**Environmental** Product Declaration

# Heterogeneous Vinyl Flooring

INDUSTRY-WIDE ENVIRONMENTAL PRODUCT DECLARATION

This Environmental Product Declaration is provided by members of the Resilient Floor Covering Institute (RFCI) who have been environmental leaders in the building materials industry by continually developing new programs which encourage and reward flooring companies for reducing the environmental impacts of their products. These programs include: FloorScore for Indoor Air Quality, NSF/ ANSI – 332 for product sustainability, and this industry average EPD which recognizes the importance of transparency by providing information on the raw materials, production and environmental impacts of resilient flooring products.

This is an industry-wide EPD facilitated by RFCI with participation from the following companies:

- Armstrong
- Congoleum
- Gerflor
- IVC US
- LG Hausys
- Lonseal
- Mannington
- Shaw
- Tarkett

For more information visit:

www.rfci.com.

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ENVIRONMENTAL PRODUCT DECLARATION
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# ENVIRONMENTAL PRODUCT DECLARATION

**Industry-Wide EPD**
Heterogeneous Vinyl Flooring

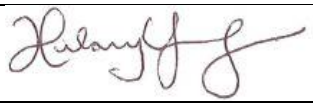
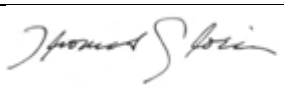
**According to ISO 14025**

This Environmental Product Declaration (EPD) has been prepared in accordance with ISO 14025 for Type III environmental performance labels. This EPD does not guarantee that any performance benchmarks, including environmental performance benchmarks, are met. EPDs provide life cycle assessment (LCA)-based information and additional information on the environmental aspects of products to assist purchasers and users to make informed comparisons between products. In providing transparent information about environmental impacts of products over their life cycle, EPDs encourage improvement of environmental performance. EPDs not based on an LCA covering all life cycle stages, or based on a different Product Category Rules (PCR), are examples of declarations that have limited comparability. EPDs from different programs may also not be comparable.


| | |
|---|---|
| PROGRAM OPERATOR | UL Environment |
| DECLARATION HOLDER | Resilient Floor Covering Institute |
| DECLARATION NUMBER | 12CA56057.101.1 |
| DECLARED PRODUCT | Heterogeneous Vinyl Flooring |
| REFERENCE PCR | Flooring: Carpet, Resilient, Laminate, Ceramic, and Wood (NSF 2012) |

| | |
|---|---|
| DATE OF ISSUE | 11 July 2013 |
| PERIOD OF VALIDITY | 5 years |

| | |
|---|---|
| CONTENTS OF THE DECLARATION | Product definition and information about building physics<br>Information about basic material and the material's origin<br>Description of the product's manufacture<br>Indication of product processing<br>Information about the in-use conditions<br>Life cycle assessment results<br>Testing results and verifications |

| | |
|---|---|
| The PCR review was conducted by: | NSF International |
| | Accepted by PCR Review Panel |
| | ncss@nsf.org |
| This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories<br>☐ INTERNAL ☒ EXTERNAL |  |
| | Hilary Young |
| This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by: |  |
| | Thomas Gloria, Life-Cycle Services, LLC |

**Industry-Wide EPD**
Heterogeneous Vinyl Flooring

**According to ISO 14025**

## Resilient Floor Covering Institute

RFCI is all about resilient flooring… and resilient flooring is all about sustainability, durability, affordability and style. It encompasses a surprisingly wide variety of hard surface flooring products – from vinyl and linoleum to rubber and cork.

The Resilient Floor Covering Institute (RFCI) is an industry trade association of leading resilient flooring manufacturers and suppliers of raw materials, additives and sundry flooring products for the North American market. The institute was established to support the interests of the total resilient floor covering industry—as well as the people and communities that use its products. For more information visit www.rfci.com

Information in this document has been coordinated by the RFCI Technical Staff based on information submitted by the leading manufacturers of heterogeneous vinyl flooring. The product configurations offered herein use ranges representative of all types of heterogeneous vinyl flooring from the following six primary manufacturers:

Armstrong World Industries is a global leader in the design and manufacture of commercial and residential flooring. For over 100 years, Armstrong has provided high-quality, innovative and award-winning flooring designs that enable our customers to create exceptional and sustainable indoor environments.

Inspired design and industry-leading innovation have been the hallmark of the Congoleum brand for over 125 years. Proudly manufacturing in the United States with an unwavering commitment to quality, value and customer satisfaction, Congoleum remains the flooring brand of choice in millions of homes and businesses.

For more than 70 years and in more than 100 countries, Gerflor is recognized as an expert and a world leader in its field thanks to technical, decorative and eco-responsible added value solutions specific to each market application.

IVC US Inc. is the North American subsidiary of IVC Group which was founded in 1997 in Belgium. Since its incorporation in 2004, IVC US has been rapidly growing as an independent player in the domestic resilient flooring market, manufacturing resilient products for both residential and commercial applications in its state-of-the-art manufacturing plant and HQ in Dalton, GA.

LG Hausys is one of the world's largest resilient flooring manufacturers and has various product line-ups such as sheets, tiles, specialties and residential floorings. Over 50 years, we have striven to meet the specific technology and design requirements for any project. LG Hausys is a conscientious company leading changes for the good in business, society, and the environment.

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Lonseal is a designer and manufacturer of resilient flooring products that have pushed the limits of vinyl convention for over 35 years. Lonseal leads the vinyl surfacing industry in exciting new directions through technological, visual, and textured innovations. Our products have been featured in healthcare, educational, recreational, fitness, corporate, retail, and hospitality markets throughout the United States and across the globe.

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

Shaw Industries Group, Inc. is the world's largest carpet manufacturer and a leading floor covering provider. We supply carpet, resilient, hardwood, laminate, tile & stone flooring products and synthetic turf to residential and commercial markets worldwide via our brands Anderson, Patcraft, Philadelphia Commercial, Shaw Contract Group, Shaw Floors, Shaw Hospitality Group, Shaw Sports Turf, and more.

With more than 130 years of history, Tarkett is a worldwide leader of innovative and sustainable flooring and sports surface solutions. Tarkett provides integrated and coordinated flooring and sports surface solutions to professionals and end-users that measurably enhance both people's quality of life and building facilities' life-time return.

## Use of EPDs

Two main purposes for creating EPDs are promoting transparency of environmental performance and verbalizing complex life cycle assessment information in a standardized way. Additionally there is a desire to try and compare life cycle information across similar product categories. The current EPD landscape emphasizes transparency and standardization of format, but exact comparability is not always possible. LCA results across EPDs can be calculated with different background databases, modeling assumptions, geographic scope and time periods, all of which are valid and acceptable according to the Product Category Rules (PCR) and ISO standards. Caution should be used when attempting to compare EPD results.

This EPD follows the specifications of PCR Flooring: Carpet, Resilient, Laminate, Ceramic, and Wood (NSF 2012). Eco-toxicity and human health assessments are not part of this PCR and are not addressed in this EPD. The current available models used to calculate eco-toxicity and human health assessments impact categories have a large amount of uncertainty and variation in their results. Over time, it is expected that research will improve the accuracy of these models making the results meaningful like other impact categories (i.e. greenhouse gas, acidification, etc.).

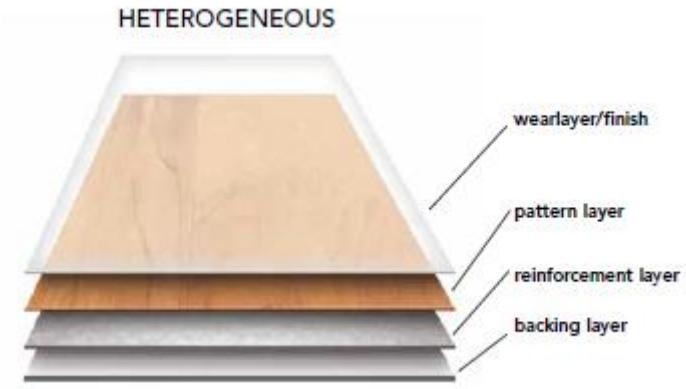
# Product Definition

## Product Classification and Description

This declaration covers a broad range of styles and colors produced by the 7 major manufacturers of Heterogeneous Vinyl Flooring. There are two basic types of heterogeneous vinyl flooring. In the Type I construction, a clear wear layer protects the décor layer below it; this layer sits on top of a separate backing layer. In Type II construction, the décor and the wear layer are one and the same and like the first construction, the product has a separate backing layer. There can be an inner construction layer(s) between the backing and the décor layer for purposes of functional property enhancement. The wear layer has a vinyl plastic binder and may include pigments, fillers, extenders and other ingredients; this layer is stabilized against heat and light deterioration. The binder of the wear layer consists of one or more resins, plasticizers and stabilizers. The wear layer may be transparent, translucent or opaque. A background or pattern under the wear layer may be printed with color inks. The surface of the wear layer may be smooth, embossed or otherwise textured. Heterogeneous vinyl flooring is intended for use in commercial, light commercial and residential buildings depending on the wear layer thickness. It is used in residences, multi-family dwellings, and commercially in education/institutional, hospital/healthcare, retail/mercantile, office and hospitality healthcare facilities. Heterogeneous vinyl flooring is available in thicknesses from 1.1 to 3.8mm thick and in many different patterns.

The manufacturing process results in a multi-layer product with a decorative application and high performance coating being applied to the surface of some of these products. A diagram of heterogenous vinyl flooring cross-section is shown below.

**Figure 1: Diagram of Heterogeneous Vinyl Flooring Cross-Section**




## Range of Applications

Heterogeneous vinyl flooring is commonly used in commercial, light commercial, and residential interiors.

## Product Standards

The products considered in this EPD meet or exceed one of the following Technical Specifications:

- ASTM F 1303 – Standard Specification for Vinyl Sheet Floor Covering with Backing
- ISO 10582 – Resilient floor coverings – Heterogeneous polyvinyl chloride floor covering - Specification

Fire Testing:

- Class 1 when tested in accordance with ASTM E 648/NFPA 253, Standard Test Method for Critical Radiant Flux
- Meets 450 or less when tested in accordance with ASTM E 662/NFPA 258, Standard Test Method for Smoke Density if applicable
- FSCI-150; SD-150 when tested in accordance with CAN/ULC S102.2, Standard Test Method for Flame Spread Rating and Smoke Development if applicable

## Accreditation

Compliant with FloorScore Flooring Products Certification Program for Indoor Air Quality.

## Product Characteristics

| Heterogeneous Vinyl Flooring | | Average Value | Unit | Minimum Value | Maximum Value |
|---|---|---|---|---|---|
| **Product Thickness** | | | mm | 1.1 | 5.5 |
| **Wear Layer Thickness (where relevant)** | | | mm | 0.20 | 0.9 |
| **Product Weight *** | | 2,268 | g/m$^2$ | 1,446 | 5,616 |
| **Product Form:** | **Roll Width** | | m | 1.83 | 3.66 |
| **VOC emissions test method** | *Compliant with California Department of public Health Standard v1.1, 2010 and certified by FloorScore Flooring Products Certification Program for Indoor Air Quality.* | | | | |

*To determine the average product weight, the actual volume of each participating manufacturer's production was used proportionately to determine the overall average value in the above chart.

## Material Content

**Material Content of the Product**

| Component | Material | Mass % | Availability | | | Origin of raw materials |
|---|---|---|---|---|---|---|
| | | | Renewable | Non-renewable | Recycled | |
| **Resin** | Polyvinyl chloride | 41.4% | | Fossil limited | | US / Europe |
| **Plasticizer** | DOTP | 21.2% | | Fossil limited | | US / Europe |
| **Fillers** | Dolomite, limestone | 19.0% | | Mineral abundant | | Global |
| **Backing** | Felt<br>Glass fiber | 12.2% | Bio-based crop | Mineral abundant | | US / Europe |
| **Additives** | Various | 4.6% | | Fossil limited | | Global |
| **Other components** | Various | 1.6% | | Fossil limited | | Global |

### Production of Main Materials

**Polyvinyl chloride (PVC):**

Derived from fossil fuel and salt. Petroleum or natural gas is processed to make ethylene, and salt is subjected to electrolysis to separate out the natural element chlorine. Ethylene and chlorine are combined to produce ethylene dichloride, which is further processed into a gas called vinyl chloride monomer (VCM). Finally in polymerization the VCM molecule forms chains, converting the gas into fine, white powder—vinyl resin, CAS# 9002-86-2.

**Plasticizers:**

Plastizers are used to make vinyl soft and flexible. Dioctyl terephthalate (DOTP), CAS# 6422-86-22, is prepared by the reaction of dimethyl terephthalate and 2-ethylhexanol.

**Dolomite:**

A carbonate mineral, CAS# 16389-88-1 used as inert filler.

**Limestone:**

Calcium carbonate, CAS# 1317-65-3 used as inert filler.

**Felt Backing:**

Composite substrate with high percentage of minerals (such as calcium carbonate, talc, kaolin, etc.) combined with fibers (such as cellulose, glass, polyester, etc.) and a binder (such as latex) and produced on a paper making machine.

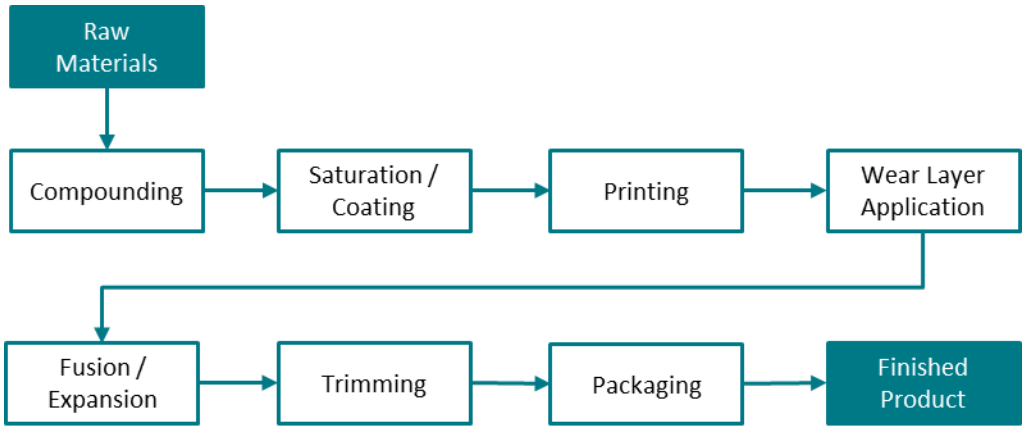
**Glass Fiber Backing:**

Nonwoven glass scrim comprised of chopped glass fibers and binder.

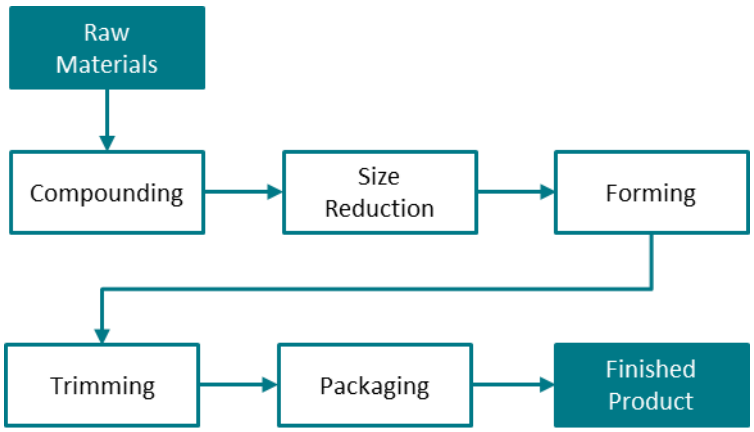
## Production of the Floor Covering

**Figure 2: Diagram of Production Process**

Heterogeneous Vinyl Flooring




Heterogeneous Vinyl Flooring with filled wear layer




### Production Waste

On average, 2.0% of production materials are sent to the the landfill as waste.

## Delivery and Installation of the Floor Covering

### Delivery

In this study, transport to construction site by truck and flooring installation in the building are included. In the case of products manufactured in Europe and Asia, shipping to the US is included as part of transport to the installation site by truck.

### Installation

Adhesive is typically required for installation; 300 grams / square meter are used. During installation, approximately 6% of the total material is cut off as waste. Though some of this waste could be recycled, this scrap is modeled as being disposed of in a landfill.

### Waste

Both installed product waste and packaging waste are assumed to be sent to a landfill for this EPD (although packaging material is often recycled in local programs). Landfill emissions from paper, plastic, and wood packaging are allocated to installation. Electricity generated from landfill gas (produced from the decomposition of bio-based packaging) is assumed to replace energy on the US grid.

### Packaging

This EPD presumes that polypropylene wrap, polyethylene wrap, cardboard, and wood packaging are sent with the flooring material to the jobsite and then sent to landfill as waste.

## Use stage

The service life of heterogeneous vinyl flooring will vary depending on the amount of floor traffic and the type and frequency of maintenance. The level of maintenance is also dependent on the actual use and desired appearance of the floor. For this product, the Reference Service Life (RSL) is 30 years. This means that the product will meet its functional requirements for an average of 30 years before replacement. Since the EPD must present results for both one-year and 60-year time periods, impacts are calculated for both time horizons. In the case of one-year results, the use phase impacts are based on the cleaning and maintenance model for one year. In the case of 60-year results, the production, transport, installation, and end-of-life are scaled to reflect replacements during the 60 year period; use phase impacts are scaled to represent maintenance for 60 years.

### Cleaning and Maintenance

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 is presented based on typical installations.

**Table 1: Cleaning Process**

| Level of use | Cleaning Process | Cleaning Frequency | Consumption of energy and resources |
|---|---|---|---|
| **Commercial / Residential / Industrial** | Dust mop | Daily | None |
| | Damp mop / neutral cleaner | Weekly | Hot water<br>Neutral detergent |
| | Spray buff / finish restorer | Monthly | Floor finish<br>Electricity |

This cleaning process translates to:

**Table 2: Cleaning Inputs**

| | Amount | Units |
|---|---|---|
| **Detergent** | 119 | mL / $m^2$ / yr. |
| **Electricity** | 0.022 | kWh / $m^2$ / yr. |
| **Finish** | 0.12 | L / $m^2$ / yr. |
| **Finish remover** | 0 | L / $m^2$ / yr. |
| **Water** | 5.8 | L / $m^2$ / yr. |

### Prevention of Structural Damage

Heavy furniture and equipment should be kept off the floor for a minimum of 72 hours after floor installation to allow the adhesive to set. Damage from wheeled vehicles, castered furniture and dollies can be prevented by using proper furniture rests, wheels or casters with suitable widths and diameters for the loads to be carried.

Moisture in subfloors is an important consideration for the successful installation of heterogeneous vinyl flooring. To avoid damage from moisture, recommended guidelines in ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring and ASTM F 1482 Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring should be followed.

### Health Aspects During Usage

The flooring products in this EPD comply with the VOC emissions requirements in the California Department of Public Health (CDPH) Standard Method v1.1 as certified by the FloorScore Certification Program for Indoor Air Quality.

Low VOC cleaning materials are available for use in maintaining heterogeneous vinyl flooring.

## End of Life

Based on current best information a small amount of waste is incinerated or recycled, but for the purposes of this EPD 100% of all flooring removal waste is considered disposed of in a landfill.

## Life Cycle Assessment

A full Life Cycle Assessment has been carried out according to ISO 14040 and 14044, per the Product Category Rules (PCR) for Flooring: Carpet, Resilient, Laminate, Ceramic, Wood, as published by NSF International (2012).

The following life cycle stages are considered:

- Product stage
- Construction stage
- Use stage
- End-of-life stage
- Benefits and loads beyond the product system boundary

The main purpose of EPDs is for use in business-to-business communication. As all EPDs are publicly available via the Program Operator and therefore are accessible to the end consumer, they can also be used in business-to-consumer communication.

### Functional Unit Description

The declaration refers to the functional unit of 1m² installed floor covering.

### Cut-off Criteria

At a minimum, all raw materials representing 1% of input mass or greater were included. In order to satisfy the condition that neglected input flows shall be a maximum of 5% mass, material flows with a proportion of less than 1% were considered so that ultimately, materials below the cut-off criteria accounted for no more than 5% of total input mass. For manufacturing, the water required for steam generation, the utilized thermal energy, the electrical energy, the required packaging materials, and all direct production waste are all included in the analysis.

### Background Data

As a general rule, specific data derived from specific production processes or average data derived from specific production processes shall be the first choice as a basis for calculating LCA results.

For life cycle modeling of the considered products, the GaBi 6 Software System for Life Cycle Engineering, developed by thinkstep AG, has been used to model the product systems considered in this assessment. All relevant background datasets are taken from the GaBi 2014 software database. The datasets from the GaBi database are documented in the online documentation (thinkstep 2015). To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

### Data Quality

A variety of tests and checks were performed throughout the project to ensure high quality of the completed LCA. Checks included an extensive review of project-specific LCA models as well as the background data used.

**Temporal Coverage**

Foreground data are based on 1 year averaged data between 2010 and 2011. Background datasets are all based on data from the last 10 years (since 2004), with the majority of datasets based on data from 2010 or later.

### Technological Coverage

The raw material inputs in the calculation for this EPD are based on annual total purchases divided by annual production.

Waste, emissions and energy use are based on measured data during the reference year.

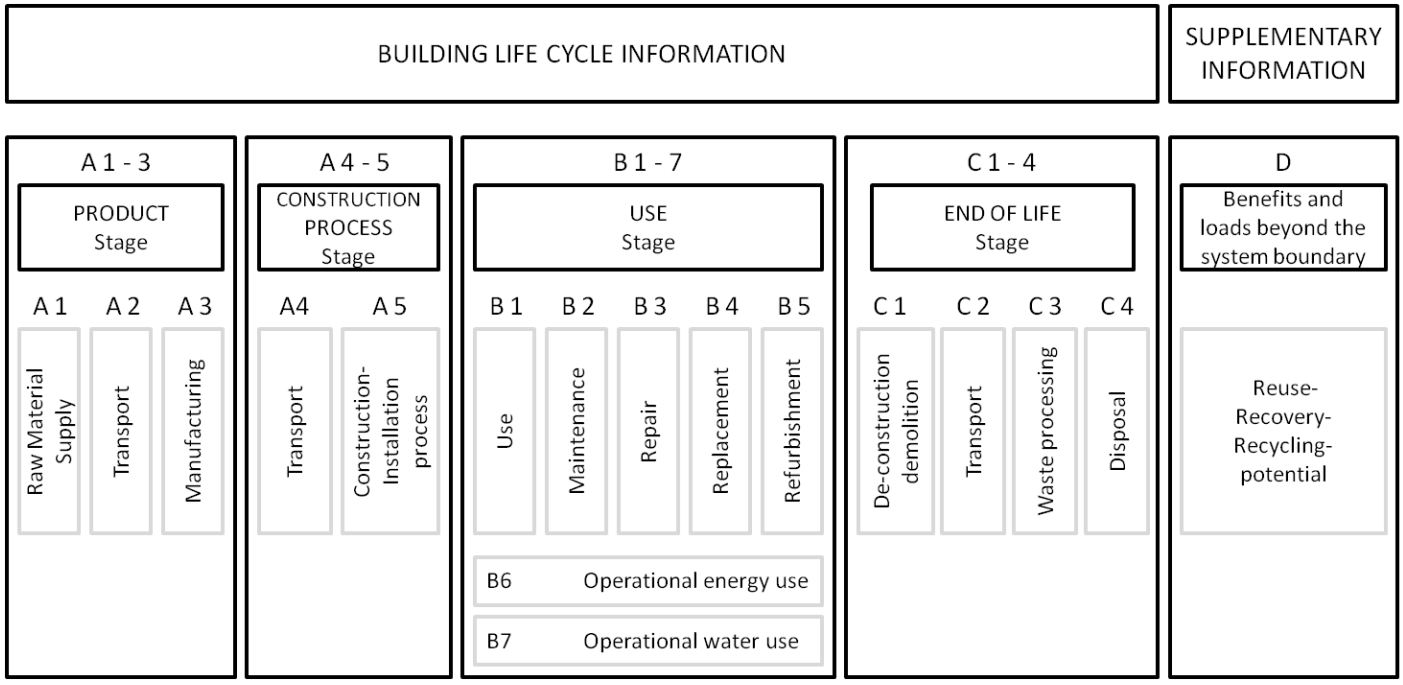
### Geographical Coverage

In order to satisfy cut-off criteria, proxy datasets were used as needed for raw material inputs to address lack of data for a specific material or for a specific geographical region. These proxy datasets were chosen for their representativeness of the actual product. For example, a DINP dataset was used to represent all phthalate plasticizers. Additionally, European data or global data were used when North American data (for raw materials sourced in the US) were not available.

## System Boundaries

The system boundary of the EPD follows the modular design defined by EN 15804. The following pages describe the modules which are contained within the scope of this study in detail.

**Figure 3: LCA system boundaries**

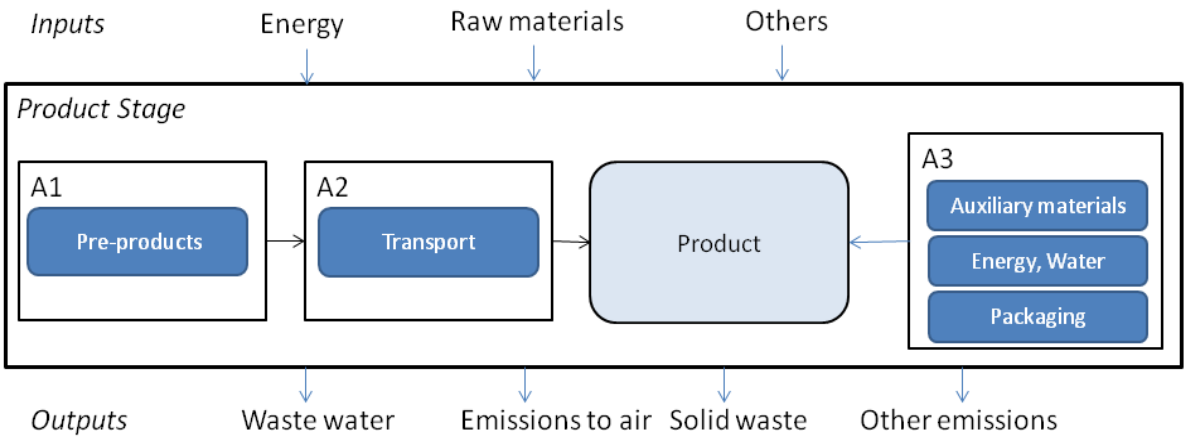



Impacts and aspects related to wastage (i.e. production, transport and waste processing and end-of-life stage of lost waste products and materials) are considered in the module in which the wastage occurs.

### Product Stage

The following flowchart shown in Figure 4 represents the system boundaries for the product stage.

**Figure 4: Schematic representation of the LCA system boundaries of the production stage (Modules A1-A3)**




The product stage is an information module which must be contained in each EPD and includes:

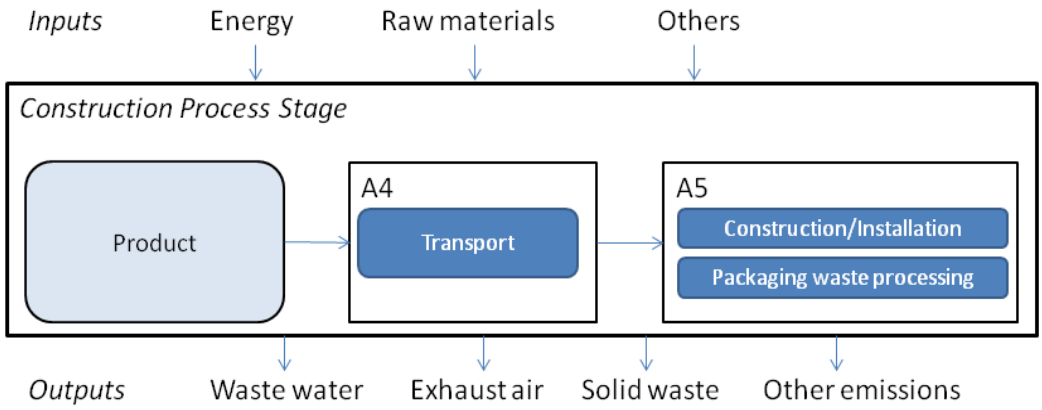
- A1 — raw material extraction and processing, processing of secondary material input (e.g. recycling processes)
- A2 — transport to the manufacturer and
- A3 — manufacturing.

This includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues during the product stage.

### Construction Process

The following flowchart shown in Figure 5 represents the system boundaries for the construction stage.

**Figure 5: Schematic representation of the LCA system boundaries of the construction stage (Modules A4-A5)**




The construction process stage (delivery and installation) comprises:

- A4 — transport to the installation site and
- A5 — installation in the building.

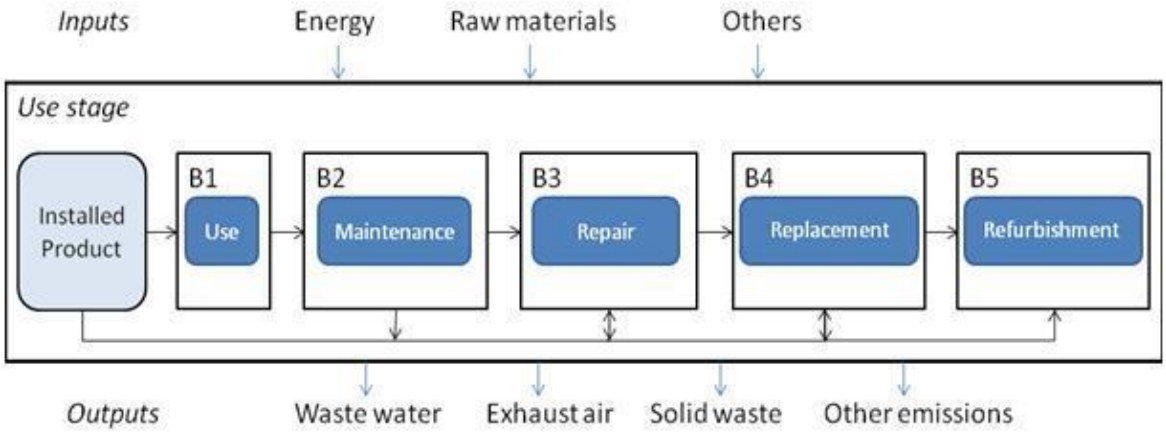
This includes provision of all materials, products and energy, as well as waste processing and disposal of waste created during the installation stage. These information modules also include all impacts and aspects related to any scrap materials generated during the installation.

In this study, transport 500 miles to installation site by truck and flooring installation in the building are included. For products manufactured outside of the US, transport by boat before shipping to installation site was also included.

### Use

The following flowchart shown in Figure 6 represents the system boundaries for the use stage related to the building fabric. The processes B1, B3, and B5 are not relevant for the flooring and therefore not considered in this study.

**Figure 6: Schematic representation of the LCA system boundaries of the use stage (Modules B1-B5)**




The use stage, related to the building includes:

- B2 — maintenance;
- B4 — replacement;

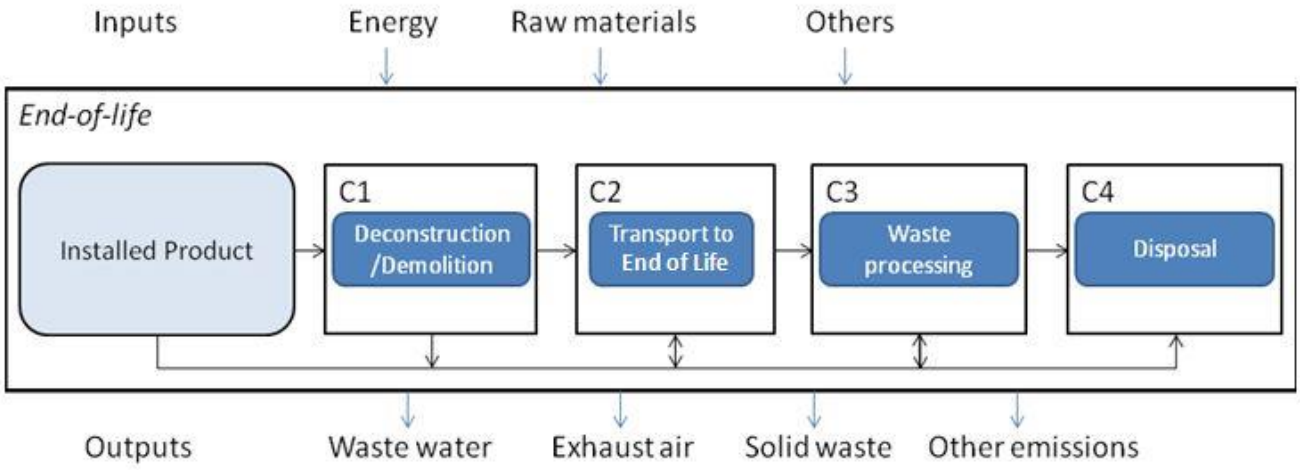
This includes provision and transport of all materials, products and related energy and water use, as well as waste processing up to the end-of-waste state or disposal of final residues during this part of the use stage. These information modules also include all impacts and aspects related to the losses during this part of the use stage (i.e., production, transport, and waste processing and disposal of the lost products and materials).

In this study the cleaning process (i.e., maintenance) consisting of dust mopping, damp mopping, and spray buffing is considered.

**End-of-Life**

The following flowchart shown in Figure 7 represents the system boundaries for the End-of-lLife stage:

**Figure 7: Schematic representation of the LCA system boundaries of the End-of-Life stage (Module C1-C4)**




The end-of-life stage starts when the flooring product is removed from the building and does not provide any further function. This stage includes:

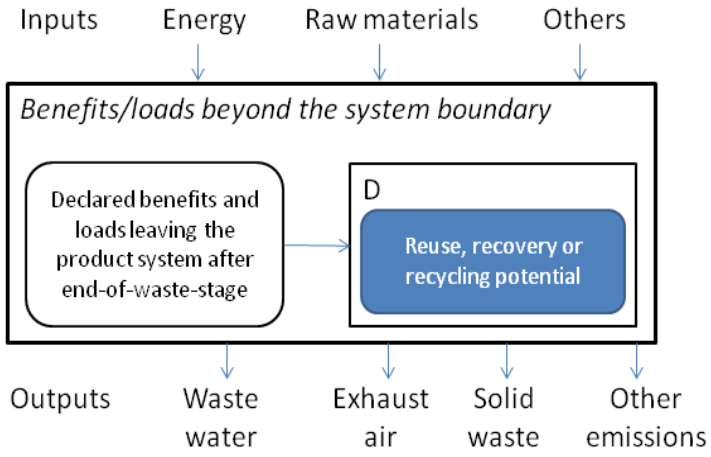
- C1 — de-construction, demolition:
- C2 — transport to waste processing;
- C3 — waste processing for reuse, recovery and/or recycling;
- C4 — disposal

This includes provision and all transports, provision of all materials, products and related energy and water use. Materials are assumed transported 20 miles by truck to disposal.

### Benefits and Loads beyond the system boundary (Credits)

The flowchart shown in Figure 8 represents the benefits/loads beyond the system boundary. In particular, these credits include the benefit from capturing methane gas at landfills which can be used for electricity generation.

**Figure 8: Schematic representation of the LCA system boundaries of the benefits and loads beyond the product system boundary (Module D)**




This life cycle phase includes credits from all net flows that leave the product system boundary. Since the electricity generated from landfill gas combustion is utilized outside the flooring life cycle, a credit is applied (represented by negative emissions) for the displaced average US electricity grid mix.

## Allocation

### Co-Product Allocation

No co-product allocation occurs in the product system.

### Multi-Input Processes Allocation

No multi-input allocation occurs in the product system.

### Reuse, Recycling, and Recovery Allocation

The cut-off allocation approach is adopted in the case of any post-consumer recycled content, which is assumed to enter the system burden-free. Only environmental impacts from the point of recovery and forward (e.g., collection, sorting, processing, etc.) are considered.

Product and packaging waste is modeled as being disposed in a landfill rather than incinerated or recycled. Plastic and other construction waste is assumed to be inert in landfills so no system expansion or allocation is necessary as landfill gas is not produced. In the case of bio-based packaging waste disposed during installation, landfill gas from the decomposition of this waste is assumed to be collected and used to produce electricity. It is assumed that this recovered energy offsets that are produced by the US average grid.

## Results

It is important to note that results reported in the tables below represent an average of all of the flooring manufacturers participating in this EPD based on the actual square meters produced by each manufacturer for sale in North America. Caution should be used when trying to compare the results presented in this EPD to the enviromental performance of other heterogeneous vinyl flooring products as the thickness of floors will influence the environmental impacts. Although the environmental impacts should be lower for the thinner floors (less raw materials), a thicker floor most often lasts longer, balancing the advantage gained by a thinner floor.

### Life Cycle Inventory Analysis

#### Primary Energy Demand

Total primary energy results for one square meter installed heterogeneous vinyl flooring are presented in Tables 3 and 4 for specific energy resources.

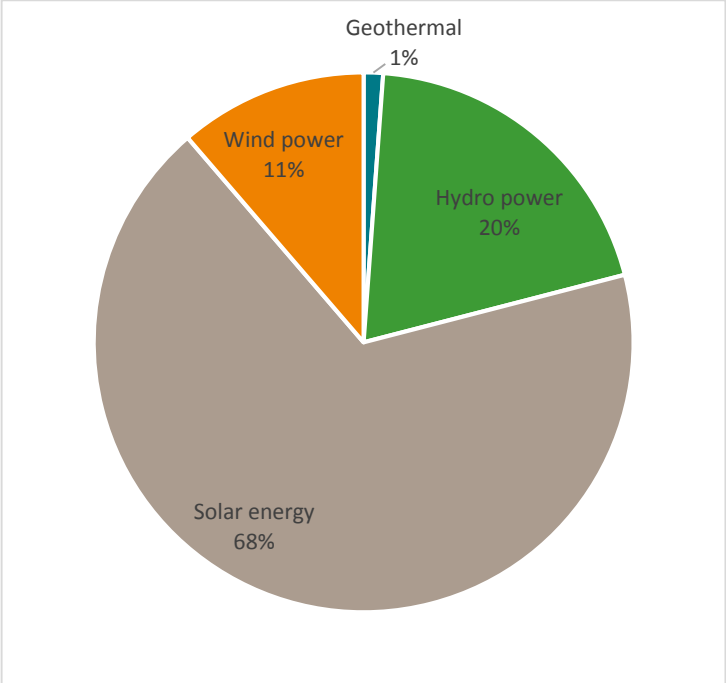
**Table 3: Primary energy, non-renewable for all life cycle stages of 1 square meter of heterogeneous flooring for one year**

| Non-Renewable Energy Resources | Units | Sourcing / Extraction | Manufacturing | Installation | Use (1-year) | End-of-Life | Total Life Cycle | Percentage of Total |
|---|---|---|---|---|---|---|---|---|
| Total resources | MJ | 130 | 27.4 | 10.3 | 1.57 | 2.87 | 172 | 100% |
| Crude Oil | MJ | 43.7 | 3.82 | 4.26 | 0.313 | 0.793 | 52.9 | 31% |
| Hard Coal | MJ | 9.25 | 6.33 | 0.255 | 0.21 | 0.313 | 16.4 | 10% |
| Lignite | MJ | 2.54 | 0.513 | 0.256 | 0.023 | 0.147 | 3.48 | 2% |
| Natural Gas | MJ | 69.2 | 13.5 | 5.14 | 0.932 | 1.44 | 90.2 | 52% |
| Uranium | MJ | 5.28 | 3.21 | 0.402 | 0.0951 | 0.175 | 9.17 | 5% |

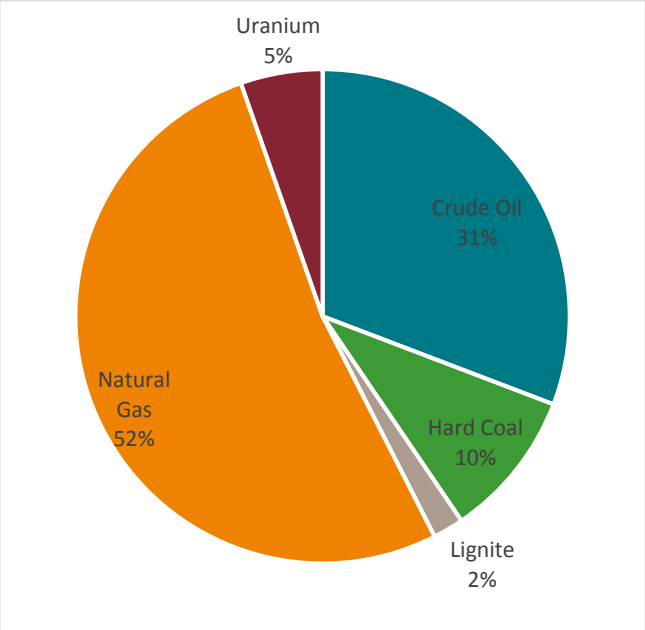
**Table 4: Primary energy, renewable for all life cycle stages of 1 square meter of heterogeneous flooring for one year**

| Renewable Energy Resources | Units | Sourcing / Extraction | Manufacturing | Installation | Use (1-year) | End-of-Life | Total Life Cycle | Percentage of Total |
|---|---|---|---|---|---|---|---|---|
| Total resources | MJ | 5.98 | 1.85 | 1.63 | 0.0398 | 0.146 | 9.64 | 100% |
| Geothermal | MJ | 0.104 | 0.00223 | 0.000803 | 0.0026 | 0.00239 | 0.112 | 1% |
| Hydro power | MJ | 0.85 | 0.96 | 0.0487 | 0.0151 | 0.0336 | 1.91 | 20% |
| Solar energy | MJ | 4.14 | 0.786 | 1.52 | 0.0116 | 0.0791 | 6.53 | 68% |
| Wind power | MJ | 0.886 | 0.101 | 0.0653 | 0.0105 | 0.0308 | 1.09 | 11% |

**Renewable Primary Energy (6% of total Primary Energy Demand)**




**Non-Renewable Primary Energy (96% of total Primary Energy Demand)**




### Other Resources and Wastes

Secondary material and secondary fuel (fossil and renewable) consumption are presented in Table 5.

**Table 5: Other resources and wastes for all life cycle stages of 1 square meter of heterogeneous flooring for one year**

| | Units | Sourcing / Extraction | Manufacturing | Installation | Use (1-year) | End-of-Life | Total Life Cycle |
|---|---|---|---|---|---|---|---|
| **Resources** | | | | | | | |
| Non-renewable material | kg | 6.83 | 1.77 | 0.543 | 0.0665 | 0.674 | 9.89 |
| Secondary material | kg | 0.0071 | 0 | 0 | 0 | 0 | 0.0071 |
| Secondary fuel, fossil | MJ | 0.0328 | 0.0103 | 0.00194 | 0.000784 | 0.00405 | 0.0498 |
| Secondary fuel, renewable | MJ | 0.0031 | 0.00102 | 0.000294 | 8.62E-05 | 0.00179 | 0.00629 |
| **Wastes** | | | | | | | |
| Hazardous waste | kg | 0 | 0 | 0 | 0 | 0 | 0 |
| Non-hazardous waste | kg | 5.3 | 1.82 | 0.569 | 0.0747 | 2.49 | 10.2 |
| Radioactive waste | kg | 0.00208 | 0.00126 | 0.00016 | 3.73E-05 | 6.89E-05 | 0.00361 |

## Life Cycle Impact Assessment

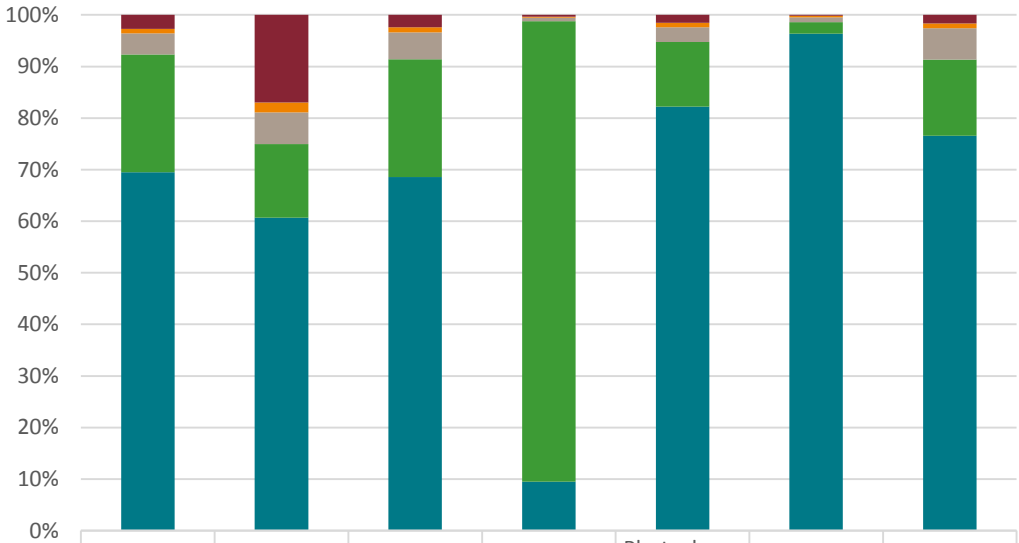
CML 2001 – April 2013 impact assessment results for 1-year use and 60-years use are presented in Table 6. Since the RSL for this product is 30 years, it must be produced 2 times in a 60 year period.

**Table 6: Impact assessment results for all life cycle stages of one square meter of heterogeneous flooring for 1-year and 60-year use**

| Impact Assessment Method: CML 2001 – April 2013 | Units | Sourcing / Extraction | Manufacturing | Installation | Use | End-of-Life | Total Life Cycle |
|---|---|---|---|---|---|---|---|
| **1-year Use** | | | | | | | |
| Acidification Potential | kg $SO_2$-eq. | 0.0157 | 0.00516 | 0.000928 | 0.000206 | 0.000605 | 0.0226 |
| Eutrophication Potential | kg $PO_4^{3-}$-eq. | 0.0022 | 0.000518 | 0.000224 | 6.93E-05 | 0.000615 | 0.00362 |
| Global Warming Potential | kg $CO_2$-eq. | 5.49 | 1.83 | 0.419 | 0.0791 | 0.191 | 8.01 |
| Ozone Depletion Potential | kg R11-eq. | 4.07E-10 | 3.82E-09 | 2.98E-11 | 9.63E-12 | 1.37E-11 | 4.28E-09 |
| Photochem. Oxidant Formation | kg Ethene- | 0.00383 | 0.000584 | 0.000133 | 3.94E-05 | 7.10E-05 | 0.00465 |
| Abiotic Depletion, Elements | kg Sb-eq. | 2.28E-05 | 5.14E-07 | 2.28E-07 | 7.47E-08 | 3.61E-08 | 2.37E-05 |
| Abiotic Depletion, Fossil | MJ | 125 | 24.1 | 9.91 | 1.48 | 2.7 | 163 |
| **60-years Use** | | | | | | | |
| Acidification Potential | kg $SO_2$-eq. | 0.0314 | 0.0103 | 0.00186 | 0.0123 | 0.00121 | 0.0571 |
| Eutrophication Potential | kg $PO_4^{3-}$-eq. | 0.00439 | 0.00104 | 0.000447 | 4.16E-03 | 0.00123 | 0.0113 |
| Global Warming Potential | kg $CO_2$-eq. | 11 | 3.66 | 0.838 | 4.75 | 0.382 | 20.6 |
| Ozone Depletion Potential | kg R11-eq. | 8.14E-10 | 7.63E-09 | 5.96E-11 | 5.78E-10 | 2.74E-11 | 9.11E-09 |
| Photochem. Oxidant Formation | kg Ethene- | 0.00765 | 0.00117 | 0.000266 | 2.37E-03 | 1.42E-04 | 0.0116 |
| Abiotic Depletion, Elements | kg Sb-eq. | 4.57E-05 | 1.03E-06 | 4.56E-07 | 4.48E-06 | 7.23E-08 | 5.17E-05 |
| Abiotic Depletion, Fossil | MJ | 249 | 48.3 | 19.8 | 88.7 | 5.39 | 412 |

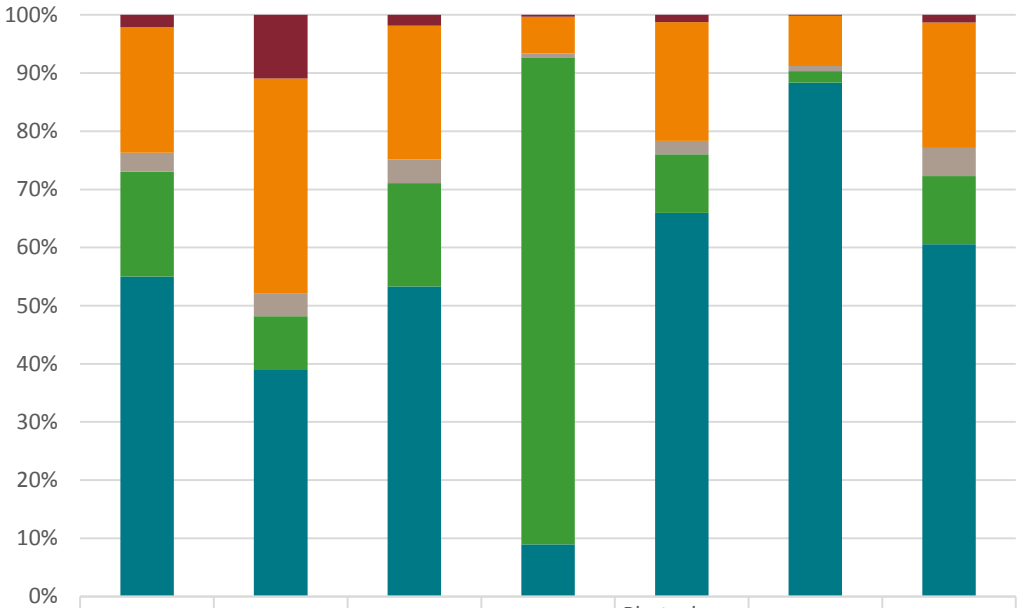
The impact assessment results are calculated using characterization factors published by the University of Leiden's CML 2001 – April 2013 as well as the US EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) version 2.1.

**Figure 9: CML 2001 – April 2013 impact assessment results for 1-year use**




| | Acidification Potential | Eutrophication Potential | Global Warming Potential | Ozone Depletion Potential | Photochem. Oxidant Formation Potential | Abiotic Depletion, Elements | Abiotic Depletion, Fossil |
|---|---|---|---|---|---|---|---|
| End-of-Life | 3% | 17% | 2% | 0% | 2% | 0% | 2% |
| Use (1-year) | 1% | 2% | 1% | 0% | 1% | 0% | 1% |
| Installation | 4% | 6% | 5% | 1% | 3% | 1% | 6% |
| Manufacturing | 23% | 14% | 23% | 89% | 13% | 2% | 15% |
| Sourcing / Extraction | 69% | 61% | 69% | 10% | 82% | 96% | 77% |

**Figure 10: CML 2001 – April 2013 impact assessment results for 60-years use**




| | Acidification Potential | Eutrophication Potential | Global Warming Potential | Ozone Depletion Potential | Photochem. Oxidant Formation Potential | Abiotic Depletion, Elements | Abiotic Depletion, Fossil |
|---|---|---|---|---|---|---|---|
| End-of-Life | 2% | 11% | 2% | 0% | 1% | 0% | 1% |
| Use (60-year) | 22% | 37% | 23% | 6% | 20% | 9% | 22% |
| Installation | 3% | 4% | 4% | 1% | 2% | 1% | 5% |
| Manufacturing | 18% | 9% | 18% | 84% | 10% | 2% | 12% |
| Sourcing / Extraction | 55% | 39% | 53% | 9% | 66% | 88% | 60% |

**Table 7: CML 2001 –2010 and TRACI 2.0 impact assessment results for 1 square meter of heterogeneous flooring - cumulative impacts after 1-year and 60-years**

| Impact Assessment Method: CML 2001 – April 2013 | | | |
|---|---|---|---|
| **Impact Category** | **Units** | **1-year** | **60-years** |
| Acidification Potential | kg $SO_2$-eq. | 0.0226 | 0.0571 |
| Eutrophication Potential | kg $PO_4^{3-}$-eq. | 0.00362 | 0.0113 |
| Global Warming Potential | kg $CO_2$-eq. | 8.01 | 20.6 |
| Ozone Depletion Potential | kg R11-eq. | 4.28E-09 | 9.11E-09 |
| Photochem. Oxidant Formation Potential | kg Ethene-eq. | 0.00465 | 0.0116 |
| Abiotic Depletion, Elements | kg Sb-eq. | 2.37E-05 | 5.17E-05 |
| Abiotic Depletion, Fossil | MJ | 163 | 412 |
| **Impact Assessment Method: TRACI 2.1** | | | |
| **Impact Category** | **Units** | **1-year** | **60-years** |
| Acidification Potential | kg $SO_2$-eq.. | 0.0239 | 0.0625 |
| Eutrophication Potential | kg N-eq. | 0.00271 | 0.0122 |
| Global Warming Potential | kg $CO_2$-eq. | 8.01 | 20.6 |
| Ozone Depletion Potential | kg CFC11-eq. | 5.08E-09 | 1.08E-08 |
| Smog Formation Potential | kg $O_3$-eq | 3.98E-01 | 9.59E-01 |

## Interpretation

When considering a 60 year product life, raw materials production and recommended maintenance are the two largest contributors in each impact category considered. The production of raw materials represents a substantial fraction of the life cycle impacts, even over the life of a building. The impacts associated with flooring maintenance add up over time, and are relevant contributors to the life cycle.

## References


| | |
|---|---|
| thinkstep 2015 | GaBi 6 dataset documentation for the software-system and databases, LBP, University of Stuttgart and thinkstep AG, Leinfelden-Echterdingen, 2012 (http://documentation.gabi-software.com/) |
| EN 15804 | EN 15804:2010-08 Sustainability of construction works -Environmental Product Declarations - Core rules for the product category of construction products |
| ISO 14025 | ISO 14025:2011-10 Environmental labels and declarations - Type III environmental declarations - Principles and procedures |
| ISO 14040 | ISO 14040:2009-11 Environmental management - Life cycle assessment - Principles and framework |
| ISO 14044 | ISO 14044:2006-10 Environmental management - Life cycle assessment - Requirements and guidelines |
| NSF PCR 2012 | NSF Product Category Rule for Flooring: Carpet, Resilient, Laminate, Ceramic, Wood |


This LCA was conducted and EPD prepared by:

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