Declaration Owner

LG Hausys, Ltd.

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Product

Homogeneous Vinyl Sheet Flooring:
Origin, Origin Conductive, Space, Unite, Atmosphere, Prairie

EPD represents delivery of product to customers in North America.

Functional Unit

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

EPD Number and Period of Validity

SCS-EPD-06159
EPD Valid May 26, 2020 through May 25, 2025

Product Category Rule

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

PCR Guidance for Building-Related Products and Services Part B: Flooring EPD Requirements. Version 2. UL Environment. May 2018.

Program Operator

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Address:	Fl. 18-23, LG Seoul Station Bldg., 98, Huam-ro, Jung-gu, Seoul, 04637, Korea
Declaration Number:	SCS-EPD-06159
Declaration Validity Period:	May 26, 2020 through May 25, 2025
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 1.10 software and the Ecoinvent v3.6 database
Product RSL:	Various
Markets of Applicability:	North America
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Grave
LCIA Method and Version:	CML-IA and TRACI 2.1
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
Part A Product Category Rule:	PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. Sept. 2018
Part A PCR Review conducted by:	Lindita Bushi, PhD (Chair); Hugues Imbeault-Tétreault, ing., M.Sc.A.; Jack Geibig
Part B Product Category Rule:	PCR Guidance for Building-Related Products and Services Part B: Flooring EPD Requirements. Version 2. UL Environment. May 2018.
Part B PCR Review conducted by:	Jack Geibig (chair), Ecoform; Thomas Gloria, Industrial Ecology Consultants; Thaddeus Owen
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
Declaration Contents:	

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.

1. LG Hausys

As part of the LG global corporation, LG 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 range of human friendly and eco-conscious luxury vinyl tiles. 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

Easy Clean UV Surface Treatment

· High-density PUR surface treatment allows strong iodine resistance (Origin)

· High density PUR treatment allows strong anti-scratch & anti-contamination (Space, Unite)

Phthalate & Heavy metal free

· Use 100% Phthalate free plasticizers only

· No hazardous ingredients used during production

Design Competitiveness

· 2/3 stage & chip-in-chip marbling technique applied for mind comforting design

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 LG Hausys Vinyl Sheet 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.

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

Table 1. *Life cycle phases included in the LG Hausys Vinyl Sheet 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

2.5 TECHNICAL DATA

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

Table 2. *Product specifications for the LG Hausys Homogeneous Vinyl Sheet flooring products.*

Characteristic			Nominal Value	Unit	Minimum Value	Maximum Value
Product thickness			2.00 (0.08)	mm (in)	-	-
Wear layer thickness			-	mm (in)	-	-
Product weight			3,600 (11.80)	g/m^2 (oz/ft^2)	-	-
Sustainable certifications			ISO 14001, OHSAS 18001, KOSHA 18001, ISO 9001			
VOC emissions test method			Floorscore (SCS-FS-03425)			
Product Form	Rolls	Width	2.0 (6.6)	m (ft)	-	-
		Length	20 (65.6)	m (ft)	-	-

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.lghausys.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 and coatings.

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

Component	Homogeneous Vinyl Sheet	
	Mass (kg/m^2)	Percent mass
Limestone	2.17	61%
PVC	0.916	26%
Plasticizer	0.363	10%
Stabilizer	2.91×10^{-2}	0.81%
Pigments & Coatings	6.71×10^{-2}	1.90%
Other	2.94×10^{-2}	0.82%
Total Product	**3.58**	**100%**

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

2.9 MANUFACTURING

LG Hausys vinyl sheet flooring is produced at their manufacturing facilities 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.

2.10 PACKAGING

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

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

Component	Homogeneous Vinyl Sheet	
	Mass (kg/m^2)	Percent mass
Corrugated	0.136	96%
Plastic Film	5.23×10^{-3}	3.70%
Total Packaging	**0.141**	**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 product is based on the manufacturer's warranted lifetime and is summarized in Table 5 below. 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 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 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 http://www.lghausys.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 75-year period. The corresponding reference flow for each product system is presented in Table 5. For the present assessment, a reference service lifetime (RSL) corresponding to the manufacturer's warranted lifetime is assumed. The total number of required product lifecycles during the 75-year period over which the product system is modeled is also summarized for the product in Table 5.

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

Product	Reference Flow (kg/m^2)	Reference Service Life (RSL)	Replacement Cycle (ESL/RSL-1)
Homogeneous Vinyl Sheet	3.58	10	6.5

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 6. *The modules and unit processes included in the scope for the LG Hausys flooring products.*

Module	Module description from the PCR	Unit Processes Included in Scope
A1	Extraction and processing of raw materials; any reuse of products or materials from previous product systems; processing of secondary materials; generation of electricity from primary energy resources; energy, or other, recovery processes from secondary fuels	Extraction and processing of raw materials for the vinyl flooring 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 (incl. upstream unit processes*)
A4	Transport (to the building site)	Transport of product (including packaging) to the building site
A5	Construction-installation process	Impacts from the installation of the product are assumed negligible. Only impacts from packaging disposal are included in this phase.
B1	Product use	Use of the flooring in a commercial building setting. There are no associated emissions or impacts from the use of the product
B2	Product maintenance	Maintenance of products, including periodic cleaning over the 75-year ESL of the assessment.
B3	Product repair	The flooring is not expected to require repair over its lifetime. Impacts from this phase are reported as zero.
B4	Product replacement	The materials and energy required for replacement of the product over the 75-year ESL of the assessment are included in this phase.
B5	Product refurbishment	The flooring is not expected to require refurbishment over its lifetime. Impacts from this phase are reported as zero
B6	Operational energy use by technical building systems	There is no operational energy use associated with the use of the product
B7	Operational water use by technical building systems	There is no operational water use associated with the use of the product
C1	Deconstruction, demolition	Demolition of the product is accomplished using hand tools with no associated emissions and negligible impacts
C2	Transport (to waste processing)	Transport of flooring product to waste treatment at end-of-life
C3	Waste processing for reuse, recovery and/or recycling	The product is disposed of by incineration and/or landfilling which require no waste processing
C4	Disposal	Disposal of flooring product in municipal landfill or incineration
D	Reuse-recovery-recycling potential	Module Not Declared

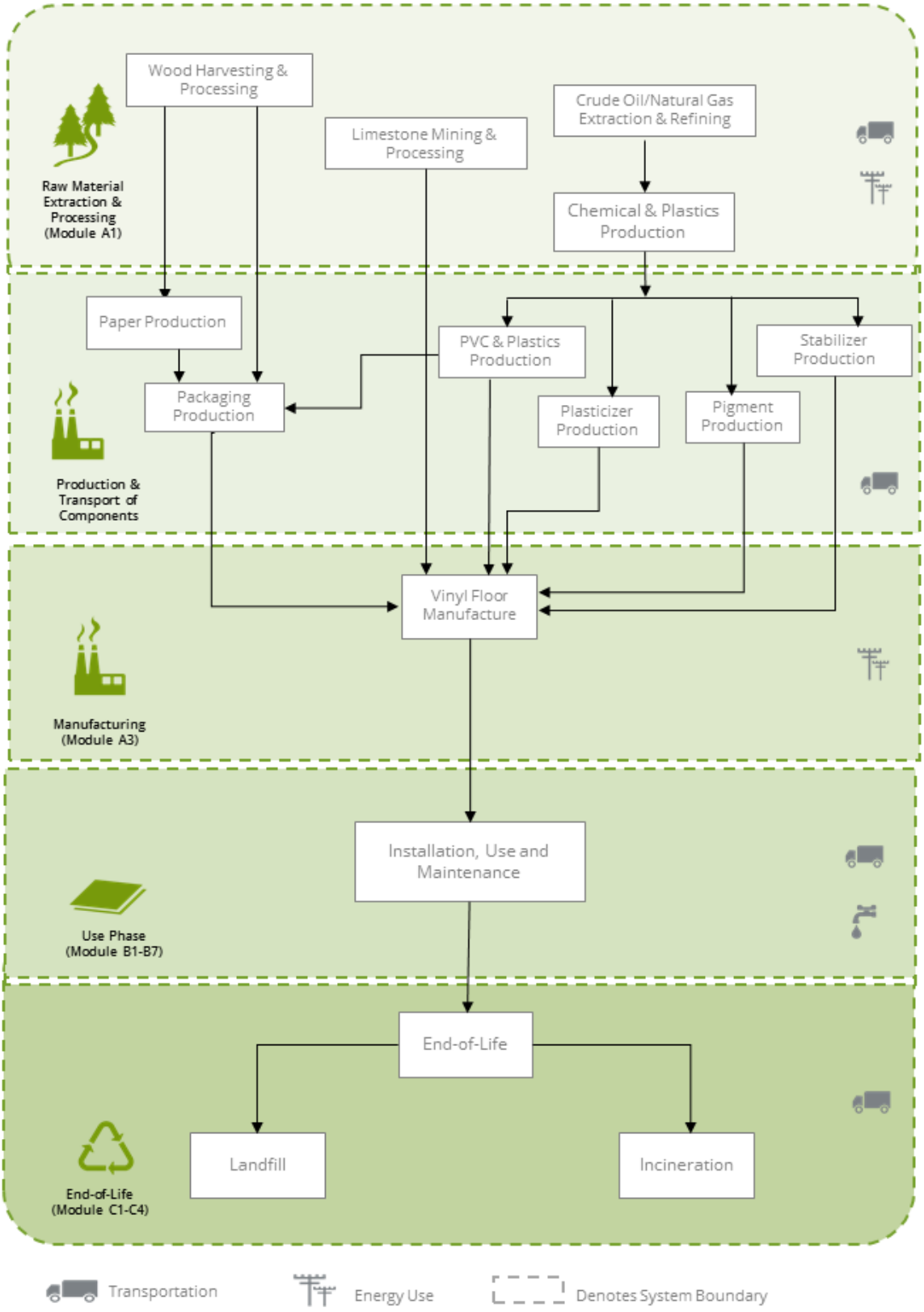

Figure 1. *Flow Diagram for the life cycle of the LG Hausys vinyl flooring product system.*

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

- The LG Hausys facilities under review are located in Korea. An Ecoinvent inventory dataset for the Korean energy grid mix was used to model resource use and emissions from electricity use at the manufacturing facility.

- Life cycle inventory data for the plasticizer, a dioctyl terephthalate (DOTP) mixture, were not available. Inventory data developed for diisoheptyl phthalate (DIHP) was used as a surrogate to represent DOTP in the LCA model.

- Disposal of the product packaging is modeled based on regional statistics regarding municipal solid waste generation and disposal in the United States, as specified in the PCR. The data include end-of-life recycling rates of packaging and product materials. No components of the product are assumed recycled.

- For final disposal of the packaging material and vinyl flooring at end-of-life, all materials are assumed to be transported ~32 km (20 miles) by diesel truck to either a landfill, incineration facility, 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 LG Hausys for their manufacturing facilities. The sources of secondary LCI data are the Ecoinvent database.

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

Component	Dataset	Source	Publication date
Product			
Filler	market for limestone, crushed, washed | limestone, crushed, washed | Cutoff	EI v3.6	2019
PVC	market for polyvinylchloride, bulk polymerised | polyvinylchloride, bulk polymerised | Cutoff	EI v3.6	2019
Plasticizer	diisoheptyl phthalate (DIHP) {GLO} | market for | Alloc Rec	EI v3.6	2019
Stabilizer	*Ba-Zn stabilizer*		
	market for barite | barite | Cutoff	EI v3.6	2019
	market for fatty acid | fatty acid | Cutoff	EI v3.6	2019
	market for phenol | phenol | Cutoff	EI v3.6	2019
	market for phosphoryl chloride | phosphoryl chloride | Cutoff	EI v3.6	2019
	market for zinc oxide | zinc oxide | Cutoff	EI v3.6	2019
Pigments/Coatings	*Printing Film*		
	market for polyvinylchloride, bulk polymerised | polyvinylchloride, bulk polymerised | Cutoff	EI v3.6	2019
	diisoheptyl phthalate (DIHP) {GLO} | market for | Alloc Rec	EI v3.6	2019
	market for carbon black | carbon black | Cutoff	EI v3.6	2019
	market for titanium dioxide | titanium dioxide | Cutoff	EI v3.6	2019
	UV Coating Paint		
	market for chemical, organic | chemical, organic | Cutoff	EI v3.6	2019
	market for polyurethane, flexible foam | polyurethane, flexible foam | Cutoff	EI v3.6	2019
Other	market for soybean oil, refined | soybean oil, refined | Cutoff	EI v3.6	2019
	market for glycerin | glycerine | Cutoff	EI v3.6	2019
	market for acrylic filler | acrylic filler | Cutoff	EI v3.6	2019
	market for fatty acid | fatty acid | Cutoff	EI v3.6	2019
	market for paraffin | paraffin | Cutoff	EI v3.6	2019
Packaging			
Paper/Corrugated	market for corrugated board box | corrugated board box | Cutoff	EI v3.6	2019
	market for kraft paper, unbleached | kraft paper, unbleached | Cutoff	EI v3.6	2019
Plastics	market for acrylic binder, without water, in 34% solution state | acrylic binder, without water, in 34% solution state | Cutoff	EI v3.6	2019
	market for polyethylene, linear low density, granulate | polyethylene, linear low density, granulate | Cutoff	EI v3.6	2019
	market for packaging film, low density polyethylene | packaging film, low density polyethylene | Cutoff	EI v3.6	2019
Wood	market for EUR-flat pallet | EUR-flat pallet | Cutoff	EI v3.6	2019
Transport			
Road transport	market for transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff	EI v3.6	2019
Rail transport	market for transport, freight train | transport, freight train | Cutoff	EI v3.6	2019
Ship transport	transport, freight, sea, transoceanic ship | transport, freight, sea, transoceanic ship | Cutoff	EI v3.6	2019
Resources			
Grid electricity	market for electricity, medium voltage | electricity, medium voltage | Cutoff, S/KR	EI v3.6	2019
Natural gas	market group for heat, district or industrial, natural gas | heat, district or industrial, natural gas | Cutoff	EI v3.6	2019
Steam	market for heat, from steam, in chemical industry | heat, from steam, in chemical industry | Cutoff	EI v3.6	2019

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 LG Hausys LVT 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 (typically 2016). 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 annualized production for 2018-19.
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.
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 v3.6 data where available. Different portions of the product life cycle are equally considered; however, it must be noted that final disposition of the product is based on assumptions of current average practices in the United States.
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 LG Hausys' facilities in South Korea represent an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI datasets, Ecoinvent v3.6 LCI data are used, with a bias towards the most recent representative data.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the flooring products and packaging is low. Actual supplier data for upstream operations was not available for all suppliers 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 the 12-month period from July 2018 – June 2019.

3.10 ALLOCATION

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

3.11 COMPARABILITY

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

4. LCA: Scenarios and Additional Technical Information

Delivery and Installation stage (A4 - A5)

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

Table 9. *Product distribution parameters, per 1 m^2 (A4).*

Parameter	Unit	Homogeneous Vinyl Sheet
Diesel truck – Fuel utilization	L/100 km	42
Diesel truck – Capacity utilization	%	76%
Diesel truck – Distance	km	1,142
Freight train – Fuel utilization	g/tkm	10
Freight train – Capacity utilization	%	67%
Freight train – Distance	km	425
Ocean freighter – Fuel utilization	g/tkm	2.5
Ocean freighter – Capacity utilization	%	65%
Ocean freighter – Distance	km	17,751
Gross mass of products transported (including packaging)	kg	3.72

The impacts associated with the product installation are assumed negligible. The impacts associated with packaging disposal are included with the installation phase as per PCR requirements.

Table 10. *Installation parameters for the vinyl flooring products, per 1 m^2 (A5).*

Parameter		Homogeneous Vinyl Sheet
Ancillary materials (kg)		negligible
Net freshwater consumption (m^3)		-
Electricity consumption (kWh)		-
Product loss per functional unit (kg)		negligible
Waste materials generated by product installation (kg)		negligible
Output materials resulting from on-site waste processing (kg)		na
Mass of packaging waste (kg)	Corrugated board	0.136
	Plastic	5.23×10^{-3}
Biogenic carbon contained in packaging (kg CO_2)		0.240
Direct emissions to ambient air, soil and water (kg)		-

Use stage (B1)

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

Maintenance stage (B2)

According to the manufacturer, typical maintenance involves regular sweeping, damp mopping and vacuuming. The present assessment is based on a recommended weekly cleaning schedule including sweeping and damp mopping with a neutral cleaner. Weekly vacuuming of the vinyl flooring is also included.

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

Parameter	Unit	Vinyl Sheet Flooring
Maintenance cycle	Cycles / RSL	520
Maintenance cycle	Cycles / ESL	3,900
Maintenance process	-	Damp mopping
Net freshwater consumption	$m^3/m^2/yr$	0.0058
Cleaning agent	$kg/m^2/yr$	0.0119
Maintenance process	-	Vacuuming
Electricity	$kWh/m^2/yr$	0.022
Further assumptions	-	Moderate traffic; weekly maintenance

Repair/Refurbishment stage (B3; B5)

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

Replacement stage (B4)

The materials and energy required for replacement of the product over the 75-year ESL of the assessment are included in this stage.

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 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.

Transportation of waste materials at end-of-life (C2) assumes a 20 mile (~32 km) average distance to disposal, consistent with assumptions used in the US EPA WARM model. The recycling rates used for the product packaging are based on regional statistics regarding municipal solid waste generation and disposal in the United States for 2015, from the US Environmental Protection Agency. No recycling of the product materials is assumed at end-of-life. The relevant disposal statistics used for the packaging are summarized in Table 12 and Table 13. For material not recycled, 80% are assumed landfilled and 20% incinerated.

Table 12. *Recycling rates for packaging materials at end-of-life.*

Material	Recycling Rate
Paper & Pulp	78.2%
Plastics	14.5%
Wood	26.1%

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

Parameter		Homogeneous Vinyl Sheet
Assumptions for scenario development		100% landfill
Collection process	Collected separately (kg)	-
	Collected with mixed construction waste (kg)	36.7
Recovery	na	-
Disposal	Landfill (kg)	36.7
Removals of biogenic carbon, excluding packaging (kg CO_2 eq)		3.00

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 2.1 and CML-IA.

CMLI-A Impact Category	Unit	TRACI 2.1 Impact Category	Unit
Global Warming Potential (GWP)	kg CO_2 eq	Global Warming Potential (GWP)	kg CO_2 eq
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq	Ozone Depletion Potential (ODP)	kg CFC 11 eq
Acidification Potential of soil and water (AP)	kg SO_2 eq	Acidification Potential (AP)	kg SO_2 eq
Eutrophication Potential (EP)	kg PO_4^{3-} eq	Eutrophication Potential (EP)	kg N eq
Photochemical Oxidant Creation Potential (POCP)	kg C_2H_4 eq	Smog Formation Potential (SFP)	kg O_3 eq
Abiotic depletion potential (ADP-elements) for non-fossil resources	kg Sb eq	Fossil Fuel Depletion Potential (ADP_{fossil})	MJ Surplus, LHV
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ, LHV	-	-

These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

The following inventory parameters, specified by the PCR, are also reported.

Resources	Unit	Waste and Outflows	Unit
RPR_E: Renewable primary resources used as energy carrier (fuel)	MJ, LHV	**HWD:** Hazardous waste disposed	kg
RPR_M: Renewable primary resources with energy content used as material	MJ, LHV	**NHWD:** Non-hazardous waste disposed	kg
$NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	**HLRW:** High-level radioactive waste, conditioned, to final repository	kg
$NRPR_M$: Non-renewable primary resources with energy content used as material	MJ, LHV	**ILLRW:** Intermediate- and low-level radioactive waste, conditioned, to final repository	kg
SM: Secondary materials	MJ, LHV	**CRU:** Components for re-use	kg
RSF: Renewable secondary fuels	MJ, LHV	**MR:** Materials for recycling	kg
NRSF: Non-renewable secondary fuels	MJ, LHV	**MER:** Materials for energy recovery	kg
RE: Recovered energy	MJ, LHV	**EE:** Recovered energy exported from the product system	MJ, LHV
FW: Use of net fresh water resources	m^3	-	-

Table 14. *CML Life Cycle Impact Assessment (LCIA) results for the Homogeneous Vinyl Sheet flooring product over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Module	GWP	ODP	AP	EP	POCP	ADPE	ADPF
	(kg CO_2 eq)	(kg CFC-11 eq)	(kg SO_2 eq)	(kg $(PO_4)^{3-}$ eq)	(kg C_2H_4 eq)	(kg Sb eq)	(MJ eq)
Total	87.7	$1.48x10^{-5}$	0.401	0.191	$2.23x10^{-2}$	$2.72x10^{-6}$	1,340
	100%	100%	100%	100%	100%	100%	100%
A1	5.16	$1.47x10^{-6}$	$2.11x10^{-2}$	$7.24x10^{-3}$	$1.41x10^{-3}$	$3.37x10^{-7}$	107
	5.9%	9.9%	5.3%	3.8%	6.3%	12%	8.0%
A2	$6.10x10^{-2}$	$9.33x10^{-9}$	$3.94x10^{-4}$	$1.02x10^{-4}$	$1.24x10^{-5}$	$6.46x10^{-11}$	0.819
	0.07%	0.06%	0.10%	0.05%	0.06%	0.00%	0.06%
A3	1.80	$1.37x10^{-7}$	$5.21x10^{-3}$	$3.35x10^{-3}$	$2.28x10^{-4}$	$1.63x10^{-8}$	21.2
	2.1%	0.93%	1.3%	1.8%	1.0%	0.60%	1.6%
A4	1.42	$2.38x10^{-7}$	$1.96x10^{-2}$	$2.66x10^{-3}$	$5.39x10^{-4}$	$1.06x10^{-9}$	19.6
	1.6%	1.6%	4.9%	1.4%	2.4%	0.04%	1.5%
A5	$8.30x10^{-2}$	$8.13x10^{-9}$	$2.22x10^{-4}$	$1.12x10^{-4}$	$1.51x10^{-5}$	$1.46x10^{-11}$	0.641
	0.09%	0.06%	0.06%	0.06%	0.07%	0.00%	0.05%
B1	0	0	0	0	0	0	0
B2	9.59	$5.65x10^{-7}$	$4.29x10^{-2}$	$1.82x10^{-2}$	$2.82x10^{-3}$	$6.01x10^{-8}$	198
	11%	3.8%	11%	9.5%	13%	2.2%	15%
B3	0	0	0	0	0	0	0
B4	67.7	$1.23x10^{-5}$	0.310	0.150	$1.69x10^{-2}$	$2.31x10^{-6}$	990
	77%	83%	77%	78%	76%	85%	74%
B5	0	0	0	0	0	0	0
B6	0	0	0	0	0	0	0
B7	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0
C2	0.146	$2.54x10^{-8}$	$6.82x10^{-4}$	$1.47x10^{-4}$	$2.26x10^{-5}$	$3.99x10^{-11}$	2.00
	0.17%	0.17%	0.17%	0.08%	0.10%	0.00%	0.15%
C3	0	0	0	0	0	0	0
C4	1.74	$1.03x10^{-8}$	$4.44x10^{-4}$	$9.46x10^{-3}$	$3.70x10^{-4}$	$1.85x10^{-10}$	1.07
	2.0%	0.07%	0.11%	4.9%	1.7%	0.01%	0.08%
D	MND	MND	MND	MND	MND	MND	MND

MND = Module not declared

Table 15. *TRACI Life Cycle Impact Assessment (LCIA) results for the Homogeneous Vinyl Sheet flooring product over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Module	GWP	ODP	AP	EP	SFP	FFD
	(kg CO_2 eq)	(kg CFC-11 eq)	(kg SO_2 eq)	(kg N eq)	(kg O_3 eq)	(MJ eq)
Total	85.3	$1.65x10^{-5}$	0.432	0.405	6.77	164
	100%	100%	100%	100%	100%	100%
A1	5.06	$1.54x10^{-6}$	$2.19x10^{-2}$	$1.44x10^{-2}$	0.269	13.4
	5.9%	9.4%	5.1%	3.6%	4.0%	8.2%
A2	$6.08x10^{-2}$	$1.24x10^{-8}$	$4.88x10^{-4}$	$1.03x10^{-4}$	$1.36x10^{-2}$	0.105
	0.07%	0.08%	0.11%	0.03%	0.20%	0.06%
A3	1.79	$1.73x10^{-7}$	$5.73x10^{-3}$	$6.89x10^{-3}$	$9.20x10^{-2}$	2.00
	2.1%	1.0%	1.3%	1.7%	1.4%	1.2%
A4	1.42	$3.16x10^{-7}$	$2.13x10^{-2}$	$1.95x10^{-3}$	0.419	2.67
	1.7%	1.9%	4.9%	0.48%	6.2%	1.6%
A5	$7.91x10^{-2}$	$1.08x10^{-8}$	$2.80x10^{-4}$	$2.08x10^{-4}$	$7.68x10^{-3}$	$9.06x10^{-2}$
	0.09%	0.07%	0.06%	0.05%	0.11%	0.06%
B1	0	0	0	0	0	0
B2	9.44	$6.81x10^{-7}$	$4.44x10^{-2}$	$3.68x10^{-2}$	0.507	23.9
	11%	4.1%	10%	9.1%	7.5%	15%
B3	0	0	0	0	0	0
B4	65.7	$1.37x10^{-5}$	0.336	0.319	5.43	121
	77%	83%	78%	79%	80%	74%
B5	0	0	0	0	0	0
B6	0	0	0	0	0	0
B7	0	0	0	0	0	0
C1	0	0	0	0	0	0
C2	0.146	$3.39x10^{-8}$	$8.43x10^{-4}$	$1.11x10^{-4}$	$2.38x10^{-2}$	0.283
	0.17%	0.21%	0.20%	0.03%	0.35%	0.17%
C3	0	0	0	0	0	0
C4	1.55	$1.36x10^{-8}$	$1.20x10^{-3}$	$2.54x10^{-2}$	$9.81x10^{-3}$	0.128
	1.8%	0.08%	0.28%	6.3%	0.14%	0.08%
D	MND	MND	MND	MND	MND	MND

MND = Module not declared

Table 16. *Resource use for the Homogeneous Vinyl Sheet flooring product over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Module	RPR_E	RPR_M	$NRPR_E$	$NRPR_M$	SM	RSF/NRSF	RE	FW
	(MJ)	(MJ)	(MJ)	(MJ)	(kg)	(MJ)	(MJ)	(m^3)
Total	95.2	0.00	INA	INA	0.00	0.00	0.00	5.14
	100%	0.00			0.00	0.00	0.00	100%
A1	4.45	0.00	INA	INA	0.00	0.00	0.00	0.324
	4.7%	0.00			0.00	0.00	0.00	6.3%
A2	$1.80x10^{-2}$	0.00	INA	INA	0.00	0.00	0.00	$8.96x10^{-4}$
	0.02%	0.00			0.00	0.00	0.00	0.02%
A3	5.38	0.00	INA	INA	0.00	0.00	0.00	0.134
	5.6%	0.00			0.00	0.00	0.00	2.6%
A4	0.201	0.00	INA	INA	0.00	0.00	0.00	$1.22x10^{-2}$
	0.21%	0.00			0.00	0.00	0.00	0.24%
A5	$2.83x10^{-3}$	0.00	INA	INA	0.00	0.00	0.00	$2.47x10^{-4}$
	0.00%	0.00%			0.00%	0.00%	0.00%	0.00%
B1	0	0	0	0	0	0	0	0
B2	19.5	0.00	INA	INA	0.00	0.00	0.00	1.58
	20%	0.00%			0.00%	0.00%	0.00%	31%
B3	0	0	0	0	0	0	0	0
B4	65.6	0.00	INA	INA	0.00	0.00	0.00	3.08
	69%	0.00%			0.00%	0.00%	0.00%	60%
B5	0	0	0	0	0	0	0	0
B6	0	0	0	0	0	0	0	0
B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	$7.36x10^{-3}$	0.00	INA	INA	0.00	0.00	0.00	$6.57x10^{-4}$
	0.01%	0.00%			0.00%	0.00%	0.00%	0.01%
C3	0	0	0	0	0	0	0	0
C4	$4.25x10^{-2}$	0.00	INA	INA	0.00	0.00	0.00	$2.41x10^{-3}$
	0.04%	0.00%			0.00%	0.00%	0.00%	0.05%
D	MND	MND	MND	MND	MND	MND	MND	MND

MND = Module not declared | INA = Indicator not assessed

Table 17. *Waste and outflows for the Homogeneous Vinyl Sheet flooring product over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Module	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(MJ)
Total	$1.72x10^{-3}$	36.7	$4.04x10^{-4}$	$2.88x10^{-3}$	0.00	1.56	Neg.	Neg.
	100%	100%	100%	100%	0.00	100%	Neg.	Neg.
A1	$1.60x10^{-5}$	0.429	$4.71x10^{-6}$	$4.20x10^{-5}$	0.00	0.00	Neg.	Neg.
	0.93%	1.2%	1.2%	1.5%	0.00	0.00%	Neg.	Neg.
A2	$8.59x10^{-7}$	$2.15x10^{-2}$	$1.48x10^{-7}$	$4.57x10^{-6}$	0.00	0.00	Neg.	Neg.
	0.05%	0.06%	0.04%	0.16%	0.00	0.00%	Neg.	Neg.
A3	$1.68x10^{-4}$	0.172	$3.87x10^{-5}$	$1.29x10^{-4}$	0.00	0.112	Neg.	Neg.
	9.8%	0.47%	9.6%	4.5%	0.00	7.1%	Neg.	Neg.
A4	$1.45x10^{-5}$	0.536	$2.66x10^{-6}$	$1.45x10^{-4}$	0.00	0.00	Neg.	Neg.
	0.84%	1.5%	0.66%	5.0%	0.00	0.00%	Neg.	Neg.
A5	$2.56x10^{-7}$	$2.71x10^{-2}$	$2.02x10^{-8}$	$4.82x10^{-6}$	0.00	0.00	Neg.	Neg.
	0.01%	0.07%	0.00%	0.17%	0.00	0.00%	Neg.	Neg.
B1	0	0	0	0	0	0	0	0
B2	$1.93x10^{-4}$	0.849	$5.49x10^{-5}$	$2.78x10^{-4}$	0.00	0.00	Neg.	Neg.
	11%	2.3%	14%	9.7%	0.00	0.00%	Neg.	Neg.
B3	0	0	0	0	0	0	0	0
B4	$1.32x10^{-3}$	31.1	$3.03x10^{-4}$	$2.25x10^{-3}$	0.00	1.45	Neg.	Neg.
	77%	85%	75%	78%	0.00	93%	Neg.	Neg.
B5	0	0	0	0	0	0	0	0
B6	0	0	0	0	0	0	0	0
B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	$7.68x10^{-7}$	$9.41x10^{-3}$	$5.43x10^{-8}$	$1.51x10^{-5}$	0.00	0.00	Neg.	Neg.
	0.04%	0.03%	0.01%	0.52%	0.00%	0.00%	Neg.	Neg.
C3	0	0	0	0	0	0	0	0
C4	$2.99x10^{-6}$	3.59	$2.65x10^{-7}$	$6.40x10^{-6}$	0.00	0.00	Neg.	Neg.
	0.17%	9.8%	0.07%	0.22%	0.00%	0.00%	Neg.	Neg.
D	MND	MND	MND	MND	MND	MND	MND	MND

MND = Module not declared | Neg. = Negligible

6. LCA: Interpretation

In general, excluding the product replacement phase, the main contributions to the indicator results for the impact category indicators assessed are from the product maintenance phase (B2), accounting for ~30% to 50% of the total impacts of the product system depending on the specific product and impact indicator. Other life cycle stage results vary across indicators although generally the raw material and extraction phase (A1) and product manufacturing (A3) disposal (C4) phases are the next highest contributors followed by the product disposal (C4) and distribution (A4) phases.

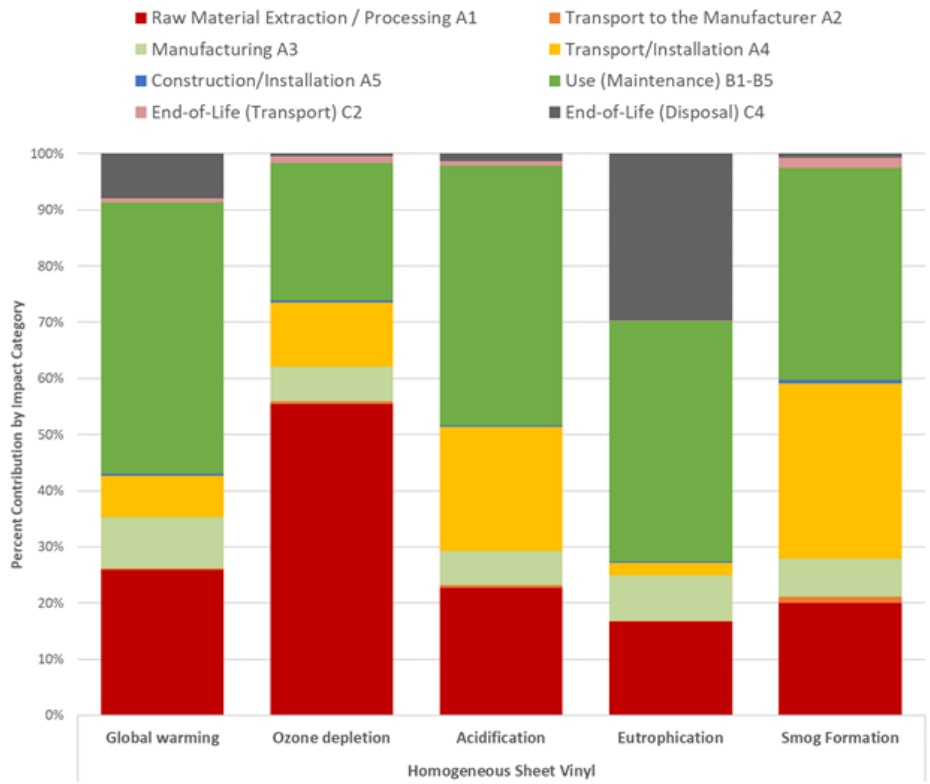

Figure 2. *Contribution analysis for the LG Hausys Homogeneous Vinyl Sheet flooring product – TRACI v2.1.*

7. Additional Environmental Information

7.1 ENVIRONMENT AND HEALTH DURING MANUFACTURING

The LG Hausys manufacturing facilities are certified to ISO 9001 and ISO 14001 – Environmental management systems.

7.2 ENVIRONMENT AND HEALTH DURING INSTALLATION

The LG Hausys Vinyl Sheet flooring products meet the requirements of the following:

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

7.3 ENVIRONMENTAL ACTIVITIES AND CERTIFICATIONS

For more information on LG Hausys' certifications and environmental initiatives please view the website at http://www.lghausys.com/

8. References

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