufacturer's warranted lifetime.

2.14 RE-USE PHASE

The flooring products are not reused at end-of-life.

2.15 DISPOSAL

At end-of-life, the products are disposed of in a landfill.

2.16 FURTHER INFORMATION

Further information on the product can be found on the manufacturer's website https://floors.milliken.com.

3. LCA: Calculation Rules

3.1 FUNCTIONAL UNIT

The functional unit used in the study is defined as 1 m^2 of floor covering installed for use over a 75-year period. The corresponding reference flow for the product system is presented in Table 5. For the present assessment, a reference service lifetime (RSL) corresponding to the manufacturer's warranted lifetime is assumed. The total number of required product lifecycles during the 75-year period over which the product system is modeled is also summarized for the products in Table 5.

Table 5. *Reference flow and RSL for the flooring products.*

Product Name	Reference Flow (kg/m^2)	Reference Service Life – RSL (years)	Replacement Cycle (ESL/RSL-1)
2.5mm PVC Free: En Plein Air	3.77	22	2.4

3.2 SYSTEM BOUNDARY

The scope of the EPD is cradle-to-grave, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal.

Consistent with PCR requirements, processes excluded from the system boundary include the following:

- Construction activities, capital equipment, and infrastructure
- Maintenance and operation of capital equipment
- Personnel travel and resource use

The deletion of these processes is permitted since it is not expected to significantly change the overall conclusions of the study.

The life cycle phases included in the EPD scope are described in Table 6 and illustrated in Figure 1.

Table 6. *The modules and unit processes included in the scope for the flooring product system.*

Module	Module Description	Unit Processes Included in Scope
A1	Extraction and processing of raw materials; any reuse of products or materials from previous product systems; processing of secondary materials; generation of electricity from primary energy resources; energy, or other recovery processes from secondary fuels	Extraction and processing of raw materials for the product components.
A2	Transport (to the manufacturer)	Transport of component materials to the manufacturing facilities
A3	Manufacturing, including ancillary material production	Manufacturing of flooring products and packaging (including upstream unit processes)
A4	Transport (to the building site)	Transport of product (including packaging) to the building site
A5	Construction-installation process	Impacts from the installation of product are assumed negligible. Impacts from the production, transport and disposal of waste material associated with installation are included in this phase in addition to impacts from packaging disposal
B1	Product use	Use of the product in a commercial building setting. There are no associated emissions or impacts from the use of the product
B2	Product maintenance	Maintenance of products over the product RSL, including periodic cleaning.
B3	Product repair	The product is not expected to require repair over its lifetime
B4	Product replacement	The materials and energy required for replacement of the product over the 75-year ESL of the assessment are included in this phase
B5	Product refurbishment	The product is not expected to require refurbishment over its lifetime
B6	Operational energy use by technical building systems	There is no operational energy use associated with the use of the product

B7	Operational water uses by technical building systems	There is no operational water use associated with the use of the product
C1	Deconstruction, demolition	Demolition of the product is accomplished using hand tools with no associated emissions and negligible impacts
C2	Transport (to waste processing)	Transport of the product to waste treatment at end-of-life
C3	Waste processing for reuse, recovery and/or recycling	The products are disposed of by landfilling which requires no waste processing
C4	Disposal	Disposal of the product
D	Reuse-recovery-recycling potential	Module not declared

**This includes unit processes involved in the generation of electricity, and production of material input (e.g., adhesives and pigments).*

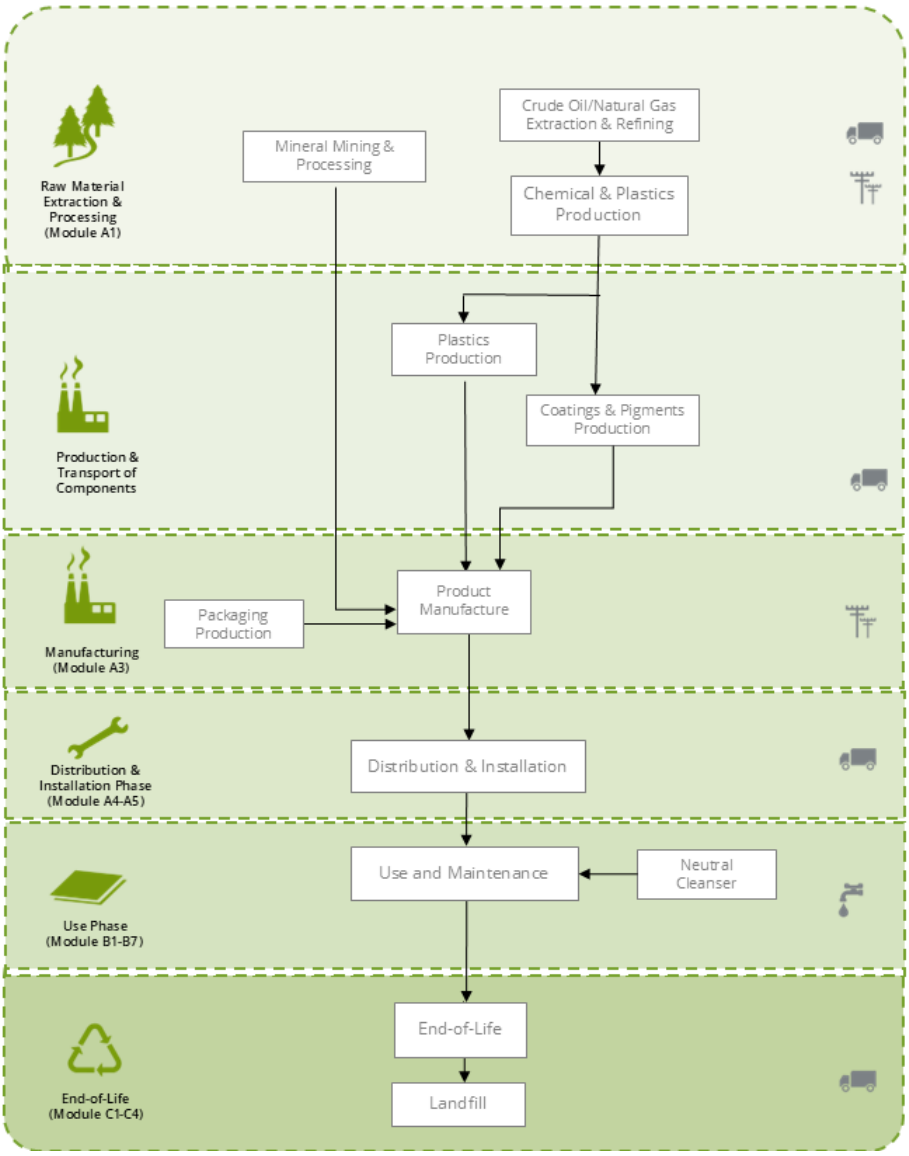

Figure 1. *Flow diagram for the life cycle of the flooring products.*

3.3 PRODUCT SPECIFIC CALCULATION FOR USE PHASE

The recommended cleaning regime is highly dependent on the use of the premises where the floor covering is installed. In high traffic areas more frequent cleaning will be needed compared to areas where there is low traffic. For the purposes of this EPD, average maintenance (moderate traffic levels) is presented based on typical installations.

3.4 UNITS

All data and results are presented using SI units.

3.5 ESTIMATES AND ASSUMPTIONS

- Electricity use at the manufacturing facility was allocated to the products based on the product area as a fraction of the total production.
- The Milliken manufacturing facility under review is located in South Korea. Ecoinvent inventory datasets for the South Korean energy resource mix were used to model resource use and emissions from electricity use at the manufacturing facility.
- The Reference Service Life (RSL) of the products was modeled based on information provided by the manufacturer assuming their products are installed and maintained as recommended and used for the specific application noted.
- Downstream transport was modeled based on information provided by the manufacturer representing distribution to consumer markets in North America.
- The maintenance phase of the product life cycle was modeled based on information provided by the manufacturer including recommended installation and cleaning methods, as well as cleaning frequency.
- For the product at end-of-life, disposal of product materials are assumed landfilled while product packaging is modeled based on regional statistics regarding recycling rates of packaging materials.
- For final disposal of the packaging materials at end-of-life, all materials are assumed to be transported 161 km by diesel truck to either a landfill or material reclamation facility (for recycling). Datasets representing disposal in a landfill and waste incineration are from Ecoinvent.
- For final disposal of the flooring products at end-of-life, all materials are assumed to be transported 161 km by diesel truck to landfill. Datasets representing disposal in a landfill are from Ecoinvent.

The PCR requires the results for several inventory flows related to construction products to be reported including energy and resource use and waste and outflows. These are aggregated inventory flows, and do not characterize any potential impact; results should be interpreted taking into account this limitation.

3.6 CUT-OFF RULES

According to the PCR, processes contributing greater than 5% of the total environmental impact indicator for each impact are included in the inventory. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results. No known flows are deliberately excluded from this EPD.

3.7 DATA SOURCES

Primary data were provided for the manufacturing facility. The sources of secondary LCI data are the Ecoinvent database.

Table 7. *Data sources for the flooring products.*

Component	Dataset	Data Source	Publication Date
PRODUCT			
Filler			
Calcium Carbonate	limestone production, crushed, washed | limestone, crushed, washed | Cutoff, S/RoW	EI v3.12	2025
Talc	Talcum powder production - LCI/EU27+3	EI v3.12, LCI	2025
Pigment			
Carbon Black	carbon black production | carbon black | Cutoff, S/GLO	EI v3.12	2025
TiO_2	market for titanium dioxide | titanium dioxide | Cutoff, S/RoW	EI v3.12	2025
Plastics			
PE	polyethylene production, low density, granulate | polyethylene, low density, granulate | Cutoff, S/RoW	EI v3.12	2025
PP	polypropylene production, granulate | polypropylene, granulate | Cutoff, S/RoW	EI v3.12	2025
Acrylic dispersion	acrylic dispersion production, with water, in 58% solution state | acrylic dispersion, with water, in 58% solution state | Cutoff, S/RoW	EI v3.12	2025
Other			
Coating	market for polyurethane, flexible foam | polyurethane, flexible foam | Cutoff, S/RoW	EI v3.12	2025
	chemical production, inorganic | chemical, inorganic | Cutoff, S/GLO	EI v3.12	2025
	chemical production, organic | chemical, organic | Cutoff, S/GLO	EI v3.12	2025
PACKAGING			
Cardboard	corrugated board box production | corrugated board box | Cutoff, S/RoW	EI v3.12	2025
Wood	EUR-flat pallet production | EUR-flat pallet | Cutoff, S/RoW	EI v3.12	2025
Plastic	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cutoff, S/RoW;	EI v3.12	2025
	polyethylene terephthalate production, granulate, amorphous | polyethylene terephthalate, granulate, amorphous | Cutoff, S/RoW	EI v3.12	2025
TRANSPORT			
Road transport	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff, S/RoW	EI v3.12	2025
Ship transport	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, S/GLO	EI v3.12	2025
RESOURCES			
Grid electricity	market for electricity, medium voltage | electricity, medium voltage | Cutoff, S/KR	EI v3.12	2025
Heat – natural gas	market for heat, central or small-scale, natural gas | heat, central or small-scale, natural gas | Cutoff, S/RoW	EI v3.12	2025
Heat - Heavy fuel oil	heat production, heavy fuel oil, at industrial furnace 1MW | heat, district or industrial, other than natural gas | Cutoff, S/RoW	EI v3.12	2025
Heat - Light fuel oil	heat production, light fuel oil, at industrial furnace 1MW | heat, district or industrial, other than natural gas | Cutoff, S/RoW	EI v3.12	2025
Tap Water	tap water production, conventional treatment | tap water | Cutoff, S/RoW	EI v3.12	2025
Wastewater	treatment of wastewater, average, wastewater treatment | wastewater, average | Cutoff, S/RoW	EI v3.12	2025
MAINTENANCE			
Neutral cleaner	ethoxylated alcohol (AE7) production, petrochemical | ethoxylated alcohol (AE7) | Cutoff, S/RoW	EI v3.12	2025
	fatty acid production, from palm oil | fatty acid | Cutoff, S/RoW	EI v3.12	2025
	market group for tap water | tap water | Cutoff, S/GLO	EI v3.12	2025
Water	tap water production, conventional treatment | tap water | Cutoff, S/RoW	EI v3.12	2025
WASTE DISPOSAL			
Landfill	treatment of municipal solid waste, sanitary landfill | municipal solid waste | Cutoff, S/RoW	EI v3.12	2025

Component	Dataset	Data Source	Publication Date
	treatment of waste wood, untreated, sanitary landfill | waste wood, untreated | Cutoff, S/RoW	EI v3.12	2025
	treatment of waste polyethylene, sanitary landfill | waste polyethylene | Cutoff, S/RoW	EI v3.12	2025
	treatment of waste paperboard, sanitary landfill | waste paperboard | Cutoff, S/RoW	EI v3.12	2025
	treatment of waste plastic, mixture, sanitary landfill | waste plastic, mixture | Cutoff, S/RoW	EI v3.12	2025
	treatment of waste polyvinylchloride, sanitary landfill | waste polyvinylchloride | Cutoff, S/RoW	EI v3.12	2025
	treatment of waste wood, untreated, sanitary landfill | waste wood, untreated | Cutoff, S/RoW	EI v3.12	2025
	treatment of waste polypropylene, sanitary landfill | waste polypropylene | Cutoff, S/RoW	EI v3.12	2025
Incineration	treatment of waste polyethylene, municipal incineration | waste polyethylene | Cutoff, S/RoW	EI v3.12	2025
	treatment of waste wood, untreated, municipal incineration | waste wood, untreated | Cutoff, S/RoW	EI v3.12	2025
	treatment of waste paperboard, municipal incineration | waste paperboard | Cutoff, S/RoW	EI v3.12	2025

3.8 DATA QUALITY

The data quality assessment addressed the following parameters: time-related coverage, geographical coverage, technological coverage, precision, completeness, representativeness, consistency, reproducibility, sources of data, and uncertainty.

Table 8. *Data quality assessment for the flooring product system.*

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 5 years old. All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. Manufacturer-supplied data (primary data) are based on annual production for 2025.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Electricity use for product manufacture is modeled using representative data for Asia. Surrogate data used in the assessment are representative of global or European operations. Data representative of European operations are considered sufficiently similar to actual processes. Data representing product disposal are based on regional statistics.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Representative fabrication datasets, specific to the type of material, are used to represent the actual processes, as appropriate.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of the flooring products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.

Data Quality Parameter	Data Quality Discussion
reflects the true population of interest	
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent v3.12 data where available. Different portions of the product life cycle are equally considered.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing energy use at the manufacturing facility represents an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI data, Ecoinvent v3.12 LCI data are used.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the products and packaging is low. Actual supplier data for upstream operations were not available, and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

3.9 PERIOD UNDER REVIEW

The LCA results are based on annualized production data for 2025.

3.10 ALLOCATION

Resource use at the production facility (e.g., water and energy) were allocated to the product based on the product area as a fraction of the total facility production volume (i.e., area-based allocation). Area-based allocation was deemed most appropriate for the flooring products as total facility production was available as total square meters of product produced.

Impacts from transportation, including product distribution to point of sale, were attributed to the products based on the mass of material and distance transported.

3.11 COMPARABILITY

The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.

4. LCA: Scenarios and Additional Technical Information

Delivery and Installation stage (A4 - A5)

Distribution of the flooring products to the point of sale is included, based on data from the manufacturer. Average transport distances for distribution of the products from the manufacturing facilities to distribution centers in North America were provided by the manufacturer. Transport by diesel truck from the distribution centers to the point of installation is also included, based on information provided by the manufacturer. Transportation parameters for modeling product distribution are summarized in Table 9.

Table 9. *Product distribution parameters by transport mode.*

Parameter	Unit	Value	
Ground transport			
Fuel type	-	Diesel	
Liters of fuel	L/100km	18.7	
Vehicle type	-	Diesel truck	
Capacity utilization	%	76	
Ocean transport			
Fuel type	-	Fuel oil	
Liters of fuel	g/tkm	2.52	
Vehicle type	-	Ocean freighter	
Capacity utilization	%	70	
Product Name	**Gross mass transported (kg)**	**Transport Distance (km)**	
		Road	Ship
2.5mm PVC Free: En Plein Air	4.03	934	11,500

Installation of the product is accomplished using hand tools with no associated emissions and negligible impacts. Approximately 4% installation waste is assumed landfilled. The impacts associated with packaging disposal, as well as the production, transport and disposal of installation waste are included with the installation phase as per PCR requirements. Modeling parameters for product installation are summarized in Table 10.

Assumptions for end-of-life for the packaging are based on regional statistics regarding municipal solid waste generation and disposal, including end-of-life recycling rates of packaging and product materials. The packaging materials are recycled based on material recycling rates for North America[1].

Table 10. *Installation parameters for the flooring products, per 1 m^2.*

Parameter		2.5mm PVC Free: En Plein Air
Ancillary materials – adhesive (kg)		$3.00x10^{-2}$
Net freshwater consumption (m^3)		0.00
Electricity consumption (kWh)		0.00
Product loss per functional unit (kg)		0.151
Waste materials generated by product installation (kg)		0.222
Output materials resulting from on-site waste processing (kg)		n/a
Mass of packaging waste (kg)	Plastic	$2.50x10^{-3}$
	Corrugate	$7.17x10^{-2}$
	Wood	0.187
Biogenic carbon contained in packaging (kg CO_2)[1]		0.474
Direct emissions (kg)		0.00

[1] https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling

[1] Biogenic carbon contained in packaging calculated assuming the carbon content of corrugate and wood is 50% by weight

Use stage (B1)

No impacts are associated with the use of the product over the Reference Service Lifetime.

Maintenance stage (B2)

According to the manufacturer, typical maintenance involves regular sweeping and damp mopping, as well as periodic machine cleaning of the vinyl flooring. The present assessment is based on a recommended weekly cleaning schedule including sweeping and mopping with a neutral cleaner and monthly machine cleaning. The parameters used to model the product maintenance are summarized in Table 11.

Table 11. *Maintenance parameters for the flooring products, per 1 m^2.*

Parameter	Unit	Value
Maintenance cycle	Cycles / RSL	1,144
Maintenance cycle	Cycles / ESL	3,900
Maintenance process	-	Damp mopping
Net freshwater consumption	$m^3/m^2/yr$	0.0058
Cleaning agent	$kg/m^2/yr$	0.0119
Maintenance process	-	Machine cleaning
Electricity	$kWh/m^2/yr$	0.022
Further assumptions	-	Moderate traffic; weekly maintenance

Repair/Refurbishment stage (B3; B5)

Product repair and refurbishment are not relevant during the lifetime of the product.

Replacement stage (B4)

The materials and energy required for replacement of the product over the 75-year estimated service lifetime of the assessment are included in this stage. Modeling parameters for the product replacement stage are summarized in Table 12.

Table 12. *Product replacement parameters for the flooring products, per 1 m^2.*

Product	Unit	Value
Reference service life	Years	22
Replacement cycle	-	2.4
Energy input	kWh	
Freshwater consumption	m^3	-
Ancillary materials	kg	-
Replacement parts	kg	9.67
Direct emissions	kg	-

Building operation stage (B6 – B7)

There is no operational energy or water use associated with the use of the product.

Disposal stage (C1 - C4)

At end-of-life, the product is assumed to be disposed in a landfill per PCR requirements.

Transportation of waste materials at end-of-life (*C2*) assumes a 161 km (~100 miles) average distance to disposal. No recycling of the product materials is assumed at end-of-life. The relevant disposal parameters used for the product system are summarized in Table 13.

Table 13. *End-of-life disposal scenario parameters for the flooring product.*

Parameter	Value
Assumptions for scenario development	100% landfill
Collection process	
Collected with mixed construction waste (kg)	3.77
Recovery	n/a
Landfill disposal (kg)	3.77
Removals of biogenic carbon (kg CO_2 eq)[1]	n/a

[1] Excluding packaging

Biogenic Carbon Emissions and Removals

The product systems include biogenic material in the packaging components and therefore biogenic carbon emissions and removals are reported in line with the PCR and ISO 21930 standard. Per ISO 21930, biogenic carbon entering the product system is accounted for as a removal and presented as a negative carbon emission. Biogenic carbon leaving the product system as a product, co-products or combustion emissions are accounted for as positive emissions.

Biogenic carbon emissions and removals for the flooring products analyzed are presented in Table 14.
The emissions and removals reported are listed below. Note that only the packaging parameters (BCRK and BCEK) are applicable for the product systems.

- Biogenic carbon associated with the packaging materials (BCRK) is reported in module A3
- Biogenic carbon associated with the disposal of packaging waste materials during installation (BCEK) is reported in module A5

Table 14. *Biogenic carbon emissions and removals for the* **2.5mm PVC Free: En Plein Air** *flooring products.*

Parameter	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
BCRK	kg CO_2	0.00	0.00	-0.474	0.00	0.00	0.00	0.00	0.00	0.00
BCEK	kg CO_2	0.00	0.00	0.00	0.00	0.474	0.00	0.00	0.00	0.00

5. LCA: Results

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The following environmental impact category indicators are reported using characterization factors based on the U.S. EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI 2.2) and The Intergovernmental Panel on Climate Change (IPCC 2021).

IPCC 2021 Impact Category	Unit
Global Warming Potential (GWP)	kg CO_2 eq
TRACI 2.2 Impact Category	**Unit**
Global Warming Potential (GWP)	kg CO_2 eq
Ozone Depletion Potential (ODP)	kg CFC 11 eq
Acidification Potential (AP)	kg SO_2 eq
Eutrophication Potential – freshwater (EP_fw)	kg P eq
Eutrophication Potential – marine (EP_marine)	kg N eq
Smog Formation Potential (SFP)	kg O_3 eq

These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

Note that the TRACI 2.2 global warming calculations are based on the IPCC 2021 characterization factors and do not include biogenic carbon uptake or biomass CO_2 emissions. Based on the component materials of the product and production processes, there are no impacts associated with land-use changes, nor are environmental impacts associated with carbonation relevant for the product system.

These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

The following inventory parameters, specified by the PCR, are also reported.

Resources	Unit	Waste and Outflows	Unit
RPR_E: Renewable primary resources used as energy carrier (fuel)	MJ, LHV	HWD: Hazardous waste disposed	kg
RPR_M: Renewable primary resources with energy content used as material	MJ, LHV	NHWD: Non-hazardous waste disposed	kg
$NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	HLRW: High-level radioactive waste, conditioned, to final repository	kg
$NRPR_M$: Non-renewable primary resources with energy content used as material	MJ, LHV	ILLRW: Intermediate- and low-level radioactive waste, conditioned, to final repository	kg
SM: Secondary materials	kg	CRU: Components for re-use	kg
RSF: Renewable secondary fuels	MJ, LHV	MR: Materials for recycling	kg
NRSF: Non-renewable secondary fuels	MJ, LHV	MER: Materials for energy recovery	kg
RE: Recovered energy	MJ, LHV	EE: Recovered energy exported from the product system	MJ, LHV
FW: Use of net freshwater resources	m^3	ADPF: Abiotic Depletion	MJ, LHV

Modules B1, B3, B5, B6, and B7 are not applicable and therefore set to zero. In addition, modules C1 and C3 are likewise not associated with any impact as the products are expected to be manually deconstructed. Except for the packaging, the flooring product systems do not contain bio-based materials. Biogenic carbon emissions and removals are reported for the packaging component materials only (see Section 5.2). Impacts associated with Module D are negligible. In the interest of space and table readability, these modules are not included in the results presented below.

Note that the use of the results of modules A1-A3 without considering the results of module C is discouraged.

Table 15. *Life Cycle Impact Assessment results, per 1 m^2, for the product over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* **(2.5mm PVC Free: En Plein Air)**

Impact Category	Unit	Raw Materials	Upstream Transport	Manufacturing	Downstream Transport	Installation	Maintenance	Replacements	Transport to Disposal	Disposal
TRACI										
Global warming potential	kg CO2 eq	6.57	0.150	2.54	1.21	0.742	6.20	30.1	0.113	1.21
	%	13%	0.31%	5.2%	2.5%	1.5%	13%	62%	0.23%	2.5%
Ozone depletion potential	kg CFC-11 eq	$1.72x10^{-7}$	$2.19x10^{-9}$	$5.36x10^{-8}$	$1.79x10^{-8}$	$1.81x10^{-8}$	$7.21x10^{-8}$	$6.41x10^{-7}$	$2.65x10^{-9}$	$1.12x10^{-9}$
	%	18%	0.22%	5.5%	1.8%	1.8%	7.3%	65%	0.27%	0.11%
Acidification potential	kg SO2 eq	$2.98x10^{-2}$	$5.86x10^{-4}$	$7.68x10^{-3}$	$1.47x10^{-2}$	$3.04x10^{-3}$	$2.07x10^{-2}$	0.136	$4.20x10^{-4}$	$4.29x10^{-4}$
	%	14%	0.27%	3.6%	6.9%	1.4%	9.7%	64%	0.2%	0.2%
Eutrophication potential: freshwater	kg P eq	$1.57x10^{-3}$	$1.57x10^{-5}$	$1.20x10^{-3}$	$9.33x10^{-5}$	$1.87x10^{-4}$	$1.50x10^{-3}$	$7.77x10^{-3}$	$7.42x10^{-6}$	$1.64x10^{-4}$
	%	13%	0.13%	9.6%	0.75%	1.5%	12%	62%	0.059%	1.3%
Eutrophication potential: marine	kg N eq	$1.25x10^{-2}$	$5.92x10^{-4}$	$6.82x10^{-3}$	$1.20x10^{-2}$	$1.93x10^{-3}$	$1.51x10^{-2}$	$8.64x10^{-2}$	$4.53x10^{-4}$	$1.69x10^{-3}$
	%	9.1%	0.43%	5%	8.7%	1.4%	11%	63%	0.33%	1.2%
Smog formation potential	kg O3 eq	0.300	$1.45x10^{-2}$	0.156	0.292	$4.33x10^{-2}$	0.232	1.98	$1.11x10^{-2}$	$8.20x10^{-3}$
	%	9.9%	0.48%	5.1%	9.6%	1.4%	7.7%	65%	0.36%	0.27%
IPCC 2021										
Global warming	kg CO2 eq	6.71	0.153	2.61	1.23	0.775	6.28	31.3	0.115	1.44
	%	13%	0.3%	5.2%	2.4%	1.5%	12%	62%	0.23%	2.9%

Table 16. *Resource use, per 1 m^2, for the product over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* **(2.5mm PVC Free: En Plein Air)**

Parameter	Unit	Raw Materials	Upstream Transport	Manufacturing	Downstream Transport	Installation	Maintenance	Replacements	Transport to Disposal	Disposal
Resources										
Use of renewable primary energy resources used as energy carrier (PERE)	MJ	4.31	$2.95x10^{-2}$	1.56	0.190	0.420	67.0	15.7	$2.66x10^{-2}$	$1.84x10^{-2}$
	%	4.8%	0.033%	1.7%	0.21%	0.47%	75%	18%	0.03%	0.021%
Use of renewable primary energy resources used as raw materials (PERM)	MJ	0.00	0.00	4.76	0.00	0.214	0.00	11.9	0.00	0.00
	%	0%	0%	28%	0%	1.3%	0%	71%	0%	0%
Total use of renewable primary energy resources (PERT)	MJ	4.31	$2.95x10^{-2}$	6.31	0.190	0.634	67.0	27.6	$2.66x10^{-2}$	$1.84x10^{-2}$
	%	4.1%	0.028%	5.9%	0.18%	0.6%	63%	26%	0.025%	0.017%
Use of nonrenewable primary energy resources used as energy carrier (PENRE)	MJ	81.2	2.11	38.2	16.2	12.0	86.3	365	1.62	0.979
	%	13%	0.35%	6.3%	2.7%	2%	14%	60%	0.27%	0.16%
Use of nonrenewable primary energy resources used as raw materials (PENRM)	MJ	62.5	0.00	$2.41x10^{-2}$	0.00	$1.08x10^{-3}$	0.00	150	0.00	0.00
	%	29%	0%	0.011%	0%	0.00051%	0%	71%	0%	0%
Total use of nonrenewable primary energy resources (PENRT)	MJ	144	2.11	38.2	16.2	12.0	86.3	515	1.62	0.979
	%	18%	0.26%	4.7%	2%	1.5%	11%	63%	0.2%	0.12%
Use of secondary materials (SM)	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Use of renewable secondary fuels (RSF)	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Use of nonrenewable secondary fuels (NRSF)	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Recovered energy (RE)	m3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Abiotic depletion potential for fossil resources (ADPF)	MJ	142	2.10	27.9	16.1	11.3	79.0	485	1.60	0.968
	%	19%	0.27%	3.6%	2.1%	1.5%	10%	63%	0.21%	0.13%
Use of net fresh water (FW)	m3	$6.35x10^{-2}$	$2.90x10^{-4}$	$1.04x10^{-2}$	$1.82x10^{-3}$	$3.35x10^{-3}$	0.517	0.157	$1.98x10^{-4}$	$-1.41x10^{-2}$
	%	8.6%	0.039%	1.4%	0.25%	0.45%	70%	21%	0.027%	-1.9%

Table 17. *Waste and outflows, per 1 m², for the product over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* **(2.5mm PVC Free: En Plein Air)**

Parameter	Unit	Raw Materials	Upstream Transport	Manufacturing	Downstream Transport	Installation	Maintenance	Replacements	Transport to Disposal	Disposal
Wastes										
Hazardous waste disposed (HWD)	kg	0.402	$3.56x10^{-3}$	0.106	$2.39x10^{-2}$	$3.26x10^{-2}$	0.422	1.37	$1.66x10^{-3}$	$1.42x10^{-3}$
	%	17%	0.15%	4.5%	1%	1.4%	18%	58%	0.07%	0.06%
Nonhazardous waste disposed (NHWD)	kg	17.7	$2.05x10^{-2}$	1.47	0.145	2.46	8.57	76.5	$1.78x10^{-2}$	10.1
	%	15%	0.018%	1.3%	0.12%	2.1%	7.3%	65%	0.015%	8.6%
High-level radioactive waste (HLRWD)	kg	$1.75x10^{-5}$	$1.23x10^{-7}$	$6.13x10^{-5}$	$7.89x10^{-7}$	$4.21x10^{-6}$	$2.41x10^{-5}$	$2.02x10^{-4}$	$1.19x10^{-7}$	$8.37x10^{-8}$
	%	5.6%	0.04%	20%	0.25%	1.4%	7.8%	65%	0.038%	0.027%
Low-level Radioactive waste (ILLRWD)	kg	$4.24x10^{-5}$	$2.96x10^{-7}$	$1.05x10^{-4}$	$1.89x10^{-6}$	$8.45x10^{-6}$	$7.46x10^{-5}$	$3.80x10^{-4}$	$3.63x10^{-7}$	$2.02x10^{-7}$
	%	6.9%	0.048%	17%	0.31%	1.4%	12%	62%	0.059%	0.033%
Components for re-use (CRU)	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Materials for recycling (MFR)	kg	0.00	0.00	0.00	0.00	$5.75x10^{-2}$	0.00	0.138	0.00	0.00
	%	0%	0%	0%	0%	29%	0%	71%	0%	0%
Materials for energy recovery (MER)	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Exported electrical energy (EEE)	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Exported thermal energy (EET)	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%

6. LCA: Interpretation

Category indicator results for the flooring products are summarized by life cycle phase above. A review of the results shows that, with the exception of Eutrophication-marine, Acidification and Smog Formation Potential indicators, impacts over a single product life cycle are dominated by the production stages (A1-A3) followed by product maintenance (B2) and product disposal (C4). Impacts related to phase A1 are associated primarily with the extraction and processing of plastics and plasticizers, while manufacturing impacts (A3) are dominated by electricity consumption at the production facility.

Contributions to the Eutrophication, Acidification and Smog Formation Potential indicators are dominated by impacts associated with product distribution followed by extraction and processing of plastic component materials and the product disposal stages.

7. References

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