Declaration Owner

Zhejiang Kingdom New Material Group Co., Ltd.
No.38 Desheng Road, Heshan Town,
Tongxiang City, Zhejiang Province, China
www.kingdomflooring.com.cn | Sales@kingdomflooring.com.cn
+ 0086-573-8938 3298

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

Product
Engineered Stone Plastic Composite Core (ESPC) 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-10029
EPD Valid March 21, 2024 through March 20, 2029

Product Category Rule
Product Category Rule.PCR2019:14. Construction Products. International EPD® System. Version 1.3.2. December 2023
Complementary Product Category Rules (c-PCR) To PCR 2019:14. Resilient, Textile And Laminate Floor Coverings (EN 16810:2017). International EPD® System. Version 2019-12-20. December 2019
CEN standard EN 15804 serves as the core Product Category Rules (PCR)

Program Operator
SCS Global Services
2000 Powell Street, Ste. 600, Emeryville, CA 94608
+1.510.452.8000 | www.SCSglobalServices.com

Declaration Owner:	Zhejiang Kingdom New Material Group Co., Ltd.
Address:	No.38 Desheng Road, Heshan Town, Tongxiang City, Zhejiang Province, China
Declaration Number:	SCS-EPD-10029
Declaration Validity Period:	EPD Valid March 21, 2024 through March 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 v1.11 software and the Ecoinvent v3.9.1 database
Product RSL:	25 years
Markets of Applicability:	Europe
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Grave
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
Product Category Rule:	Product Category Rule.PCR2019:14. Construction Products. International EPD® System. Version 1.3.2. December 2023.
Part A PCR Review conducted by:	The Technical Committee of the International EPD® System. Review chair: Claudia A. Peña, University of Concepción, Chile.
Complementary Product Category Rule:	Complementary Product Category Rules (c-PCR) To PCR 2019:14. Resilient, Textile And Laminate Floor Coverings (EN 16810:2017). International EPD® System. Version 2019-12-20. December 2019
Part B PCR Review conducted by:	The Technical Committee of the International EPD® System.
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:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and EN 15804.*

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: *EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.*

1. Kingdom Floor

Kingdomfloor has been involved in the manufacturing and exporting of vinyl flooring since 1992. With its technically advanced production equipment, professional technical staffs and experienced sales team, Kingdomfloor has maintained its position at the forefront of vinyl flooring industry.

Till now, Kingdomfloor has exported to more than 50 countries such as Germany, France, the Netherlands, UK, USA, Australia, South American etc and has a proven reputation. Kingdomfloor covers an area of about 170,000 square meters and produces a wide range of flooring products including LVT, EPC, SPC, digital printed SPC, PVC-free, wall panel and flooring accessories. The annual production capacity reaches 45 million square meters.

All products from Kingdomfloor meet the highest quality standards. To this end, we continue to maintain our high quality level with an experienced production team, carefully selected and responsible raw material suppliers, reliable quality management and professional sales service team. Besides all internal quality control, we have our products checked through annual audit by well-known third party testing institute EPH, Eurofins. This is how we ensure consistent quality that is proven by the following certificates, Floorscore, VOC A+, CE, EPD, Blue Angel etc.

2. Product

2.1 PRODUCT DESCRIPTION

Product Name	Representative Thickness (mm)	Description
ESPC Engineered Stone Plastic Composite Core	6.0 mm	ESPC products are formed using a hot pressing process, which combines the flexibility of LVT and the rigidity of SPC, providing excellent stability, flame retardancy, and environmental friendliness

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
Modules Declared	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Geography	GLO	GLO	CN	GLO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Share of specific data	>90%			>90%		-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	-			-		-	-	-	-	-	-	-	-	-	-	-	-
Variation - sites	-			-		-	-	-	-	-	-	-	-	-	-	-	-

X = Included in system boundary
GLO = Global; NA = North America; CN = China

2.5 TECHNICAL DATA

Technical specifications for the SPC flooring product are summarized in Table 2.

Table 2. *Product characteristics for the* **ESPC Engineered Stone Plastic CompositeCore** *flooring product.*

Characteristic			Description			
Sustainable certifications			CE, Floorscore, IAC Gold			
VOC emissions test method			French VOC, AgBB, ISO 16000, California Specification 01350			
Characteristic			**Average Value**	**Unit**	**Min Value**	**Max Value**
Product thickness			6.00 (0.24)	mm (in)	4.00 (0.16)	8.00 (0.31)
Wear layer thickness (where applicable)			0.50 (0.02)	mm (in)	0.30 (0.01)	0.70 (0.03)
Product weight			11,758 (38.5)	g/m^2 (oz/ft^2)	7,800 (25.6)	15,600 (51.1)
Product Form	Planks	Width	180.0 (7.09)	mm (in)	110.0 (4.33)	950.0 (37.4)
		Length	1.22 (4.00)	m (ft)	0.55 (1.80)	1.84 (6.04)

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 www.kingdomflooring.com.cn/.

2.7 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

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

2.8 MATERIAL COMPOSITION

The SPC flooring products (UNSPSC Class Code 30161700/CSI Code 09 65 00) are manufactured at the production facility in China. 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.*

Component	Renewable	Recycled Content (%)	Value
PVC	No	0%	3.07
			26%
Re-grind	No	100% pre-consumer	0.00
			0%
$CaCO_3$	No	0%	8.17
			69%
Plasticizer	No	0%	0.198
			1.7%
Stabilizer	No	0%	0.00
			0%
IXPE; PET, PE	No	0%	0.00
			0%
Other	No	0%	0.326
			2.8%
Total Product			**11.8**
			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 Tongxiang City, Zhejiang, China. The manufacturer provided primary data for their annual production, resource use and electricity consumption and waste generation at the facility. Electricity consumption is modeled using Ecoinvent datasets for the regional electricity grid resource mix on the market[1].

The production of the flooring involves the following general manufacturing processes. The raw materials are first mixed and heated. The mixture is then pressed 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 planks and packaged. Quality checks are made at each step of the production process.

[1] The Chinese electricity grid resource mix consists of approximately 66% coal, 32% wind and hydropower, and 2% natural gas as represented in the ecoinvent v3.9 database. The GWP-GHG (AR6) impact of the grid electricity is ~0.9443 kg CO_2e/kWh.

2.10 PACKAGING

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

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

Component	Renewable	Recycled Content (%)	Value
Corrugated	Yes	0%	0.124
			31%
Plastic	No	0%	$6.04x10^{-3}$
			1.5%
Wood	Yes	0%	0.275
			68%
Total Packaging			**0.405**
			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 www.kingdomflooring.com.cn/.

3. LCA: Calculation Rules

3.1 FUNCTIONAL UNIT

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

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

Product Name	Reference Flow (kg/m^2)	Reference Service Life – RSL (years)	Replacement Cycle (ESL/RSL-1)
ESPC Engineered Stone Plastic Composite	12.16	25	2.0

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 and illustrated in Figure 1.

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

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

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

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 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 (incl. 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	There are no significant impacts associated with Module D as only minimal amounts of recycled materials are used in the products.

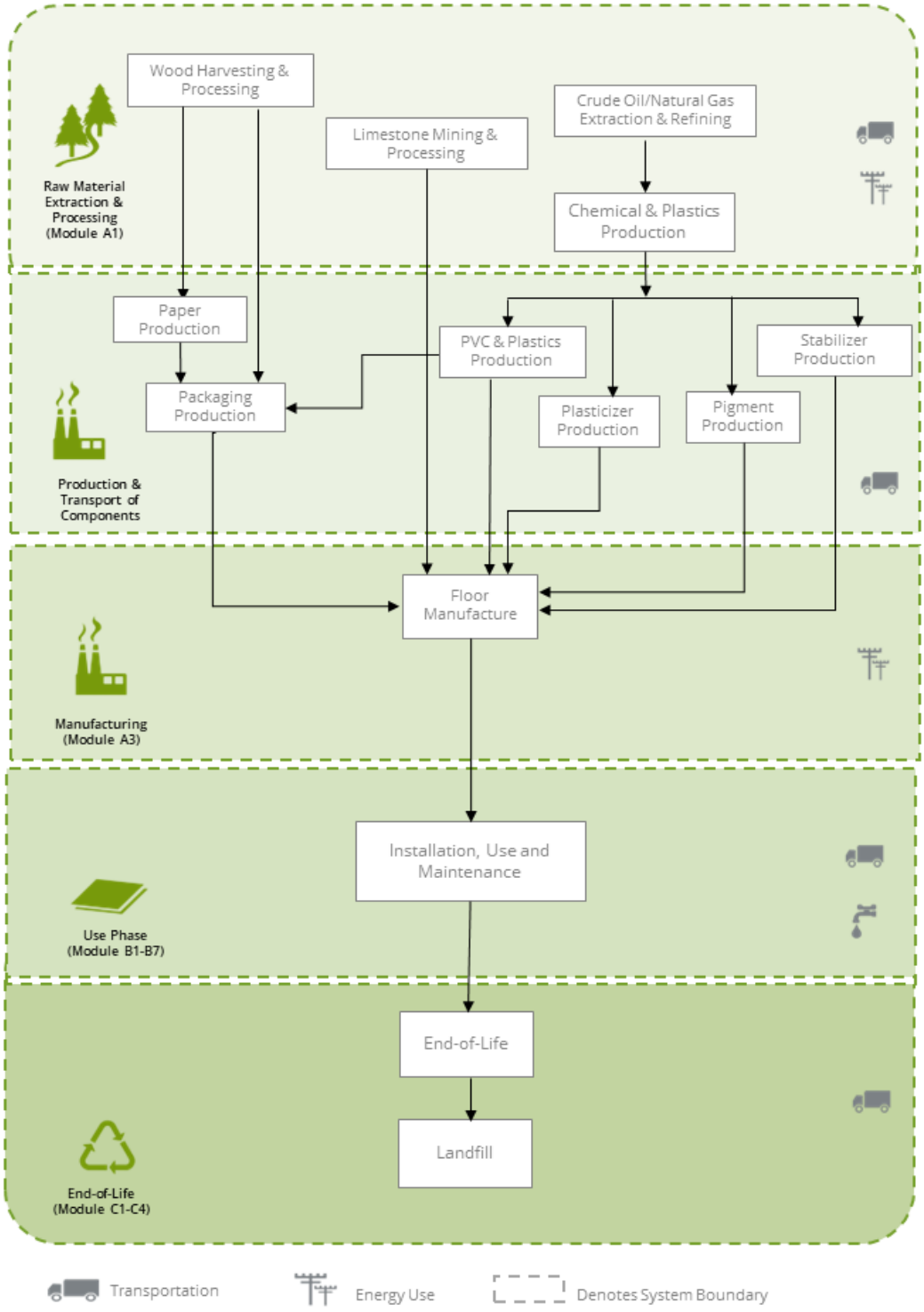

Figure 1. *Flow diagram for the life cycle of the ESPC flooring products.*

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 Kingdom Floors facility under review is located in eastern China. An Ecoinvent inventory dataset for the country-specific energy grid was used to model resource use and emissions from electricity use at the manufacturing facility.
- The Reference Service Life (RSL) of the products was modeled based on information provided by the manufacturer assuming their products are installed and maintained as recommended and used for the specific application noted.
- Downstream transport was modeled based on information provided by the manufacturer representing distribution to consumer markets in Europe.
- Inventory data for some material components were unavailable and modeled using proxy datasets from the Ecoinvent LCI databases.
- 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 regional statistics 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 5% of the total environmental impact indicator for each impact are included in the inventory. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results. No known flows are deliberately excluded from this EPD.

3.7 DATA SOURCES

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

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

Component	Dataset	Data Source	Publication Date
PRODUCT			
PVC			
Polyvinyl Chloride	polyvinylchloride production, bulk polymerisation | polyvinylchloride, bulk polymerised | Cutoff, S/RoW	EI v3.9	2022
Filler			
Calcium Carbonate	limestone production, crushed, washed | limestone, crushed, washed | Cutoff, S/RoW	EI v3.9	2022
Plasticizer			
PVC Plasticizer	dioctyl terephthalate production | dioctyl terephthalate | Cutoff, S/GLO	EI v3.9	2022
Pigment			
Carbon Black	carbon black production | carbon black | Cutoff, S/GLO	EI v3.9	2022
Other			
Organic chemicals	chemical production, organic | chemical, organic | Cutoff, S/GLO	EI v3.9	2022
Adhesive	polyurethane adhesive production | polyurethane adhesive | Cutoff, S/GLO	EI v3.9	2022
Lubricant	lubricating oil production | lubricating oil | Cutoff, S/RoW	EI v3.9	2022
Epoxy	epoxy resin production, liquid | epoxy resin, liquid | Cutoff, S/RoW	EI v3.9	2022
PACKAGING			
Cardboard	corrugated board box production | corrugated board box | Cutoff, S/RoW	EI v3.9	2022
Wood	EUR-flat pallet production | EUR-flat pallet | Cutoff, S/RoW	EI v3.9	2022
Plastic	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cutoff, S/RoW;	EI v3.9	2022
	polyethylene terephthalate production, granulate, amorphous | polyethylene terephthalate, granulate, amorphous | Cutoff, S/RoW	EI v3.9	2022
TRANSPORT			
Road transport	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff, S/RoW	EI v3.9	2022
Ship transport	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, S/GLO	EI v3.9	2022
RESOURCES			
Grid electricity	market group for electricity, medium voltage | electricity, medium voltage | Cutoff, S/CN	EI v3.9	2022
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 v3.9	2022
Heat - Light fuel oil	heat production, light fuel oil, at industrial furnace 1MW | heat, district or industrial, other than natural gas | Cutoff, S/RoW	EI v3.9	2022

3.8 DATA QUALITY

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

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

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 5 years old. All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. Manufacturer-supplied data (primary data) are based on annual production for 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 Asia. Surrogate data used in the assessment are representative of global or European operations. Data representative of European operations are considered sufficiently similar to actual processes. Data representing product disposal are based on regional statistics.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Representative fabrication datasets, specific to the type of material, are used to represent the actual processes, as appropriate.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of the flooring products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set 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 v3.9 data where available. Different portions of the product life cycle are equally considered.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing energy use at the manufacturing facility represents an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI data, Ecoinvent v3.9 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 2022.

3.10 ALLOCATION

Manufacturing resource use was allocated to the products based on surface area. Impacts from transportation were modeled based on the mass of material and distance transported.

3.11 COMPARABILITY

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

4. LCA: Scenarios and Additional Technical Information

Delivery and Installation stage (A4 - A5)

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

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

Parameter	Unit	Value
	Truck transport	
Fuel type	-	Diesel
Liters of fuel	L/100km	18.7
Vehicle type	-	Diesel truck
Transport distance	km	558
Capacity utilization	%	76
Gross density of products transported	kg/m3	2,027
Weight of products transported	kg	12.16
	Ocean transport	
Fuel type	-	Fuel oil
Liters of fuel	L/tkm	2.23
Vehicle type	-	Ocean freighter
Transport distance	km	18,383
Capacity utilization	%	70
Gross density of products transported	kg/m3	2,027
Weight of products transported	kg	12.16

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

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

Parameter		Value
Ancillary materials (kg)		neg.
Net freshwater consumption (m^3)		-
Electricity consumption (kWh)		-
Product loss per functional unit (kg)		0.470
Waste materials generated by product installation (kg)		0.470
Output materials resulting from on-site waste processing (kg)		n/a
Mass of packaging waste (kg)	Corrugated	0.124
	Plastic	$6.04x10^{-3}$
	Wood	0.275
Biogenic carbon contained in packaging (kg CO_2)		0.731
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, as well as periodic machine cleaning of the vinyl flooring. The present assessment is based on a recommended weekly cleaning schedule including sweeping and mopping with a neutral cleaner and monthly machine cleaning. The parameters used to model the product maintenance are summarized in Table 11.

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

Parameter	Unit	ESPC Engineered Stone Plastic Composite
Maintenance cycle	Cycles / RSL	1,300
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	Value	Units
Reference service life	25	Years
Replacement cycle	2.0	-
Energy input	-	kWh
Freshwater consumption	-	m^3
Ancillary materials	-	kg
Replacement parts	24.33	kg
Direct emissions	-	kg

Building operation stage (B6 – B7)

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

Disposal stage (C1 - C4)

At end-of-life, the product is assumed to be disposed in a landfill per PCR requirements. Assumptions for end-of-life for the packaging are based on regional statistics regarding municipal solid waste generation and disposal, including end-of-life recycling rates of packaging and product materials. The packaging materials are recycled based on material recycling rates for Europe[3].

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

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

Parameter	Value
Assumptions for scenario development	100% landfill
Collection process	
Collected with mixed construction waste (kg)	12.16
Recovery	n/a
Landfill disposal (kg)	12.16
Removals of biogenic carbon (kg CO_2 eq)[1]	n/a

[3] Eurostat, Recovery and recycling rates for packaging. 2015. https://ec.europa.eu/eurostat/web/products-datasets/-/cei_wm020

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 impact indicators specified by the PCR include:

- Potential for Global Warming,
- Acidification Potential,
- Eutrophication Potential,
- Ozone Depletion Potential,
- Photochemical Ozone (smog) Creation Potential.
- Ecotoxicity,
- Human Toxicity, and
- Land Use/Land Occupation

Impact category indicators for acidification, eutrophication, ozone depletion potential and photochemical ozone creation are estimated using the characterization factors[4], as prescribed by the PCR, including from CML-IA and ReCiPe methodologies as well as those defined by EN 15804 reference package based on EF 3.0. Impact indicators for Ecotoxicity and Human Toxicity are estimated using the USEtox 2.02 characterization method, while Land Occupation impacts are estimated using the ReCiPe 2016 version 1.1 methodology. The impact category indicators included in the assessment are summarized below.

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

[4] https://www.environdec.com/resources/indicators

Table 14. *Key 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.* ***(ESPC Engineered Stone Plastic Composite Core)***

Impact Category	Climate change (kg CO2 eq)	Climate change - Biogenic (kg CO2 eq)	Climate change - Fossil (kg CO2 eq)	Climate change - Land use and LU change	GWP-GHG (IPCC AR6)	Acidification (mol H+ eq)	Eutrophication, freshwater (kg (PO4)3-	Eutrophication, marine (kg N eq)	Eutrophication, terrestrial (mol N eq)	Ozone depletion (kg CFC11 eq)	Photochemical ozone formation	Particulate matter (disease inc.)
Key Indicators												
A1	11.1	$4.86x10^{-2}$	11.0	$1.02x10^{-2}$	10.6	$5.03x10^{-2}$	$9.25x10^{-3}$	$9.60x10^{-3}$	0.102	$6.53x10^{-6}$	$3.85x10^{-2}$	$4.31x10^{-7}$
	12%	0.19%	17%	20%	14%	11%	25%	5.5%	8%	31%	9%	13%
A2	0.579	$2.49x10^{-4}$	0.578	$2.94x10^{-4}$	0.563	$2.48x10^{-3}$	$1.41x10^{-4}$	$9.11x10^{-4}$	$9.75x10^{-3}$	$8.95x10^{-9}$	$3.35x10^{-3}$	$3.79x10^{-8}$
	0.65%	0.00097%	0.91%	0.58%	0.72%	0.53%	0.38%	0.53%	0.77%	0.043%	0.78%	1.2%
A3	0.734	$9.50x10^{-2}$	0.638	$1.74x10^{-3}$	1.02	$1.94x10^{-3}$	$3.75x10^{-4}$	$1.92x10^{-3}$	$5.47x10^{-3}$	$3.16x10^{-8}$	$2.74x10^{-3}$	$3.28x10^{-8}$
	0.82%	0.37%	1%	3.5%	1.3%	0.42%	1%	1.1%	0.43%	0.15%	0.64%	1%
A4	3.64	$2.22x10^{-4}$	3.64	$2.42x10^{-3}$	3.55	$7.34x10^{-2}$	$5.55x10^{-4}$	$1.90x10^{-2}$	0.209	$5.48x10^{-8}$	$5.82x10^{-2}$	$1.52x10^{-7}$
	4.1%	0.00087%	5.7%	4.8%	4.5%	16%	1.5%	11%	16%	0.26%	14%	4.6%
A5	1.35	0.586	0.767	$6.08x10^{-4}$	1.05	$5.74x10^{-3}$	$4.44x10^{-4}$	$2.39x10^{-3}$	$1.58x10^{-2}$	$2.67x10^{-7}$	$5.27x10^{-3}$	$3.93x10^{-8}$
	1.5%	2.3%	1.2%	1.2%	1.3%	1.2%	1.2%	1.4%	1.2%	1.3%	1.2%	1.2%
B1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	3.17	$3.63x10^{-2}$	3.13	$3.05x10^{-3}$	3.02	$1.54x10^{-2}$	$3.48x10^{-3}$	$2.65x10^{-3}$	$2.74x10^{-2}$	$2.50x10^{-8}$	$1.43x10^{-2}$	$1.26x10^{-7}$
	3.6%	0.14%	4.9%	6.1%	3.9%	3.3%	9.3%	1.5%	2.2%	0.12%	3.3%	3.8%
B3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B4	57.3	17.1	40.2	$3.16x10^{-2}$	50.1	0.300	$2.27x10^{-2}$	0.114	0.830	$1.39x10^{-5}$	0.276	$2.09x10^{-6}$
	64%	67%	63%	63%	64%	64%	60%	66%	65%	67%	64%	64%
B5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2	2.68	$5.60x10^{-4}$	2.68	$3.32x10^{-4}$	2.61	$1.43x10^{-2}$	$1.50x10^{-4}$	$6.23x10^{-3}$	$6.74x10^{-2}$	$4.10x10^{-8}$	$2.64x10^{-2}$	$3.29x10^{-7}$
	3%	0.0022%	4.2%	0.66%	3.3%	3.1%	0.4%	3.6%	5.3%	0.2%	6.2%	10%
C3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C4	8.59	7.79	0.799	$2.17x10^{-4}$	5.67	$1.76x10^{-3}$	$4.40x10^{-4}$	$1.67x10^{-2}$	$5.26x10^{-3}$	$3.93x10^{-9}$	$3.61x10^{-3}$	$2.42x10^{-8}$
	9.6%	30%	1.3%	0.43%	7.3%	0.38%	1.2%	9.7%	0.41%	0.019%	0.84%	0.74%
D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 15. *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.* ***(ESPC Engineered Stone Plastic Composite Core)***

Impact Category	Freshwater ecotoxicity (PAF.m^3.day)	Human toxicity, cancer (cases)	Human toxicity, non-cancer (cases)	Land use (species.yr)	Resource use, fossils (MJ)[1]	Resource use, minerals and metals (kg Sb eq)[1]	Water use (m^3 depriv.)[1]
Other Indicators							
A1	173,000	$8.10x10^{-7}$	$2.01x10^{-6}$	$1.50x10^{-9}$	232	$1.05x10^{-4}$	-1.62
	6.8%	17%	8.8%	6.2%	21%	27%	-11%
A2	2,490	$3.88x10^{-8}$	$7.75x10^{-8}$	$1.91x10^{-10}$	8.00	$1.82x10^{-6}$	$4.12x10^{-2}$
	0.098%	0.81%	0.34%	0.78%	0.72%	0.46%	0.28%
A3	47,600	$6.18x10^{-8}$	$3.96x10^{-7}$	$4.99x10^{-9}$	8.30	$1.33x10^{-6}$	-0.552
	1.9%	1.3%	1.7%	21%	0.75%	0.34%	-3.8%
A4	9,140	$2.16x10^{-7}$	$2.76x10^{-7}$	$5.13x10^{-10}$	46.1	$6.36x10^{-6}$	0.165
	0.36%	4.5%	1.2%	2.1%	4.1%	1.6%	1.1%
A5	39,500	$6.21x10^{-8}$	$3.25x10^{-7}$	$3.08x10^{-10}$	13.2	$4.69x10^{-6}$	$-6.94x10^{-2}$
	1.5%	1.3%	1.4%	1.3%	1.2%	1.2%	-0.48%
B1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	50,200	$2.19x10^{-7}$	$5.72x10^{-7}$	$4.99x10^{-10}$	75.9	$2.59x10^{-5}$	20.1
	2%	4.6%	2.5%	2.1%	6.8%	6.6%	140%
B3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B4	$1.67x10^{6}$	$3.06x10^{-6}$	$1.48x10^{-5}$	$1.59x10^{-8}$	691	$2.44x10^{-4}$	-3.65
	65%	64%	65%	65%	62%	62%	-25%
B5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2	2,450	$5.02x10^{-8}$	$1.08x10^{-7}$	$1.23x10^{-10}$	34.0	$1.68x10^{-6}$	$6.84x10^{-2}$
	0.096%	1%	0.47%	0.51%	3.1%	0.43%	0.47%
C3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C4	559,000	$2.90x10^{-7}$	$4.21x10^{-6}$	$3.13x10^{-10}$	3.77	$6.20x10^{-7}$	0.145
	22%	6%	18%	1.3%	0.34%	0.16%	0.99%
D	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1)] *The results of this environmental impact indicator shall be used with case as uncertainties on these results are high or as there is limited experience with the indicator.*

Table 16. *Resource use for the flooring products over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values.* ***(ESPC Engineered Stone Plastic Composite Core)***

Impact Category	Use of renewable primary energy (MJ)	Use of renewable primary energy resources used as raw materials (MJ)	Total Renewable primary energy (MJ)	Use of nonrenewable primary energy (MJ)	Use of nonrenewable primary energy resources used as raw materials (MJ)	Total Nonrenewable primary energy (MJ)	Use of secondary materials (MJ)	Use of Renewable secondary fuels (MJ)	Use of Nonrenewable secondary fuels (MJ)	Use of net fresh water (m3)
Resources										
A1	8.93	0.00	8.93	ND	ND	232	0.00	0.00	0.00	0.768
	14%	0%	14%			0%	0%	0%	0%	23%
A2	0.102	0.00	0.102	ND	ND	8.00	0.00	0.00	0.00	$6.11x10^{-3}$
	0.16%	0%	0.16%			0%	0%	0%	0%	0.19%
A3	9.73	0.00	9.73	ND	ND	8.30	0.00	0.00	0.00	$1.43x10^{-2}$
	15%	0%	15%			0%	0%	0%	0%	0.44%
A4	0.430	0.00	0.430	ND	ND	46.1	0.00	0.00	0.00	$2.53x10^{-2}$
	0.66%	0%	0.66%			0%	0%	0%	0%	0.77%
A5	0.781	0.00	0.781	ND	ND	13.2	0.00	0.00	0.00	$3.35x10^{-2}$
	1.2%	0%	1.2%			0%	0%	0%	0%	1%
B1	0.00	0.00	0.00	ND	ND	0.00	0.00	0.00	0.00	0.00
B2	4.70	0.00	4.70	ND	ND	75.9	0.00	0.00	0.00	0.686
	7.2%	0%	7.2%			0%	0%	0%	0%	21%
B3	0.00	0.00	0.00	ND	ND	0.00	0.00	0.00	0.00	0.00
B4	40.5	0.00	40.5	ND	ND	691	0.00	0.00	0.00	1.73
	62%	0%	62%			0%	0%	0%	0%	53%
B5	0.00	0.00	0.00	ND	ND	0.00	0.00	0.00	0.00	0.00
B6	0.00	0.00	0.00	ND	ND	0.00	0.00	0.00	0.00	0.00
B7	0.00	0.00	0.00	ND	ND	0.00	0.00	0.00	0.00	0.00
C1	0.00	0.00	0.00	ND	ND	0.00	0.00	0.00	0.00	0.00
C2	0.134	0.00	0.134	ND	ND	34.0	0.00	0.00	0.00	$1.21x10^{-2}$
	0.2%	0%	0.2%			0%	0%	0%	0%	0.37%
C3	0.00	0.00	0.00	ND	ND	0.00	0.00	0.00	0.00	0.00
C4	0.155	0.00	0.155	ND	ND	3.77	0.00	0.00	0.00	$7.50x10^{-3}$
	0.24%	0%	0.24%			0%	0%	0%	0%	0.23%
D	0.00	0.00	0.00	ND	ND	0.00	0.00	0.00	0.00	0.00

Table 17 *Waste and outflows for the flooring products over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values.* ***(ESPC Engineered Stone Plastic Composite Core)***

Impact Category	Hazardous waste (kg)	Nonhazardous waste (kg)	Radioactive waste (kg)	Components for re-use (kg)	Materials for recycling (kg)	Materials for energy recovery (kg)	Exported energy (MJ)
Wastes & Outflows							
A1	$3.72x10^{-4}$	1.19	$1.74x10^{-4}$	0.00	0.00	0.00	0.00
	12%	2.5%	0%	0%	0%	0%	0%
A2	$5.17x10^{-5}$	0.389	$1.62x10^{-6}$	0.00	0.00	0.00	0.00
	1.7%	0.81%	0%	0%	0%	0%	0%
A3	$3.50x10^{-5}$	0.753	$4.03x10^{-6}$	0.00	0.00	0.00	0.00
	1.1%	1.6%	0%	0%	0%	0%	0%
A4	$2.56x10^{-4}$	0.960	$6.75x10^{-6}$	0.00	0.00	0.00	0.00
	8.3%	2%	0%	0%	0%	0%	0%
A5	$3.81x10^{-5}$	0.714	$7.72x10^{-6}$	0.00	0.218	0.00	0.00
	1.2%	1.5%	0%	0%	33%	0%	0%
B1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	$6.34x10^{-5}$	0.225	$1.19x10^{-4}$	0.00	0.00	0.00	0.00
	2.1%	0.47%	0%	0%	0%	0%	0%
B3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B4	$2.01x10^{-3}$	31.9	$4.00x10^{-4}$	0.00	0.435	0.00	0.00
	65%	66%	0%	0%	67%	0%	0%
B5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2	$2.31x10^{-4}$	0.172	$2.48x10^{-6}$	0.00	0.00	0.00	0.00
	7.5%	0.36%	0%	0%	0%	0%	0%
C3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C4	$2.24x10^{-5}$	11.8	$2.94x10^{-6}$	0.00	0.00	0.00	0.00
	0.73%	24%	0%	0%	0%	0%	0%
D	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 (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 use and maintenance (B2), product distribution (A4), product manufacture A3), and disposal (C4). Other life cycle phase contributions are minimal.

7. References

- Life Cycle Assessment of Life Cycle Assessment of Luxury Vinyl and Stone Polymer Composite Flooring. March 2024. Draft Report. Prepared for Kingdom Floors.
- Product Category Rule.PCR2019:14. Construction Products. International EPD® System. Version 1.3.2. December 2023.
- Complementary Product Category Rules (c-PCR) To PCR 2019:14. Resilient, Textile And Laminate Floor Coverings (EN 16810:2017). International EPD® System. Version 2019-12-20. December 2019.
- EN 15804:2012+A2:2019/AC:2021. Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products.
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and ISO procedures
- 14040: 2006 Environmental Management – Life cycle assessment – Principles and framework
- ISO 14044: 2006/AMD 1:2017/ AMD 2:2020 Environmental Management – Life cycle assessment – Requirements and Guidelines.
- CML 4.1 baseline, from Institute of Environmental Sciences Faculty of Science University of Leiden, Netherlands.
- Rosenbaum (2008). Rosenbaum, R.K., Bachmann, T.M., Gold, L.S. et al. USEtox - the UNEP-SETAC toxicity model: recommended characterisation factors for human toxicity and freshwater ecotoxicity in life cycle impact assessment. Int J Life Cycle Assess (2008) 13: 532. doi:10.1007/s11367-008-0038-4. USEtox version 2.02.
- ReCiPe Mid/Endpoint method, version 1.13 November 2016. https://sites.google.com/site/lciarecipe/characterisation-and-normalisation-factors
- Ecoinvent Centre (2022) Ecoinvent data from v3.9. Swiss Center for Life Cycle Inventories, Dubendorf, 2022, http://www.ecoinvent.org
- SCS Type III Environmental Declaration Program: Program Operator Manual. V12.0 November 2023. SCS Global Services
- European Commission. EU Construction & Demolition Waste Management Protocol. 2016. Available online: http://ec.europa.eu/growth/content/eu-construction-and-demolition-waste-protocol-0_en
- Eurostat, Recovery and recycling rates for packaging. 2015. http://ec.europa.eu/eurostat/web/environment/waste/main-tables

For more information, contact:

Zhejiang Kingdom New Material Group Co., Ltd.
No.38 Desheng Road, Heshan Town,
Tongxiang City, Zhejiang Province, China
www.kingdomflooring.com.cn | Sales@kingdomflooring.com.cn | + 0086-573-8938 3298

SCS Global Services
2000 Powell Street, Ste. 600, Emeryville, CA 94608 USA
Main +1.510.452.8000 | fax +1.510.452.8001