Environmental Product Declaration

Milliken Flooring Products: Luxury VinylTiles(LVT): Quiet Life and Lumenology (Asia)

Milliken
LUXURY VINYL TILES(LVT): Quiet Life and Lumenology (Asia)

Designing innovative products and solutions for our customers is 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 to end-of-life management. Our commitment to transparency, health, safety, quality and sustainability allows us to put our customers, associates and communities first.

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CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
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ENVIRONMENTAL PRODUCT DECLARATION

Milliken
LUXURY VINYL TILES(LVT): Quiet Life and Lumenology (Asia)

According to ISO 14025, EN 15804 and ISO 21930:2017

EPD Program and Program Operator Name, Address, Logo, and Website	UL Environment 333 Pfingsten Road Northbrook, IL60611 https://www.ul.com/ https://spot.ul.com
General Program Instructions and Version Number	General Program Instructions v.2.5 March 2020
Manufacturer Name and Address	**Milliken Textile (Zhangjiagang) co., Ltd**, 19 North Guotai Rd,Zhangjiagang, Jiangsu Province China 215638 **Milliken Maple**, 301 Lukken Industrial Dr., LaGrange GA USA 30240 **Milliken Australia Pty Ltd**, 171 Briens Road, Northmead, NSW, 2152 **Milliken Industrials Ltd. Beech Hill Plant**, Gidlow Lane Wigan WN6 8RN United Kingdom
Declaration Number	4790011668.101.1
Declared Product & Functional Unit or Declared Unit	Milliken Luxury Vinyl Tiles (LVT): Quiet Life and Lumenology (Asia); 1 m^2
Reference PCR and Version Number	Product Category Rules for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements, *Standard 10010, Version 3.2* Part B: Flooring EPD Requirements, *UL 10010-7, Version 2.0*
Description of product application/use	Commercial and institutional applications
Product RSL Description	Commercial: 10 Years Residential: 15 Years
Markets of Applicability	Europe, North America, Global
Date of Issue	February 3, 2023
Period of Validity	5 Years
EPD Type	Product-Specific
Range of Dataset Variability	N/A
EPD Scope	Cradle to grave
Year(s) of reported primary data	Jan 2019 – Dec 2019
LCA Software & Version Number	SimaPro 9
LCI Database(s) & Version Number	Ecoinvent 3, Ecoinvent 3- CN, USLCI, ELCD
LCIA Methodology & Version Number	CML-IA (baseline) & TRACI

This PCR review was conducted by:	UL Environment PCR Review Panel epd@ulenvironment.com
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Grant R. Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	James Mellentine, Thrive ESG

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.

1. Product Definition and Information

1.1 Description of Company/ Organization

The Milliken Floor Covering division is part of Milliken & Company, an innovation company that has been exploring, discovering and creating ways to enhance people's lives since 1865. The company is a privately held for-profit corporation. The company is headquartered in Spartanburg, South Carolina, and operates design and manufacturing facilities in the United States, United Kingdom, Australia and China. In 2017, Milliken was recognized as one of the world's most ethical companies for the eleventh consecutive year.

The product range includes Glue down LVT, Loose lay LVT, Click LVT & WPC with Valinge click system of 2G, 2G-FD & 5G-C. The products are exported to all over the world. 90% of the products are exported to North America and Europe.

1.2 Product Description

1.2.1 Product Identification

This Environmental Product Declaration (EPD) covers Milliken flooring products: LVT with various thickness (range from 3.0 mm to 6.0 mm) and wearing layer (range from 0.15 mm to 0.76 mm).

1.2.2 Product Specification

LVT belongs to the family of Vinyl tile, offering 3D printing technology which adds depth and realism, durability, with a high performance wearing layer to a vinyl tile product. Vinyl tile is made primarily from calcium carbonate (limestone), polyvinyl chloride (PVC), additives (i.e. pigments and stabilizers), impact modifier (foaming regulator) and vesicant. The functional chemical groups include alkyl group, ester group, hydroxyl group and amino group. The following figure shows the structure of LVT, from bottom up, the tile is composed of several layers, i.e. the bottom vinyl layer, the middle vinyl layer, the vinyl decor film, vinyl wear layer and the UV coating layer.

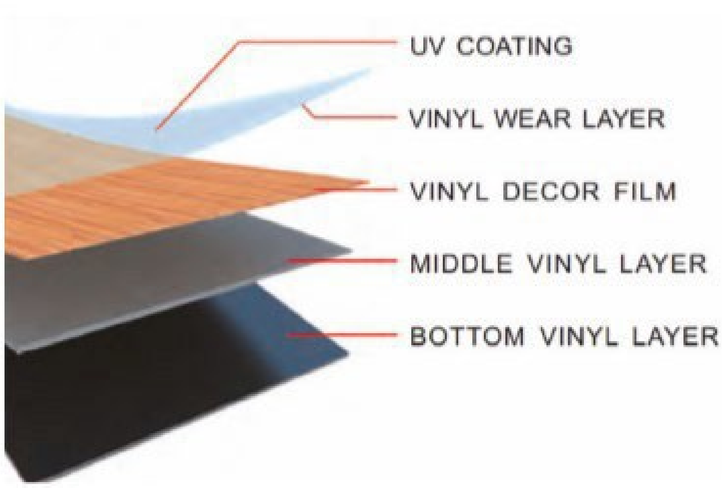

Figure 1.Construction of LVT flooring

Table 1. Technical Specifications of LVT flooring

Name	Standard	Value	
Dimensional Stability (6h - 80℃)	ISO23999	≤0.25 %	
Curl (6h - 80℃)	ISO23999/ASTM F2199	±2.0 mm	
Flexibility	ISO24344/ASTM F137	Through the 2 inches diameter mandrel, the floor specimen has no crack or break.	
Color Fastness	ISO 105 B02/ASTM F1515	$\geq 6/\Delta E \leq 8$	
Abrasion Resistance	EN660-2	Pass	
Wear Layer Abrasion Resistance	EN 13329 (S-42, 200 cycle change)	IP≥4000cycles(0.55mm wear layer), IP≥1800cycles(0.30mm wear layer)	
Castor Resistance	ISO4918	No visible damage after 25000 revolutions	
Height Difference	ISO10582/EN13329	Average ≤ 0.10 mm, Individual values ≤ 0.15 mm	
Resistance to Chemicals	ISO26987/ASTM F925	Class 0 / Excellent	
Sound Absorption	DIN 52210	<4dB	
Impact Insulation Class	ASTM E492	IIC47	
Sound Transmission Class	ASTM E90	STC50	
Burning Behavior	EN 13501-1	Bfl – s1	
Slip Resistance	EN 13893	DS	
Static Coefficient of Friction	ASTM D2047	Dry: 0.37 / Wet 1 : 0.69	
Thermal Conductivity	EN 12667	0.1167 $W/(m \cdot K)$	
Thermal Resistance	EN 12667	0.0364 $(mm^2 \cdot K)/W$	
Residual Indentation	ISO24343-1 ASTM F1914	≤ 0.10 mm/average less than 8 %, maximum single reading 10 %	
Suitable for Underfloor Heating		YES	
		28 °C MAX	
Toxicity	EN 71	Non Toxic	
VOC Emission	AgBB/DIBt	Certified	
Electrical Resistance	EN 1081	Horizontal: $> 1.0 \times 10^{89}$ OHM Vertical: 5.1×10^{82} OHM	
Formaldehyde emission	EN 717-1	E1	
Antistatic Performance	EN 1815	PVC SOLE: + 3.5 KV	
Phthalate	CPSC-CH-C1001-09.3	DBP, DEHP, BBP, DINP, DNOP, DIDP, DIBP, DnHP, DCHP≤0.1%	
Heavy Metals	ASTM F963 CPSC-CH-E1002-08.3	Total Lead (Pb)	≤100PPm
		SOL. Lead (Pb)	≤90PPm
		SOL. Mercury (Hg)	≤60PPm
		SOL. Chromium (Cr)	≤60PPm
		SOL. Arsenic (As)	≤25PPm
		SOL. Antimony (Sb)	≤60PPm
		SOL. Barium (Ba)	≤1000PPm
		SOL. Selenium (Se)	≤500PPm
		SOL. Cadmium (Cd)	≤75PPm

1.2.3 Product-Specific EPD

This EPD is for Milliken flooring products: LVT with various thickness (range from 3.0 mm to 6.0 mm) and wearing layer (range from 0.15 mm to 0.76 mm). The "LVT (4.0*0.5)" is the representative specification studied in this report because they have the highest annual production quantity. (4.0*0.5) means the thickness of the product is 4.0 mm and the thickness of its wearing layer is 0.5 mm. In the Life-Cycle Assessment (LCA) study, the "LVT (4.0*0.5)" was analyzed, and the LCA results were presented and the LCA results of the representative specification are presented in this declaration and the rest series of product's value can be applied using the scaling factor in table 19.

While allocating energy and materials within the production site, allocation was carried out based on either the average annual mass or average annual surface area produced.

1.3 Application

The products covered in this declaration are for use in corporate offices, retail spaces, residential spaces, hospitality, and a variety of other commercial environments.

1.4 Declaration of Methodological Framework

In this project, a full LCA approach was considered with some simplification on data modeling using generic data for most background systems. The EPD analysis uses a cradle-to-grave system boundary. No known flows are deliberately excluded from this EPD.

To calculate the LCA results for the product maintenance stage, a 10- or 15-year reference service life (RSL) was assumed for the declared products. Product with wearing layer over 0.5 (including 0.5) will be used for commercial purposes with a RSL of 10 years, and products with wearing layer below 0.5 will be considered for residential use with a RSL of 15 years.

Additional details on assumptions, cut-offs and allocation procedures can be found in section 2.4, 2.5, and 2.9, respectively.

1.5 Technical Requirements

The products offer a wide range of beautiful flooring options in various specifications for many applications. Therefore, the following technical data provides a range of values for each parameter.

Table 2. Technical Data for LVT (4.0*0.5)

Name			Average Value	Min Value	Max Value	Unit
Product thickness			4.0	3.9	4.13	mm
Wear layer thickness (where applicable)			0.5	0.5	0.5	mm
Product weight			7101	6923	7332	g/m²
Product form	Rolls	Width	-	-	-	mm
		Length	-	-	-	m
	Tiles		-	-	-	mm
	Planks		-	40 x 360	90 x 600	mm

1.6 Placing on the Market / Application Rules

Milliken Flooring products have the technical specifications shown in Table 1. They also meet the criteria of the following certifications and standards:

- GREENGUARD
- FloorScore®
- DIBt
- CE
- U-mark

1.7 Material Composition

According to the estimate by Milliken, almost all of the raw materials are from Chinese mainland. The type and ratio/weightof raw materials per product are listed in tables below.

Table 3. Material Composition of LVT (4.0*0.5)

Component	Materials	Total Weight of material in product [g/m2]	Percent of Total Product Weight(%)
UV COATING	UV COATING	20	0.28
WEAR LAYER	PVC	483	6.80
	DOTP	144.9	2.04
	STABILIZER	12.1	0.17
FILM	PVC	10.1	0.14
MIDDLE LAYER	PVC	813.2	11.45
	DOTP	244.15	3.44
	STABILIZER	24.7	0.35
	CALCIUM CARBONATE	3659.9	51.54
	CARBON BLACK	8.1	0.11
GLASS FIBER	GLASS FIBER	80	1.13
BOTTOM LAYER	PVC	563.4	7.93
	DOTP	169	2.38
	STABILIZER	17	0.24
	CALCIUM CARBONATE	845.1	11.90
TOTAL		7094.7	99.91

1.8 Manufacturing

The manufacturing process of LVT mainly includes backing layer preparation, laminating, UV coating, cutting, edge treatment and packaging, which involves raw materials, energy, water, emissions.

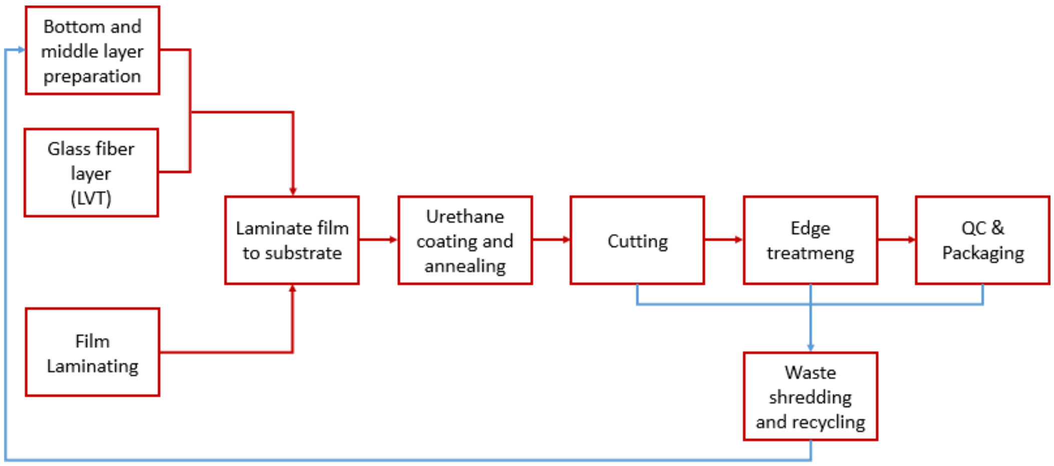

Figure 2. Production Process Flowchart of product

1.9 Packaging

Cardboard and wood pallets are the main packaging materials for Milliken Flooring products. According to Milliken, the target market of flooring products including USA, Europe, and other region mainly Asia, with the market ratio of 70%, 20% and 10% respectively. The disposal of packaging materials will adopt a rough country and region weighted average disposal mode following literature review. For packaging disposal in Asia and the rest market, the waste disposal scenario from China is set default, as the detailed market ratio information of the rest market is unavailable and China is assumed to be the main consumer. A sensitivity analysis on packaging disposal scenarios was also conducted.

1.10 Transportation

According to Milliken, most of flooring products are consumed in North America, Europe and Asia. Oceanic and road transportation distance for product delivery is estimated with reference to external resources. Table 8 demonstrates the data used for stage A4 in the LCA modelling.

1.11 Product Installation

During the installation process, only LVT products with the thickness of 2.0mm or 2.5mm require glue. As for LVT with other thickness, they can be installed over most solid subfloor with minimal subfloor preparation, and the installation is completely glue free, eliminating the need for using additional materials and chemicals with potential VOC issues.

Therefore, in this report the chosen representative specifications are all glue-free. The installation is a relatively simple task and only a few tools like cutting instruments (knife, scissors) are necessary for installation. In this LCA study we assume the floor is flat and the energy or material required to do floor preparation is omitted. As tools are reusable, the production and disposal stage of tools is also omitted. For the simplicity of the study, we assume that the scrap of the installation is treated following the normal end of life disposal scenarios used in the target market.

1.12 Use and Maintenance

Very little effort is required in order to use flooring products, hence in the usage stage the focus is to put on maintaining the floor tile in terms of protecting its integrity and functionality. In normal condition, routine vacuuming, cleaning and surface conditioning is required. The energy, water and detergent consumption data was based on estimation from Milliken and study of comparative product's usage data.

1.13 Reference Service Life and Estimated Building Service Life

Product with wearing layer over 0.5 (including 0.5) will be used for commercial purposes with a RSL of 10 years, and products with wearing layer below 0.5 will be considered for residential use with a RSL of 15 years. The building estimated service life (ESL) is 75 years

1.14 Disposal

According to Milliken, most of flooring products are consumed in Europe, USA, Asia and other regions. The disposal of the used flooring products will adopt a country and region average disposal mode following literature review. End of life disposal treatment process (C4) from Ecoinvent and USLCI will be used in this LCA study. For the waste scenario, a standard 161km of road transportation (C2) from home to MSW treatment site is assumed and zero input and output is assumed for deconstruction (C1, according to Milliken, the tile can be manually removed from the floor for flooring product,hence it is omitted in this model) and waste processing (C3) of the tile.

2. Life Cycle Assessment Background Information

2.1 Functional or Declared Unit

In this study, the functional unit was defined as 1 (one) m^2 of flooring.

Table 4. Functional Unit Information

NAME	VALUE	UNIT
FUNCTIONAL UNIT	1	m^2
MASS	7.15	kg

2.2 System Boundary

The life cycle stages considered in this LCA study are from cradle to grave.

The following stages have been assessed:

- A1-A3: Product stage (raw material acquisition, transport to manufacturing site and manufacturing)
- A4-A5: Construction stage (transport to user site, installation)
- B2: Maintenance
- B4 Replacement
- C1-C4: End of life stage (deconstruction, transport, waste processing and disposal)

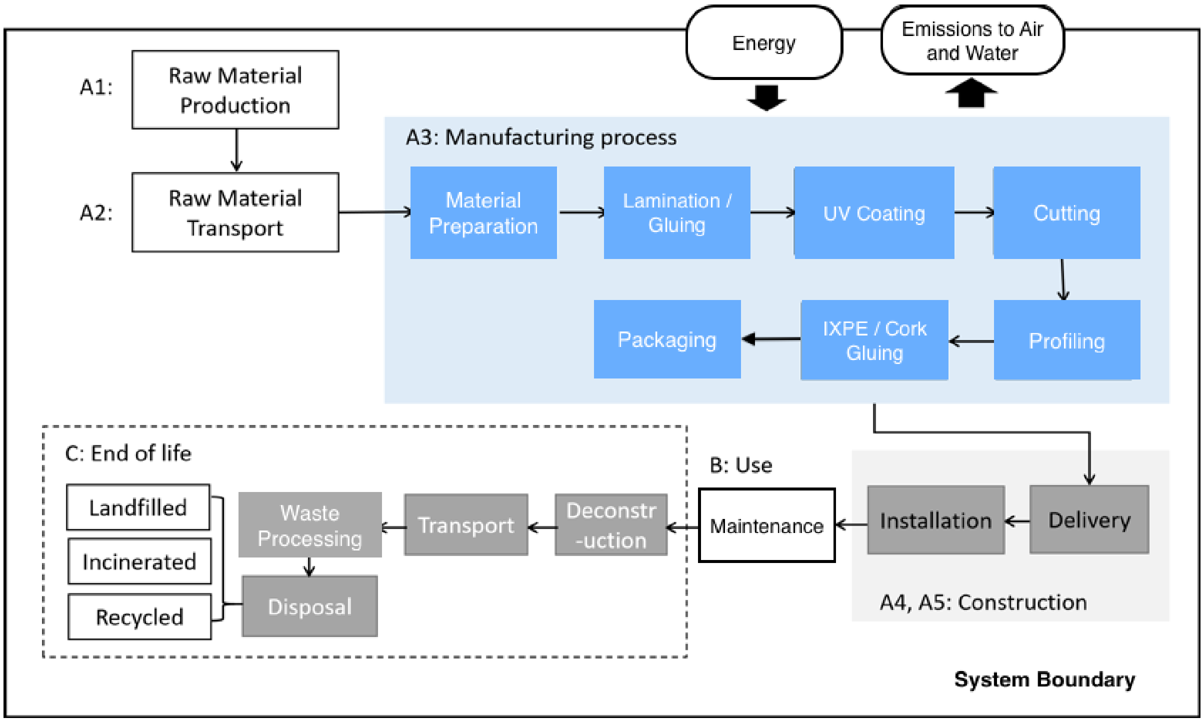

Figure 3. System Boundary of LCA Study

The LCA study traced all energy and material inputs back to the extraction of resources for each life-cycle stage of the products. In addition, the study quantified emissions from the whole system, and included various waste management scenarios.

2.3 Product for Maintenance Phase (Modules B1-B7)

For the calculations of maintenance phase, the following cleaning routine was considered:

Table 5. Cleaning and Maintenance

CLEANING PROCESS	CLEANING FREQUENCY	CONSUMPTION OF ENERGY AND RESOURCES
VACUUMING	WEEKLY	ELECTRICITY
MOPPING	WEEKLY	WATER AND DETERGENT

Table 6. Inputs in Maintenance Stage

	AMOUNT	UNITS	SCENARIO
WATER	5.20	L/m^2/year	BASED ON WEEKLY MOPPING AND 10L/100M2 WATER USAGE ASSUMPTION
ELECTRICITY	0.01805	kWh/m^2/year	BASED ON WEEKLY VACUUM USE AND AT POWER RATE OF 250W,5SECOND PER SQUARE METER ASSUMPTION
DETERGENT	10.4	g/m^2/year	BASED ON WEEKLY MOPPING AND 20G/100M2 DETERGENT USAGE ASSUMPTION

2.4 Estimates and Assumptions

The main assumptions of this LCA study are as follows:

- The product description paper (1 page) included in the packaging contributes less than 0.1% to the total weight of the final product's packaging and was therefore excluded from the analysis;
- The raw materials Calcium stearate and Zinc stearate were not in the background database, so they were substituted with stearic acid from EI database;
- The distribution of energy, water and natural gas usage among the various product series is done via total production (floor area with the unit as m^2) of all product produced on a yearly average;
- Transport assumptions were made where it was not possible to obtain the specific data, e.g., distance of oceanic transportation and in land transportation in USA, EU and Asia and other market. When this occurred, it was clearly stated in the report and a sensitivity analysis is conducted;
- Electricity and water consumption data were not obtained for certain processes so assumptions were made for these, e.g. maintenance stage. When this or similar situation occurred, it was clearly stated in the report.

2.5 Cut-off Criteria

The following procedures were followed for the exclusion of inputs and outputs:

- All inputs and outputs to a (unit) process were included in the calculation where data was available. Data gaps were filled by conservative assumptions with average or generic data. Any assumptions for such choices were documented;
- In case of insufficient input data or data gaps for a unit process, according to the PCR requirement, the cut-off criteria chosen is 1% of renewable and non-renewable primary energy usage and 1% of the total mass of that unit process. The total neglected input flows of the cradle to grave stage, e.g. per module A1-A3, A4-A5, B1-B5, B6-B7, and C1-C4 shall be a maximum of 5% of energy usage and mass. In this study, the neglected flow is demonstrated in the table below.

Table 7. Cut-off Flows

FLOW NAME	PROCESS STAGE	MASS %	TOTAL MASS %
GLUE AND DESCRIPTION PACKAGING PAPER	PACKAGING	<<1%	<<1%

Material and energy flows known to have the potential to cause significant emissions into air, water or soil related to the environmental indicators of this study were included in the assessment. After reviewing the Material Safety Data Sheets and relevant physical, chemical and other information of the flows listed in table above, no significant negative emission to the environment from above listed flows was identified.
Other processes that contribute to obviously less than 1% of overall mass and energy contribution were cut off, which include:

- Storage phases and sales of product
- Handling operations at the distribution center and retail outlet
- Secondary and transit packaging

- Transport from distribution warehouse to retail outlet and from retail outlet to consumer household or commercial center

2.6 Data Sources

The study used generic data from various sources, including scientific literature, public sources, and databases such as Ecoinvent, ELCD, Chinese LCI, USLCI, and others.

In the study, the key parameters for producer-specific foreground data were based on one year (Jan 2019 to Dec 2019) of averaged data from Milliken. The life-cycle inventory includes data collected from a variety of publicly available sources, taking into consideration the degree to which it was technologically, temporally and geographically representative. The study utilized the Chinese-regionalized LCI database to the greatest extent possible. In the event data was missing from or not available in the LCI database, the study referred to Ecoinvent and regional databases such as USLCI, ELCD and other relevant databases. The study then conducted sensitivity analyses to validate the data and outputs using realisticparameters.

2.7 Data Quality

The data quality requirements for this study were as follows:

- Existing LCI data were, at most, 10 years old. Newly collected LCI data were current or up to 3 years old.
- The LCI data related to the geographical locations in which the processes occurred, e.g.,electricity and transportation data from China, disposal in USA and Europe and etc.
- The technology represented the average technologies at the time of data collection.

2.8 Period under Review

The study used primary data collected from Jan 2019 to Dec 2019.

2.9 Allocation

This study assumed that in-plant recycling for the production of the base layer was a closed loop, meaning that the study allocated all of the environmental impacts from the recycling of the base layer, cutting, and profiling scraps and all of the environmental benefits of using recycled material to avoid waste generation during the production of the base layer to the process of production.

To be conservative, the environmental benefits of recycling and energy recovery were not included in the study for the recycling and disposal processes at the end-of-life stage.

For process-related allocations, the study distinguished between multi-input and multi-output processes.

- Multi-input processes

  For data sets in this study, the allocation of the inputs from coupled processes is generally carried out via the mass. For literature data, the source is generally referred to. In this study one allocation occurs on Milliken flooring production, in allocating the input and output, i.e. energy within the production site such as electricity, natural gas and etc. and some other raw material such as water, pressure oil and etc., emission such as off gas and waste water, among the various series of flooring products, allocation is done via total production (floor area with the unit as m^2) of all product produced on a yearly average.

– Multi-output processes

In this study, there are no other by products produced from the production line, hence there is quite little occasion that requires allocation for multi-output processes. One allocation occurs on the environmental emissions allocation, especially in the area of waste treatment. At the end of life stage, the allocation within the disposal scenario follows mass allocation.

2.10 Comparability (Optional)

No comparisons or benchmarking are included in this EPD. LCA results across EPDs can be calculated with different background databases, modeling assumptions, geographic scope and time periods, all of which are valid and acceptable according to the Product Category Rules (PCR) and ISO standards. 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.

3. Life Cycle Assessment Scenarios

According to Milliken, most of flooring products are consumed in North America, Europe and Asia. Oceanic and road transportation distance for product delivery is estimated with reference to external resources. A sensitivity analysis was also conducted to test the impact level by changes of assumption of various transportation distances (sensitivity). In this study a default value for the distance is given in table below.

Table 8. Transport to the Building Site (A4)

NAME	VALUE		UNIT
Fuel type	DIESEL	HEAVY OIL	
Liters of fuel	6.48×10^{-3}	1.37×10^{-3}	L /100KM
Vehicle type	LORRY	SHIP	
Transport distance	1000	22051	KM
Capacity utilization (including empty runs, mass based	50	100	%
Gross density of products transported	1787.5	1787.5	kg/m^3
Capacity utilization volume factor (factor: =1 or <1 or ⩾ 1 for compressed or nested packaging products)	0.4	0.4	-

Table 9. Installation into the Building (A5)

NAME	VALUE	UNIT
Ancillary materials (Glue) (Only for LVT (2.0) and LVT (2.5), and the value is the amount needed for one functional unit, i.e. one square meter of floor covering.)	0.05	kg
Net freshwater consumption specified by water source and fate (e.g., X m^3 river water evaporated, X m^3 city water disposed to sewer)	-	m^3
Other resources	-	kg

Electricity consumption	-	kWh
Other energy carriers	-	MJ
Product loss per functional unit	-	m^2/m^2
Waste materials at the construction site before waste processing, generated by product installation	-	m^2/m^2
Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal)	-	kg
Mass of packaging waste specified by type	Pulp: 1.67 Wood: 0.25	kg
Biogenic carbon contained in packaging	3.52	kg CO_2
Direct emissions to ambient air, soil and water	-	kg
VOC emissions	N/A	µg/m^3

Table 10. Reference Service Life

NAME	VALUE	UNIT
RSL	10 (Commercial use)	years
Declared product properties (at the gate) and finishes, etc.	See Table 1-3	
Design application parameters (if instructed by the manufacturer), including references to the appropriate practices and application codes)	-	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	-	-
Outdoor environment	-	-
Indoor environment	18-24 ℃ RH: 45-60 %	18-24 ℃ RH: 45-60 %
Use conditions, e.g. frequency of use, mechanical exposure.	Commercial use	
Maintenance, e.g. required frequency, type and quality of replacement components	Weekly vacuuming Weekly mopping	

Table 11. Maintenance (B2)

NAME	VALUE	UNIT
Maintenance process information	Weekly vacuum and weekly mopping	-
Maintenance cycle	521 3911	Cycles/ RSL
Net freshwater consumption specified by water source and fate	5.2 city water disposed to sewer	㎣/ m^2/year
Ancillary materials specified by type (e.g. cleaning agent)	104 (cleaning agent)	g/m^2/year
Other resources	-	kg
Energy input, specified by activity, type and amount	0.1805	kWh/m^2/RSL
Other energy carriers specified by type	-	kWh

Power output of equipment	-	kW
Waste materials from maintenance (specify materials)	-	kg
Direct emissions to ambient air, soil and water	-	kg

PVC flooring products do not crack, expansion or deformation, resulting in no repair, replacement or refurbishment. Hence, for these modules there are no input and output flows and therefore no impacts.

Table 12. Repair (B3)

NAME	VALUE	UNIT
Repair process information (cite source in report)	0	-
Inspection process information (cite source in report)	0	-
Repair cycle	0	Number/ RSL
Repair cycle	0	Number/ ESL
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	0	m^3
Ancillary materials specified by type (e.g. cleaning agent)	0	kg
Energy input, specified by activity, type and amount	0	kWh
Waste materials from repair (specify materials)	0	kg
Direct emissions to ambient air, soil and water	0	kg
Further assumptions for scenario development (e.g. frequency and time period of use, number of occupants);	_	

Table 13. Replacement (B4)

NAME	VALUE	UNIT
Replacement cycle	0	Number/ RSL
Replacement cycle	6.5	Number/ ESL
Energy input, specified by activity, type and amount	0	kWh
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	0	m^3
Ancillary materials specified by type (e.g. cleaning agent)	0	kg
Replacement of worn parts, specify parts/materials	8.865	kg
Direct emissions to ambient air, soil and water	0	kg
Further assumptions for scenario development, e.g. frequency and time period of use	-	As appropriate

Table14. Refurbishment (B5)

NAME	VALUE	UNIT
Refurbishment process description (cite source in report)	-	-
Replacement cycle	0	Number/ RSL

Replacement cycle	0	Number/ ESL
Energy input, specified by activity, type and amount	0	kWh
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	0	m3
Material input for refurbishment, including ancillary materials specified by type (e.g. cleaning agent)	0	kg
Waste material(s), specified by material	0	kg
Direct emissions to ambient air, soil and water	0	kg
Further assumptions for scenario development (e.g. frequency and time period of use, number of occupants);	-	

Generally, no operational energy use or water use is applied during the use stages of PVC flooring products. Hence, for these modules there are no input and output flows and therefore no impacts.

Table 15. Operational energy use (B6) and Operational water use (B7)

NAME	VALUE	UNIT
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	0	m^3
Ancillary materials	0	kg
Energy input, specified by activity, type and amount	0	kWh
Equipment power output	0	kW
Characteristic performance (e.g. energy efficiency, variation of performance with capacity utilization)	0	Units as appropriate
Direct emissions to ambient air, soil and water	0	kg
Further assumptions for scenario development (e.g. frequency and time period of use, number of occupants);	0	As appropriate

Table 16. End-of-Life (C1-C4)

NAME		VALUE	UNIT
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)		See description above	
Collection process (specified by type)	Collected separately	-	kg
	Collected with mixed construction waste	7.101	kg
Recovery (specified by type)	Reuse	-	kg
	Recycling	0.746	kg
	Landfill	6.171	kg
	Incineration	0.185	kg
	Incineration with energy recovery	-	kg

	Energy conversion efficiency rate	-	
Disposal (specified by type)	Product or material for final deposition	0	kg CO_2
Removals of biogenic carbon (excluding packaging)		0	kg CO_2

4. Life Cycle Assessment Results

Table 17. Description of the System Boundary Modules

Included modules in the life cycle	Product Stage	X	A1 Raw material supply
		X	A2 Transport to the manufacturer
		X	A3 Manufacturing
	Construction Process Stage	X	A4 Transport to the site
		X	A5 Assembly/Install
	Use Stage	X	B1 Use
		X	B2 Maintenance
		X	B3 Repair
		X	B4 Replacement
		X	B5 Refurbishment
		X	B6 Operational energy use
		X	B7 Operational water use
	End of Life Stage	X	C1 Deconstruction
		X	C2 Transport to waste processing
		X	C3 Waste processing for reuse, recovery and/or recycling
		X	C4 Disposal
	Benefits and loads beyond the product system boundary	MND	D Reuse, recovery and/or recycling potentials,
Note: X=Declared Module, MND=Module not Declared in this LCA study			

4.1 Life Cycle Impact Assessment Results

To analyze the environmental impact of each process, a LCIA was conducted using the CML-IA baseline method and the TRACI method on the chosen representative LVT (4.0*0.5).

The result was allocated by stages, as shown in tables below. Note that the results are based on 10 years' usage, as the representative product will be used for commercial purposes.

Table 18. TRACI results by stage - LVT (4.0*0.5) over the ESL of 75 years

Impact category (TRACI)	Unit	Production	Transport of product	Installation	Maintenance	Replacement	Transport of waste	Disposal
		A1-A3	A4	A5	B2	B4	C2	C4
Ozone depletion	kg CFC-11 eq	3.35E-07	1.87E-07	1.66E-08	3.20E-07	3.50E-06	9.53E-07	1.25E-07
Global warming	kg CO2 eq	7.04E+00	3.35E+00	7.01E-01	4.35E+00	7.21E+01	1.13E+01	7.58E+00
Smog	kg O3 eq	4.38E-01	7.94E-01	2.68E-02	1.61E-01	8.18E+00	1.77E+00	7.43E-02
Acidification	kg SO2 eq	2.57E-02	5.09E-02	1.05E-03	1.52E-02	5.05E-01	6.17E-02	5.85E-01
Eutrophication	kg N eq	1.22E-02	2.65E-03	5.37E-03	2.56E-02	1.31E-01	5.30E-03	1.64E-01
Fossil fuel depletion	MJ surplus	1.95E+01	5.99E+00	3.55E-01	2.15E+00	1.68E+02	2.39E+01	1.10E+00

Table 19. EU Impact Assessment (CML) Results for LVT (4.0*0.5) over the ESL of 75 years.

Impact category (CML)	Unit	Production	Transport of product	Installation	Maintenance	replacement	Transport of waste	Disposal
		A1-A3	A4	A5	B2	B4	C2	C4
Abiotic depletion	kg Sb eq	8.29E-06	9.62E-07	8.23E-08	8.40E-06	6.07E-05	4.46E-06	7.22E-07
Abiotic depletion (fossil fuels)	MJ	1.48E+02	4.69E+01	2.55E+00	2.23E+01	1.28E+03	1.67E+02	8.93E+00
Global warming (GWP100a)	kg CO_2 eq	7.04E+00	3.35E+00	7.01E-01	4.35E+00	7.21E+01	1.13E+01	7.58E+00
Ozone layer depletion (ODP)	kg CFC-11 eq	2.62E-07	1.42E-07	1.26E-08	2.81E-07	2.71E-06	7.19E-07	9.83E-08
Photochemical oxidation	kg C_2H_4 eq	1.39E-03	2.05E-03	1.69E-04	2.27E-03	2.35E-02	1.97E+03	1.54E-03
Acidification	kg SO_2 eq	2.39E-02	4.96E-02	8.15E-04	1.38E-02	4.83E-01	4.95E-02	3.29E-03
Eutrophication	kg PO_4--- eq	7.11E-03	4.72E-03	2.11E-03	1.25E-02	9.06E-02	1.01E-02	6.05E-02

* Zero input and output were assumed for deconstruction of the tile (C1) and waste processing (C3). Therefore, values for the two modules are zero and not included in the tables.

4.2 Life Cycle Inventory Results

Table 20. Resource Use over the ESL

PARAMETER	UNIT	LVT (4.0*0.5)
RPR_E: Renewable primary resources used as energy carrier (fuel)	[MJ]	1.83E+02
RPR_M: Renewable primary resources with energy content used as material	[MJ]	2.23E+01
$NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel)	[MJ]	8.06E+00
$NRPR_M$: Non-renewable primary resources with energy content used as material	[MJ]	3.05E+02
SM: Secondary materials	[kg]	0
RSF: Renewable secondary fuels	[MJ]	0
NRSF: Non-renewable secondary fuels	[MJ]	0
RE: Recovered energy	[MJ]	0
FW: Use of net fresh water resources	[m3]	4.84E-01

Table 21. Output Flows and Waste Categories over the ESL

PARAMETER	UNIT	LVT (4.0*0.5)
HWD : Hazardous waste disposed	[kg]	9.89E-02
NHWD: Non-hazardous waste disposed	[kg]	6.02E-02
HLRW: High-level radioactive waste, conditioned, to final repository	[kg]	1.49E-08
ILLRW: Intermediate- and low-level radioactive waste, conditioned, to final repository	[kg]	9.38E-08
CRU: Components for re-use	[kg]	0
MR: Materials for recycling	[kg]	0
MER: Materials for energy recovery	[kg]	0
EE: Recovered energy exported from the product system	[MJ]	0

Table 22. Carbon Emissions and Removals over the ESL

PARAMETER	UNITS	LVT (4.0*0.5)
BCRP	[kg CO_2]	N/A
BCEP	[kg CO_2]	N/A
BCRK	[kg CO_2]	3.52E+00
BCEK	[kg CO_2]	1.21E+00
BCEW	[kg CO_2]	N/A
CCE	[kg CO_2]	N/A
CCR	[kg CO_2]	N/A
CWNR	[kg CO_2]	N/A

4.3 Results of other series of LVT

As for LVT with other thickness, they can be installed over most solid subfloor with minimal subfloor preparation, and the installation is completely glue free. Therefore, we can assume that for all the series of WPC floor with different thickness, the result of life cycle stages ranging from A5 (Assembly/Install) to maintenance (B2) is not affected by the thickness and can use the value from the representative product LVT (4.0*0.5). As for the result of life cycle stages from other stages including A1-A4, C2, and C4, and the result of Life cycle inventory, the scaling factors below in table 19 can be applied for calculation. (result of each series=scaling factor*value of LVT (4.0*0.5))

Table 23: All range of LVT series and relevant scaling factors

LVT	3.0*0.15	3.0*0.2	3.0*0.3	4.0*0.15	4.0*0.2	4.0*0.3	4.0*0.4
Total weight (g)	5483.5	5462	5380.9	7408.68	7387.2	7206.2	7163.1
Scaling factor	**0.77**	**0.77**	**0.76**	**1.04**	**1.04**	**1.01**	**1.01**
LVT	4.0*0.5	4.0*0.55	5.0*0.3	5.0*0.4	5.0*0.5	5.0*0.55	5.0*0.7
Total weight (g)	7101.15	7070.1	9206.1	9163.1	9151	9120	8776.9
Scaling factor	**1.00**	**1.00**	**1.30**	**1.29**	**1.29**	**1.28**	**1.24**
LVT	5.0*0.76	6.0*0.3	6.0*0.4	6.0*0.5	6.0*0.55	6.0*0.7	6.0*0.76
TOTAL WEIGHT (G)	8740	11106.1	11063.1	11001.2	10970.2	10676.9	10640
SCALING FACTOR	**1.23**	**1.56**	**1.56**	**1.55**	**1.54**	**1.50**	**1.50**

5. LCA Interpretation

A stage contribution analysis on various impact categories reveals that production, transportation (oceanic and road), maintenance and end of life treatment of flooring products are the main contributors to environment impacts. The process contribution analysis reveals that PVC material supply, electricity consumption, transportation, and incineration and landfill process for waste treatment contributes to most of the environmental impacts.

Sensitivity analysis shows that change in assumptions such as transportation distance, inputs during maintenance, disposal scenario and the quality of data can lead to certain fluctuation of the final LCA results, hence it is recommended to update the model to get up-to-date results, in case the assumption or process parameters will be changed in the future, or better data would be provided.

The LCA study has been carried out based on available data, information, regional and global knowledge and experience to achieve more possible accuracy, completeness and representative of the results. No known flows are deliberately excluded from this EPD.

6. Additional Environmental Information

6.1 Environment and Health During Manufacturing

No toxic chemicals and hazardous substances listed in the List of Toxic Chemicals Severely Restricted on the Import and Export in China (Circular No. 65 [2005]) and Measures for the Administration of Restricted Use of Hazardous Substances in Electrical and Electronic Products (Circular No. 32 [2016]) is found in the product.

6.2 Environment and Health During Installation

Instructions should be followed as indicated on the Safety Data Sheets and installation guidelines.

6.3 Extraordinary Effects

Fire

EN 13501-1 Fire classification of construction products and building elements: Bfl – s1

Water

In daily use, prevent water and moisture from accumulating underneath walk-off mats. Exposure to flooding for long periods may result in damage to the product.

Mechanical Destruction

Performance requires proper installation according to Milliken installation guidelines.

7. References

UL ENVIRONMENT

UL Environment General Program Instructions v.2.7 March 2022

Part A: Life Cycle Assessment Calculation Rules and Report Requirements UL Environment (September 2018, version 3.2)

Part B: Flooring EPD Requirements. 10010-7 Version 2. UL Environment. September 2018

SUSTAINABILITY REPORTING STANDARDS

EN 15804:2012+A1:2013 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

ISO. (2006). ISO 14044: Environmental management - Life cycle assessment - Requirements and guidelines.

ISO. (2009). ISO 14040: Environmental management - Life cycle assessment - principles and frameworks.

ISO. (2011). ISO 14025: Environmental labels and declarations - Type III environmental declarations - principles and procedures.

ISO. (2017). ISO 21930 Sustainability in building construction - Environmental declaration of building products.

8. Contact Information

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8.2 LCA and EPD Practitioner

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