

NOVALIS[®]

INNOVATIVE FLOORING

**Declaration Owner**

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Product

- KR Luxury Vinyl Tile (LVT)
 - For 2.0 & 2.5mm
- KR Loose Lay LVT (LLT)
 - For 4.5 & 5.0mm

(UNSPSC Class Code 30161707)

Functional Unit

The functional unit is one square meter of flooring installed and maintained over a 75-year period

EPD Number and Period of Validity

SCS-EPD-10261

EPD Valid October 21, 2024 through October 20, 2029

Product Category Rule

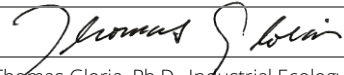
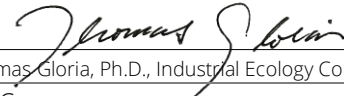
PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. December 2018.

PCR Guidance for Building-Related Products and Services Part B: Flooring EPD Requirements. Version 2.0 UL Environment. September 2018.

Program Operator

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Declaration Owner:	Novalis US, LLC
Address:	200 Munkata Dr. SE, Dalton, Georgia 30721. United States
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Declaration Validity Period:	October 21, 2024 through October 20, 2029
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Gerard Mansell, Ph.D., SCS Global Services
LCA Software and LCI database:	OpenLCA v2.1 software and the Ecoinvent v3.10 database
Product RSL:	15 years
Markets of Applicability:	Global
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Grave
LCIA Method and Version:	CML-IA and TRACI 2.1
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	 Thomas Gloria, Ph.D., Industrial Ecology Consultants
Part A Product Category Rule:	PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. December 2018
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 Part B: Flooring EPD Requirements. Version 2.0/ UL Environment. September 2018.
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:	 Thomas Gloria, Ph.D., Industrial Ecology Consultants
Declaration Contents:	1. Novalis US, LLC..... 2 2. Product 2 3. LCA: Calculation Rules 5 4. LCA: Scenarios and Additional Technical Information 11 5. LCA: Results 14 6. LCA: Interpretation..... 19 7. References 20
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.	

1. Novalis US, LLC

Novalis Innovative Flooring is an industry leader in the designing and manufacturing of sustainable and innovative Luxury Vinyl Tile (LVT). With over 30 years of experience, we continue to develop designs and products that set the global benchmark in LVT quality and performance. Established in 1984, Novalis has grown worldwide with sales offices and distribution partners in North America, Europe, Asia Pacific, and Africa. Novalis continues to be a private, family-owned company.

2. Product

2.1 PRODUCT DESCRIPTION

KR Luxury Vinyl Tile (LVT)

Novalis KR Luxury Vinyl Tile (LVT) is a glue-down vinyl flooring product that is manufactured in Korea and warranted for Heavy Commercial, Light Commercial and Residential environments.

KR Loose Lay LVT (LLT)

Novalis KR Loose Lay LVT (LLT) is a glue-down vinyl flooring product that is manufactured in Korea and warranted for Heavy Commercial, Light Commercial and Residential environments.

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 | MND = Module Not Declared

2.5 TECHNICAL DATA

Technical specifications for the LVT flooring product are summarized in Table 2 and Table 3.

Table 2. Product specifications for 2.0mm Dryback vinyl flooring.

Characteristic		Description			
Sustainable certifications		ISO 14001; CE			
VOC emissions test method		FloorScore®			
Characteristic		Nominal Value	Unit	Maximum Value	Minimum Value
Product thickness		2.5 (0.089)	mm (inch)	3.2 (0.126)	2.0 (0.079)
Wear layer thickness (where applicable)		0.5 (0.020)	mm (inch)	0.7 (0.028)	0.15 (0.59)
Product weight		4,129 (13.53)	g/m ² (oz/ft ²)	4,178 (13.66)	3,467 (11.36)
Product Form	Tiles	Width	152 (6)	mm (inch)	914 (36)
		Length	1219 (48)	mm (inch)	1829 (72)
					305 (12)

Table 3. Product specifications for 5.0mm Loose Lay vinyl flooring.

Characteristic			Description			
Sustainable certifications			ISO 14001; CE			
VOC emissions test method			FloorScore®			
Characteristic			Nominal Value	Unit	Maximum Value	Minimum Value
Product thickness			5.0 (0.197)	mm (inch)	5.0 (0.197)	4.5 (0.177)
Wear layer thickness (where applicable)			0.5 (0.020)	mm (inch)	0.7 (0.028)	0.3 (0.012)
Product weight			8,760 (29)	g/m ² (oz/ft ²)	8,990 (29)	7,890 (26)
Product Form	Tiles	Width	178 (7.0)	mm (inch)	229 (9.0)	152 (6.0)
		Length	1219 (48)	mm (inch)	1219 (48)	914 (36)

2.6 MARKET PLACEMENT/APPLICATION RULES

Technical specifications of the flooring products are summarized below. Detailed product performance results can be found on the manufacturer's website <https://novalisinnovativeflooring.com/>.

2.7 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

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

2.8 MATERIAL COMPOSITION

The luxury vinyl flooring products are made primarily from virgin and recycled polyvinyl chloride (PVC), calcium carbonate (mineral reinforcement), plasticizers and additives (i.e., pigments and stabilizers). The products are structured with multiple layers including a PVC wear layer and a polyurethane (PU) protective layer.

Table 4. Material content for the LVT flooring products in kg per square meter and percent of total mass.

Material	2.0mm Dryback	5.0mm Loose Lay
PVC	1.75	3.82
	49%	43%
Filler	1.48	4.35
	41%	49%
Plasticizer	0.260	0.719
	7.2%	8%
Stabilizer	4.00x10 ⁻²	2.09x10 ⁻²
	1.1%	0.23%
Pigment/Coating	7.40x10 ⁻²	3.65x10 ⁻²
	2.1%	0.41%
Total Product	3.60	8.94
	100%	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 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.

The production of luxury vinyl tile flooring involves the following general manufacturing processes. The raw materials are first mixed and heated. The mixture is then calendared into a sheet to create the backing or the transparent wear layers. The sheets are cut and laminated with a print film. Finally, the product is cut into tiles and packaged. Quality checks are made at each step of the production process.

2.10 PACKAGING

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

Table 5. Material content for the flooring product packaging in kg per square meter of flooring.

Material	2.0mm Dryback	5.0mm Loose Lay
Corrugated	0.120	0.184
	55%	51%
Wood	9.64x10 ⁻²	0.178
	45%	49%
Total Packaging	0.216	0.362
	100%	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 varies 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://novalisinnovativeflooring.com/>.

3. LCA: Calculation Rules

3.1 FUNCTIONAL UNIT

The functional unit used in the study is defined as 1 m² of floor covering installed for use over a 75-year period. The corresponding reference flow for each product system is presented in Table 6. 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 6.

Table 6. Reference flow and RSL for the LVT flooring products.

Product Line	Reference flow (kg/m ²)	Reference Service Life – RSL (years)	Total # of Products Modeled
2.0mm Dryback	3.82	15	5
5.0mm Loose Lay	9.30	15	5

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. The life cycle phases included in the EPD scope are described in Table 7 and illustrated in Figure 1.

Table 7. The modules and unit processes included in the scope for the flooring product system.

Module	Module description from the PCR	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 flooring components.
A2	Transport (to the manufacturer)	Transport of component materials to the manufacturing facility
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 flooring 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 75-year ESL, including periodic cleaning.
B3	Product repair	The flooring 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 flooring 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 use 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 flooring product to waste treatment at end-of-life
C3	Waste processing for reuse, recovery and/or recycling	The product is disposed of by landfilling which require no waste processing
C4	Disposal	Disposal of flooring product in municipal landfill
D	Reuse-recovery-recycling potential	Module Not Declared

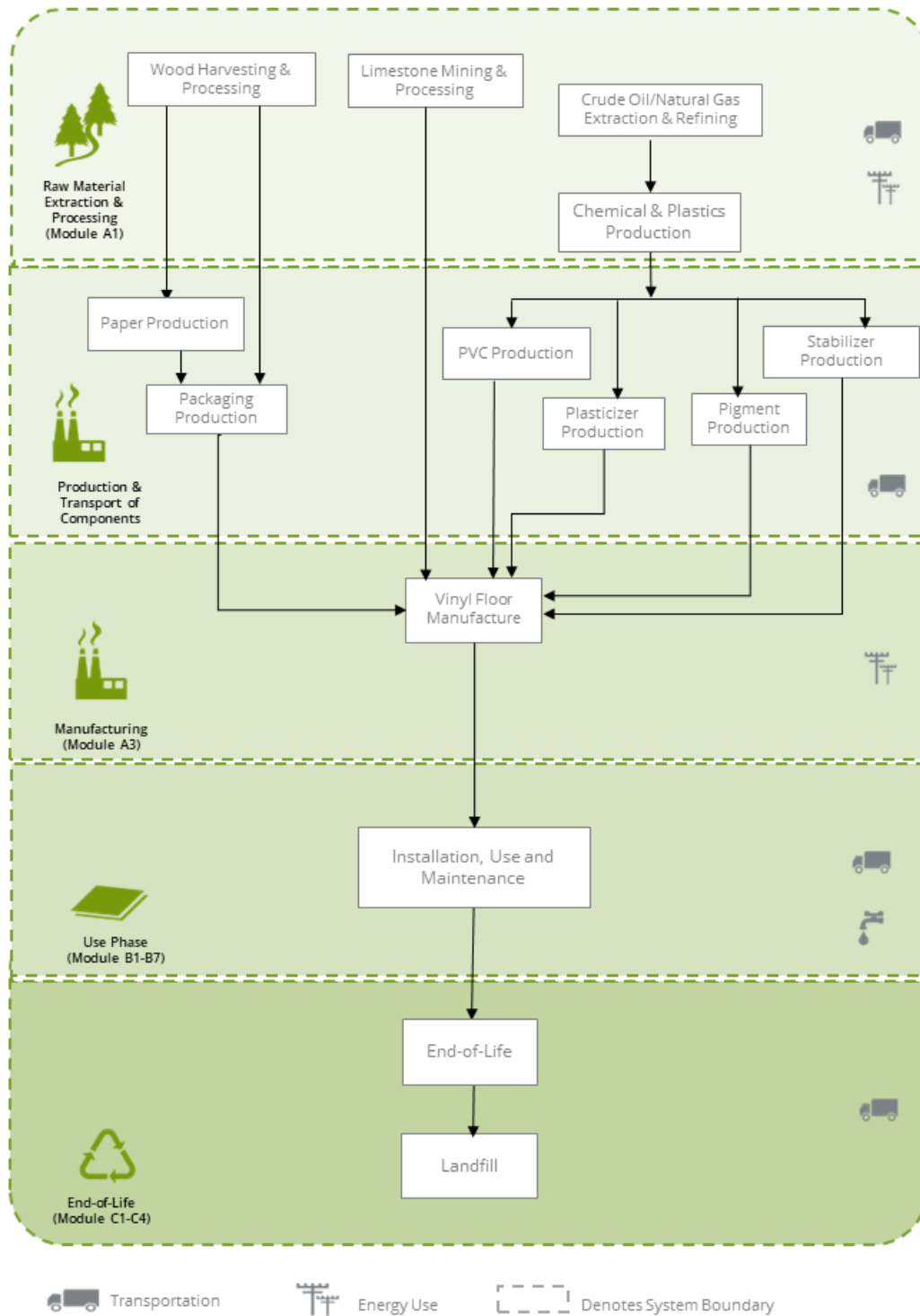


Figure 1. Flow diagram for the life cycle of the LVT flooring products.

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 manufacturing facilities under review are located in Korea. Ecoinvent inventory datasets for the appropriate regional energy grid was used to model resource use and emissions from electricity use at the manufacturing facility.
- Inventory data for some material components were unavailable and modeled using proxy datasets from the Ecoinvent LCI databases.
- The Reference Service Life (RSL) of the products was modeled based on information provided by the manufacturers 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 global product distribution.
- 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 end-of-life, disposal of product and product packaging is modeled based on the PCR guidance regarding recycling rates of product and packaging materials.
- For final disposal of the packaging material and flooring products at end-of-life, all materials are assumed to be transported 161 km (100 miles) 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.

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 1% 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 8. *Data sources for the LVT flooring products.*

Component	Dataset	Data Source	Publication Date
PRODUCT			
PVC			
Polyvinyl Chloride	polyvinylchloride production, bulk polymerisation polyvinylchloride, bulk polymerised Cutoff, S/RoW	EI v3.10	2023
Filler			
Calcium Carbonate	limestone production, crushed, washed limestone, crushed, washed Cutoff, S/RoW	EI v3.10	2023
Plasticizer			
PVC Plasticizer	dioctyl terephthalate production dioctyl terephthalate Cutoff, S/GLO	EI v3.10	2023
Stabilizer			
Stabilizer	barium carbonate production barium carbonate Cutoff, S/GLO	EI v3.10	2023
	zinc oxide production zinc oxide Cutoff, S/RoW	EI v3.10	2023
	solvent production, organic solvent, organic Cutoff, S/GLO	EI v3.10	2023
	chemical production, organic chemical, organic Cutoff, S/GLO	EI v3.10	2023
Other			
Pigments, Catalysts, Additives	chemical production, organic chemical, organic Cutoff, S/GLO; carbon black production carbon black Cutoff, S/GLO; market for titanium dioxide titanium dioxide Cutoff, S/RoW; magnesium oxide production magnesium oxide Cutoff, S/RoW; zinc oxide production zinc oxide Cutoff, S/RoW	EI v3.10	2023
PACKAGING			
Cardboard	containerboard production, linerboard, kraftliner containerboard, linerboard Cutoff, S/RoW	EI v3.10	2023
Wood	market for EUR-flat pallet EUR-flat pallet Cutoff, S/GLO	EI v3.10	2023
TRANSPORT			
Road transport	transport, freight, lorry 16-32 metric ton, EURO4 transport, freight, lorry 16-32 metric ton, EURO4 Cutoff, S/RoW	EI v3.10	2023
Ship transport	transport, freight, sea, container ship transport, freight, sea, container ship Cutoff, S/GLO	EI v3.10	2023
RESOURCES			
Grid electricity - Korea	market for electricity, medium voltage electricity, medium voltage Cutoff, S/KR	EI v3.10	2023
Heat – natural gas	heat production, natural gas, at boiler modulating >100kW heat, district or industrial, natural gas Cutoff, S/RoW	EI v3.10	2023
Heat – fuel oil	heat production, light fuel oil, at industrial furnace 1MW heat, district or industrial, other than natural gas Cutoff, S/RoW	EI v3.10	2023
Heat – gasoline	petrol, unleaded, burned in machinery petrol, unleaded, burned in machinery Cutoff, S/GLO	EI v3.10	2023

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 9. 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 2023.
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 regional power mixes from the Ecoinvent LCI database. Surrogate data used in the assessment are representative of global or North American operations. Data representative of global operations are considered sufficiently similar to actual processes. Data representing product disposal are based on US 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 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 reflects the true population of interest	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.
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 v3.10 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 manufacturing facility represent 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 v3.10 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 all upstream operations were not available and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) 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 period of review calendar year 2023.

3.10 ALLOCATION

Manufacturing resource use was allocated to the products based on surface area. Impacts from transportation were allocated 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 installation is included in the assessment based on information provided by the manufacturer. Transportation parameters for modeling transport to consumer markets are summarized in Table 10.

Table 10. *Product distribution parameters by transport mode and consumer market.*

Parameter	Unit	2.0mm Dryback	5.0mm Loose Lay
Fuel type	-	Diesel	Diesel
Liters of fuel	L/100km	18.7	18.7
Vehicle type	-	Diesel truck	Diesel truck
Transport distance	km	800	800
Capacity utilization	%	76	76
Gross density of products transported	kg/m ²	3.82	9.30
Fuel type	-	Fuel oil	Fuel oil
Liters of fuel	L/tkm	2.23	2.23
Vehicle type	-	Ocean freighter	Ocean freighter
Transport distance	km	11,331	11,331
Capacity utilization	%	70	70
Gross density of products transported	kg/m ²	3.82	9.30

Installation and maintenance of the products are based on typical application and intended use. Approximately 4.5% of the product mass is assumed lost as waste during product installation which is disposed of via landfilling. 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. The VOC emissions associated with the installation, use and maintenance of the products are negligible. The impacts associated with packaging disposal are also included with the installation phase as per PCR requirements.

Table 11. *Installation parameters for the LVT flooring products, per 1 m².*

Parameter		2.0mm Dryback	5.0mm Loose Lay
Ancillary materials – adhesive (kg)		-	-
Net freshwater consumption (m ³)		-	-
Electricity consumption (kWh)		-	-
Product loss per functional unit (kg)		0.144	0.358
Waste materials generated by product installation (kg)		0.361	0.720
Output materials resulting from on-site waste processing (kg)		n/a	n/a
Mass of packaging waste (kg)	Corrugate	0.120	0.662
	Wood	9.64x10 ⁻²	0.397
Biogenic carbon contained in packaging (kg CO ₂)		0.397	0.664
Direct emissions (kg)			

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 of the flooring. The present assessment is based on a recommended weekly cleaning schedule including sweeping and mopping with a neutral cleaner.

Table 12. *Maintenance parameters for the flooring products, per 1 m².*

Parameter	Unit	Value
Maintenance cycle	Cycles / RSL	780
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
Further assumptions	-	Moderate traffic

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 13.

Table 13. *Product replacement parameters for the flooring products, per 1 m².*

Parameter	Units	2.0mm Dryback	5.0mm Loose Lay
Reference service life	Years	15	15
Replacement cycle	-	4	4
Energy input	kWh	0	0
Freshwater consumption	m ³	0	0
Ancillary materials	kg	Negligible	Negligible
Replacement parts	kg	15.3	37.2
Direct emissions	kg	0	0

Building operation stage (B6 – B7)

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

Disposal stage (C1 - C4)

The disposal stage includes demolition of the products (C1); transport of the flooring products to waste treatment facilities (C2); waste processing (C3); and associated emissions as the product degrades in a landfill (C4). For the LVT flooring products, no emissions are generated during demolition (C1) while no waste processing (C3) is required for landfill disposal.

Transportation of waste materials at end-of-life (C2) assumes a 161 km (100 miles) average distance to disposal, consistent with the PCR. The recycling rates used for the product packaging are based on national waste disposal statistics regarding recycling rates for North America as specified in the PCR. No recycling of the product materials is assumed at end-of-life. The relevant disposal statistics used for the packaging are summarized in Table 15.

Table 14. *Recycling rates for packaging materials at end-of-life.*

Material	Recycling rate
Packaging	
Paper & Pulp	81%
Wood	27%
Disposal of Non-recyclables	
Landfill	80%
Incineration	20%

Table 15. *End-of-life disposal scenario parameters for the flooring product.*

Parameter	2.0mm Dryback	5.0mm Loose Lay
Assumptions for scenario development	100% landfill	100% landfill
Collection process		
Collected with mixed construction waste (kg)	3.60	8.94
Recovery	n/a	n/a
Landfill disposal (kg)	3.60	8.94
Removals of biogenic carbon (kg CO ₂ eq)	n/a	n/a

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. All LCA results are stated to three significant figures in agreement with the PCR for this flooring product and therefore the sum of the total values may not exactly equal 100%.

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 2.1 and CML-IA.

CML-IA Impact Category	Unit	TRACI 2.1 Impact Category	Unit
Global Warming Potential (GWP)	kg CO ₂ eq	Global Warming Potential (GWP)	kg CO ₂ eq
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq	Ozone Depletion Potential (ODP)	kg CFC 11 eq
Acidification Potential of soil and water (AP)	kg SO ₂ eq	Acidification Potential (AP)	kg SO ₂ eq
Eutrophication Potential (EP)	kg PO ₄ ³⁻ eq	Eutrophication Potential (EP)	kg N eq
Photochemical Oxidant Creation Potential (POCP)	kg C ₂ H ₄ eq	Smog Formation Potential (SFP)	kg O ₃ eq
Abiotic depletion potential (ADPE) for non-fossil resources	kg Sb eq	Fossil Fuel Depletion Potential (FFD)	MJ Surplus, LHV
Abiotic depletion potential (ADPF) for fossil resources	MJ, LHV		

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
RPRE : Renewable primary resources used as energy carrier (fuel)	MJ, LHV	HWD : Hazardous waste disposed	kg
RPRM : Renewable primary resources with energy content used as material	MJ, LHV	NHWD : Non-hazardous waste disposed	kg
NRPRE : Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	HLRW : High-level radioactive waste, conditioned, to final repository	kg
NRPRM : 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		

Modules B1, B3, B5, B6 and B7 are not associated with any impact and are therefore declared as zero. In addition, module C1 is likewise not associated with any impact as the floor is manually deconstructed. Additionally, as the LVT flooring products do not typically contain significant amounts of bio-based materials, biogenic carbon emissions and removals are not declared. Module D is not declared. In the interest of space and table readability, these modules are not included in the results presented below.

Table 16. Life Cycle Impact Assessment (LCIA) results for the **2.0mm Dryback** flooring products over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.

Impact Category	A1	A2	A3	A4	A5	B2	B4	C2	C4
TRACI									
GWP (kg CO ₂ eq)	6.53	0.229	3.18	1.02	0.577	3.19	53.1	0.800	0.949
	9.4%	0.33%	4.6%	1.5%	0.83%	4.6%	76%	1.1%	1.4%
AP (kg SO ₂ eq)	2.42x10 ⁻²	8.71x10 ⁻⁴	7.23x10 ⁻³	1.33x10 ⁻²	2.10x10 ⁻³	1.24x10 ⁻²	0.209	3.90x10 ⁻³	7.05x10 ⁻⁴
	8.8%	0.32%	2.6%	4.8%	0.77%	4.5%	76%	1.4%	0.26%
EP (kg N eq)	1.97x10 ⁻²	2.38x10 ⁻⁴	4.35x10 ⁻²	1.14x10 ⁻³	7.70x10 ⁻³	8.31x10 ⁻³	0.661	3.99x10 ⁻⁴	9.27x10 ⁻²
	2.4%	0.028%	5.2%	0.14%	0.92%	0.99%	79%	0.048%	11%
SFP (kg O ₃ eq)	0.323	2.22x10 ⁻²	0.144	0.263	3.80x10 ⁻²	0.148	3.66	0.118	7.76x10 ⁻³
	6.8%	0.47%	3%	5.6%	0.8%	3.1%	77%	2.5%	0.16%
ODP (kg CFC-11 eq)	3.87x10 ⁻⁶	3.74x10 ⁻⁹	4.39x10 ⁻⁸	1.63x10 ⁻⁸	1.58x10 ⁻⁷	7.32x10 ⁻⁸	1.64x10 ⁻⁵	1.32x10 ⁻⁸	1.27x10 ⁻⁹
	19%	0.018%	0.21%	0.079%	0.77%	0.35%	80%	0.064%	0.0062%
FFD (MJ surplus)	15.8	0.454	3.36	1.95	0.968	8.47	96.8	1.56	0.137
	12%	0.35%	2.6%	1.5%	0.75%	6.5%	75%	1.2%	0.11%
CML									
GWP (kg CO ₂ eq)	6.62	0.231	3.35	1.03	0.610	3.24	55.2	0.806	1.16
	9.2%	0.32%	4.6%	1.4%	0.84%	4.5%	76%	1.1%	1.6%
AP (kg SO ₂ eq)	2.21x10 ⁻²	7.24x10 ⁻⁴	6.21x10 ⁻³	1.23x10 ⁻²	1.87x10 ⁻³	1.14x10 ⁻²	0.186	3.06x10 ⁻³	3.46x10 ⁻⁴
	9.1%	0.3%	2.5%	5%	0.77%	4.7%	76%	1.3%	0.14%
EP (kg (PO ₄) ³⁻ eq)	9.58x10 ⁻³	1.99x10 ⁻⁴	1.72x10 ⁻²	1.68x10 ⁻³	3.04x10 ⁻³	4.13x10 ⁻³	0.263	7.03x10 ⁻⁴	3.34x10 ⁻²
	2.9%	0.06%	5.2%	0.5%	0.91%	1.2%	79%	0.21%	10%
POCP (kg C ₂ H ₄ eq)	2.53x10 ⁻³	3.55x10 ⁻⁵	4.33x10 ⁻⁴	3.74x10 ⁻⁴	1.67x10 ⁻⁴	7.70x10 ⁻⁴	1.57x10 ⁻²	1.36x10 ⁻⁴	2.44x10 ⁻⁴
	12%	0.17%	2.1%	1.8%	0.82%	3.8%	77%	0.67%	1.2%
ODP (kg CFC-11 eq)	3.17x10 ⁻⁶	2.75x10 ⁻⁹	2.72x10 ⁻⁸	1.21x10 ⁻⁸	1.29x10 ⁻⁷	5.16x10 ⁻⁸	1.34x10 ⁻⁵	9.85x10 ⁻⁹	9.18x10 ⁻¹⁰
	19%	0.016%	0.16%	0.072%	0.77%	0.31%	80%	0.058%	0.0054%
ADPF (MJ eq)	122	3.21	31.7	13.6	7.52	65.2	756	10.4	0.998
	12%	0.32%	3.1%	1.3%	0.74%	6.5%	75%	1%	0.099%
ADPE (kg Sb eq)	1.81x10 ⁻⁵	3.29x10 ⁻⁷	1.18x10 ⁻⁶	1.01x10 ⁻⁶	8.45x10 ⁻⁷	8.11x10 ⁻⁶	8.71x10 ⁻⁵	2.48x10 ⁻⁷	4.58x10 ⁻⁸
	15%	0.28%	1%	0.87%	0.72%	6.9%	74%	0.21%	0.039%

Table 17. Resource use and waste flows for the **2.0mm Dryback** flooring products over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.

Parameter	A1	A2	A3	A4	A5	B2	B4	C2	C4
Resources									
RPR _E (MJ)	6.25	4.30x10 ⁻²	6.69	0.150	0.530	2.42	54.9	4.53x10 ⁻²	2.51x10 ⁻²
	8.8%	0.06%	9.4%	0.21%	0.75%	3.4%	77%	0.064%	0.035%
RPR _M (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%
NRPR _E (MJ)	108	3.25	43.5	13.7	8.27	67.5	834	10.4	1.03
	9.9%	0.3%	4%	1.3%	0.76%	6.2%	77%	0.96%	0.094%
NRPR _M (MJ)	20.1	0.00	0.00	0.00	0.00	0.00	80.6	0.00	0.00
	20%	0%	0%	0%	0%	0%	80%	0%	0%
SM (kg)	0.690	0.00	0.00	0.00	0.00	0.00	2.76	0.00	0.00
	20%	0%	0%	0%	0%	0%	80%	0%	0%
RSF/NRSF (MJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RE (MJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW (m ³)	0.481	2.61x10 ⁻³	0.199	8.95x10 ⁻³	2.80x10 ⁻²	0.688	2.90	3.90x10 ⁻³	1.55x10 ⁻³
	11%	0.06%	4.6%	0.21%	0.65%	16%	67%	0.09%	0.036%
Wastes									
HWD (kg)	2.15x10 ⁻³	2.26x10 ⁻⁵	1.26x10 ⁻⁴	8.57x10 ⁻⁵	1.01x10 ⁻⁴	9.52x10 ⁻⁴	1.03x10 ⁻²	7.32x10 ⁻⁵	6.82x10 ⁻⁶
	16%	0.16%	0.91%	0.62%	0.73%	6.9%	74%	0.53%	0.049%
NHWD (kg)	0.508	0.154	1.52	0.403	0.326	0.139	26.3	4.96x10 ⁻²	3.61
	1.5%	0.47%	4.6%	1.2%	0.99%	0.42%	80%	0.15%	11%
HLRW (kg)	2.66x10 ⁻⁵	1.96x10 ⁻⁷	6.75x10 ⁻⁵	6.77x10 ⁻⁷	3.82x10 ⁻⁶	1.07x10 ⁻⁵	3.97x10 ⁻⁴	2.36x10 ⁻⁷	1.33x10 ⁻⁷
	5.3%	0.039%	13%	0.13%	0.76%	2.1%	78%	0.047%	0.026%
ILLRW (kg)	7.17x10 ⁻⁵	4.62x10 ⁻⁷	1.15x10 ⁻⁴	1.60x10 ⁻⁶	7.59x10 ⁻⁶	2.45x10 ⁻⁵	7.87x10 ⁻⁴	5.55x10 ⁻⁷	3.34x10 ⁻⁷
	7.1%	0.046%	11%	0.16%	0.75%	2.4%	78%	0.055%	0.033%
CRU (kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR (kg)	0.00	0.00	0.00	0.00	0.123	0.00	0.492	0.00	0.00
	0%	0%	0%	0%	20%	0%	80%	0%	0%
MER (kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 18. Life Cycle Impact Assessment (LCIA) results for the **5.0mm Loose Lay** flooring products over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.

Impact Category	A1	A2	A3	A4	A5	B2	B4	C2	C4
TRACI									
GWP (kg CO ₂ eq)	13.1	0.495	4.23	2.49	1.10	3.19	104	1.98	2.56
	9.9%	0.37%	3.2%	1.9%	0.82%	2.4%	78%	1.5%	1.9%
AP (kg SO ₂ eq)	4.96x10 ⁻²	1.89x10 ⁻³	8.01x10 ⁻³	3.24x10 ⁻²	4.16x10 ⁻³	1.24x10 ⁻²	0.430	9.68x10 ⁻³	1.72x10 ⁻³
	9%	0.34%	1.5%	5.9%	0.76%	2.3%	78%	1.8%	0.31%
EP (kg N eq)	3.90x10 ⁻²	5.15x10 ⁻⁴	9.06x10 ⁻²	2.78x10 ⁻³	1.66x10 ⁻²	8.31x10 ⁻³	1.50	9.89x10 ⁻⁴	0.226
	2.1%	0.027%	4.8%	0.15%	0.88%	0.44%	80%	0.052%	12%
SFP (kg O ₃ eq)	0.663	4.80x10 ⁻²	0.157	0.640	7.39x10 ⁻²	0.148	7.57	0.292	1.95x10 ⁻²
	6.9%	0.5%	1.6%	6.7%	0.77%	1.5%	79%	3%	0.2%
ODP (kg CFC-11 eq)	9.33x10 ⁻⁶	8.11x10 ⁻⁹	4.59x10 ⁻⁸	3.98x10 ⁻⁸	3.78x10 ⁻⁷	7.32x10 ⁻⁸	3.93x10 ⁻⁵	3.27x10 ⁻⁸	3.19x10 ⁻⁹
	19%	0.016%	0.093%	0.081%	0.77%	0.15%	80%	0.066%	0.0065%
FFD (MJ surplus)	32.1	0.984	3.55	4.76	1.84	8.47	190	3.88	0.343
	13%	0.4%	1.4%	1.9%	0.75%	3.4%	77%	1.6%	0.14%
CML									
GWP (kg CO ₂ eq)	13.3	0.500	4.63	2.51	1.17	3.24	109	2.00	3.13
	9.5%	0.36%	3.3%	1.8%	0.84%	2.3%	78%	1.4%	2.2%
AP (kg SO ₂ eq)	4.52x10 ⁻²	1.57x10 ⁻³	6.85x10 ⁻³	2.98x10 ⁻²	3.72x10 ⁻³	1.14x10 ⁻²	0.383	7.59x10 ⁻³	8.95x10 ⁻⁴
	9.2%	0.32%	1.4%	6.1%	0.76%	2.3%	78%	1.5%	0.18%
EP (kg (PO ₄) ³⁻ eq)	1.89x10 ⁻²	4.32x10 ⁻⁴	3.45x10 ⁻²	4.08x10 ⁻³	6.48x10 ⁻³	4.13x10 ⁻³	0.590	1.74x10 ⁻³	8.15x10 ⁻²
	2.5%	0.058%	4.6%	0.55%	0.87%	0.56%	80%	0.23%	11%
POCP (kg C ₂ H ₄ eq)	5.67x10 ⁻³	7.69x10 ⁻⁵	7.20x10 ⁻⁴	9.10x10 ⁻⁴	3.62x10 ⁻⁴	7.70x10 ⁻⁴	3.50x10 ⁻²	3.38x10 ⁻⁴	6.61x10 ⁻⁴
	13%	0.17%	1.6%	2%	0.81%	1.7%	79%	0.76%	1.5%
ODP (kg CFC-11 eq)	7.47x10 ⁻⁶	5.97x10 ⁻⁹	2.86x10 ⁻⁸	2.94x10 ⁻⁸	3.02x10 ⁻⁷	5.16x10 ⁻⁸	3.14x10 ⁻⁵	2.44x10 ⁻⁸	2.30x10 ⁻⁹
	19%	0.015%	0.073%	0.075%	0.77%	0.13%	80%	0.062%	0.0058%
ADPF (MJ eq)	248	6.95	33.3	33.0	14.1	65.2	1,460	25.8	2.51
	13%	0.37%	1.8%	1.7%	0.75%	3.5%	77%	1.4%	0.13%
ADPE (kg Sb eq)	5.53x10 ⁻⁵	7.13x10 ⁻⁷	1.34x10 ⁻⁶	2.47x10 ⁻⁶	2.43x10 ⁻⁶	8.11x10 ⁻⁶	2.52x10 ⁻⁴	6.16x10 ⁻⁷	1.16x10 ⁻⁷
	17%	0.22%	0.42%	0.76%	0.75%	2.5%	78%	0.19%	0.036%

Table 19. Resource use and waste flows for the **5.0mm Loose Lay** flooring products over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.

Parameter	A1	A2	A3	A4	A5	B2	B4	C2	C4
Resources									
RPR _E (MJ)	11.4	9.32x10 ⁻²	10.6	0.366	0.909	2.42	94.3	0.112	6.54x10 ⁻²
	9.5%	0.077%	8.8%	0.3%	0.76%	2%	78%	0.093%	0.054%
RPR _M (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%
NRPR _E (MJ)	225	7.04	45.2	33.4	15.1	67.5	1,560	25.9	2.59
	11%	0.35%	2.3%	1.7%	0.76%	3.4%	79%	1.3%	0.13%
NRPR _M (MJ)	36.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100%	0%	0%	0%	0%	0%	0%	0%	0%
SM (kg)	1.91	0.00	0.00	0.00	0.00	0.00	7.63	0.00	0.00
	20%	0%	0%	0%	0%	0%	80%	0%	0%
RSF/NRSF (MJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RE (MJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW (m ³)	0.968	5.65x10 ⁻³	0.206	2.18x10 ⁻²	4.88x10 ⁻²	0.688	5.06	9.68x10 ⁻³	4.00x10 ⁻³
	14%	0.081%	2.9%	0.31%	0.7%	9.8%	72%	0.14%	0.057%
Wastes									
HWD (kg)	4.20x10 ⁻³	4.90x10 ⁻⁵	1.35x10 ⁻⁴	2.09x10 ⁻⁴	1.92x10 ⁻⁴	9.52x10 ⁻⁴	1.99x10 ⁻²	1.81x10 ⁻⁴	1.70x10 ⁻⁵
	16%	0.19%	0.52%	0.81%	0.74%	3.7%	77%	0.7%	0.066%
NHWD (kg)	0.999	0.334	3.69	0.981	0.737	0.139	63.3	0.123	8.96
	1.3%	0.42%	4.7%	1.2%	0.93%	0.17%	80%	0.16%	11%
HLRW (kg)	5.49x10 ⁻⁵	4.24x10 ⁻⁷	6.78x10 ⁻⁵	1.65x10 ⁻⁶	5.04x10 ⁻⁶	1.07x10 ⁻⁵	5.23x10 ⁻⁴	5.85x10 ⁻⁷	3.50x10 ⁻⁷
	8.3%	0.064%	10%	0.25%	0.76%	1.6%	79%	0.088%	0.053%
ILLRW (kg)	1.44x10 ⁻⁴	1.00x10 ⁻⁶	1.15x10 ⁻⁴	3.91x10 ⁻⁶	1.07x10 ⁻⁵	2.45x10 ⁻⁵	1.11x10 ⁻³	1.38x10 ⁻⁶	8.80x10 ⁻⁷
	10%	0.071%	8.2%	0.28%	0.76%	1.7%	79%	0.097%	0.062%
CRU (kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR (kg)	0.00	0.00	0.00	0.00	0.197	0.00	0.787	0.00	0.00
	0%	0%	0%	0%	20%	0%	80%	0%	0%
MER (kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

6. LCA: Interpretation

The contributions to total impact indicator results are dominated by the product replacement phase of the assessment. Of the remaining life cycle phases, the raw material extraction and processing and product maintenance phases are generally the highest contributors to most impact indicators with the exception of the Eutrophication Potential which is dominated by contributions from product disposal.

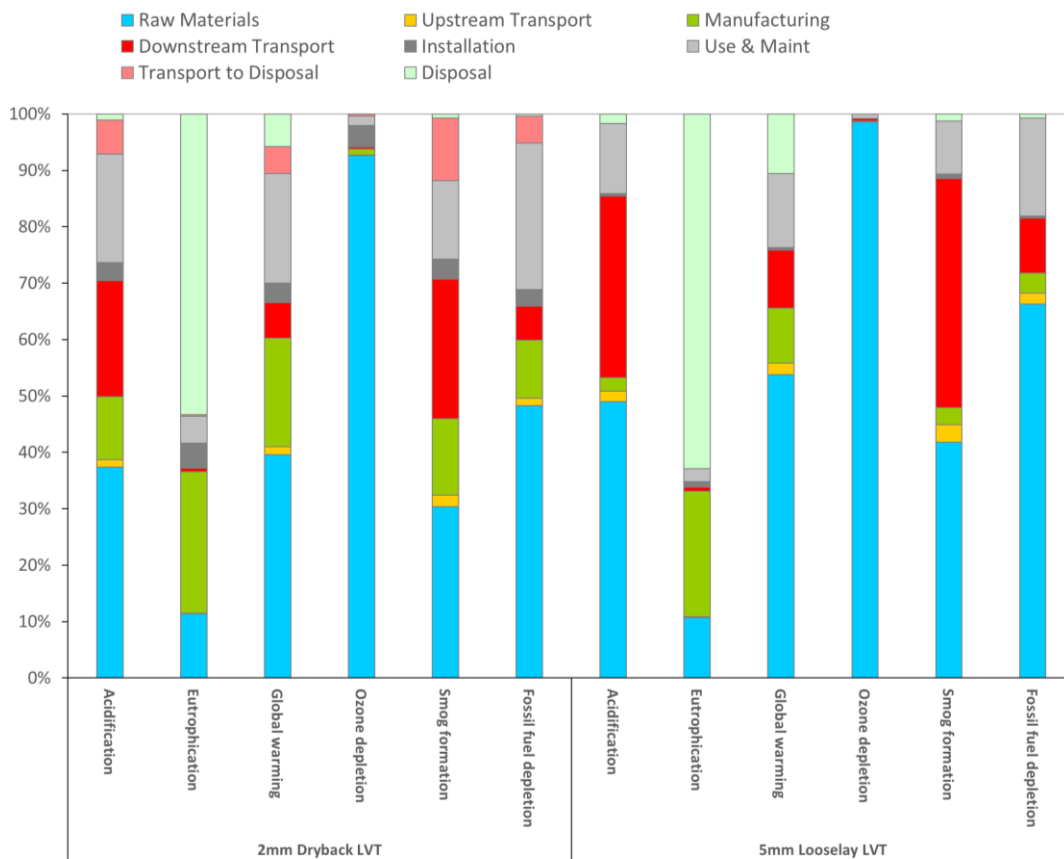


Figure 2. Contribution analysis for the flooring products – TRACI 2.1. (excluding product replacements)

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