



Environmental Product Declaration

Jae Young Chemical Co., Ltd |
Dryback & Looselay Flooring



Declaration Owner

Jae Young Chemical Co., Ltd
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Products

Vinyl Tile Dryback (3mm)
Vinyl Tile Looselay (5mm)

EPD represents delivery of product to customers in the United States.

Functional Unit

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

EPD Number and Period of Validity

SCS-EPD-10675
EPD Valid August 25, 2026 through August 24, 2031

Product Category Rule

PCR for Building-Related Products and Services - Part A: LCA Calculation Rules and Report Requirements, UL 10010, UL v.4.0, March 2022

PCR Guidance for Building-Related Products and Services - Part B: Flooring EPD Requirements, UL 10010-7, v.2.0, valid until 30.09.2026.

Program Operator

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Declaration Owner:	Jae Young Chemical Co., Ltd																
Address:	41, Jiryegongdan-Gil, Jirye-Myeon, Gimcheon-Si, Korea, Republic of																
Declaration Number:	SCS-EPD-10675																
Declaration Validity Period:	August 25, 2026 through August 24, 2031																
Program Operator:	SCS Global Services																
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide																
LCA Practitioner:	Riley Tesman, SCS Consulting Services																
LCA Software and LCI database:	OpenLCA v2.5 software and the Ecoinvent v3.12 database																
Product RSL:	10 years																
Markets of Applicability:	United States																
EPD Type:	Product-Specific																
EPD Scope:	Cradle-to-Grave																
LCIA Method and Version:	TRACI 2.2 and IPCC 2021																
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external																
LCA Reviewer:	 Lindita Bushi, Ph.D., Athena Sustainable Materials Institute																
Part A Product Category Rule:	PCR for Building-Related Products and Services - Part A: LCA Calculation Rules and Report Requirements, UL 10010, UL v.4.0, March 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 - Flooring EPD Requirements, v.2.0, validity extended to September 30, 2026.																
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:	 Lindita Bushi, Ph.D., Athena Sustainable Materials Institute																
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Disclaimers: This EPD conforms to ISO 14025, 14040, 14044, and ISO 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. The owner of the declaration shall be liable for the underlying information and evidence; SCS shall not be liable with respect to manufacturer information, life cycle assessment data, and evidence supplied or made available to SCS.																	

1. Jae Young Chemical Co., Ltd

Jae Young Chemical Co., Ltd. strives to become a world premier business with cutting edge technology that is both for the people and the environment. Through a corporate culture that fosters creativity and innovation, Jae Young Chemical Co., Ltd seeks to realize its vision of creating technology that is not only beneficial to our customers but also environmentally-friendly as well. With the goal of becoming the world's leading brand of PVC Flooring, Jae Young Chemical Co., Ltd commenced production for the domestic market and has rapidly expanded its business overseas to the Middle East, Africa, Asia, North America, and Central America. Through constant technological development and improvement of the production process, Jae Young Chemical Co., Ltd has continued to supply a wide variety of flooring materials with different functional characteristics suited the needs of each our customers including Eco-Leum (Vinyl Foamed Flooring), Rigid Flooring, Ultralong, Venice Premium and Coin Mat. From the beginning of product development in 1980s, Jae Young Chemical Co., Ltd has opened up eco-friendly products, becoming the first mover of innovation in Korean flooring industry about 30 years.

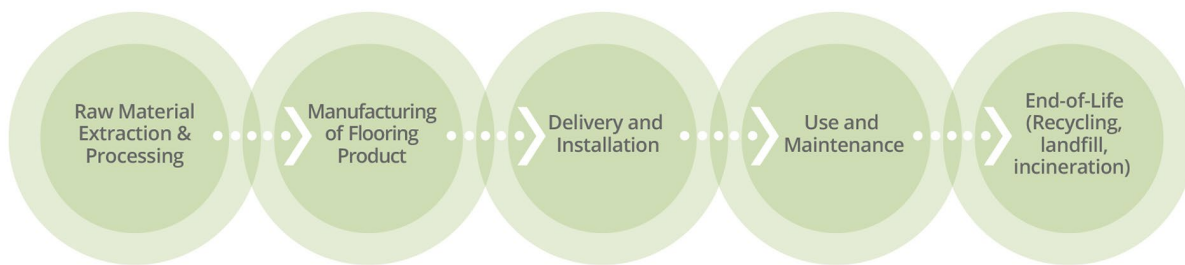
2. Product

2.1 PRODUCT DESCRIPTION

As a floor covering materials, we supply resilient vinyl flooring tile with various wood designs such as modern, natural, vintage and antique as well as other designs of concrete, fabric, marble and slate. Our products have features such as easy cleaning maintenance, anti-slip, water resistance and anti-scratch function by polyurethane (PU) & ceramic coating treatment on product surfaces. Also, the products can be made with various designs and tile sizes upon customer's request. It is very easy to clean and maintain; even marker stains on tile surface are easily removed.

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 LVT flooring products provide the primary function of flooring for interior applications. The 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.

Table 1. Life cycle phases included in the Jae Young Chemical Co., Ltd resilient flooring product system boundary.

Product			Construction Process		Use							End-of-life				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B1	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 = Module Included | MND = Module Not Declared

Cut-off and allocation procedures are described below and conform to the PCR and ISO standards.

2.5 TECHNICAL DATA

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

Table 2. Product characteristics for the Jflor 3mm Dryback flooring products.

Characteristic			Description			
Sustainable certifications			ISO 9001; ISO 14001			
VOC emissions test method			FloorScore®			
Characteristic			Nominal Value	Unit	Min Value	Max Value
Product thickness			3.00 (0.118)	mm (inch)	2.85 (0.112)	3.15 (0.124)
Wear layer thickness (where applicable)			0.500 (0.019)	mm (inch)	0.490 (0.019)	0.510 (0.020)
Product weight			5,000 (16.4)	g/m ² (oz/ft ²)	5,000 (16.4)	5,000 (16.4)
Product Form	Tiles	Width	178 (7.00)	mm (inch)	178 (6.99)	178 (7.01)
		Length	1,220 (48.0)	mm (inch)	1,220 (48.0)	1,220 (48.0)
Product Form	Tiles	Width	229 (9.00)	mm (inch)	228 (8.99)	229 (9.01)
		Length	1,220 (48.0)	mm (inch)	1,220 (48.0)	1,220 (48.0)

Table 3. Product characteristics for the Jae Young Chemical Co., Ltd 5mm Looselay flooring products.

Characteristic			Description			
Sustainable certifications			ISO 9001; ISO 14001			
VOC emissions test method			FloorScore®			
Characteristic			Nominal Value	Unit	Min Value	Max Value
Product thickness			5.00 (0.197)	mm (inch)	4.85 (0.191)	5.15 (0.203)
Wear layer thickness (where applicable)			0.500 (0.019)	mm (inch)	0.490 (0.019)	0.510 (0.020)
Product weight			8,400 (27.5)	g/m ² (oz/ft ²)	8,400 (27.5)	8,400 (27.5)
Product Form	Tiles	Width	178 (7.00)	mm (inch)	178 (6.99)	178 (7.01)
		Length	1,220 (48.0)	mm (inch)	1,220 (48.0)	1,220 (48.0)
Product Form	Tiles	Width	229 (9.00)	mm (inch)	228 (8.99)	229 (9.01)
		Length	1,220 (48.0)	mm (inch)	1,220 (48.0)	1,220 (48.0)

2.6 MARKET PLACEMENT/APPLICATION RULES

Technical specifications and product performance results for the LVT products can be found on the manufacturer's website: <http://www.jflor.co.kr/>

2.7 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

The products are delivered for installation in the form of tiles.

2.8 MATERIAL COMPOSITION

The product system studied in this LCA includes the cradle-to-grave impacts of the flooring products described above. The flooring is made primarily of polyvinyl chloride (PVC), calcium carbonate filler, plasticizer (DOTP), and various coatings. Although style and color options may vary across the products assessed, the impact of the different options and coatings on the estimated impact indicators is expected to be less than $\pm 10\%$. The reference flow for the product system is defined as 1 m² of product, excluding packaging.

Table 4 summarizes the components by weight and material for the products. Also presented are the material components as a percentage of total mass.

Table 4. Material content for the Dryback Flooring (3mm) & Looselay Flooring (5mm) products in kg per square meter and percent of total mass.

Component	Vinyl Tile Dryback (3mm)	Vinyl Tile Looselay (5mm)
Calcium Carbonate	2.48	3.61
	50%	43%
PVC	5.18×10^{-5}	8.25×10^{-5}
	0.001%	0.00098%
Stabilizer	0.625	0.815
	13%	9.7%
Pigment	1.23	2.02
	25%	24%
Plasticizer	3.81×10^{-2}	7.68×10^{-2}
	0.76%	0.91%
UV Coating	1.50×10^{-2}	1.70×10^{-2}
	0.3%	0.2%
Regrind	0.610	1.46
	12%	17%
Glses Fiber	0.00	0.400
	0%	4.8%
Print Film	1.76×10^{-3}	2.13×10^{-3}
	0.035%	0.025%
Ink	1.34×10^{-4}	2.13×10^{-4}
	0.0027%	0.0025%
Total Product	4.99	8.40
	100%	100%

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

2.9 MANUFACTURING

The flooring products are manufactured at two Jae Young Chemical Co., Ltd production facilities in South Korea (referred to herein as Facility 1 and Facility 2). The manufacturer provided primary data for annual production, resource use, electricity consumption, and waste generation at each facility separately. Electricity consumption is modeled using Ecoinvent v3.12

datasets for the South Korean grid. No green power sources or CO2 certificates are included. Scrap waste generated during product manufacture is re-ground and used as material input for subsequent production. Disposal of general manufacturing wastes via landfilling is accounted for in the manufacturing stage. Per-facility primary data are reported separately in this EPD; no production-weighted averaging across facilities is performed.

Jae Young Chemical Co., Ltd vinyl tile flooring is manufactured in South Korea. The vinyl flooring is made primarily from polyvinyl chloride (PVC), calcium carbonate (mineral reinforcement), plasticizers and additives (i.e., pigments and stabilizers). The product is structured with multiple layers including PVC backing, a PVC wear layer and a UV protective layer.

The production of vinyl tile flooring involves the following general manufacturing processes:

- Polyvinyl chloride resins are mixed with calcium carbonate, plasticizers, and pigments in a large industrial mixer.
- The core is extruded to a dough-like consistency. The dough-like substance is then put through calender rollers and squeezed into sheets.
- The LVT sheets are embossed, adhered to the core and then cut into individual planks and tile, profiled, and then packaged for shipment.

2.10 PACKAGING

The products are packaged for shipment using cardboard cartons, plastic wrap and wooden pallets.

Table 5. Material content for the Dryback Flooring (3mm) & Looselay Flooring (5mm) flooring product packaging, in kg per square meter and percent of total mass.

Component	Vinyl Tile Dryback (3mm)	Vinyl Tile Looselay (5mm)
Corrugate	0.163	0.163
	13%	13%
LDPE	0.220	0.220
	18%	18%
Wood	0.185	0.185
	15%	15%
Plywood	0.642	0.642
	53%	53%
Adhesive	3.00x10 ⁻³	3.00x10 ⁻³
	0.25%	0.25%
Total Packaging	1.21	1.21
	100%	100%

2.11 PRODUCT INSTALLATION

Installation of the product is accomplished using hand tools with negligible impacts and waste. 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 PRODUCT REFERENCE SERVICE LIFE AND BUILDING ESTIMATED SERVICE LIFE

The Reference Service Life (RSL) of the flooring products is 10 years based on the manufacturer's warranted lifetime. The building Estimated Service Life (ESL) is 75 years, consistent with the PCR.

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 assumed to be disposed of in a landfill. Although in some instances, the flooring can be recycled into other products, the practice is not typical, nor widely available as a disposal route for the products in the consumer markets considered. It is assumed that no components of the product are recycled at end-of-life.

2.16 FURTHER INFORMATION

Further information on the product can be found on the manufacturers' website at www.jflor.co.kr

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 product in Table 6.

Table 6. Reference flows and RSL for the resilient flooring product.

Product	Reference Flow (kg/m ²)	Reference Service Lifetime (yr)	Replacement Cycle	Total # of Life Cycles
Vinyl Tile Dryback (3mm)	6.20	10	6.5	7.5
Vinyl Tile Looselay (5mm)	9.61	10	6.5	7.5

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 Jae Young Chemical Co., Ltd flooring products.*

Module	Module Description	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 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 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 landfilling which requires no waste processing
C4	Disposal	Disposal of the product
D	Reuse-recovery-recycling potential	Module not declared

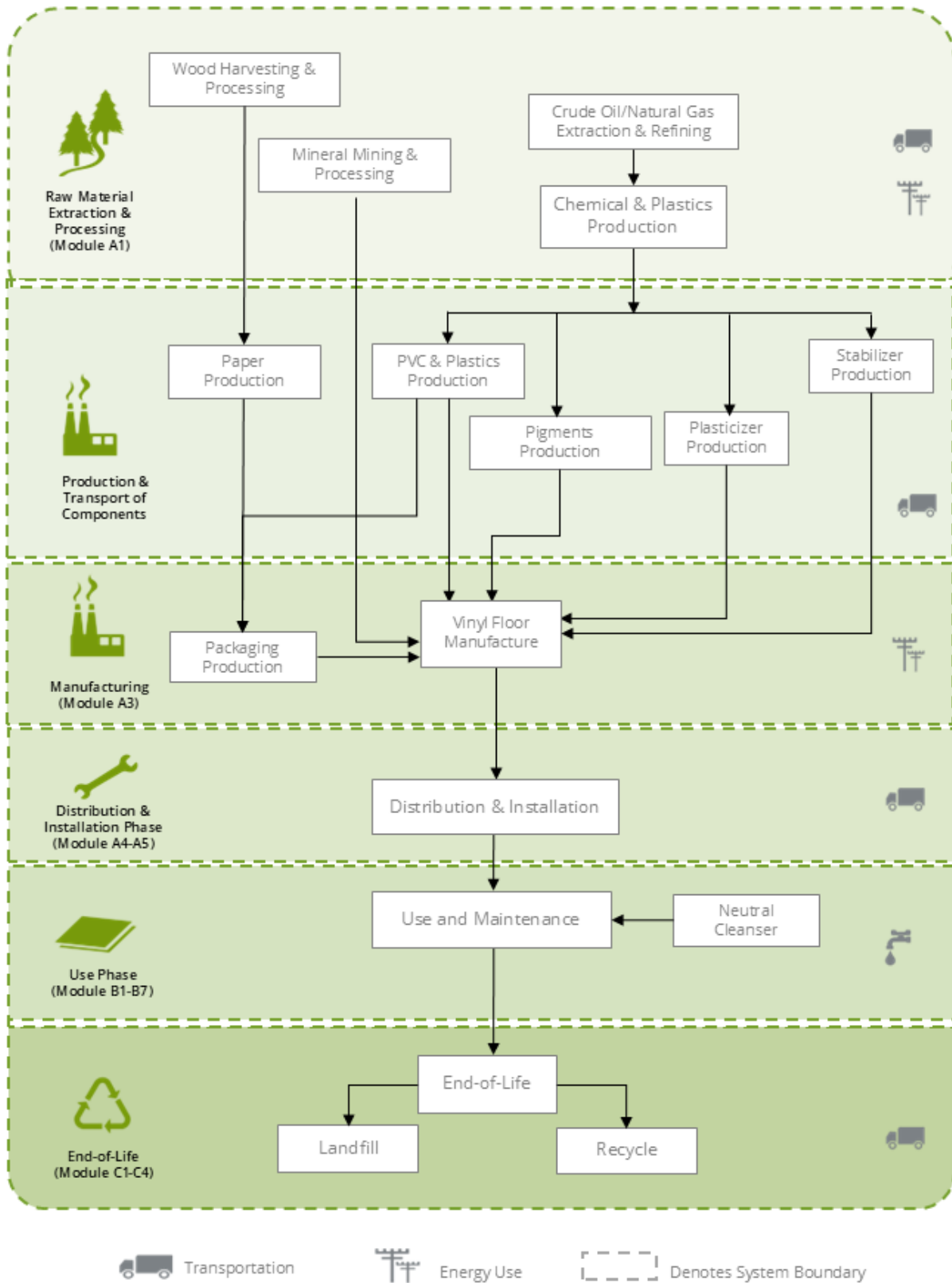


Figure 1. Flow Diagram for the life cycle of the Jae Young Chemical Co., Ltd floor resilient flooring product system.

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 facilities was allocated to the products based on the product surface area as a fraction of the total production.
- The manufacturing facilities under review are located in South Korea. An Ecoinvent inventory dataset for the regional electricity energy grid was used to model resource use and emissions from electricity use at the manufacturing facility.
- Life cycle inventory data for the plasticizer, dioctyl terephthalate (DOTP), were not available. Inventory data developed for diisooheptyl phthalate (DIHP) was used as a surrogate to represent DOTP in the LCA model.
- 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 transport for US 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 20 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 considering 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 by the manufacturer for their production facility. The sources of secondary LCI data are the Ecoinvent database.

Table 8. Data sources for the Jae Young Chemical Co., Ltd flooring product system.

Component	Dataset	Data Source	Publication Date
PRODUCT			
PVC			
Polyvinyl Chloride	market for polyvinyl chloride, unspecified polymerisation, weighted average polyvinyl chloride, unspecified polymerisation, weighted average Cutoff, S/RoW	EI v3.12	2025

Component	Dataset	Data Source	Publication Date
Filler			
Calcium Carbonate	limestone production, crushed, washed limestone, crushed, washed Cutoff, S/RoW	EI v3.12	2025
Plasticizer			
PVC Plasticizer	dioctyl terephthalate production dioctyl terephthalate Cutoff, S/GLO	EI v3.12	2025
Stabilizer			
Stabilizer	Ca-Zn stabilizer;	EI v3.12	2025
	chemical production, organic chemical, organic Cutoff, S/GLO	EI v3.12	2025
	chemical production, inorganic chemical, inorganic Cutoff, S/GLO	EI v3.12	2025
	limestone production, crushed, washed limestone, crushed, washed Cutoff, S/RoW	EI v3.12	2025
	zinc oxide production zinc oxide Cutoff, S/RoW	EI v3.12	2025
Pigment			
Titanium Dioxide	market for titanium dioxide titanium dioxide Cutoff, S/RoW	EI v3.12	2025
Ink			
Methyl Ethyl Ketone	methyl ethyl ketone production methyl ethyl ketone Cutoff, S/RoW	EI v3.12	2025
Plastics			
IXPE	polyethylene production, low density, granulate polyethylene, low density, granulate Cutoff, S/RoW	EI v3.12	2025
	ethylene vinyl acetate copolymer production ethylene vinyl acetate copolymer Cutoff, S/RoW	EI v3.12	2025
	chemical production, inorganic chemical, inorganic Cutoff, S/GLO	EI v3.12	2025
	zinc oxide production zinc oxide Cutoff, S/RoW	EI v3.12	2025
Other			
Coating	market for polyurethane, flexible foam polyurethane, flexible foam Cutoff, S/RoW	EI v3.12	2025
	chemical production, inorganic chemical, inorganic Cutoff, S/GLO	EI v3.12	2025
	chemical production, organic chemical, organic Cutoff, S/GLO	EI v3.12	2025
Adhesive			
Holt Melt	Hot Melt LCI	EI v3.12, LCI	2025
PACKAGING			
Cardboard	corrugated board box production corrugated board box Cutoff, S/RoW	EI v3.12	2025
Wood	EUR-flat pallet production EUR-flat pallet Cutoff, S/RoW	EI v3.12	2025
Plastic	packaging film production, low density polyethylene packaging film, low density polyethylene Cutoff, S/RoW;	EI v3.12	2025
	polyethylene terephthalate production, granulate, amorphous polyethylene terephthalate, granulate, amorphous Cutoff, S/RoW	EI v3.12	2025
TRANSPORT			
Road transport	transport, freight, lorry 16-32 metric ton, EURO4 transport, freight, lorry 16-32 metric ton, EURO4 Cutoff, S/RoW	EI v3.12	2025
Ship transport	transport, freight, sea, container ship transport, freight, sea, container ship Cutoff, S/GLO	EI v3.12	2025
RESOURCES			
Grid electricity	market for electricity, medium voltage electricity, medium voltage Cutoff, S/KR	EI v3.12	2025
Heat – natural gas	market for heat, central or small-scale, natural gas heat, central or small-scale, natural gas Cutoff, S/RoW	EI v3.12	2025
Heat – Propane	heat production, propane, at industrial furnace >100kW heat, district or industrial, other than natural gas Cutoff, S/RoW	EI v3.12	2025
Water	tap water production, conventional treatment tap water Cutoff, S/RoW	EI v3.12	2025
MAINTENANCE			
Neutral cleaner			
Ethoxylated Alcohol	ethoxylated alcohol (AE7) production, petrochemical ethoxylated alcohol (AE7) Cutoff, S/RoW	EI v3.12	2025
Fatty Acid	fatty acid production, from palm oil fatty acid Cutoff, S/RoW	EI v3.12	2025
Water	market group for tap water tap water Cutoff, S/GLO	EI v3.12	2025
Grid electricity	market group for electricity, low voltage electricity, low voltage Cutoff, S/RNA	EI v3.12	2025
WASTE			
Landfill	treatment of inert waste, inert material landfill inert waste, for final disposal Cutoff, U	EI v3.12	2025
Wastewater	treatment of wastewater, average, wastewater treatment wastewater, average Cutoff, S/RoW	EI v3.12	2025

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 Jae Young Chemical Co., Ltd 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 2025.
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 South Korea. 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 v3.12 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 v3.12 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 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 is calendar year 2025.

3.10 ALLOCATION

Resource use at the production facilities (e.g., water and energy) was allocated to the product based on the product area as a fraction of the total facility production volume (i.e., area-based allocation). Area-based allocation was deemed most appropriate for the flooring products as total facility production was available as total square meters of product produced. Based on the location, electricity use at the manufacturing facilities was modeled using inventory datasets representative of the energy mix for South Korea, as appropriate.

Impacts from transportation 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 product distribution are summarized in Table 10. Average distances by transport mode were used to represent product distribution to each consumer market.

Table 10. Product distribution parameters, per 1 m².

Parameter	Unit	Value	
Ground transport			
Fuel type	-	Diesel	
Liters of fuel	L/100km	18.7	
Vehicle type	-	Diesel truck	
Capacity utilization	%	76	
Ocean transport			
Fuel type	-	Fuel oil	
Liters of fuel	g/tkm	2.52	
Vehicle type	-	Ocean freighter	
Capacity utilization	%	70	
Product Name	Gross mass transported (kg)	Transport Distance (km)	
		Road	Ship
Dryback Flooring - 3mm (Facility 1)	6.20	1,022	9,650
Looselay Flooring - 5mm (Facility 1)	9.61	1,022	9,650
Dryback Flooring - 3mm (Facility 2)	6.20	1,022	9,650
Looselay Flooring - 5mm (Facility 2)	9.61	1,022	9,650

Installation of the product and periodic cleaning are included in the life cycle use phase. The manufacturer provided installation and maintenance guidelines detailing the recommended installation method and maintenance routine. For the current assessment, approximately 4% of the product mass is assumed lost as waste during product installation which is

assumed landfilled. Impacts associated with the production, transport, waste processing, and disposal of installation wastage are included in this life cycle phase. 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. The relevant disposal statistics used for the packaging are summarized in Table 11. For materials not recycled, 80% are assumed landfilled and 20% incinerated. Modeling parameters for installation are summarized in Table 12.

Table 11. *Recycling rates for packaging materials at end-of-life.*

Material	Recycling rate (%)
Recycling Rates	
Paper & Pulp	75%
Wood	0%
Plastics	15%
Disposal of Non-recyclables	
Landfill	80%
Incineration	20%

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

Parameter		Dryback Flooring (3mm)	Looselay Flooring (5mm)
Ancillary materials – adhesive (kg)		0.00	0.00
Net freshwater consumption (m ³)		0.00	0.00
Electricity consumption (kWh)		0.00	0.00
Product loss per functional unit (kg)		0.200	0.336
Waste materials generated by product installation (kg)		1.410	1.576
Output materials resulting from on-site waste processing (kg)		n/a	n/a
Mass of packaging waste (kg)	Plastic	0.220	0.220
	Corrugate	0.163	0.163
	Wood	0.827	0.827
Biogenic carbon contained in packaging (kg CO ₂) ¹		1.81	1.81
Direct emissions (kg)		0.00	0.00

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

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

Parameter	Unit	Dryback Flooring (3mm)	Looselay Flooring (5mm)
Maintenance cycle	Cycles / RSL	520	520
Maintenance cycle	Cycles / ESL	3,900	3,900
Maintenance process	-	Damp mopping	Damp mopping
Net freshwater consumption	m ³ /m ² /yr	0.0058	0.0058
Cleaning agent	kg/m ² /yr	0.119	0.119
Maintenance process	-	Machine cleaning	Machine cleaning
Maintenance cycle	Cycles / RSL	360	360
Maintenance cycle	Cycles / ESL	900	900
Electricity	kWh/m ² /yr	0.022	0.022
Further assumptions	-	Moderate traffic; weekly maintenance	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 14. Impacts associated with production, transport, waste processing, and disposal of all materials required for the replacement of the product over the 75-year assessment period are included in this life cycle phase.

Table 14. Product replacement parameters for the flooring products, per 1 m².

Parameter	Unit	Dryback Flooring (3mm)	Looselay Flooring (5mm)
Reference service life	Years	10	10
Replacement cycle	-	6.5	6.5
Energy input	kWh	0	0
Freshwater consumption	m ³	0	0
Ancillary materials	kg	Negligible	Negligible
Replacement parts	kg	40.3	62.5
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 removal 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 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 100 mile (~161 km) average distance to disposal, consistent with the PCR. No recycling of the product materials is assumed at end-of-life. The relevant disposal parameters are summarized in Table 15.

Table 15. End-of-life disposal scenario parameters for the flooring products, per 1 m².

Parameter	Dryback Flooring (3mm)	Looselay Flooring (5mm)
Assumptions for scenario development	100% landfill	100% landfill
Collection process	-	-
Collected with mixed construction waste (kg)	4.99	8.40
Recovery	n/a	n/a
Disposal	Landfill (kg)	
	4.99	8.40
Removals of biogenic carbon (kg CO ₂ eq) ¹	n/a	n/a

¹ Excluding packaging

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.

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 2.2. Note that the Global warming results are based on the IPCC 2021 (AR6) characterization factors. All other impact categories use TRACI 2.2.

TRACI 2.2 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 – freshwater (EP_fw)	kg P eq
Eutrophication Potential – marine (EP_marine)	kg N eq
Smog Formation Potential (SFP)	kg O ₃ eq
IPCC 2021 Impact Category	Unit
Global Warming Potential (GWP)	kg CO ₂ eq

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	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	ADPF : Abiotic depletion potential for fossil resources	MJ, LHV

Modules B1, B3, B5, B6, and B7 are not associated with any impact and are therefore declared as zero. In addition, modules C1 and C3 are likewise not associated with any impact as the products are expected to be manually deconstructed. Additionally, as the flooring products do not 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 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. (Dryback Flooring - 3mm – Facility 1)

Impact Category	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
TRACI										
Global warming potential	kg CO ₂ eq	6.67	0.231	5.06	1.85	0.858	6.16	96.5	0.150	3.04x10 ⁻²
	%	5.7%	0.2%	4.3%	1.6%	0.73%	5.2%	82%	0.13%	0.026%
Ozone depletion potential	kg CFC-11 eq	7.04x10 ⁻⁶	3.36x10 ⁻⁹	7.89x10 ⁻⁸	2.71x10 ⁻⁸	2.86x10 ⁻⁷	7.38x10 ⁻⁸	4.84x10 ⁻⁵	3.51x10 ⁻⁹	9.58x10 ⁻¹⁰
	%	13%	0.006%	0.14%	0.049%	0.51%	0.13%	87%	0.0063%	0.0017%
Acidification potential	kg SO ₂ eq	2.27x10 ⁻²	8.98x10 ⁻⁴	1.88x10 ⁻²	2.00x10 ⁻²	2.63x10 ⁻³	2.10x10 ⁻²	0.428	5.56x10 ⁻⁴	1.96x10 ⁻⁴
	%	4.4%	0.17%	3.6%	3.9%	0.51%	4.1%	83%	0.11%	0.038%
Eutrophication potential: freshwater	kg P eq	1.57x10 ⁻³	2.41x10 ⁻⁵	2.18x10 ⁻³	1.50x10 ⁻⁴	1.77x10 ⁻⁴	1.48x10 ⁻³	2.68x10 ⁻²	9.83x10 ⁻⁶	2.59x10 ⁻⁶
	%	4.9%	0.074%	6.7%	0.46%	0.55%	4.6%	83%	0.03%	0.008%
Eutrophication potential: marine	kg N eq	1.21x10 ⁻²	9.08x10 ⁻⁴	1.50x10 ⁻²	1.65x10 ⁻²	2.12x10 ⁻³	1.52x10 ⁻²	0.308	6.00x10 ⁻⁴	2.20x10 ⁻⁴
	%	3.3%	0.24%	4%	4.5%	0.57%	4.1%	83%	0.16%	0.059%
Smog formation potential	kg O ₃ eq	0.313	2.22x10 ⁻²	0.360	0.403	4.74x10 ⁻²	0.233	7.58	1.47x10 ⁻²	5.37x10 ⁻³
	%	3.5%	0.25%	4%	4.5%	0.53%	2.6%	84%	0.16%	0.06%
IPCC 2021										
Global warming potential	kg CO ₂ eq	6.81	0.234	5.14	1.87	0.902	6.23	98.4	0.152	3.13x10 ⁻²
	%	5.7%	0.2%	4.3%	1.6%	0.75%	5.2%	82%	0.13%	0.026%

Table 17. Resource use 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. (Dryback Flooring - 3mm – Facility 1)

Parameter	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
Resources										
Use of renewable primary energy resources used as energy carrier (PERE)	MJ	4.72	4.53x10 ⁻²	21.2	0.301	1.06	67.6	178	3.53x10 ⁻²	7.11x10 ⁻³
	%	1.7%	0.017%	7.8%	0.11%	0.39%	25%	65%	0.013%	0.0026%
Use of renewable primary energy resources used as raw materials (PERM)	MJ	0.00	0.00	17.8	0.00	0.712	0.00	120	0.00	0.00
	%	0%	0%	13%	0%	0.51%	0%	87%	0%	0%
Total use of renewable primary energy resources (PERT)	MJ	4.72	4.53x10 ⁻²	39.0	0.301	1.77	67.6	298	3.53x10 ⁻²	7.11x10 ⁻³
	%	1.1%	0.011%	9.5%	0.073%	0.43%	16%	72%	0.0086%	0.0017%
Use of nonrenewable primary energy resources used as energy carrier (PENRE)	MJ	113	3.24	79.9	24.9	10.1	85.6	1,520	2.15	0.757
	%	6.1%	0.18%	4.3%	1.4%	0.55%	4.7%	83%	0.12%	0.041%
Use of nonrenewable primary energy resources used as raw materials (PENRM)	MJ	23.3	0.00	8.15	0.00	0.326	0.00	206	0.00	0.00
	%	9.8%	0%	3.4%	0%	0.14%	0%	87%	0%	0%
Total use of nonrenewable primary energy resources (PENRT)	MJ	136	3.24	88.0	24.9	10.4	85.6	1,720	2.15	0.757
	%	6.5%	0.16%	4.2%	1.2%	0.5%	4.1%	83%	0.1%	0.036%
Use of secondary materials (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%
Use of renewable secondary fuels (RSF)	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%
Use of nonrenewable secondary fuels (NRSF)	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%
Recovered energy (RE)	m ³	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%
Abiotic depletion potential for fossil resources	MJ	134	3.22	71.2	24.7	9.62	78.4	1,600	2.12	0.750
	%	7%	0.17%	3.7%	1.3%	0.5%	4.1%	83%	0.11%	0.039%
Use of net fresh water (FW)	m ³	8.00x10 ⁻²	4.45x10 ⁻⁴	4.21x10 ⁻²	2.89x10 ⁻³	6.24x10 ⁻⁴	0.521	0.827	2.62x10 ⁻⁴	7.88x10 ⁻⁴
	%	5.4%	0.03%	2.9%	0.2%	0.042%	35%	56%	0.018%	0.053%

Table 18. Waste and outflows 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. (Dryback Flooring - 3mm – Facility 1)

Parameter	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
Wastes										
Hazardous waste disposed (HWD)	kg	0.286	5.47x10 ⁻³	0.215	3.75x10 ⁻²	2.41x10 ⁻²	0.424	3.72	2.20x10 ⁻³	2.48x10 ⁻³
	%	6.1%	0.12%	4.6%	0.79%	0.51%	9%	79%	0.047%	0.053%
Nonhazardous waste disposed (NHWD)	kg	6.08	3.15x10 ⁻²	4.14	0.226	5.55	8.62	137	2.35x10 ⁻²	5.01
	%	3.6%	0.019%	2.5%	0.14%	3.3%	5.2%	82%	0.014%	3%
High-level radioactive waste (HLRWD)	kg	2.04x10 ⁻⁵	1.88x10 ⁻⁷	1.02x10 ⁻⁴	1.25x10 ⁻⁶	4.99x10 ⁻⁶	3.18x10 ⁻⁵	8.40x10 ⁻⁴	1.57x10 ⁻⁷	0.00
	%	2%	0.019%	10%	0.12%	0.5%	3.2%	84%	0.016%	0%
Low-level Radioactive waste (ILLRWD)	kg	5.03x10 ⁻⁵	4.54x10 ⁻⁷	1.77x10 ⁻⁴	3.00x10 ⁻⁶	9.33x10 ⁻⁶	7.19x10 ⁻⁵	1.57x10 ⁻³	4.80x10 ⁻⁷	0.00
	%	2.7%	0.024%	9.4%	0.16%	0.5%	3.8%	83%	0.026%	0%
Components for re-use (CRU)	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%
Materials for recycling (MFR)	kg	0.00	0.00	0.00	0.00	0.108	0.00	0.699	0.00	0.00
	%	0%	0%	0%	0%	13%	0%	87%	0%	0%
Materials for energy recovery (MER)	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%
Exported electrical energy (EEE)	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%
Exported thermal energy (EET)	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%

Table 19. 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. (Looselay Flooring - 5mm – Facility 1)

Impact Category	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
TRACI										
Global warming potential	kg CO ₂ eq	11.7	0.381	5.21	1.79	1.06	6.16	132	0.144	2.92x10 ⁻²
	%	7.4%	0.24%	3.3%	1.1%	0.67%	3.9%	83%	0.091%	0.018%
Ozone depletion potential	kg CFC-11 eq	1.04x10 ⁻⁵	5.55x10 ⁻⁹	8.15x10 ⁻⁸	2.63x10 ⁻⁸	4.20x10 ⁻⁷	7.38x10 ⁻⁸	7.09x10 ⁻⁵	3.37x10 ⁻⁹	9.20x10 ⁻¹⁰
	%	13%	0.0068%	0.1%	0.032%	0.51%	0.09%	87%	0.0041%	0.0011%
Acidification potential	kg SO ₂ eq	4.37x10 ⁻²	1.48x10 ⁻³	1.95x10 ⁻²	1.94x10 ⁻²	3.49x10 ⁻³	2.10x10 ⁻²	0.573	5.33x10 ⁻⁴	1.88x10 ⁻⁴
	%	6.4%	0.22%	2.9%	2.8%	0.51%	3.1%	84%	0.078%	0.028%
Eutrophication potential: freshwater	kg P eq	2.87x10 ⁻³	3.97x10 ⁻⁵	2.20x10 ⁻³	1.45x10 ⁻⁴	2.30x10 ⁻⁴	1.48x10 ⁻³	3.57x10 ⁻²	9.44x10 ⁻⁶	2.49x10 ⁻⁶
	%	6.7%	0.093%	5.2%	0.34%	0.54%	3.5%	84%	0.022%	0.0058%
Eutrophication potential: marine	kg N eq	2.38x10 ⁻²	1.50x10 ⁻³	1.57x10 ⁻²	1.60x10 ⁻²	2.61x10 ⁻³	1.52x10 ⁻²	0.392	5.76x10 ⁻⁴	2.11x10 ⁻⁴
	%	5.1%	0.32%	3.3%	3.4%	0.56%	3.2%	84%	0.12%	0.045%
Smog formation potential	kg O ₃ eq	0.605	3.67x10 ⁻²	0.377	0.390	5.98x10 ⁻²	0.233	9.67	1.41x10 ⁻²	5.16x10 ⁻³
	%	5.3%	0.32%	3.3%	3.4%	0.53%	2%	85%	0.12%	0.045%
IPCC 2021										
Global warming potential	kg CO ₂ eq	11.9	0.387	5.29	1.81	1.11	6.23	134	0.146	3.00x10 ⁻²
	%	7.4%	0.24%	3.3%	1.1%	0.69%	3.9%	83%	0.09%	0.019%

Table 20. Resource use 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. (Looselay Flooring - 5mm – Facility 1)

Parameter	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
Resources										
Use of renewable primary energy resources used as energy carrier (PERE)	MJ	8.71	7.48x10 ⁻²	21.3	0.291	1.22	67.6	205	3.39x10 ⁻²	6.82x10 ⁻³
	%	2.9%	0.025%	7%	0.096%	0.4%	22%	67%	0.011%	0.0022%
Use of renewable primary energy resources used as raw materials (PERM)	MJ	0.00	0.00	17.8	0.00	0.712	0.00	120	0.00	0.00
	%	0%	0%	13%	0%	0.51%	0%	87%	0%	0%
Total use of renewable primary energy resources (PERT)	MJ	8.71	7.48x10 ⁻²	39.1	0.291	1.93	67.6	326	3.39x10 ⁻²	6.82x10 ⁻³
	%	2%	0.017%	8.8%	0.066%	0.44%	15%	73%	0.0076%	0.0015%
Use of nonrenewable primary energy resources used as energy carrier (PENRE)	MJ	189	5.35	82.5	24.1	13.9	85.6	2,060	2.06	0.727
	%	7.7%	0.22%	3.3%	0.98%	0.56%	3.5%	84%	0.084%	0.029%
Use of nonrenewable primary energy resources used as raw materials (PENRM)	MJ	38.4	0.00	8.15	0.00	0.326	0.00	305	0.00	0.00
	%	11%	0%	2.3%	0%	0.093%	0%	87%	0%	0%
Total use of nonrenewable primary energy resources (PENRT)	MJ	227	5.35	90.6	24.1	14.2	85.6	2,370	2.06	0.727
	%	8.1%	0.19%	3.2%	0.85%	0.5%	3%	84%	0.073%	0.026%
Use of secondary materials (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%
Use of renewable secondary fuels (RSF)	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%
Use of nonrenewable secondary fuels (NRSF)	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%
Recovered energy (RE)	m ³	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%
Abiotic depletion potential for fossil resources	MJ	223	5.32	73.8	23.9	13.3	78.4	2,220	2.04	0.720
	%	8.4%	0.2%	2.8%	0.91%	0.5%	3%	84%	0.077%	0.027%
Use of net fresh water (FW)	m ³	0.140	7.36x10 ⁻⁴	4.27x10 ⁻²	2.80x10 ⁻³	3.08x10 ⁻³	0.521	1.24	2.51x10 ⁻⁴	7.56x10 ⁻⁴
	%	7.2%	0.038%	2.2%	0.14%	0.16%	27%	64%	0.013%	0.039%

Table 21. Waste and outflows 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. (Looselay Flooring - 5mm – Facility 1)

Parameter	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
Wastes										
Hazardous waste disposed (HWD)	kg	0.511	9.04x10 ⁻³	0.220	3.63x10 ⁻²	3.34x10 ⁻²	0.424	5.29	2.12x10 ⁻³	2.38x10 ⁻³
	%	7.8%	0.14%	3.4%	0.56%	0.51%	6.5%	81%	0.032%	0.036%
Nonhazardous waste disposed (NHWD)	kg	10.8	5.20x10 ⁻²	4.00	0.219	5.71	8.62	167	2.26x10 ⁻²	4.81
	%	5.4%	0.026%	2%	0.11%	2.8%	4.3%	83%	0.011%	2.4%
High-level radioactive waste (HLRWD)	kg	3.77x10 ⁻⁵	3.11x10 ⁻⁷	1.02x10 ⁻⁴	1.21x10 ⁻⁶	5.69x10 ⁻⁶	3.18x10 ⁻⁵	9.58x10 ⁻⁴	1.51x10 ⁻⁷	0.00
	%	3.3%	0.027%	9%	0.11%	0.5%	2.8%	84%	0.013%	0%
Low-level Radioactive waste (ILLRWD)	kg	9.14x10 ⁻⁵	7.50x10 ⁻⁷	1.78x10 ⁻⁴	2.90x10 ⁻⁶	1.10x10 ⁻⁵	7.19x10 ⁻⁵	1.85x10 ⁻³	4.61x10 ⁻⁷	0.00
	%	4.1%	0.034%	8.1%	0.13%	0.5%	3.3%	84%	0.021%	0%
Components for re-use (CRU)	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%
Materials for recycling (MFR)	kg	0.00	0.00	0.00	0.00	0.108	0.00	0.699	0.00	0.00
	%	0%	0%	0%	0%	13%	0%	87%	0%	0%
Materials for energy recovery (MER)	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%
Exported electrical energy (EEE)	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%
Exported thermal energy (EET)	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%

Table 22. 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. (Dryback Flooring - 3mm – Facility 2)

Impact Category	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
TRACI										
Global warming potential	kg CO ₂ eq	6.66	0.231	4.65	1.10	0.766	6.16	87.8	7.54x10 ⁻²	1.53x10 ⁻²
	%	6.2%	0.21%	4.3%	1%	0.71%	5.7%	82%	0.07%	0.014%
Ozone depletion potential	kg CFC-11 eq	7.04x10 ⁻⁶	3.36x10 ⁻⁹	7.33x10 ⁻⁸	1.62x10 ⁻⁸	2.86x10 ⁻⁷	7.38x10 ⁻⁸	4.82x10 ⁻⁵	1.77x10 ⁻⁹	4.83x10 ⁻¹⁰
	%	13%	0.006%	0.13%	0.029%	0.51%	0.13%	87%	0.0032%	0.00087%
Acidification potential	kg SO ₂ eq	2.26x10 ⁻²	8.98x10 ⁻⁴	1.85x10 ⁻²	1.20x10 ⁻²	2.27x10 ⁻³	2.10x10 ⁻²	0.368	2.80x10 ⁻⁴	9.88x10 ⁻⁵
	%	5.1%	0.2%	4.2%	2.7%	0.51%	4.7%	83%	0.063%	0.022%
Eutrophication potential: freshwater	kg P eq	1.57x10 ⁻³	2.41x10 ⁻⁵	1.93x10 ⁻³	8.97x10 ⁻⁵	1.58x10 ⁻⁴	1.48x10 ⁻³	2.46x10 ⁻²	4.95x10 ⁻⁶	1.31x10 ⁻⁶
	%	5.3%	0.081%	6.5%	0.3%	0.53%	5%	82%	0.017%	0.0044%
Eutrophication potential: marine	kg N eq	1.19x10 ⁻²	9.08x10 ⁻⁴	1.49x10 ⁻²	9.87x10 ⁻³	1.78x10 ⁻³	1.52x10 ⁻²	0.259	3.02x10 ⁻⁴	1.11x10 ⁻⁴
	%	3.8%	0.29%	4.8%	3.1%	0.57%	4.8%	82%	0.096%	0.035%
Smog formation potential	kg O ₃ eq	0.309	2.22x10 ⁻²	0.362	0.241	4.05x10 ⁻²	0.233	6.40	7.39x10 ⁻³	2.71x10 ⁻³
	%	4.1%	0.29%	4.8%	3.2%	0.53%	3.1%	84%	0.097%	0.036%
IPCC 2021										
Global warming potential	kg CO ₂ eq	6.80	0.234	4.71	1.12	0.800	6.23	89.4	7.65x10 ⁻²	1.58x10 ⁻²
	%	6.2%	0.21%	4.3%	1%	0.73%	5.7%	82%	0.07%	0.014%

Table 23. Resource use 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. (Dryback Flooring - 3mm – Facility 2)

Parameter	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
Resources										
Use of renewable primary energy resources used as energy carrier (PERE)	MJ	4.71	4.53x10 ⁻²	21.1	0.180	1.05	67.6	176	1.78x10 ⁻²	3.58x10 ⁻³
	%	1.7%	0.017%	7.8%	0.066%	0.39%	25%	65%	0.0066%	0.0013%
Use of renewable primary energy resources used as raw materials (PERM)	MJ	0.00	0.00	17.8	0.00	0.712	0.00	120	0.00	0.00
	%	0%	0%	13%	0%	0.51%	0%	87%	0%	0%
Total use of renewable primary energy resources (PERT)	MJ	4.71	4.53x10 ⁻²	38.9	0.180	1.76	67.6	297	1.78x10 ⁻²	3.58x10 ⁻³
	%	1.2%	0.011%	9.5%	0.044%	0.43%	16%	72%	0.0043%	0.00087%
Use of nonrenewable primary energy resources used as energy carrier (PENRE)	MJ	112	3.24	73.6	14.9	9.36	85.6	1,400	1.08	0.381
	%	6.6%	0.19%	4.3%	0.88%	0.55%	5%	82%	0.064%	0.022%
Use of nonrenewable primary energy resources used as raw materials (PENRM)	MJ	23.3	0.00	8.15	0.00	0.326	0.00	206	0.00	0.00
	%	9.8%	0%	3.4%	0%	0.14%	0%	87%	0%	0%
Total use of nonrenewable primary energy resources (PENRT)	MJ	136	3.24	81.8	14.9	9.69	85.6	1,600	1.08	0.381
	%	7%	0.17%	4.2%	0.77%	0.5%	4.4%	83%	0.056%	0.02%
Use of secondary materials (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%
Use of renewable secondary fuels (RSF)	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%
Use of nonrenewable secondary fuels (NRSF)	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%
Recovered energy (RE)	m ³	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%
Abiotic depletion potential for fossil resources	MJ	134	3.22	67.4	14.8	9.02	78.4	1,490	1.07	0.378
	%	7.4%	0.18%	3.7%	0.82%	0.5%	4.4%	83%	0.059%	0.021%
Use of net fresh water (FW)	m ³	7.98x10 ⁻²	4.45x10 ⁻⁴	4.06x10 ⁻²	1.73x10 ⁻³	8.77x10 ⁻⁴	0.521	0.806	1.32x10 ⁻⁴	3.97x10 ⁻⁴
	%	5.5%	0.031%	2.8%	0.12%	0.06%	36%	56%	0.0091%	0.027%

Table 24. Waste and outflows 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. (Dryback Flooring - 3mm – Facility 2)

Parameter	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
Wastes										
Hazardous waste disposed (HWD)	kg	0.286	5.47x10 ⁻³	0.201	2.24x10 ⁻²	2.28x10 ⁻²	0.424	3.51	1.11x10 ⁻³	1.25x10 ⁻³
	%	6.4%	0.12%	4.5%	0.5%	0.51%	9.5%	78%	0.025%	0.028%
Nonhazardous waste disposed (NHWD)	kg	6.07	3.15x10 ⁻²	3.66	0.135	5.26	8.62	115	1.19x10 ⁻²	2.53
	%	4.3%	0.022%	2.6%	0.096%	3.7%	6.1%	81%	0.0084%	1.8%
High-level radioactive waste (HLRWD)	kg	2.03x10 ⁻⁵	1.88x10 ⁻⁷	8.71x10 ⁻⁵	7.47x10 ⁻⁷	4.36x10 ⁻⁶	3.18x10 ⁻⁵	7.33x10 ⁻⁴	7.91x10 ⁻⁸	0.00
	%	2.3%	0.021%	9.9%	0.085%	0.5%	3.6%	84%	0.009%	0%
Low-level Radioactive waste (ILLRWD)	kg	5.02x10 ⁻⁵	4.54x10 ⁻⁷	1.52x10 ⁻⁴	1.79x10 ⁻⁶	8.25x10 ⁻⁶	7.19x10 ⁻⁵	1.38x10 ⁻³	2.42x10 ⁻⁷	0.00
	%	3%	0.027%	9.1%	0.11%	0.49%	4.3%	83%	0.015%	0%
Components for re-use (CRU)	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%
Materials for recycling (MFR)	kg	0.00	0.00	0.00	0.00	0.108	0.00	0.699	0.00	0.00
	%	0%	0%	0%	0%	13%	0%	87%	0%	0%
Materials for energy recovery (MER)	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%
Exported electrical energy (EEE)	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%
Exported thermal energy (EET)	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%

Table 25. 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. (Looselay Flooring - 5mm – Facility 2)

Impact Category	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
TRACI										
Global warming potential	kg CO ₂ eq	11.7	0.381	4.85	1.79	1.05	6.16	129	0.144	2.92x10 ⁻²
	%	7.5%	0.25%	3.1%	1.1%	0.67%	4%	83%	0.092%	0.019%
Ozone depletion potential	kg CFC-11 eq	1.04x10 ⁻⁵	5.55x10 ⁻⁹	7.61x10 ⁻⁸	2.63x10 ⁻⁸	4.19x10 ⁻⁷	7.38x10 ⁻⁸	7.08x10 ⁻⁵	3.37x10 ⁻⁹	9.20x10 ⁻¹⁰
	%	13%	0.0068%	0.093%	0.032%	0.51%	0.09%	87%	0.0041%	0.0011%
Acidification potential	kg SO ₂ eq	4.37x10 ⁻²	1.48x10 ⁻³	1.93x10 ⁻²	1.94x10 ⁻²	3.48x10 ⁻³	2.10x10 ⁻²	0.572	5.33x10 ⁻⁴	1.88x10 ⁻⁴
	%	6.4%	0.22%	2.8%	2.8%	0.51%	3.1%	84%	0.078%	0.028%
Eutrophication potential: freshwater	kg P eq	2.87x10 ⁻³	3.97x10 ⁻⁵	1.95x10 ⁻³	1.45x10 ⁻⁴	2.20x10 ⁻⁴	1.48x10 ⁻³	3.40x10 ⁻²	9.44x10 ⁻⁶	2.49x10 ⁻⁶
	%	7%	0.097%	4.8%	0.36%	0.54%	3.6%	84%	0.023%	0.0061%
Eutrophication potential: marine	kg N eq	2.38x10 ⁻²	1.50x10 ⁻³	1.57x10 ⁻²	1.60x10 ⁻²	2.61x10 ⁻³	1.52x10 ⁻²	0.393	5.76x10 ⁻⁴	2.11x10 ⁻⁴
	%	5.1%	0.32%	3.4%	3.4%	0.56%	3.2%	84%	0.12%	0.045%
Smog formation potential	kg O ₃ eq	0.605	3.67x10 ⁻²	0.381	0.390	5.98x10 ⁻²	0.233	9.69	1.41x10 ⁻²	5.16x10 ⁻³
	%	5.3%	0.32%	3.3%	3.4%	0.52%	2%	85%	0.12%	0.045%
IPCC 2021										
Global warming potential	kg CO ₂ eq	11.9	0.387	4.91	1.81	1.09	6.23	132	0.146	3.00x10 ⁻²
	%	7.5%	0.24%	3.1%	1.1%	0.69%	3.9%	83%	0.092%	0.019%

Table 26. Resource use 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. (Looselay Flooring - 5mm – Facility 1)

Parameter	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
Resources										
Use of renewable primary energy resources used as energy carrier (PERE)	MJ	8.71	7.48x10 ⁻²	21.1	0.291	1.22	67.6	205	3.39x10 ⁻²	6.82x10 ⁻³
	%	2.9%	0.025%	7%	0.096%	0.4%	22%	67%	0.011%	0.0022%
Use of renewable primary energy resources used as raw materials (PERM)	MJ	0.00	0.00	17.8	0.00	0.712	0.00	120	0.00	0.00
	%	0%	0%	13%	0%	0.51%	0%	87%	0%	0%
Total use of renewable primary energy resources (PERT)	MJ	8.71	7.48x10 ⁻²	39.0	0.291	1.93	67.6	325	3.39x10 ⁻²	6.82x10 ⁻³
	%	2%	0.017%	8.8%	0.066%	0.44%	15%	73%	0.0077%	0.0015%
Use of nonrenewable primary energy resources used as energy carrier (PENRE)	MJ	189	5.35	76.4	24.1	13.6	85.6	2,020	2.06	0.727
	%	7.8%	0.22%	3.2%	1%	0.56%	3.5%	84%	0.085%	0.03%
Use of nonrenewable primary energy resources used as raw materials (PENRM)	MJ	38.4	0.00	8.15	0.00	0.326	0.00	305	0.00	0.00
	%	11%	0%	2.3%	0%	0.093%	0%	87%	0%	0%
Total use of nonrenewable primary energy resources (PENRT)	MJ	227	5.35	84.5	24.1	13.9	85.6	2,330	2.06	0.727
	%	8.2%	0.19%	3.1%	0.87%	0.5%	3.1%	84%	0.075%	0.026%
Use of secondary materials (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%
Use of renewable secondary fuels (RSF)	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%
Use of nonrenewable secondary fuels (NRSF)	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%
Recovered energy (RE)	m ³	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%
Abiotic depletion potential for fossil resources	MJ	223	5.32	70.1	23.9	13.2	78.4	2,200	2.04	0.720
	%	8.5%	0.2%	2.7%	0.92%	0.5%	3%	84%	0.078%	0.028%
Use of net fresh water (FW)	m ³	0.140	7.36x10 ⁻⁴	4.10x10 ⁻²	2.80x10 ⁻³	3.01x10 ⁻³	0.521	1.23	2.51x10 ⁻⁴	7.56x10 ⁻⁴
	%	7.2%	0.038%	2.1%	0.14%	0.16%	27%	63%	0.013%	0.039%

Table 27. Waste and outflows 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. (Looselay Flooring - 5mm – Facility 2)

Parameter	Unit	A1	A2	A3	A4	A5	B2	B4	C2	C4
Wastes										
Hazardous waste disposed (HWD)	kg	0.511	9.04x10 ⁻³	0.206	3.63x10 ⁻²	3.28x10 ⁻²	0.424	5.20	2.12x10 ⁻³	2.38x10 ⁻³
	%	8%	0.14%	3.2%	0.56%	0.51%	6.6%	81%	0.033%	0.037%
Nonhazardous waste disposed (NHWD)	kg	10.8	5.20x10 ⁻²	3.68	0.219	5.70	8.62	165	2.26x10 ⁻²	4.81
	%	5.5%	0.026%	1.9%	0.11%	2.9%	4.3%	83%	0.011%	2.4%
High-level radioactive waste (HLRWD)	kg	3.77x10 ⁻⁵	3.11x10 ⁻⁷	8.72x10 ⁻⁵	1.21x10 ⁻⁶	5.08x10 ⁻⁶	3.18x10 ⁻⁵	8.56x10 ⁻⁴	1.51x10 ⁻⁷	0.00
	%	3.7%	0.031%	8.6%	0.12%	0.5%	3.1%	84%	0.015%	0%
Low-level Radioactive waste (ILLRWD)	kg	9.14x10 ⁻⁵	7.50x10 ⁻⁷	1.52x10 ⁻⁴	2.90x10 ⁻⁶	9.97x10 ⁻⁶	7.19x10 ⁻⁵	1.67x10 ⁻³	4.61x10 ⁻⁷	0.00
	%	4.6%	0.037%	7.6%	0.14%	0.5%	3.6%	84%	0.023%	0%
Components for re-use (CRU)	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%
Materials for recycling (MFR)	kg	0.00	0.00	0.00	0.00	0.108	0.00	0.699	0.00	0.00
	%	0%	0%	0%	0%	13%	0%	87%	0%	0%
Materials for energy recovery (MER)	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%
Exported electrical energy (EEE)	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%
Exported thermal energy (EET)	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%

6. LCA: Interpretation

Results were summarized by life cycle phase for the cradle-to-grave assessment of the Jae Young Chemical Co., Ltd flooring products at both Facility 1 and Facility 2. Across all four product/facility combinations, the contributions to total impact indicator results are dominated by the product replacement phase (B4) of the assessment. Of the remaining life cycle phases, the raw material extraction and processing phase (A1) is the largest contributor to overall impacts followed by product manufacturing (A3), and product distribution (A4). Other life cycle phase contributions are minimal. Differences between Facility 1 and Facility 2 results are driven primarily by differences in facility-level electricity and fuel consumption per square meter of product produced.

7. Additional Environmental Information

7.1 ENVIRONMENT AND HEALTH DURING MANUFACTURING

The manufacturing facility is certified to ISO 9001 and ISO 14001 – Environmental management systems.

7.2 ENVIRONMENT AND HEALTH DURING INSTALLATION

The Jae Young Chemical Co., Ltd flooring products meet the requirements of the following:

- Indoor Air Comfort Gold (VOC certification)
- CDPH/EHLB Standard Method v1.2-2017 (California Section 01350)

7.3 ENVIRONMENTAL ACTIVITIES AND CERTIFICATIONS

For more information on Jae Young Chemical Co., Ltd certifications and environmental initiatives please view the website at <http://www.jflor.co.kr/>.

8. References

- Life Cycle Assessment of Luxury Vinyl Flooring. SCS Consulting Services Report. Prepared for Jae Young Chemical Co., Ltd. June 2026.
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- ISO 14040: 2006/Amd 1:2020 Environmental Management – Life cycle assessment – Principles and Framework
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- PCR for Building-Related Products and Services - Part A: LCA Calculation Rules and Report Requirements, UL 10010, UL v.4.0, March 2022.
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- Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI). Dr. Bare, J., <https://www.epa.gov/chemical-research/tool-reduction-and-assessment-chemicals-and-other-environmental-impacts-traci>
- Ecoinvent Centre (2025) ecoinvent data from v3.12. Swiss Center for Life Cycle Inventories, Dübendorf, 2025, <http://www.ecoinvent.org>
- European Joint Research Commission. International Reference Life Cycle Data System handbook. *General guide for Life Cycle Assessment – Detailed Guidance*. © European Union, 2010.

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