Declaration Owner

Resilient Floor Covering Institute
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Product

WPC Rigid Core Flooring
(UNSPSC Class Code 30161700/CSI Code 09 65 00)

Functional Unit

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

EPD Number and Period of Validity

SCS-EPD-10152
EPD Valid May 9, 2024 through May 8, 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. UL Environment. September May 2018.

Program Operator

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Declaration Owner:	Resilient Floor Covering Institute, Inc.
Address:	115 Broad Street, Suite 201, La Grange, GA 30240
Declaration Number:	SCS-EPD-10152
Declaration Validity Period:	EPD Valid May 9, 2024 through May 8, 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 v1.11 software and the Ecoinvent v3.9 database
Product RSL:	30 years
Markets of Applicability:	North America
EPD Type:	Industry-wide Average
EPD Scope:	Cradle-to-Grave
LCIA Method and Version:	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 2022
Part A PCR Review conducted by:	Lindita Bushi, PhD (Chair); Hugues Imbeault-Tétreault, ing., M.Sc.A.; Jack Geibig
Part B Product Category Rule:	PCR Guidance for Building-Related Products and Services Part B: Flooring EPD Requirements. Version 2. 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. Participating Companies ... 2 2. Product ... 3 3. LCA: Calculation Rules ... 7 4. LCA: Scenarios and Additional Technical Information ... 14 5. LCA: Results ... 17 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. Participating Companies

The Resilient Floor Covering Institute (RFCI) is an industry trade association of leading resilient flooring manufacturers and suppliers of raw materials, additives, and sundry flooring products used in conjunction with the resilient flooring industry for the North American market. The institute was established to support the interests of the entire resilient floor covering industry, as well as the people and communities that use its products. For more information visit www.rfci.com. This Industry Wide EPD is available for use by participating resilient flooring manufacturers.

Information in this document has been coordinated by the RFCI Technical Staff based on information submitted by the leading manufacturers of WPC Rigid Core flooring. The product configurations offered herein use ranges representative of all types of WPC Rigid Core flooring from five primary manufacturers produced at four manufacturing facilities located in China and Vietnam. Product accounted for in this EPD represents approximately 8% of WPC Rigid Core flooring sold in North America.

AHF Products is the leader in hardwood and vinyl flooring, with a family of strong brands that serve the residential and commercial markets. With decades of experience in award-winning wood flooring design, innovation, product development, manufacturing, and service, we improve the quality of people's lives through great products and a deep commitment to outstanding customer service. Headquartered in Mountville, PA, USA with manufacturing operations across the United States and in Cambodia, AHF Products employs more than 2,400 dedicated team members.

Headquartered in Norwalk, Connecticut, ***HMTX Industries*** is a global flooring company serving a diverse cross section of the construction and renovation marketplaces. The HMTX family of companies includes four subsidiaries. Halstead™ is the leading supplier of resilient flooring to the home center market. Metroflor™ is its signature residential brand in North America. HMTX Commercial markets the Teknoflor™ and Aspecta™ commercial brands to designers and architects in North America; and HMTX Global serves the residential and commercial sectors worldwide through diverse channel partners focused on Aspecta™, Allure™, and OEM-private label brands. As a global leader in sustainable practices, HMTX sets industry standards for quality and performance as well as superior product design. Its manufacturing processes, workplaces and product ingredients all reflect a significant dedication to sustainability, transparency, and societal impact. HMTX has received numerous accolades for innovation, supply chain performance, online excellence, and customer partnership.

For over 40 years we have been creating stylish, high quality design flooring for the home and commercial projects. A global leader in flooring design with operations in the USA, UK, Australasia and Europe, we pride ourselves on environmental awareness in the supply and maintenance of our products worldwide. As a family-owned business, we remain true to our roots and are fiercely committed to our customers.

Founded in 1915, ***Mannington*** manufactures commercial and residential resilient sheet, LVT, laminate, hardwood, and premium rubber, as well as commercial carpet in eight communities across America. Known for industry-leading design, quality, customer satisfaction and environmental commitments.

Shaw Industries Group, Inc. supplies carpet, resilient, hardwood, tile and stone, synthetic turf, and other specialty products to residential and commercial markets worldwide. The company meets its diverse customer needs through an expansive portfolio of brands, including: Anderson Tuftex, COREtec, Patcraft, Philadelphia Commercial, Shaw Contract, Shaw Floors, Shaw Sports Turf, Shawgrass, Southwest Greens, Watershed Geo and more. Headquartered in Dalton, Ga., Shaw is a wholly owned subsidiary of Berkshire Hathaway, Inc. with more than $7 billion in annual revenue and approximately 20,000 associates worldwide.

2. Product

2.1 PRODUCT DESCRIPTION

This declaration covers WPC rigid core flooring produced by member companies of the Resilient Floor Covering Institute. WPC stands for wood plastic (or polymer) composite and is LVT with a rigid core that includes a foaming agent and wood plastic (or polymer) core. WPC is a multi-layer product with a high performance finish, transparent and print layers, and the WPC core. Some products have an optional acoustical underlayment. The print layer includes wood, stone, and other natural types of digital imaging to maximize aesthetic alternatives. In addition to the WPC rigid core, materials in this flooring product category include vinyl (polyvinyl chloride or PVC), pigments, plasticizers, extenders, and stabilizers. See Figure 1. for a cross-section diagram of WPC rigid core flooring.

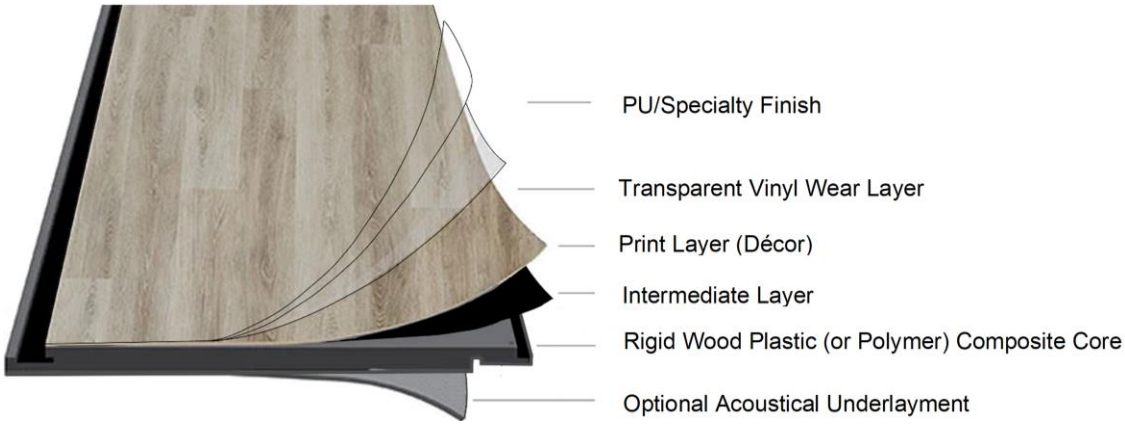


Figure 1. *Cross-Section Diagram of WPC Rigid Core Flooring.*

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. See Table 15 for the one year use phase results summary.*

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 flooring product are summarized in Table 2.

Table 2. *Product characteristics for the **WPC Rigid Core Flooring** product.*

Characteristic			Average Value	Unit	Min Value	Max Value
Product thickness			7.75 (0.305)	mm (inch)	7.50 (0.295)	8.00 (0.315)
Product weight			8,036 (26.3)	g/m^2 (oz/ft^2)	7,500 (24.6)	8,805 (28.9)
Product Form		Tiles	Various	mm (in)	Various	Various
		Planks	Various	m (ft)	Various	Various

2.6 MARKET PLACEMENT/APPLICATION RULES

WPC rigid core flooring is used in both commercial buildings and residences. WPC is durable, stable, soft, and quiet underfoot. WPC is typically installed with a click system that "snaps" planks and/or tiles together across a subfloor and is considered a floating floor. Some installations may require a partial adherence using adhesive for commercial applications.

The WPC Rigid Core Flooring products meet or exceed the following technical specifications:

- ASTM F3261 Standard Specification for Resilient Flooring in Modular Format with Rigid Polymeric Core
- ISO 24337 Laminate floor coverings – Determination of geometrical characteristics

2.7 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

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

2.8 MATERIAL COMPOSITION

The flooring products (UNSPSC Class Code 30161707/CSI Code 09 65 00) are manufactured at the production facility in Asia. The primary materials include PVC, plasticizers, fillers and stabilizers.

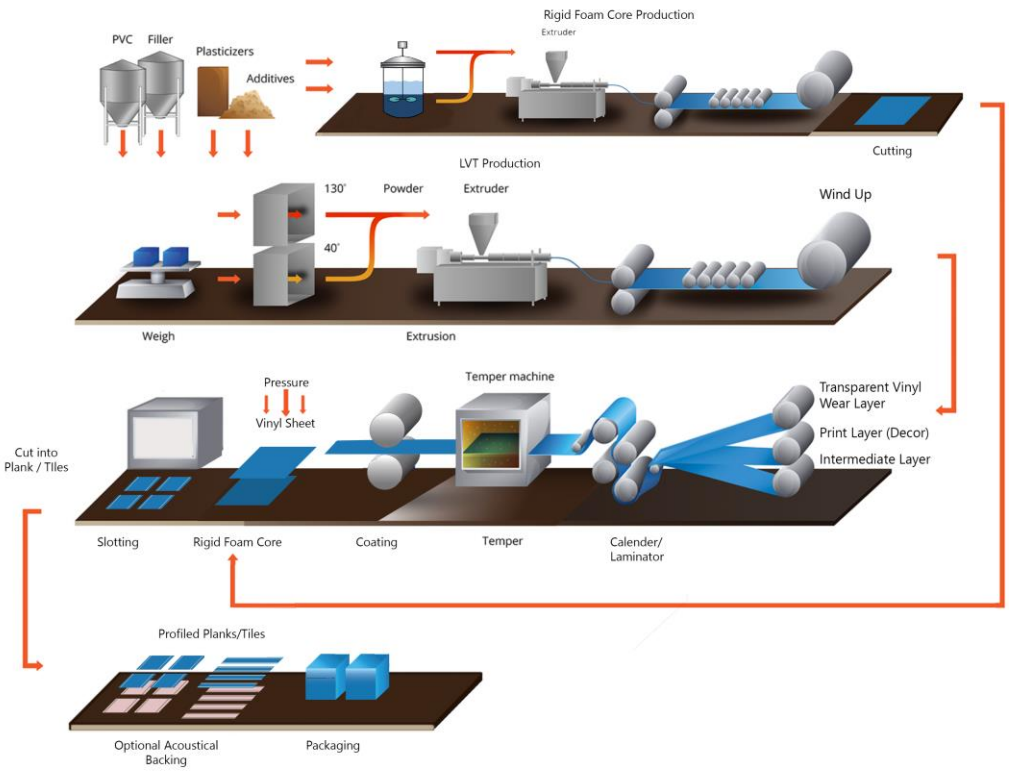
Table 3. *Material content for the flooring products in kg per square meter and percent of total mass.*

Material	Average (kg/m^2)	Percent mass
PVC	2.64	26.3%
Filler	4.09	40.7%
Plasticizer	0.331	3.3%
Stabilizer	0.286	2.8%
Plastic	0.155	1.5%
Pigment	6.58×10^{-3}	0.1%
Re-grind	2.02	20.%
Other	0.525	5.2%

No substances required to be reported as hazardous are associated with the production of this product.

2.9 MANUFACTURING

The products are manufactured at the production facilities in Asia. The manufacturers provided primary data for their annual production, resource use and electricity consumption and waste generation at their facilities. Electricity consumption is modeled using Ecoinvent datasets for regional electricity grids. Floor production follows the flow diagram shown below.



Example of Production Line for WPC Rigid Core Flooring

2.10 PACKAGING

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

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

Material	kg/m^2	Percent mass
Plastic	3.99x10^{-2}	5.3%
Corrugated	0.53	69.9%
Wood	0.188	24.8%
Total	**0.759**	**100.0%**

2.11 PRODUCT INSTALLATION

This study includes transportation to the construction site by truck and flooring installation in the building. In the case of products manufactured abroad, shipping to consumer markets in North America is included as part of transport to the installation site.

Installation of this product primarily involves hand tools for measuring and cutting floor materials. Approximately 4.5% of the total material is assumed to be trimmed and discarded as waste. While some of this waste could be recycled, this scrap is modeled as being disposed of in a landfill. Hand trowels are used to spread appropriate adhesive (300 g/sqm) which adheres flooring to subfloor.

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

No further information is provided.

3. LCA: Calculation Rules

3.1 FUNCTIONAL UNIT

The functional unit used in the study is defined as 1 m^2 of floor covering installed for use over a 75-year period. The corresponding median reference flow for the product system is presented in Table 5. For the present assessment, a reference service lifetime (RSL) of 30 years is assumed. The total number of required product lifecycles during the 75-year period over which the product system is modeled is also summarized for the products in Table 5.

Table 5. *Functional Unit, Reference Service Life (RSL) and median reference flow for the flooring products.*

Parameter	Unit	Value
Functional Unit	-	1 m^2 of installed flooring maintained for 75 years
Reference Flow	kg/m^2	8.94
Reference Service Life – RSL	years	30
Replacement Cycle	-	1.5

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 6.

Table 6. *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 product components.
A2	Transport (to the manufacturer)	Transport of component materials to the manufacturing facilities
A3	Manufacturing, including ancillary material production	Manufacturing of flooring products and packaging (including upstream unit processes)
A4	Transport (to the building site)	Transport of product (including packaging) to the building site
A5	Construction-installation process	Impacts from product installation. Impacts from the production, transport and disposal of waste material associated with installation are included in this phase in addition to impacts from packaging disposal
B1	Product use	Use of the product in a commercial building setting. There are no associated emissions or impacts from the use of the product
B2	Product maintenance	Maintenance of products over the product RSL, including periodic cleaning.
B3	Product repair	The product is not expected to require repair over its lifetime
B4	Product replacement	The materials and energy required for replacement of the product over the 75-year ESL of the assessment are included in this phase
B5	Product refurbishment	The product is not expected to require refurbishment over its lifetime
B6	Operational energy use by technical building systems	There is no operational energy use associated with the use of the product
B7	Operational water uses by technical building systems	There is no operational water use associated with the use of the product
C1	Deconstruction, demolition	Demolition of the product is accomplished using hand tools with no associated emissions and negligible impacts
C2	Transport (to waste processing)	Transport of the product to waste treatment at end-of-life
C3	Waste processing for reuse, recovery and/or recycling	The products are disposed of by recycling, landfilling or incineration which require no waste processing
C4	Disposal	Disposal of the product
D	Reuse-recovery-recycling potential	Module Not Declared

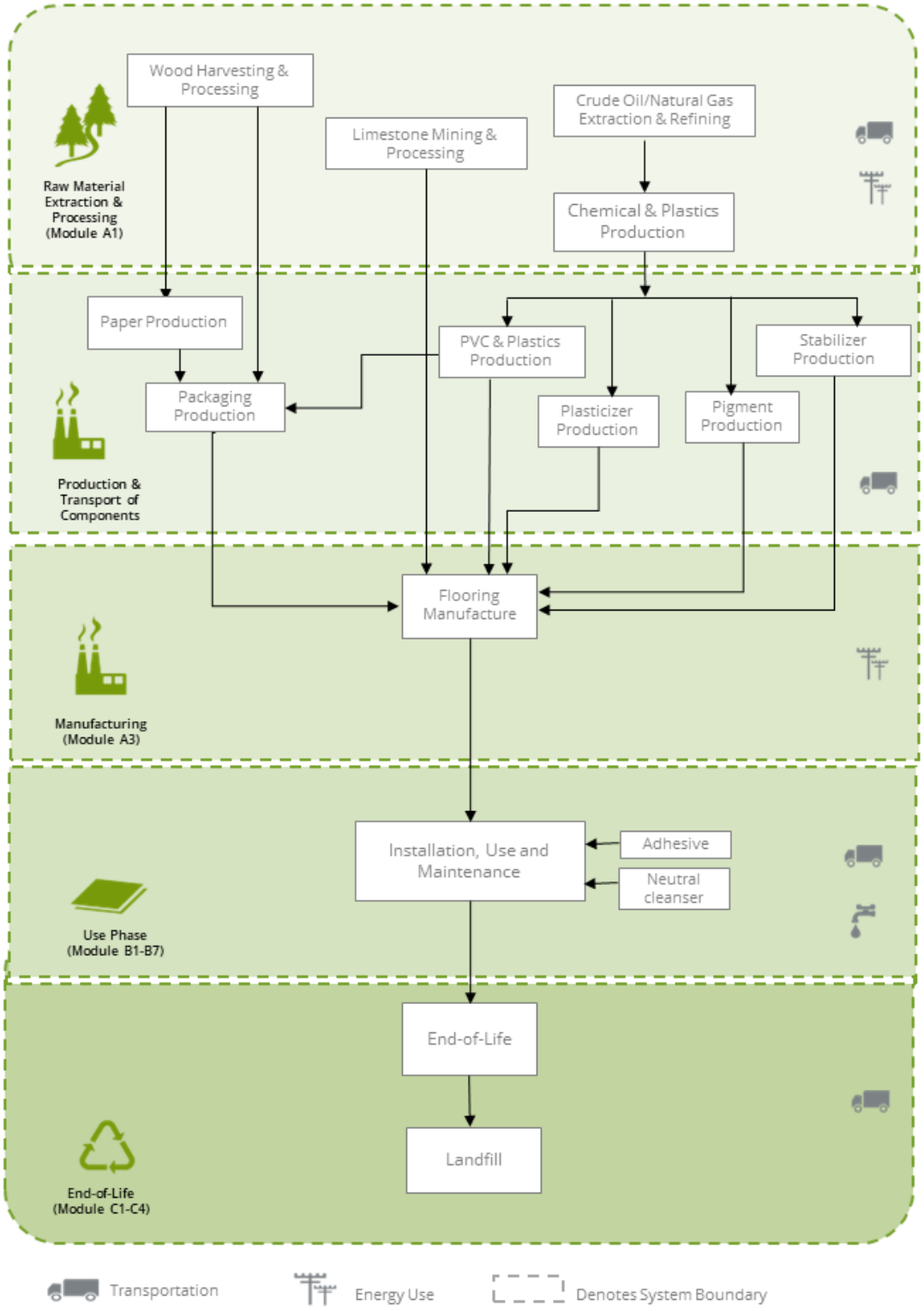


Figure 2. *Flow diagram for the life cycle of the flooring products.*

3.3 PRODUCT SPECIFIC CALCULATION FOR USE PHASE

The recommended cleaning regime is highly dependent on the use of the premises where the floor covering is installed. In high traffic areas more frequent cleaning will be needed compared to areas where there is low traffic. For the purposes of this EPD, average maintenance (moderate traffic levels) is assumed 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 facilities was allocated to the products based on the product area as a fraction of the total production.
- The manufacturing facilities under review is located in Asia. Ecoinvent inventory datasets for the appropriate regional energy grid was used to model resource use and emissions from electricity use at the manufacturing facilities.
- 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 manufacturers representing product distribution to North America.
- The maintenance phase of the product life cycle was modeled based on information provided by the manufacturers 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 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 facilities. The sources of secondary LCI data are the Ecoinvent database.

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

Component	Dataset	Data Source	Publication Date
PRODUCT			
PVC			
Polyvinyl Chloride	PVC resin, virgin, at plant (TRACI only) - Franklin Assoc.	Franklin Assoc.	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	market for chemical, organic | chemical, organic | Cutoff, S/GLO	EI v3.10	2023
	market for chemicals, inorganic | chemical, inorganic | Cutoff, S/GLO	EI v3.10	2023
	market for limestone, crushed, washed | limestone, crushed, washed | Cutoff, S/RoW	EI v3.10	2023
	market for zinc oxide | zinc oxide | Cutoff, S/GLO	EI v3.10	2023
Pigments			
Carbon Black	market for carbon black | carbon black | Cutoff, S/GLO	EI v3.10	2023
Titanium dioxide	market for titanium dioxide | titanium dioxide | Cutoff, S/RoW	EI v3.10	2023
Plastics			
Polyethylene	polyethylene production, low density, granulate | polyethylene, low density, granulate | Cutoff, S/RoW; polypropylene production, granulate | polypropylene, granulate | Cutoff, S/RoW; market for polyurethane, flexible foam | polyurethane, flexible foam | Cutoff, S/RoW	EI v3.10	2023
Polypropylene	polyethylene production, low density, granulate | polyethylene, low density, granulate | Cutoff, S/RoW; polypropylene production, granulate | polypropylene, granulate | Cutoff, S/RoW; market for polyurethane, flexible foam | polyurethane, flexible foam | Cutoff, S/RoW	EI v3.10	2023
Polyurethane	polyethylene production, low density, granulate | polyethylene, low density, granulate | Cutoff, S/RoW; polypropylene production, granulate | polypropylene, granulate | Cutoff, S/RoW; market for polyurethane, flexible foam | polyurethane, flexible foam | Cutoff, S/RoW	EI v3.10	2023
Other			
Chemicals	market for chemical, organic | chemical, organic | Cutoff, S/GLO; chemical production, inorganic | chemical, inorganic | Cutoff, S/GLO	EI v3.10	2023
Glass fibre	glass fibre production | glass fibre | Cutoff, S/RoW	EI v3.10	2023
Acrylics	methyl acrylate production | methyl acrylate | Cutoff, S/GLO; methyl methacrylate production | methyl methacrylate | Cutoff, S/RoW; polymethyl methacrylate production, beads | polymethyl methacrylate, beads | Cutoff, S/RoW; acrylic filler production | acrylic filler | Cutoff, S/RoW	EI v3.10	2023
Adhesive	polyurethane adhesive production | polyurethane adhesive | Cutoff, S/GLO	EI v3.10	2023
PACKAGING			
Cardboard/Paper	corrugated board box production | corrugated board box | Cutoff, S/RoW; kraft paper production | kraft paper | Cutoff, S/RoW	EI v3.10	2023
Wrapping film	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cutoff, S/RoW	EI v3.10	2023
Plastics	polyethylene terephthalate production, granulate, amorphous | polyethylene terephthalate, granulate, amorphous | Cutoff, S/RoW; polyethylene	EI v3.10	2023

Component	Dataset	Data Source	Publication Date
	production, low density, granulate | polyethylene, low density, granulate | Cutoff, S/RoW; polypropylene production, granulate | polypropylene, granulate | Cutoff, S/RoW		
Wood	EUR-flat pallet production | EUR-flat pallet | Cutoff, S/RoW	EI v3.10	2023
TRANSPORT			
Road transport	market for transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff, S/RoW	EI v3.10	2023
Rail transport	transport, freight train, diesel | transport, freight train | 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 - Vietnam	market for electricity, medium voltage | electricity, medium voltage | Cutoff, S/VN	EI v3.10	2023
Grid electricity - China	market group for electricity, medium voltage | electricity, medium voltage | Cutoff, S/CN	EI v3.10	2023
Heat – natural gas	market for heat, central or small-scale, natural gas | heat, central or small-scale, natural gas | Cutoff, S/RoW	EI v3.10	2023
Heat – heavy fuel oil	heat production, heavy fuel oil, at industrial furnace 1MW | heat, district or industrial, other than natural gas | Cutoff, S/RoW	EI v3.10	2023
Heat – light fuel oil	light fuel oil, at industrial furnace 1MW | heat, district or industrial, other than natural gas | Cutoff, S/RoW	EI v3.10	2023
Heat – diesel	diesel, burned in building machine | diesel, burned in building machine | Cutoff, S/GLO	EI v3.10	2023
Heat – steam	market for heat, from steam, in chemical industry | heat, from steam, in chemical industry | Cutoff, S/RoW	EI v3.10	2023
Heat - propane	propane, burned in building machine | propane, burned in building machine | 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 8. *Data quality assessment for the flooring product system.*

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 5 years old. All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. Manufacturer-supplied data (primary data) are based on annual production from 2021-2022.
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 the country-specific electric grids. Surrogate data used in the assessment are representative of global or European operations. Data representative of European operations is considered sufficiently similar to actual processes.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Representative fabrication datasets, specific to the type of material, are used to represent the actual processes, as appropriate.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of the flooring products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set 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 the manufacturing facilities represents an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI data, Ecoinvent v3.10 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 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 LCA results are based on annualized production data for 2021-2022.

3.10 ALLOCATION

Resource use at the manufacturing facilities (e.g., water and energy) was allocated to the products based on the product area as a fraction of the total facility production volume (i.e., area-based allocation). Electricity use at the manufacturing facilities was modeled using ecoinvent inventory datasets for the country-specific electrical grid.

The product systems include the use of recycled materials. Using the recycled content allocation approach, system inputs with recycled content do not receive any burden from the previous life cycle other than reprocessing of the waste material. At end-of-life, materials which are recycled leave the system boundaries with no additional burden.
Impacts from transportation, including product distribution to point of sale, were attributed to the products based on the mass of material and distance transported.

3.11 COMPARABILITY

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

4. LCA: Scenarios and Additional Technical Information

Delivery and Installation stage (A4 - A5)

Distribution of the flooring products to the point of installation is included in the assessment. Transportation parameters for modeling transport to consumer markets in North America are summarized in Table 9.

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

Parameter	Unit	Value
Fuel type	-	Diesel
Liters of fuel	L/100km	18.7
Vehicle type	-	Diesel truck
Transport distance	km	800
Capacity utilization	%	76
Gross density of products transported	kg/m^2	9.30
Fuel type	-	Fuel oil
Liters of fuel	L/tkm	2.23
Vehicle type	-	Ocean freighter
Transport distance	km	12,178
Capacity utilization	%	70
Gross density of products transported	kg/m^2	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. Although the product may be installed without adhesive, a conservative estimate of approximately 0.30 kg of adhesive is assumed required for installation per square meter of flooring. The VOC emissions associated with the installation, use and maintenance of the products are negligible. The impacts associated with packaging disposal are included with the installation phase as per PCR requirements.

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

Parameter		Value
Ancillary materials – adhesive (kg)		0.30
Net freshwater consumption (m^3)		-
Electricity consumption (kWh)		-
Product loss per functional unit (kg)		0.384
Waste materials generated by product installation (kg)		1.14
Output materials resulting from on-site waste processing (kg)		n/a
Mass of packaging waste (kg)	Plastic	3.99×10^{-2}
	Corrugate	0.530
	Wood	0.188
Biogenic carbon contained in packaging (kg CO_2)		1.32
Direct emissions (kg)		-

Use stage (B1)

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

Maintenance stage (B2)

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

Parameter	Unit	Value
Maintenance cycle	Cycles / RSL	1,560
Maintenance cycle	Cycles / ESL	3,900
Maintenance process	-	Damp mopping
Net freshwater consumption	$m^3/m^2/yr$	0.0058
Cleaning agent	$kg/m^2/yr$	0.0119
Maintenance process	-	Machine cleaning
Electricity	$kWh/m^2/yr$	0.022
Further assumptions	-	Moderate traffic; weekly maintenance

Repair/Refurbishment stage (B3; B5)

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

Replacement stage (B4)

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

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

Parameter	Units	Value
Reference service life	Years	30
Replacement cycle	-	1.5
Energy input	kWh	0
Freshwater consumption	m^3	0
Ancillary materials	kg	Negligible
Replacement parts	kg	13.94
Direct emissions	kg	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)

At end-of-life, the product is assumed to be disposed in a landfill per PCR requirements. Additionally, 10% of the packaging materials are recycled at end-of-life while materials not recycled are landfilled.

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

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

Parameter	Value
Assumptions for scenario development	100% landfill
Collection process	
Collected with mixed construction waste (kg)	8.54
Recovery	n/a
Landfill disposal (kg)	8.54
Removals of biogenic carbon (kg CO_2 eq)[1]	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%. Results are presented as a production-weighted average across all products and facilities (i.e., horizontal averaging).

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.

TRACI 2.1 Impact Category	Unit
Global Warming Potential **(GWP)**	kg CO_2 eq
Ozone Depletion Potential **(ODP)**	kg CFC 11 eq
Acidification Potential **(AP)**	kg SO_2 eq
Eutrophication Potential **(EP)**	kg N eq
Smog Formation Potential **(SFP)**	kg O_3 eq
Fossil Fuel Depletion Potential **(FFD)**	MJ Surplus, 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
RPR_E: Renewable primary resources used as energy carrier (fuel)	MJ, LHV	**HWD:** Hazardous waste disposed	kg
RPR_M: Renewable primary resources with energy content used as material	MJ, LHV	**NHWD:** Non-hazardous waste disposed	kg
$NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	**HLRW:** High-level radioactive waste, conditioned, to final repository	kg
$NRPR_M$: Non-renewable primary resources with energy content used as material	MJ, LHV	**ILLRW:** Intermediate- and low-level radioactive waste, conditioned, to final repository	kg
SM: Secondary materials	MJ, LHV	**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 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 14. *Life Cycle Impact Assessment results for the 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.* ***(WPC Rigid Core Flooring)***

Impact Category	A1	A2	A3	A4	A5	B2	B4	C2	C4
TRACI									
GWP (kg CO_2 eq)	8.57	0.561	2.08	2.32	2.70	3.33	31.7	1.77	3.13
	15%	1%	3.7%	4.1%	4.8%	5.9%	56%	3.2%	5.6%
AP (kg SO_2 eq)	$2.93x10^{-2}$	$3.33x10^{-3}$	$8.31x10^{-3}$	$3.16x10^{-2}$	$1.09x10^{-2}$	$1.55x10^{-2}$	0.141	$8.95x10^{-3}$	$1.50x10^{-3}$
	12%	1.3%	3.3%	13%	4.4%	6.2%	56%	3.6%	0.6%
EP (kg N eq)	$1.33x10^{-2}$	$5.72x10^{-4}$	$8.10x10^{-3}$	$2.49x10^{-3}$	$1.16x10^{-2}$	$7.46x10^{-3}$	0.142	$9.38x10^{-4}$	$5.77x10^{-2}$
	5.4%	0.23%	3.3%	1%	4.7%	3.1%	58%	0.38%	24%
SFP (kg O_3 eq)	0.508	$7.94x10^{-2}$	0.125	0.622	0.180	0.177	2.70	0.267	$2.00x10^{-2}$
	11%	1.7%	2.7%	13%	3.8%	3.8%	58%	5.7%	0.43%
ODP (kg CFC-11 eq)	$8.84x10^{-6}$	$9.76x10^{-9}$	$3.42x10^{-8}$	$3.96x10^{-8}$	$4.74x10^{-7}$	$4.02x10^{-8}$	$1.41x10^{-5}$	$2.98x10^{-8}$	$3.11x10^{-9}$
	37%	0.041%	0.14%	0.17%	2%	0.17%	60%	0.13%	0.013%
FFD (MJ Surplus)	29.8	1.10	1.57	4.46	5.39	9.60	69.1	3.49	0.314
	24%	0.88%	1.3%	3.6%	4.3%	7.7%	55%	2.8%	0.25%
Resources									
RPRE (MJ)	4.30	0.107	12.8	0.324	2.23	3.40	30.0	$9.18x10^{-2}$	0.105
	8.1%	0.2%	24%	0.61%	4.2%	6.4%	56%	0.17%	0.2%
RPRM (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%
NRPRE (MJ)	174	7.89	21.6	31.2	43.1	79.7	455	23.3	2.57
	21%	0.94%	2.6%	3.7%	5.1%	9.5%	54%	2.8%	0.31%
NRPRM (MJ)	42.8	0.00	0.00	0.00	0.00	0.00	64.2	0.00	0.00
	40%	0%	0%	0%	0%	0%	60%	0%	0%
SM (kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0%	0%	0%	0%	0%	0%	0%	0%	0%
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 (m3)	0.538	$1.22x10^{-2}$	0.167	$3.85x10^{-2}$	0.257	1.35	1.56	$1.66x10^{-2}$	$1.02x10^{-2}$
	14%	0.31%	4.2%	0.97%	6.5%	34%	39%	0.42%	0.26%
Wastes									
HWD (kg)	$1.89x10^{-3}$	$5.01x10^{-5}$	$5.18x10^{-5}$	$1.82x10^{-4}$	$1.50x10^{-4}$	$8.21x10^{-5}$	$3.74x10^{-3}$	$1.58x10^{-4}$	$1.52x10^{-5}$
	30%	0.79%	0.82%	2.9%	2.4%	1.3%	59%	2.5%	0.24%
NHWD (kg)	0.476	0.339	0.621	0.923	1.00	0.294	17.3	0.118	8.07
	1.6%	1.2%	2.1%	3.2%	3.4%	1%	59%	0.4%	28%
HLRW (kg)	$1.52x10^{-5}$	$4.93x10^{-7}$	$5.00x10^{-6}$	$1.51x10^{-6}$	$5.39x10^{-6}$	$2.04x10^{-5}$	$4.29x10^{-5}$	$5.04x10^{-7}$	$5.62x10^{-7}$
	16%	0.54%	5.4%	1.6%	5.9%	22%	47%	0.55%	0.61%
ILLRW (kg)	$4.12x10^{-5}$	$1.18x10^{-6}$	$1.38x10^{-5}$	$3.60x10^{-6}$	$1.42x10^{-5}$	$8.46x10^{-5}$	$1.15x10^{-4}$	$1.19x10^{-6}$	$1.43x10^{-6}$
	15%	0.43%	5%	1.3%	5.1%	31%	42%	0.43%	0.52%
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	$4.48x10^{-2}$	0.00	$6.72x10^{-2}$	0.00	0.00
	0%	0%	0%	0%	40%	0%	60%	0%	0%
MER (kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EE (MJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 15. *Use phase impact results over a 1-yr time horizon per square meter. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Units	Value
TRACI		
GWP	kg CO_2 eq	4.43×10^{-2}
AP	kg SO_2 eq	2.06×10^{-4}
EP	kg N eq	9.90×10^{-5}
SFP	kg O_3 eq	2.35×10^{-3}
ODP	kg CFC-11 eq	5.40×10^{-10}
FFD	MJ Surplus	0.128

6. LCA: Interpretation

The contributions to total impact indicator results are dominated by the product replacement phase (B4) of the assessment. Of the remaining life cycle phases, with few exceptions, the raw material extraction and processing (A1) phase is the largest contributor to indicator impact results followed by product maintenance (B2), product manufacture distribution (A3), product distribution and installation (A4-A5), and disposal (C4). Other life cycle phase contributions are minimal.

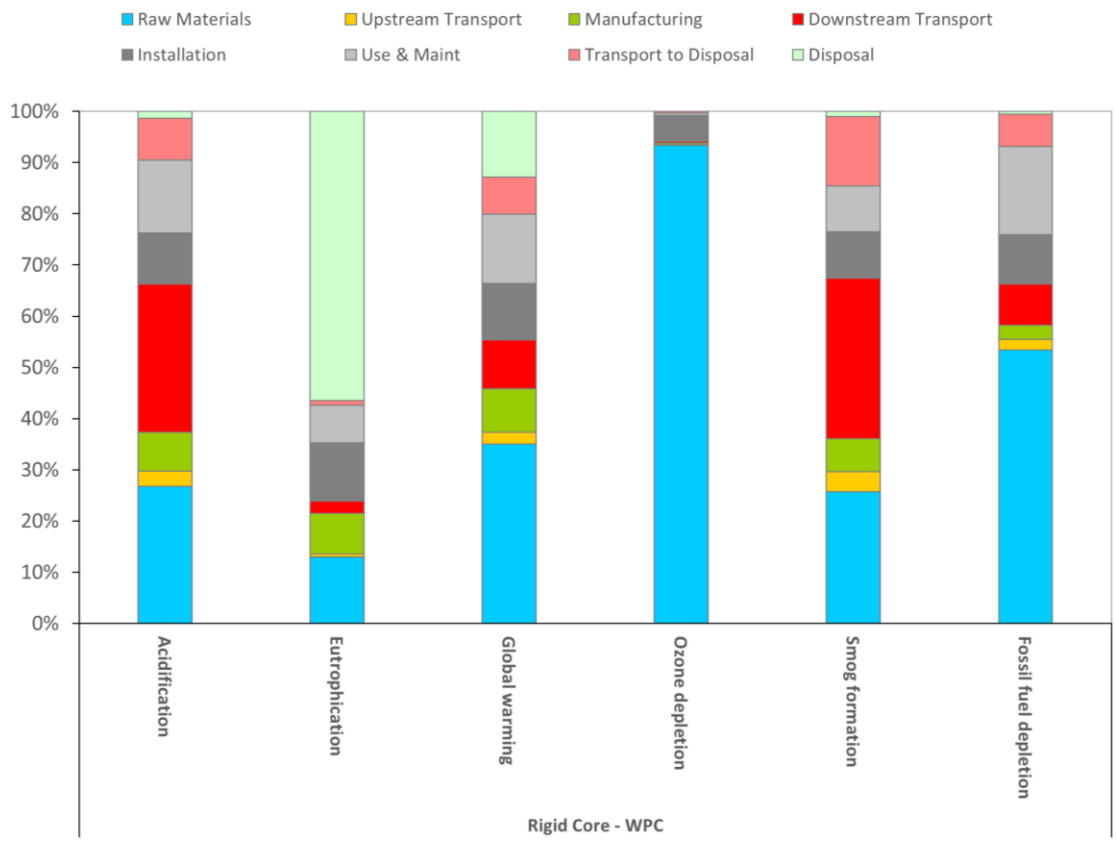


Figure 2. *Contribution analysis for the flooring products – TRACI. (excluding product replacements)*

7. References

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