






Luxury Vinyl Tile Flooring

2.0, 2.5, 3.2, 4.0 mm (Thickness)

Environmental Product
Declaration

Program Operator	NSF International 789 N. Dixboro, Ann Arbor, MI 48105 www.nsf.org	
General Program instructions and Version Number	Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 3.2	
Manufacturer Name and Address	Mannington Mills, Inc 1421 Amtico Road Madison GA 30650	
Declaration Number	EPD10668	
Declared Product and Functional Unit	Luxury Vinyl Tile 1 m ² of installed LVT Flooring and with a building service life of 75 years	
Reference PCR and Version Number	Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 3.2 Part B: Flooring EPD Requirements. UL 10010-7, September 28, 2018	
Product's intended Application and Use	Commercial Flooring Applications	
Product RSL	30 years	
Markets of Applicability	North America	
Date of Issue	10/29/2021	
Period of Validity	5 years from date of issue	
EPD Type	Product Specific	
Range of Dataset Variability	N/A	
EPD Scope	Cradle to Grave	
Year of reported manufacturer primary data	2020	
LCA Software and Version Number	GaBi 10.5.1.124	
LCI Database and Version Number	GaBi Database Version 10.5.1.124, Service Pack 2021.2	
LCIA Methodology and Version Number	TRACI 2.1 CML 2001-Jan 2016	
The sub-category PCR review was conducted by:	Jack Geibig (Chair) Thomas Gloria, PhD Thaddeus Owen	
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v3.1 (February 2018), based on CEN Norm EN 15804 (2012) and ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) <input type="checkbox"/> Internal <input checked="" type="checkbox"/> External	 Tony Favilla afavilla@nsf.org	
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	 Jack Geibig – EcoForm jgeibig@ecoform.com	
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting	
Limitations: Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of Flooring Products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with the PCR for Products 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

1. Company Description

Founded in 1915, Mannington continues to pursue its commitment to quality, customer satisfaction and the environment through innovative product design and marketing, state-of-the-art processes, and industry-leading programs. It manufactures and supplies a portfolio of flooring products including residential and commercial sheet vinyl, luxury vinyl, laminate, hardwood floors, carpet, and rubber.

Mannington is a leader in vinyl plank flooring, allowing customers to achieve the look of hardwood or tile at a fraction of the cost. Vinyl planks are waterproof, easy to clean and maintain, scratch resistant, and durable. All Mannington floors are FloorScore® certified which means they are independently tested and meet stringent indoor air quality standards. This certification also qualifies all of our floors for low VOCs.

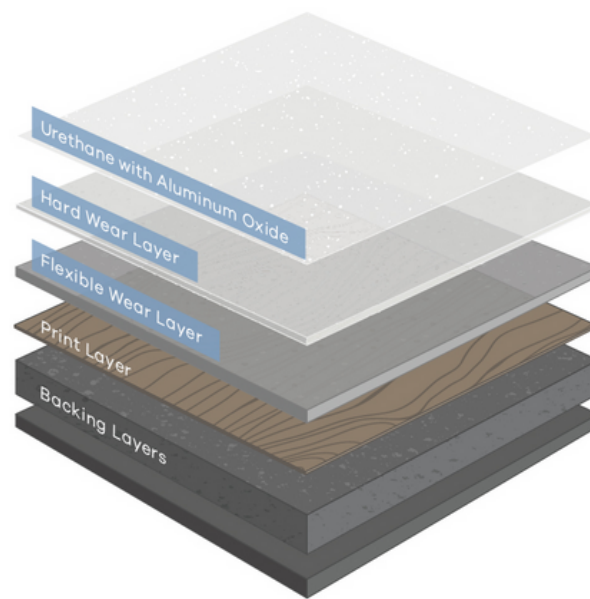


Figure 1: Product Construction

2. Product Description

Luxury Vinyl Tile (LVT), also called resilient flooring, is primarily composed of polyvinyl chloride, calcium chloride, plasticizers, stabilizers, and other additives as part of the base or backing layer. The backing layer is the same for all products. On top of the backing layer is the print layer that gives each product its unique design pattern. This is topped off with wear layers that make the product durable and dimensionally stable. See Figure 1 for a breakdown of LVT construction. Most Traditional LVT requires adhesive and is glued to the floor in an installation. Various thicknesses of LVT are studied in this EPD which include 2.0, 2.5mm, 3.2mm, and 4.0mm.

3. Application

The durability of Mannington's luxury vinyl tiles makes them an ideal choice for a range of demanding commercial spaces. Applications include flooring for healthcare, educational, specialty retail, hospitality interiors, and multi-family residential complexes.



Figure 2: Product Application

4. Properties of Declared Product as Delivered

The product is usually delivered packaged in a cardboard box to protect the tiles during transportation to the customer.

5. Declaration of Methodological Framework

This EPD is a cradle-to-grave study. A summary of the life cycle stages can be found in Section 15. The reference service life is outlined in Table 8 and is only applicable if all manufacturing guidelines are followed regarding site-selection and installation, found online. The cut-off criteria are described in Section 17 and allocation procedures are described in Section 21. No known flows are deliberately excluded from this EPD. Third party verified ISO 14040/44 secondary LCI data sets contribute more than 67% of total impacts in all impact categories required by the PCR.

Table 1: Technical Data

Vinyl Tile	2 mm	2.5 mm	3.2 mm	4 mm
Product thickness (mm)	2	2.5	3.2	4
Wear layer thickness (mm)	0.3	0.51-1	0.9	0.51
Product weight	2.66	2.79	3.67	5.45
Product form	Tile and Plank	Tile and Plank	Tile and Plank	Tile and Plank

Table 2: Performance Testing for LVT

Performance	Test	Requirements	Result
HUD/FHA	N/A	N/A	Passes
Flexibility	ASTM F137	Passes - 1" Mandrel - No Crack/Break	Passes
Dimensional Stability	ASTM F2199	Max 0.020 in/lin ft	Passes
Squareness	ASTM F540	Max 0.010"	Passes
Static Load	ASTM F970 mod.	Residual Indent \leq 0.005"	Passes - 2,000 PSI
Residual Indentation	ASTM F1914	$<$ 8% Avg / 10% Single Value	Passes
Flooring Radiant Panel	ASTM E648	\geq 0.45 watts/cm ²	Passes - Class 1
Smoke Density	ASTM E662	\leq 450	Passes
Slip Resistance	ASTM C1028	\geq 0.5 Leather; 0.6 Rubber	Passes
Acoustic IIC*	ASTM E492	6" Concrete with Drop Ceiling	N/A
Acoustic STC*	ASTM E90	6" Concrete with Drop Ceiling	N/A
Resistance to Light	ASTM F1515	N/A	Passes
Chemical Resistance	ASTM F925	N/A	Passes
Resistance to Heat	ASTM F1514	N/A	Passes

6. Flow Diagram

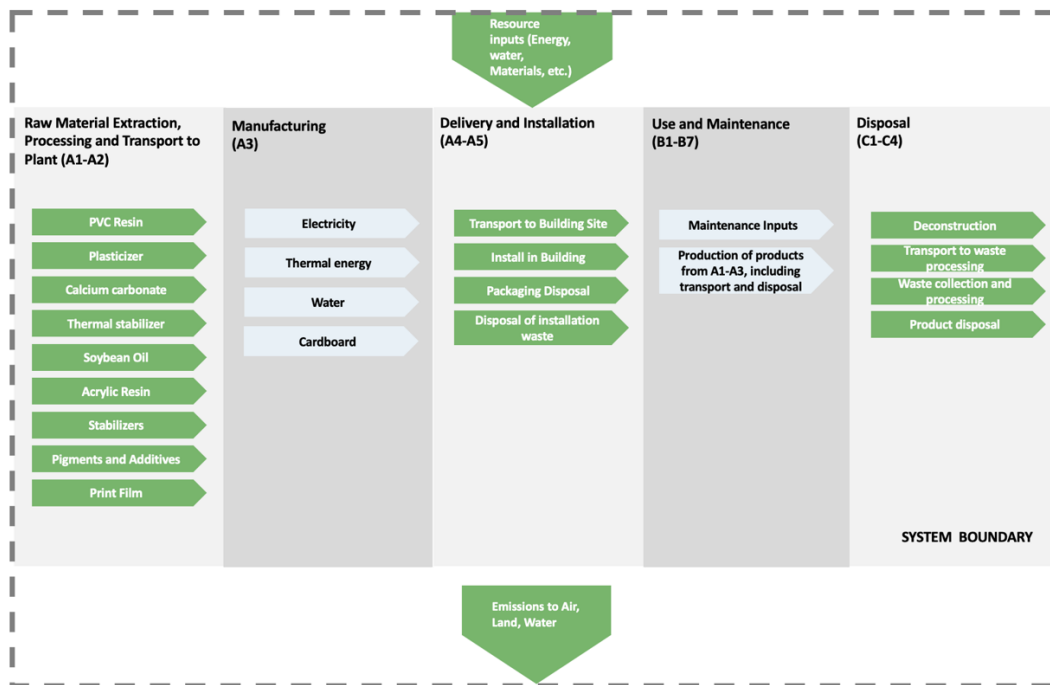


Figure 3: Flow Diagram

7. Manufacturing and Packaging

The product is manufactured in Mannington's facility in Madison, GA. The manufacturing process begins with the mixing of raw materials that form the backing layer. Each of the layers are manufactured separately in a similar manner. These layers are then extruded/ calendared to form sheets. The different layers are stacked per the construction shown in Figure 2. The layers are then laminated or bonded together under heat and pressure to form a luxury vinyl tile or plank. After manufacturing, the tiles/ planks are packaged in cardboard for shipment to the customer. Packaging materials are either recycled, landfilled or incinerated

based on waste classification mentioned in Section 2.8.5- and 2.8.6-Part A of the reference PCR. No substances required to be reported as hazardous are associated with the production of this product.

Table 3: Product Composition

Performance	2 mm	2.5 mm	3.2 mm	4 mm
PVC Resin	46.16%	45.12%	45.28%	46.28%
Calcium Carbonate	38.35%	37.49%	37.63%	38.46%
Plasticizer	11.24%	12.43%	12.24%	11.10%
Thermal Stabilizer	1.01%	0.99%	0.99%	1.02%
Epoxidized Soybean Oil	2.48%	2.43%	2.44%	2.49%
Acrylic Resin	0.29%	0.68%	0.62%	0.24%
UV Stabilizer	0.01%	0.02%	0.02%	0.01%
Pigment	0.07%	0.07%	0.07%	0.07%
Processing Additive	0.12%	0.11%	0.11%	0.11%
Topcoat	0.05%	0.13%	0.11%	0.04%
Print Film	0.22%	0.52%	0.48%	0.18%

Table 4: Packaging per square meter of tile

Packaging	2 mm	2.5 mm	3.2 mm	4 mm
Cardboard	0.076	0.095	0.121	0.151

8. Transportation

It is assumed that all raw materials are delivered to the manufacturing facility via truck and ship, based on global region. Distances were calculated using the supplier location and the location of manufacturing.

9. Product Installation

Installation of Mannington LVT Tiles primarily consists of application of adhesive to the prepared subfloor. While installation equipment is required to install the flooring product, it is not included in the study as these are multi-use tools and the impacts per declared unit is considered negligible. The recommended coverage rate of the adhesive identified by Mannington adhesive specifications and RFCI's industry wide EPD is used for this study. All waste generated during installation, including packaging waste, is disposed of according to the tables found in Section 2.8.5 of *Part A: Life Cycle Assessment Calculation Rules and Report Requirements* from UL Environment.

10. Use

The table below shows the parameters for the use phase scenario undergoing study while Table 9 shows the total material and energy inputs required in the study. These inputs were taken from Resilient Floor Coverings Institute's (RFCI) maintenance guidelines indicated in the industry-wide EPD. Resilient tile products are traditionally not repaired or refurbished and are only replaced if the product fails or a new look

is desired. Detailed maintenance instructions for resilient flooring are provided on Mannington's website: <https://www.mannington.com/Residential/VinylSheet/Resilient/Care-and-Maintenance>.

Table 5: Maintenance Procedure

Level of Use	Cleaning Process	Cleaning Frequency	Consumption of energy and resources
Commercial/ residential/ industrial	Dust mop	Daily	None
	Damp mop/ neutral cleaner	Weekly	Hot water, neutral detergent
	Spray buff/ finish restorer	Monthly	Floor finish, electricity

11. Reference Service Life and Estimated Building Service Life

The reference service life of Mannington LVT is assumed to be 30 years given that the product is installed as per manufacturer guidelines. Therefore, after initial installation in a building with an estimated service life (ESL) of 75 years there will be 1.5 replacements needed.

12. Reuse, Recycling and Energy Recovery

Mannington's LVT flooring can be easily disposed of, without any special handling requirements and without the threat of contamination.

13. Disposal

The product is considered to be 100% landfilled as specified in Sections 2.8.5 and 2.8.6 of Part A: Life Cycle Assessment Calculation Rules and Report Requirements from UL Environment.

Life Cycle Assessment Background Information

14. Functional Unit

The functional unit of the flooring product is one (1) m² of floor covering.

Table 3: Functional Unit Details

Thickness	2 mm	2.5 mm	3.2 mm	4 mm
Mass per functional unit [kg]	2.66	2.79	3.67	5.45

15. System Boundary

This EPD is a Cradle-to-Grave study.

Table 4: Life Cycle Stages Included in the Study

Production			Construction		Use							End of Life				Benefits & Loads Beyond 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 to Site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste Processing	Disposal	Reuse, Recovery, Recycling Potential
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MND

X = Module Included in LCA Report, MND = Module not Declared

Table 5: System Boundary and Modules

Module Name	Description	Analysis Period	Summary of Included Elements
A1	Product Stage: Raw Material Supply	2020	Raw Material sourcing and processing as defined by secondary data.
A2	Product Stage: Transport	2020	Shipping from supplier to manufacturing site. Fuel use requirements estimated based on product weights and estimated distance.
A3	Product Stage: Manufacturing	2020	Energy, water and material inputs required for manufacturing products from raw materials. Packaging materials and manufacturing waste are included as well.
A4	Construction Process Stage: Transport	2020	Shipping from manufacturing site to project site. Fuel use requirements estimated based on product weights and mapped distance.
A5	Construction Process Stage: Installation	2020	Installation materials, installation waste and packaging material waste.
B1	Use Stage: Use	2020	Use of the product.
B2	Use Stage: Maintenance	2020	Cleaning energy, water, and materials, including refinishing the product.
B3	Use Stage: Repair	2020	Product typically not repaired during use.

Module Name	Description	Analysis Period	Summary of Included Elements
B4	Use Stage: Replacement	2020	Total materials and energy required to manufacture a replacement.
B5	Use Stage: Refurbishment	2020	Product typically not refurbished during use.
B6	Operational Energy Use	2020	Operational Energy Use of Building Integrated System During Product Use
B7	Operational Water Use	2020	Operational Water Use of Building Integrated System During Product Use
C1	EOL: Deconstruction	2020	No inputs required for deconstruction.
C2	EOL: Transport	2020	Shipping from project site to waste disposal.
C3	EOL: Waste Processing	2020	Waste processing if incineration as chosen disposal pathway per Part A of the PCR.
C4	EOL: Disposal	2020	Disposal modeled by region as per Part A of the PCR.
D	Benefits beyond system	MND	Credits from energy or material capture.

16. Estimates and Assumptions

All estimates and assumptions are within the requirements of ISO 14040/44. The majority of the estimations are within the primary data. The primary data was collected as annual totals including all utility usage and production information. For the LCA, the usage information was divided by the production to create an energy and water use per square meter. Another assumption is that the installation tools are used enough times that the per square meter impacts are negligible.

17. Cut-Off Rules

All inputs in which data was available were included. Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. No known flows are deliberately excluded from this EPD. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit.

18. Data Sources

Primary data were collected by facility personnel and from utility bills and was used for all manufacturing processes. Whenever available, supplier data was used for raw materials used in the production process. When primary data did not exist, secondary data for raw material production was utilized from GaBi Database Version 10.5.1.124, Service Pack 2021.2.

19. Data Quality

The geographical scope of the manufacturing portion of the life cycle is Madison, Georgia. All primary data were collected from the manufacturer. The geographic coverage of primary data is considered excellent. The primary data provided by the manufacturer represent all information for calendar year 2020. Time

coverage of this data is considered good. Primary data provided by the manufacturer is specific to the technology that Mannington uses in manufacturing their product. It is site-specific and considered of good quality. It is worth noting that the energy and water used in manufacturing the product includes overhead energy such as lighting, heating and sanitary use of water. Sub-metering would improve the technological coverage of data quality. Data necessary to model cradle-to-gate unit processes was sourced from GaBi LCI datasets. Improved life cycle data from suppliers would improve technological coverage.

20. Period Under Review

The period under review is calendar year 2020.

21. Allocation

General principles of allocation were based on ISO 14040/44. There are no products other than Luxury Vinyl Tiles that are produced in the facility considered in this study. Since there are no co-products, no allocation based on co-products is required.

To derive a per unit value for manufacturing inputs such as electricity, natural gas and water, allocation based on total production by mass was adopted. As a default, secondary GaBi datasets use a physical mass basis for allocation. Throughout the study recycled materials were accounted for via the cut-off method. Under this method, impacts and benefits associated with the previous life of a raw material from recycled stock are excluded from the system boundary. Additionally, impacts and benefits associated with secondary functions of materials at end of life are also excluded (i.e. production into a third life or energy generation from the incineration plant). The study does include the impacts associated with reprocessing and preparation of recycled materials that are part of the bill of materials of the products under study.

22. Comparability and Benchmarking

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. Without understanding the specific variability, the user is therefore, not encouraged to compare EPDs. Even for similar products, differences in use and end-of-life stage assumptions, and data quality may produce incomparable results. Comparison of the environmental performance of Flooring Products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with the PCR for Products 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.

Life Cycle Assessment Scenarios

Table 6: Transport to Building Site (A4)

	Mannington - LVT
Vehicle Type	Heavy duty diesel truck
Fuel Efficiency [L/100km]	0.0041
Fuel Type	Diesel
Distance [km]	800
Capacity Utilization [%]	67%
Weight of Products Transported [kg]	2.31 – 5.45
Capacity utilization volume factor	1

Table 7: Reference Service Life

Name	Mannington - LVT	Unit
RSL [years]	30	years
Declared product properties (at the gate) and finishes, etc.	See Table 1 for technical details	N/A
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Per industry standards	N/A
Maintenance	See Use section above for maintenance instructions	N/A

Table 8: Installation at building site (A5)

	2 mm	2.5 mm	3.2 mm	4 mm
Ancillary Material [kg]	0.3	0.3	0.3	0.3
Product wastage [%]	4.5	4.5	4.5	4.5
Waste materials at the construction site before waste processing, generated by product installation [kg]	0.196	0.220	0.286	0.397
Cardboard Packaging Waste to Landfill (20%) [kg]	0.015	0.019	0.024	0.030
Cardboard Packaging Waste to Incineration (5%) [kg]	0.004	0.005	0.006	0.008
Cardboard Packaging Waste to Recycling (75%) [kg]	0.057	0.071	0.091	0.114

Table 9: Maintenance (B2)

Name	Value	Unit
Maintenance process information	Industry wide EPD by RFCI	-
Maintenance cycle	1560 (weekly)	Cycles/ RSL
Maintenance cycle	3900 (weekly)	Cycles/ ESL
Net freshwater consumption	0.435	m ³ / ESL
Ancillary materials		
Detergent	8.9	kg/ ESL
Finish	9.0	kg/ ESL
Electricity (for spray buffing)	1.7	kWh/ ESL
Power output of equipment	1.1	kW

Table 10: End-of-Life Scenario Details (C1-C4)

	2 mm	2.5 mm	3.2 mm	4 mm
Collected as mixed construction waste [kg]	2.96	3.09	3.97	5.75
Waste to Landfill [kg]	2.96	3.09	3.97	5.75
Distance to Landfill [km]	161	161	161	161
Waste to Incineration [kg]	0	0	0	0
Distance to Incineration [km]	0	0	0	0
Waste to Recycling [kg]	0	0	0	0
Distance to Recycling [km]	0	0	0	0

Life Cycle Assessment Results

All results are given per functional unit, which is 1 m² of installed flooring over an estimated building life of 75 years. Environmental Impacts were calculated using the GaBi software platform. Impact results have been calculated using both TRACI 2.1 and CML 2001-Jan 2016 characterization factors. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. These six 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 Impact Category Key table gives definitions of relevant acronyms.

Table 11: Impact Category Key

Acronym	Text	Acronym	Text
LCA Indicators			
ADP-elements	Abiotic depletion potential for non-fossil resources	GWP	Global warming potential
ADP-fossil	Abiotic depletion potential for fossil resources	OPD	Depletion of stratospheric ozone layer
AP	Acidification potential of soil and water	POCP	Photochemical ozone creation potential
EP	Eutrophication potential	Resources	Depletion of non-renewable fossil fuels
LCI Indicators			
PERE	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PENRT	Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)
PERM	Use of renewable primary energy resources used as raw materials	SM	Use of secondary materials
PERT	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	RSF	Use of renewable secondary fuels
PENRE	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	NRSF	Use of non-renewable secondary fuels
PENRM	Use of non-renewable primary energy resources used as raw materials	FW	Net use of fresh water
HWD	Disposed-of-hazardous waste	MFR	Materials for recycling
NHWD	Disposed-of non-hazardous waste	MET	Materials for energy recovery
RWD	Disposed-of Radioactive waste	EEE	Exported electrical energy
CRU	Components for reuse	EET	Exported thermal energy

Life Cycle Assessment Interpretation

In terms of Global Warming Potential, B4 emerges as the major contributor. This follows the fact that with an RSL of 30 years, there are 1.5 replacements that need to occur during the 75 years of building operation, apart from the initial product installation. This includes raw material extraction, manufacturing, distribution, install and end of life (for replaced product) for every replacement. This causes impacts from B4 to overshadow impacts from any other phase in the life cycle. If the impacts from B4 are set aside to observe impacts from other phases, B2 emerges as a major contributor over a 75-year ESL of the building. This is primarily due to the consumption of energy and resources used to maintain resilient tile over the course of its lifetime. The chart below shows the dominance analysis for all four products to highlight which of the life cycle modules contributes to the majority of the impacts.

However, within raw material extraction and manufacturing (A1-A3), around 40% of impacts come from PVC resin and 20% of GWP impacts are from DOTP plasticizer. Electricity for manufacturing contributes to around 20% and thermal energy contributes to 9% of GWP within A1-A3. Transport to customer, installation, and end of life contribute to less than 5% each to total GWP over the entire lifecycle.

Between LVT products of varying thickness, impacts increase as the thickness of the product increases. This is due to the fact that thicker (e.g. 4 mm) products have a higher mass and thus more raw materials are used than typically used in thinner (e.g. 2 mm) products.

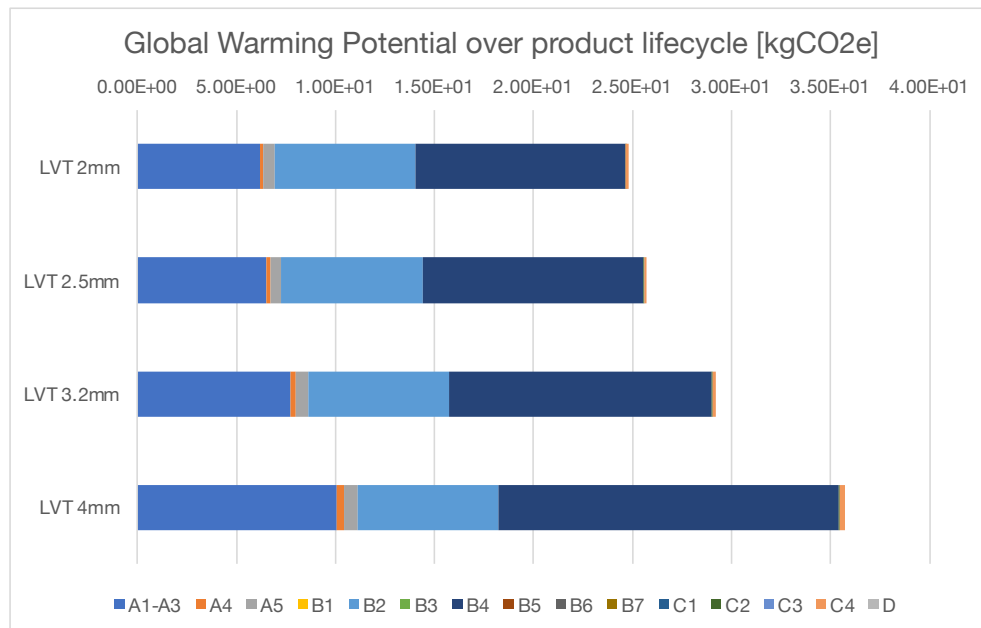


Figure 4: GWP of LVT over Lifecycle

Additional Environmental Information

23. Environmental and Health During Manufacturing

Mannington's LVT product is produced in a facility that is ISO 14001 and ISO 9001 certified.

24. Environment and Health During Installation

The product should be installed according to the manufacturer's instructions found at <https://www.manningtoncommercial.com/resources/lvt/#technical>. This is a non-hazardous product. According to the product's SDS, due to solid, inert properties, scrap pieces from installation may simply be swept up and disposed of as a solid, non-hazardous waste per local, state and federal regulations.

25. Extraordinary Effects

Fire

All products in the study meet ASTM E 648 for Flame Spread. According to the product SDS, the material is considered to be self-extinguishing.

Water

There are no environmental impacts associated with the product being flooded.

Mechanical Destruction

According to the product's SDS, this building product is relatively non-toxic, presenting no known hazard to people, except under thermal decomposition conditions which may yield hazardous by-products.

26. Environmental Activities and Certifications

Mannington's LVT flooring and its adhesives emit minimal levels of volatile organic compounds (VOCs), which are dissipated quickly through normal ventilation. Products included in this EPD are also FloorScore® certified and may be eligible for LEED credits. Mannington has also disclosed its LVT ingredients in a publicly available [Health Product Declaration](#).

Additional information about the products can be found on Mannington's [Technical Resources](#) page.

References

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2. ISO 14044: 2006/ Amd 1:2017 Environmental Management – Life cycle assessment – Requirements and Guidelines – Amendment 1.
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