LX Hausys

VERIFIED by SCS Global Services
ENVIRONMENTAL PRODUCT DECLARATION
BASED ON LCA

Declaration Owner
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Product

Heterogeneous Sheet Vinyl Flooring

UNSPSC Class Code 30161700

EPD represents delivery of product to customers globally.

Functional Unit
The functional unit is one square meter of flooring installed and maintained for over a 1-year period

EPD Number and Period of Validity
SCS-EPD-10446
EPD Valid June 18, 2025 through June 17, 2030

Product Category Rule

The International EPD System, 2024-04-30, PCR 2019:14 CONSTRUCTION PRODUCTS, version 1.3.4, VALID UNTIL: 2025-06-20.

The International EPD System, C-PCR-004 (TO PCR 2019:14), RESILIENT, TEXTILE AND LAMINATE FLOOR COVERINGS (EN 16810:2017), VERSION: 2024-04-30, VALID UNTIL: 2025-06-20

CEN standard EN 15804 serves as the core Product Category Rules (PCR)

Program Operator
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SCSglobal SERVICES

Declaration Owner:	LX Hausys, Ltd
Address:	Fl. 18-23, LG Seoul Station Bldg., 98, Huam-ro, Jung-gu, Seoul, 04637, Korea
Declaration Number:	SCS-EPD-10446
Declaration Validity Period:	EPD Valid June 18, 2025 through June 17, 2030
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 2.4 software and the Ecoinvent v3.10 database
Product RSL:	1 year
Markets of Applicability:	Global
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Grave and Module D
LCIA Method and Version:	EN15804 (EF3.1); CML-IA; TRACI 2.1
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Lindita Bushi Lindita Bushi, PhD, Athena Sustainable Materials Institute
Part A Product Category Rule:	The International EPD System, 2024-04-30, PCR 2019:14 CONSTRUCTION PRODUCTS, version 1.3.4, VALID UNTIL: 2025-06-20.
Part A PCR Review conducted by:	The Technical Committee of the International EPD® System. Review chair: Claudia A. Peña, University of Concepción, Chile.
Part B Product Category Rule:	The International EPD System, C-PCR-004 (TO PCR 2019:14), RESILIENT, TEXTILE AND LAMINATE FLOOR COVERINGS (EN 16810:2017), VERSION: 2024-04-30, VALID UNTIL: 2025-06-20
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:	Lindita Bushi Lindita Bushi, PhD, Athena Sustainable Materials Institute
Declaration Contents:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and EN 15804:2012+A2:2019/AC:2021.*

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.*

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. LX Hausys

As part of the LG global corporation, LX Hausys' principle strengths are founded in design, technology, innovation and quality. For over 70 years we've been developing and producing high performance flooring using the latest advanced manufacturing techniques, creating a variety of ranges of human friendly and eco-conscious luxury vinyl sheet. With natural woods and stones abstract in over 1,000 varieties, our collection offers incredible freedom and creativity both in terms of design capabilities and installation methods.

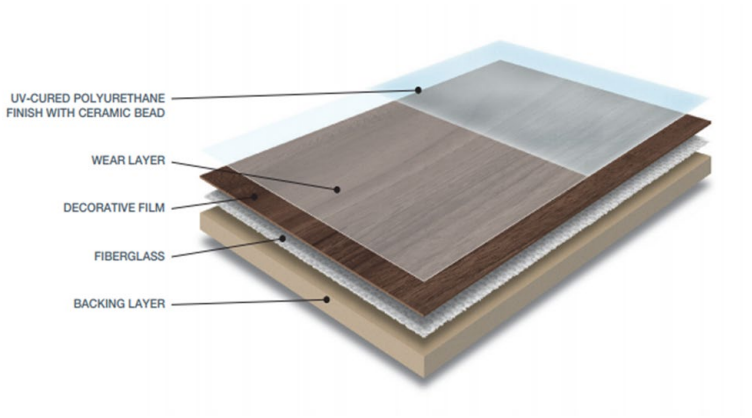
2. Product

2.1 PRODUCT DESCRIPTION

Heterogeneous Sheet Vinyl

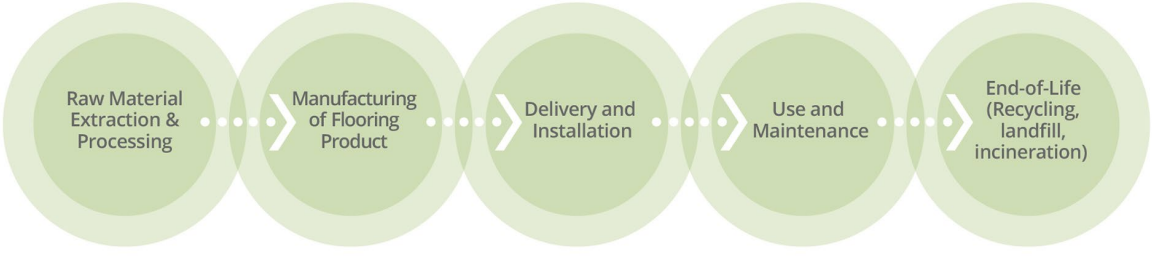
LX Hausys' promise to keep leading the trend for interior solutions sheet vinyl flooring.

1. **Light Commercial:** Provides economical choice for light commercial and residential areas through highly dense, calendered sheeting process.
2. **Commercial:** The exclusive sheet flooring collection embodies the detailed reality of natural wood which reinforces the beauty of any interior space.
3. **Acoustic:** The acoustic sheet provides excellence in sound absorption.



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 LX Hausys 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 and Module D, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal. The LCA is conducted using an attributional approach. The environmental loads and benefits resulting from recyclable materials leaving a product system (Module D) are negligible. Cut-off and allocation procedures are described below and conform to the PCR and ISO standards.

The life cycle phases included in the product system boundary are shown below.

Table 1. *Life cycle phases included in the LX Hausys flooring 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**	**n/a**	**x**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**x**	**x**	**x**	**x**	**x**
Geography	GLO	GLO	KR	GLO	GLO	n/a	GLO	n/a	n/a	n/a	n/a	n/a	GLO	GLO	GLO	GLO	GLO
Share of specific data	>90%			>90%		-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	-			-		-	-	-	-	-	-	-	-	-	-	-	-
Variation - sites	-			-		-	-	-	-	-	-	-	-	-	-	-	-

X = Included in system boundary
GLO = Global; KR = South Korea
n/a = Module not applicable

2.5 TECHNICAL DATA

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

Table 2. Product specifications for the *LX Hausys Heterogeneous Vinyl Sheet* flooring products.

Characteristic			Description			
Sustainable certifications			HPD, FloorScore®			
VOC emissions test method			CDPH Standard Method			
Use Classification (according to EN ISO 10874)			31-34; 41-43			
Characteristic			**Nominal Value**	**Unit**	**Min Value**	**Max Value**
Product thickness			2.20 (0.087)	mm (in)	1.50 (0.059)	8.00 (0.315)
Wear layer thickness (where applicable)			0.50 (0.020)	mm (in)	0.10 (0.004)	1.00 (0.039)
Product weight			3,700 (12.1)	g/m^2 (oz/ft^2)	1,700 (5.6)	3,770 (12.4)
Product Form	Rolls	Width	2,000 (78.7)	mm (in)	1,800 (70.9)	2,000 (78.7)
		Length	20.0 (65.6)	mm (in)	20.0 (65.6)	35.0 (114.8)

2.6 MARKET PLACEMENT/APPLICATION RULES

Technical specifications and product performance results for the flooring products can be found on the manufacturer's website: http://www.lxhausys.com.

2.7 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

The products are delivered for installation in the form of vinyl sheet.

2.8 MATERIAL COMPOSITION

The primary materials include polyvinyl chloride (PVC), plasticizers, fillers and various stabilizers, pigments and coatings. While the products are available with various colors, the impact of different pigments on the estimated impact indicators is expected to be less than ±10%.

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

Component	Renewable	Recycled Content (%)	kg/m^2	% mass
PVC	No	0%	1.20	32%
Filler	No	0%	1.50	41%
Plasticizer	No	0%	0.496	13%
Stabilizer	No	0%	0.270	7.3%
Pigment/Coating	No	0%	0.107	2.9%
Additives	No	0%	0.133	3.6%
Total Product			**3.70**	**100%**

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

LX Hausys vinyl sheet flooring is produced at their manufacturing facility in 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 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 sheets are embossed, adhered to the core and then cut into individual planks, profiled, a foamed backing layer adhered and then packaged for shipment.

2.10 PACKAGING

The products are packaged for shipment using paper and plastic wrap.

Table 4. *Material content for the flooring product packaging, in kg per square meter and percent of total mass.*

Component	Renewable	Recycled Content (%)	kg/m²	% mass
Paper	Yes	0%	$9.16x10^{-2}$	79%
Plastic	No	0%	$2.39x10^{-2}$	21%
Adhesive/Tape	No	0%	$1.00x10^{-3}$	0.86%
Total Packaging			**0.116**	**100%**

2.11 PRODUCT INSTALLATION

Installation of the product is accomplished using hand tools with negligible impacts. Approximately 4% installation waste is assumed. 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.

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 product is one year based on PCR requirements.

2.14 RE-USE PHASE

The flooring products are not reused at end-of-life.

2.15 DISPOSAL

At end-of-life, the products may be disposed of in a landfill or via incineration. Although in some instances, vinyl 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 products are 100% landfilled and 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 https://www.lxhausys.com

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 1-year period. The corresponding reference flow for each product system is presented in Table 5. For the present assessment, a reference service lifetime (RSL) is 1-year in conformance with the PCR.

Table 5. *Reference flows and RSL for the Vinyl Sheet flooring product.*

Product Name	Reference Flow (kg/m²)	Reference Service Life – RSL (years)
Heterogeneous Vinyl Sheet	3.70	1

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 following processes are excluded from the system boundary, consistent with the PCR:

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

The life cycle phases included in the EPD scope are described in Table 6 and illustrated in Figure 1.

Table 6. *The modules and unit processes included in the scope for the LX Hausys 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 the 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	Module not applicable
B2	Product maintenance	Maintenance of products over the product RSL, including periodic cleaning.
B3	Product repair	Module not applicable
B4	Product replacement	Module not applicable
B5	Product refurbishment	Module not applicable
B6	Operational energy use by technical building systems	Module not applicable
B7	Operational water uses by technical building systems	Module not applicable
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	There are no significant impacts associated with Module D as no recycled materials are used in the products. In addition, no product components are recycled at end-of-life.

It is noted that the generation of electricity used in the manufacturing process should be included in stage A1 as specified by EN 15804. However, since the separation of combustion emissions and energy resource extraction for electricity generation could not be accomplished with the LCI data used for the modeling, impacts from electricity use are modeled in the manufacturing stage A3 and impacts from stages A1 through A3 are combined and reported in aggregate in the LCA results presented in this EPD.

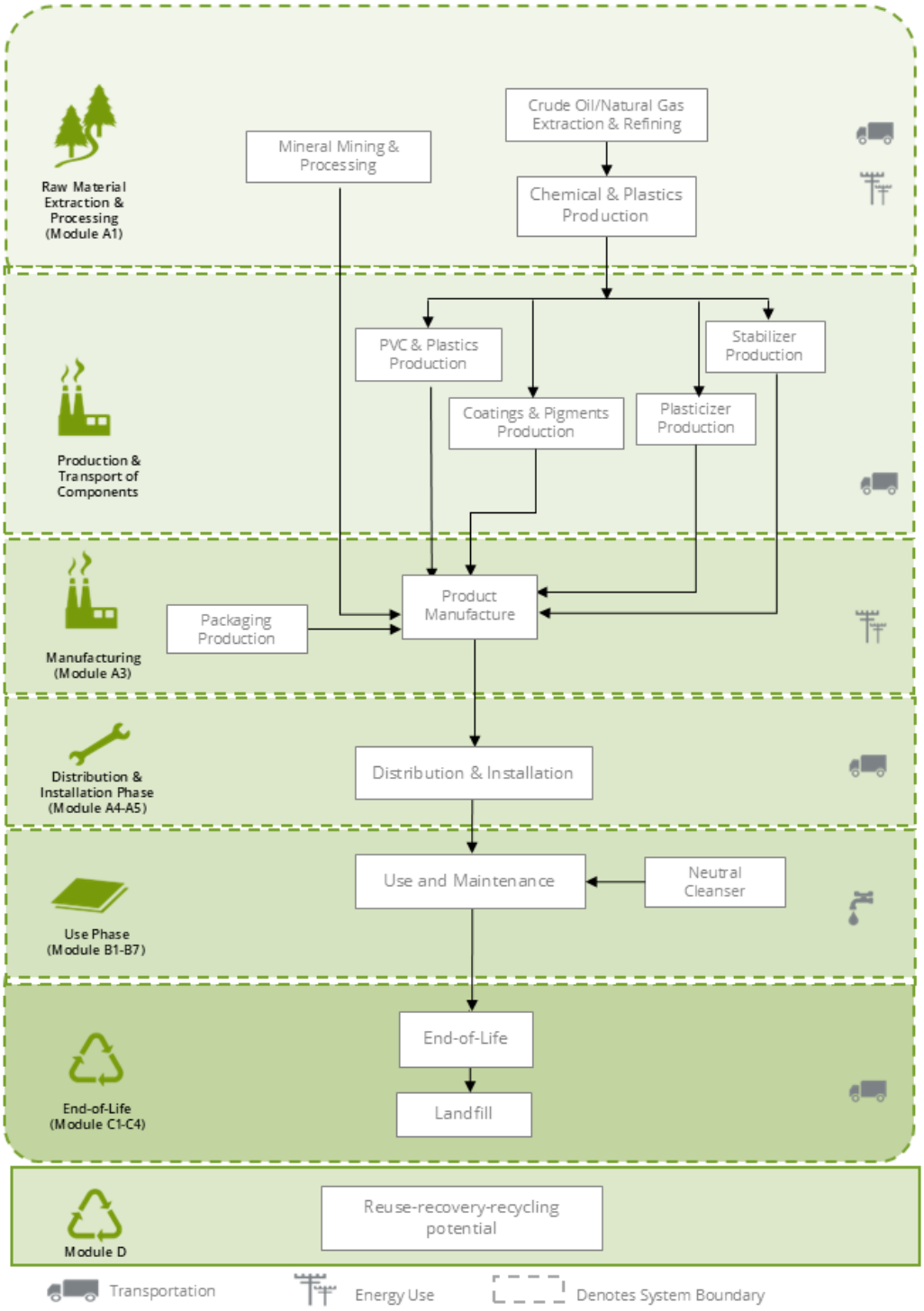


Figure 1. *Flow Diagram for the life cycle of the LX Hausys vinyl flooring product system.*

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 facility was allocated to the products based on the product area as a fraction of the total production.
- The LX Hausys facility under review is located in South Korea. 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 PCR requirements. .
- Downstream transport was modeled based on information provided by the manufacturer representing distribution to consumer markets globally.
- 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 is landfilled while product packaging is modeled based on regional statistics regarding recycling rates of 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 considering 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 by LX Hausys for their manufacturing facility. The sources of secondary LCI data are the Ecoinvent database.

Table 7. *Data sources for the LX Hausys vinyl flooring product system.*

Component	Dataset	Data Source	Publication Date
PRODUCT			
Polymer Binder			
Polyvinyl Chloride	market for polyvinylchloride, bulk polymerised | polyvinylchloride, bulk polymerised | EN15804GD, S/GLO	EI v3.10	2023
Filler			
Calcium Carbonate	limestone production, crushed, washed | limestone, crushed, washed | EN15804GD, S/RoW	EI v3.10	2023
Plasticizer			

Component	Dataset	Data Source	Publication Date
PVC Plasticizer	dioctyl terephthalate production | dioctyl terephthalate | EN15804GD, S/GLO	EI v3.10	2023
Stabilizer			
Stabilizer	chemical production, organic | chemical, organic | EN15804GD, S/GLO	EI v3.10	2023
	solvent production, organic | solvent, organic | EN15804GD, S/GLO	EI v3.10	2023
	barium carbonate production | barium carbonate | EN15804GD, S/GLO	EI v3.10	2023
	zinc oxide production | zinc oxide | EN15804GD, S/RoW	EI v3.10	2023
Pigments			
Carbon black	carbon black production | carbon black | EN15804GD, S/GLO	EI v3.10	2023
Others			
Coating	market for polyurethane, flexible foam | polyurethane, flexible foam | EN15804GD, S/RoW	EI v3.10	2023
	market for titanium dioxide | titanium dioxide | EN15804GD, S/RoW	EI v3.10	2023
	chemical production, organic | chemical, organic | EN15804GD, S/GLO	EI v3.10	2023
PACKAGING			
Paper	kraft paper production | kraft paper | EN15804GD, S/RoW	EI v3.10	2023
Plastics	polyethylene production, low density, granulate | polyethylene, low density, granulate | EN15804GD, S/RoW	EI v3.10	2023
Adhesive	polyurethane adhesive production | polyurethane adhesive | EN15804GD, S/GLO	EI v3.10	2023
TRANSPORT			
Road transport	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | EN15804GD, S/RoW	EI v3.10	2023
Ship transport	transport, freight, sea, container ship | transport, freight, sea, container ship | EN15804GD, S/GLO	EI v3.10	2023
MAINTENANCE			
Neutral cleaner	market for ethoxylated alcohol (AE7) | ethoxylated alcohol (AE7) | EN15804GD, S/RoW fatty acid production, from palm oil | fatty acid | EN15804GD, S/RoW market group for tap water | tap water | EN15804GD, S/GLO	EI v3.10	2023
Electricity	market group for electricity, low voltage | electricity, low voltage | EN15804GD, S/GLO	EI v3.10	2023
Water	market group for tap water | tap water | EN15804GD, S/GLO	EI v3.10	2023
WASTE DISPOSAL			
Incineration	treatment of municipal solid waste, municipal incineration | municipal solid waste | EN15804GD, S/RoW	EI v3.10	2023
	treatment of waste polyethylene, municipal incineration | waste polyethylene | EN15804GD, S/GLO	EI v3.10	2023
	treatment of waste paperboard, municipal incineration | waste paperboard | EN15804GD, S/GLO	EI v3.10	2023
Landfill	treatment of municipal solid waste, sanitary landfill | municipal solid waste | EN15804GD, S/RoW	EI v3.10	2023
	treatment of waste polyethylene, sanitary landfill | waste polyethylene | EN15804GD, S/RoW	EI v3.10	2023
	treatment of waste polyvinylchloride, sanitary landfill | waste polyvinylchloride | EN15804GD, S/RoW	EI v3.10	2023
	treatment of waste paperboard, sanitary landfill | waste paperboard | EN15804GD, S/RoW	EI v3.10	2023
RESOURCES			
Grid electricity[2]	market for electricity, medium voltage | electricity, medium voltage | EN15804GD, S/KR	EI v3.10	2023
Heat – natural gas	market for heat, district or industrial, natural gas | heat, district or industrial, natural gas | EN15804GD, S/RoW	EI v3.10	2023
Water	market group for tap water | tap water | EN15804GD, S/GLO	EI v3.10	2023

[2] The South Korean electricity resource mix consists of approximately 34% coal, 30% nuclear, 30% natural gas and 2% wind and hydropower as represented in the ecoinvent v3.10 database The GWP-GHG (AR6) impact of the South Korean grid electricity is ~0.6526 kg CO_2e/kWh

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 LX Hausys 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 2024.
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 5% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent v3.10 data where available. Different portions of the product life cycle are equally considered.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing energy use at the manufacturing 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 v3.10 LCI data are used.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the products and packaging is low. Actual supplier data for upstream operations were not available and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

3.9 PERIOD UNDER REVIEW

The period of review is calendar year 2024.

3.10 ALLOCATION

Resource use at the manufacturing facility (e.g., water and energy) was allocated to the products based on the product area as a fraction of the total facility production volume (i.e., area-based allocation). Area-based allocation was deemed most appropriate for the flooring products as total facility production was available as total square meters of product. Electricity use at the manufacturing facility was modeled using ecoinvent inventory datasets for the country-specific electrical grid. Manufacturing scrap has no economic value and is disposed of via landfilling. No allocation of scrap is necessary.

Impacts from transportation, including product distribution to point of sale, were attributed to the products based on the mass of material and distance transported.

3.11 COMPARABILITY

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

4. LCA: Scenarios and Additional Technical Information

Delivery and Installation stage (A4 - A5)

Distribution of the flooring products to the point of installation is included in the assessment. Transportation parameters for modeling product distribution are summarized in Table 9. Production-weighted average distances by transport mode were used to represent product distribution globally.

Table 9. *Product distribution parameters, per functional unit, from manufacturer to point of installation.*

Parameter	Unit	Value
Truck 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
Heterogeneous Vinyl Sheet	3.82	321	18,146

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 methods, as well as maintenance and cleaning guidance. For the current assessment, the impacts associated with the product installation are assumed

negligible. Approximately 4% of the product mass is assumed lost as waste during product installation which is landfilled. The VOC emissions associated with the installation, use and maintenance of the products are negligible.

Impacts associated with the disposal of packaging materials are also included in the installation life cycle phase. Assumed recycling rates for packaging component materials are based on the PCR requirements and are summarized in Table 10.

Table 10. *Recycling rates for packaging materials at end-of-life.*

Material	Packaging Recycling Rate (%)
Recycling Rates	
Plastics	40.3%
Paper & Pulp	82.8%
Wood	39.8%
Disposal of Non-recyclables	
Landfill	55%
Incineration	45%

Table 11 summarizes the relevant parameters for the product installation phase including biogenic carbon emissions and removals, and wastes associated with product packaging.

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

Parameter		Value
Ancillary materials		0.00
Net freshwater consumption (m^3)		0.00
Electricity consumption (kWh)		0.00
Product loss per functional unit (kg)		0.148
Waste materials generated by product installation (kg)		0.264
Output materials resulting from on-site waste processing (kg)		n/a
Mass of packaging waste (kg)	Plastic	$2.39x10^{-2}$
	Corrugate	$9.16x10^{-2}$
	Adhesive/Tape	$1.00x10^{-3}$
Biogenic carbon contained in packaging (kg CO_2)[1]		0.168
Direct emissions (kg)		0.00

[1] Biogenic carbon contained in packaging calculated assuming the carbon content of corrugate is 50% by weight

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 12.

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

Parameter	Unit	Value
Maintenance cycle	Cycles / ESL	52
Maintenance cycle	Cycles / RSL	52
Maintenance process	-	Damp mopping
Net freshwater consumption	$m^3/m^2/yr$	0.0058
Cleaning agent	$kg/m^2/yr$	0.119
Maintenance process	-	Vacuuming
Electricity	$kWh/m^2/yr$	0.022
Further assumptions	-	Moderate traffic; weekly maintenance

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 or is burned in an incinerator (C4). For the flooring products, no emissions are generated during demolition (C1) while no waste processing (C3) is required for incineration or landfill disposal.

At end-of-life, the product is assumed to be disposed of in a landfill. Transportation for end-of-life scenarios was modeled assuming a distance of 161 km from the point of product use to a landfill, material recovery center, or waste incinerator. Ecoinvent datasets are used to model the impacts associated with incineration and landfilling, which does not include energy recovery from landfill gas. The end-of-life disposal parameters are summarized in Table 13.

Table 13. *End-of-life disposal scenario parameters for the flooring products per $1m^2$.*

Parameter		Value
Assumptions for scenario development		100% landfill
Collection process	Collected separately (kg)	-
	Collected with mixed construction waste (kg)	3.70
Recovery	n/a	-
Disposal	Landfill (kg)	3.70
Removals of biogenic carbon, excluding packaging (kg CO_2 eq)		n/a

5. LCA: Results

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. All LCA results are stated to three significant figures in agreement with the PCR for this flooring product and therefore the sum of the total values may not exactly equal 100%.

The 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[1], 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 3.1. 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. In addition, the following impact indicators based on the CML-IA and TRACI v2.1 characterization methodologies are also included:

Impact Characterization Methodology	Unit
CML-IA	
Global Warming Potential (GWP)	kg CO_2 eq
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq
Acidification Potential of soil and water (AP)	kg SO_2 eq
Eutrophication Potential (EP)	kg PO_4^{3-} eq
Photochemical Oxidant Creation Potential (POCP)	kg C_2H_4 eq
Abiotic depletion potential for fossil resources (ADPF)	MJ, LHV
Abiotic depletion potential, elements (ADPE)	kg Sb eq
TRACI 2.1	
Global Warming Potential (GWP)	kg CO_2 eq
Ozone Depletion Potential (ODP)	kg CFC 11 eq
Acidification Potential (AP)	kg SO_2 eq
Eutrophication Potential (EP)	kg N eq
Smog Formation Potential (SFP)	kg O_3 eq

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

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

Table 14. *Core Life Cycle Impact Assessment results per 1m² of flooring products over a 1-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Unit	A1-A3	A4	A5	B2	C2	C4
Core Indicators							
Global Warming Potential - total (GWP-total)	kg CO_2 eq.	16.1	0.947	0.858	$4.91x10^{-2}$	0.832	1.94
	%	78%	4.6%	4.1%	0.24%	4%	9.4%
Global Warming Potential - fossil fuels (GWP-fossil)	kg CO_2 eq.	16.0	0.947	0.715	$5.96x10^{-2}$	0.831	0.209
	%	85%	5%	3.8%	0.32%	4.4%	1.1%
Global Warming Potential - biogenic (GWP-biogenic)	kg CO_2 eq.	$3.36x10^{-2}$	$-2.17x10^{-4}$	0.143	$-3.59x10^{-2}$	$8.90x10^{-5}$	1.73
	%	1.8%	-0.012%	7.6%	-1.9%	0.0048%	93%
Global Warming Potential - land use and land use change (GWP-luluc)	kg CO_2 eq.	$9.60x10^{-3}$	$4.68x10^{-4}$	$4.08x10^{-4}$	$2.54x10^{-2}$	$8.22x10^{-5}$	$4.33x10^{-5}$
	%	27%	1.3%	1.1%	71%	0.23%	0.12%
Global warming potential (GWP-GHG)	kg CO_2 eq.	16.2	0.948	0.823	$8.52x10^{-2}$	0.832	1.58
	%	79%	4.6%	4%	0.42%	4.1%	7.7%
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11 eq.	$5.67x10^{-6}$	$1.37x10^{-8}$	$2.28x10^{-7}$	$1.67x10^{-9}$	$1.28x10^{-8}$	$1.20x10^{-9}$
	%	96%	0.23%	3.8%	0.028%	0.22%	0.02%
Acidification potential, Accumulated Exceedance (AP)	mol H+ eq.	$5.44x10^{-2}$	$2.18x10^{-2}$	$3.23x10^{-3}$	$3.75x10^{-4}$	$4.38x10^{-3}$	$5.25x10^{-4}$
	%	64%	26%	3.8%	0.44%	5.2%	0.62%
Eutrophication potential - freshwater (EP-freshwater)	kg P eq.	$6.11x10^{-3}$	$4.11x10^{-5}$	$2.58x10^{-4}$	$1.68x10^{-5}$	$1.56x10^{-5}$	$1.92x10^{-4}$
	%	92%	0.62%	3.9%	0.25%	0.23%	2.9%
Eutrophication potential - marine (EP-marine)	kg N eq.	$1.39x10^{-2}$	$5.55x10^{-3}$	$1.08x10^{-3}$	$2.23x10^{-4}$	$1.90x10^{-3}$	$4.05x10^{-3}$
	%	52%	21%	4%	0.84%	7.1%	15%
Eutrophication potential - terrestrial (EP-terrestrial)	mol N eq.	0.139	$6.16x10^{-2}$	$8.80x10^{-3}$	$1.02x10^{-3}$	$2.09x10^{-2}$	$1.72x10^{-3}$
	%	60%	26%	3.8%	0.44%	9%	0.74%
Photochemical Ozone Creation Potential (POCP)	kg NMVOC eq.	$5.74x10^{-2}$	$1.70x10^{-2}$	$3.31x10^{-3}$	$3.31x10^{-4}$	$8.30x10^{-3}$	$1.01x10^{-3}$
	%	66%	19%	3.8%	0.38%	9.5%	1.2%
Depletion of abiotic resources - minerals and metals (kg Sb eq)[1]	MJ	$8.41x10^{-5}$	$1.48x10^{-6}$	$3.45x10^{-6}$	$5.86x10^{-7}$	$5.47x10^{-7}$	$1.23x10^{-7}$
	%	93%	1.6%	3.8%	0.65%	0.61%	0.14%
Depletion of abiotic resources - fossil fuels (MJ)[1]	kg Sb eq.	302	12.0	13.0	1.07	10.8	1.11
	%	89%	3.5%	3.8%	0.31%	3.2%	0.33%
Water use (m^3 depriv.)[1]	m^3 World eq.	3.82	$3.88x10^{-2}$	0.156	$4.77x10^{-2}$	$1.77x10^{-2}$	$1.00x10^{-2}$
	%	93%	0.95%	3.8%	1.2%	0.43%	0.24%

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 15. *Additional Life Cycle Impact Assessment results per 1m² of flooring products over a 1-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Unit	A1-A3	A4	A5	B2	C2	C4
Additional Indicators							
Potential incidence of disease due to PM emissions (PM)	Disease Incidence	$4.50x10^{-7}$	$4.04x10^{-8}$	$2.36x10^{-8}$	$5.64x10^{-9}$	$1.08x10^{-7}$	$7.92x10^{-9}$
	%	71%	6.4%	3.7%	0.89%	17%	1.2%
Potential Human exposure efficiency relative to U235 (IRP)[2]	kBq U235 eq.	2.62	$6.70x10^{-3}$	0.105	$3.12x10^{-3}$	$3.35x10^{-3}$	$2.30x10^{-3}$
	%	96%	0.24%	3.8%	0.11%	0.12%	0.084%
Potential Comparative Toxic Unit for ecosystems (ETP-fw)	CTUe	144	2.37	8.02	0.811	0.941	130
	%	50%	0.83%	2.8%	0.28%	0.33%	45%
Potential Comparative Toxic Unit for humans - cancer effects (HTP-c)[1]	CTUh	$5.76x10^{-8}$	$4.22x10^{-9}$	$2.53x10^{-9}$	$2.70x10^{-10}$	$1.25x10^{-9}$	$3.38x10^{-10}$
	%	87%	6.4%	3.8%	0.41%	1.9%	0.51%
Potential Comparative Toxic Unit for humans - non-cancer effects (HTP-nc)[1]	CTUh	$2.07x10^{-7}$	$4.37x10^{-9}$	$9.34x10^{-9}$	$7.81x10^{-10}$	$1.73x10^{-9}$	$1.24x10^{-8}$
	%	88%	1.9%	4%	0.33%	0.73%	5.3%
Potential Soil quality index (SQP)[1]	Dimensionless	59.6	2.67	2.64	1.32	1.23	2.19
	%	86%	3.8%	3.8%	1.9%	1.8%	3.1%

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.

2) This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Table 16. *Resource use per 1m^2 of flooring products over a 1-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
Resources							
Use of renewable primary energy resources used as energy carrier (PERE)	MJ	12.8	0.108	0.518	0.922	$4.65x10^{-2}$	$2.95x10^{-2}$
	%	89%	0.75%	3.6%	6.4%	0.32%	0.2%
Use of renewable primary energy resources used as raw materials (PERM)	MJ	1.56	0.00	$6.23x10^{-2}$	0.00	0.00	0.00
	%	96%	0%	3.8%	0%	0%	0%
Total use of renewable primary energy resources (PERT)	MJ	12.8	0.108	0.518	0.922	$4.65x10^{-2}$	$2.95x10^{-2}$
	%	89%	0.75%	3.6%	6.4%	0.32%	0.2%
Use of nonrenewable primary energy resources used as energy carrier (PENRE)	MJ	286	10.9	12.3	1.03	9.70	1.01
	%	89%	3.4%	3.8%	0.32%	3%	0.32%
Use of nonrenewable primary energy resources used as raw materials (PENRM)	MJ	15.9	1.16	0.724	$6.17x10^{-2}$	1.09	$9.25x10^{-2}$
	%	84%	6.1%	3.8%	0.32%	5.7%	0.49%
Total use of nonrenewable primary energy resources (PENRT)	MJ	302	12.0	13.0	1.10	10.8	1.11
	%	89%	3.5%	3.8%	0.32%	3.2%	0.33%
Use of secondary materials (SM)	kg	0.541	$8.18x10^{-3}$	$2.20x10^{-2}$	$1.95x10^{-3}$	$2.66x10^{-3}$	0.00
	%	94%	1.4%	3.8%	0.34%	0.46%	0%
Use of renewable secondary fuels (RSF)	MJ	0.00	0.00	0.00	0.00	0.00	0.00
	%	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%	0%	0%	0%	0%	0%
Use of net fresh water (FW)	m^3	$9.26x10^{-2}$	$1.02x10^{-3}$	$3.13x10^{-3}$	$6.99x10^{-3}$	$5.61x10^{-4}$	$-1.39x10^{-2}$
	%	100%	1.1%	3.5%	7.7%	0.62%	-15%

Table 17. *Waste and outflows per 1m2 of flooring products over a 1-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
Wastes							
Hazardous waste disposed (HWD)	kg	$2.84x10^{-3}$	$6.78x10^{-5}$	$1.19x10^{-4}$	$1.34x10^{-5}$	$7.51x10^{-5}$	$7.13x10^{-6}$
	%	91%	2.2%	3.8%	0.43%	2.4%	0.23%
Nonhazardous waste disposed (NHWD)	kg	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%
Radioactive waste disposed (RWD)	kg	$6.68x10^{-4}$	$1.64x10^{-6}$	$2.69x10^{-5}$	$7.66x10^{-7}$	$8.11x10^{-7}$	$5.60x10^{-7}$
	%	96%	0.23%	3.8%	0.11%	0.12%	0.08%
Components for re-use (CRU)	kg	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%
Materials for recycling (MFR)	kg	0.462	$7.86x10^{-3}$	$1.89x10^{-2}$	$1.15x10^{-3}$	$2.31x10^{-3}$	0.00
	%	94%	1.6%	3.8%	0.23%	0.47%	0%
Materials for energy recovery (MER)	kg	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%
Exported electrical energy (EEE)	MJ	$5.36x10^{-2}$	$6.33x10^{-4}$	$2.18x10^{-3}$	$2.36x10^{-4}$	$2.95x10^{-4}$	0.00
	%	94%	1.1%	3.8%	0.41%	0.52%	0%
Exported thermal energy (EET)	MJ	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%

Table 18. *TRACI and CML Life Cycle Impact Assessment results for the flooring products over a 1-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
TRACI							
Global warming	kg CO_2 eq	15.9	0.936	0.794	$8.42x10^{-2}$	0.821	1.34
	%	80%	4.7%	4%	0.42%	4.1%	6.7%
Ozone depletion	kg CFC-11 eq	$5.45x10^{-6}$	$1.45x10^{-8}$	$2.19x10^{-7}$	$1.90x10^{-9}$	$1.34x10^{-8}$	$1.27x10^{-9}$
	%	96%	0.25%	3.8%	0.033%	0.24%	0.022%
Acidification	kg SO_2 eq	$4.91x10^{-2}$	$1.86x10^{-2}$	$2.87x10^{-3}$	$3.09x10^{-4}$	$4.01x10^{-3}$	$7.01x10^{-4}$
	%	65%	25%	3.8%	0.41%	5.3%	0.93%
Eutrophication	kg N eq	$9.11x10^{-2}$	$1.14x10^{-3}$	$7.73x10^{-3}$	$4.81x10^{-4}$	$4.24x10^{-4}$	$9.03x10^{-2}$
	%	48%	0.59%	4%	0.25%	0.22%	47%
Smog	kg O_3 eq	0.862	0.360	$5.38x10^{-2}$	$4.05x10^{-3}$	0.133	$9.50x10^{-3}$
	%	61%	25%	3.8%	0.29%	9.3%	0.67%
CML							
Global warming	kg CO_2 eq	16.0	0.943	0.812	$8.46x10^{-2}$	0.827	1.49
	%	79%	4.7%	4%	0.42%	4.1%	7.4%
Acidification	kg SO_2 eq	$4.37x10^{-2}$	$1.74x10^{-2}$	$2.57x10^{-3}$	$2.80x10^{-4}$	$3.14x10^{-3}$	$3.99x10^{-4}$
	%	65%	26%	3.8%	0.42%	4.7%	0.59%
Eutrophication	kg $(PO_4)^{3-}$ eq	0.106	$2.17x10^{-3}$	$5.91x10^{-3}$	$5.27x10^{-4}$	$7.63x10^{-4}$	$3.42x10^{-2}$
	%	71%	1.4%	3.9%	0.35%	0.51%	23%
Formation potential of tropospheric ozone	kg C_2H_4 eq	$5.20x10^{-3}$	$8.87x10^{-4}$	$2.75x10^{-4}$	$4.14x10^{-5}$	$2.76x10^{-4}$	$3.17x10^{-4}$
	%	74%	13%	3.9%	0.59%	3.9%	4.5%
Depletion potential of the stratospheric ozone layer	kg CFC-11 eq	$4.47x10^{-6}$	$1.09x10^{-8}$	$1.80x10^{-7}$	$1.67x10^{-9}$	$1.01x10^{-8}$	$9.65x10^{-10}$
	%	96%	0.23%	3.8%	0.036%	0.22%	0.021%
Abiotic depletion potential for fossil resources	MJ	259	11.9	11.2	1.02	10.7	1.07
	%	88%	4%	3.8%	0.34%	3.6%	0.36%
Abiotic depletion potential for non fossil resources	kg Sb eq	$7.41x10^{-5}$	$1.45x10^{-6}$	$3.05x10^{-6}$	$5.74x10^{-7}$	$5.40x10^{-7}$	$1.19x10^{-7}$
	%	93%	1.8%	3.8%	0.72%	0.68%	0.15%

6. LCA: Interpretation

Results were summarized by life cycle phase for a cradle-to-grave assessment of the LX Hausys flooring product system. With few exceptions, the potential impacts over a single product life cycle are dominated by the raw material extraction and processing (A1), followed by the product distribution (A4), product manufacturing (A3) and product disposal (C2/C4) phases. Other life cycle phase contributions are minimal.

7. Additional Environmental Information

7.1 ENVIRONMENT AND HEALTH DURING MANUFACTURING

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

7.2 ENVIRONMENT AND HEALTH DURING INSTALLATION

The LX Hausys 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 LX Hausys' certifications and environmental initiatives please view the website at http://www.lxhausys.com/

8. References

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- ISO 14040: 2006/AMD 1:2020 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.
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