Homogeneous 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
- Mannington
- Gerflor
- Tarkett

For more information visit: www.rfci.com.
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 | 12CA56057.102.1
DECLARED PRODUCT | Homogeneous Vinyl Flooring
REFERENCE PCR | Flooring: Carpet, Resilient, Laminate, Ceramic, and Wood (NSF 2012)

DATE OF ISSUE | 10 July 2013
PERIOD OF VALIDITY | 5 years

CONTENT OF THE DECLARATION | 
| Product definition | 
| Information about basic material and the material’s origin | 
| Description of the product’s manufacture | 
| Indication of product processing | 
| Information about the in-use conditions | 
| Life cycle assessment results | 
| 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
☐ INTERNAL ☒ EXTERNAL

This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by: Thomas Gloria, Life-Cycle Services, LLC

Hilary Young
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 homogeneous vinyl flooring. The product configurations offered herein use ranges representative of all types of homogeneous vinyl flooring from the following four 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.

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.

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.

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.
Industry-Wide EPD
Homogeneous Vinyl Flooring

According to ISO 14025

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 4 major manufacturers of Homogeneous Vinyl Flooring. Homogeneous vinyl flooring has a uniform structure and composition from the top to the bottom as there is no separate backing layer. Materials in this floor include vinyl (polyvinyl chloride or PVC), pigments, plasticizers, fillers, extenders and stabilizers to protect against heat and light deterioration. A clear specialty performance top layer coating can be a vinyl or non-vinyl layer.

Homogeneous vinyl flooring is primarily intended for use in commercial and light commercial buildings. It is frequently installed in healthcare facilities because of its superior durability and high resistance to wear, cuts and stains. Additionally the seams can be welded to seal out germs and moisture. Typically, homogeneous vinyl flooring is available in 2.0 mm thickness. Homogeneous vinyl flooring is available in many different patterns including chip visuals. Recycled materials are used in the production of much of the homogeneous vinyl flooring produced.

The manufacturing process results in a single layer product although a decorative application and high performance coating can be applied to the surface. A diagram of homogeneous vinyl flooring cross-section is shown below.

Figure 1: Diagram of Homogeneous Vinyl Flooring Cross-Section

Range of Application

Homogeneous vinyl flooring is commonly used in commercial and light commercial healthcare, educational, retail and office interiors.
Industry-Wide EPD
Homogeneous Vinyl Flooring

According to ISO 14025

Product Standards

The products considered in this EPD meet or exceed one of the following Technical Specifications:
- ISO 10581 – Resilient floor coverings – Homogeneous 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
- 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

<table>
<thead>
<tr>
<th>Homogeneous Vinyl Flooring</th>
<th>Average Value</th>
<th>Unit</th>
<th>Minimum Value</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Thickness</td>
<td></td>
<td>mm</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Product weight *</td>
<td>3,178</td>
<td>g/m²</td>
<td>2,962</td>
<td>3,302</td>
</tr>
<tr>
<td>Product Form: Roll Width</td>
<td></td>
<td>m</td>
<td>1.83</td>
<td>2</td>
</tr>
<tr>
<td>VOC emissions test method</td>
<td>Compliant with California Department of public Health Standard v1.1, 2010 and certified by FloorScore Flooring Products Certification Program for Indoor Air Quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability certifications</td>
<td>Some products certified to NSF/ANSI 332 Sustainability Assessment for Resilient Floor Coverings</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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.
Industry-Wide EPD
Homogeneous Vinyl Flooring

According to ISO 14025

Material Content

Material Content of the Product

<table>
<thead>
<tr>
<th>Component*</th>
<th>Material</th>
<th>Mass %</th>
<th>Availability</th>
<th>Origin of raw materials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Renewable</td>
<td>Non-renewable</td>
</tr>
<tr>
<td>Fillers</td>
<td>Dolomite, limestone,</td>
<td>41.9%</td>
<td>Mineral abundant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>kaolin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resin</td>
<td>Polyvinyl chloride</td>
<td>36.6%</td>
<td>Fossil limited</td>
<td></td>
</tr>
<tr>
<td>Plasticizers</td>
<td>DOTP</td>
<td>15.6%</td>
<td>Fossil limited</td>
<td></td>
</tr>
<tr>
<td>Additives</td>
<td>Various</td>
<td>4.9%</td>
<td>Fossil limited</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Various</td>
<td>1.0%</td>
<td>Fossil limited</td>
<td></td>
</tr>
<tr>
<td>components</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*On average, recycled materials make up 10% of this product and are a combination of one or more ingredients including binder, fillers, plasticizer, and additives.

Production of Main Materials

**Dolomite:**
A carbonate mineral used as inert filler.

**Limestone:**
Calcium carbonate.

**Kaolin:**
A clay mineral used as inert filler.

**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.

**Plasticizers:**
Plasticizers 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.

**Recycled material:**
Per ISO 14021, recycled material can be either pre- or post- consumer material. Pre-consumer recycled material is diverted from the waste stream during a manufacturing process and excludes reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it. Post-consumer recycled material is generated by households or by commercial, industrial and institutional facilities in
their role as end-users of the product, which can no longer be used for its intended purpose.

**Production of the Floor Covering**

Homogeneous vinyl flooring is produced using several stages including calendaring, consolidation and/or laminating. First, the raw materials which include limestone, polyvinyl chloride, plasticizer, stabilizers and pigments, are thoroughly mixed. Once mixed, the material is consolidated and formed into a sheet. The sheet is then cooled, formed into rolls and finally packaged.

![Diagram of Production Process]

**Production Waste**

On average, 4.5% of production materials are sent to 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 is included. In the case of products manufactured in Europe, shipping to the US is included before 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 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 then sent to landfill as waste.

Use Stage

The service life of homogeneous 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 35 years. This means that the product will meet its functional requirements for an average of 35 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>
<thead>
<tr>
<th>Level of use</th>
<th>Cleaning Process</th>
<th>Cleaning Frequency</th>
<th>Consumption of energy and resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial / Light Commercial/ Industrial</td>
<td>Dust mop</td>
<td>Daily</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Damp mop / neutral cleaner</td>
<td>Weekly</td>
<td>Hot water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Neutral detergent</td>
</tr>
<tr>
<td></td>
<td>Spray buff / finish restorer</td>
<td>Monthly</td>
<td>Floor finish</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Electricity</td>
</tr>
</tbody>
</table>
This cleaning process translates to:

<table>
<thead>
<tr>
<th>Table 2: Cleaning Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Detergent</td>
</tr>
<tr>
<td>Electricity</td>
</tr>
<tr>
<td>Finish</td>
</tr>
<tr>
<td>Finish remover</td>
</tr>
<tr>
<td>Water</td>
</tr>
</tbody>
</table>

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 homogeneous vinyl flooring. To avoid damage from moisture, recommended guidelines in ASTM F 710 Standard Practice for Preparing Concrete Floors 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 homogeneous 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 an EPD.

For life cycle modeling of the considered products, the GaBi 5 Software System for Life Cycle Engineering, developed by PE INTERNATIONAL AG, has been used to model the product systems considered in this assessment (/GaBi 5 2012/). All relevant background datasets are taken from the GaBi 2011 software database. The datasets from the GaBi database are documented in the online documentation (/GaBi GABI 5 2012D/). 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 2002), with the majority of datasets based on data from 2008 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. Likewise, a calcium zinc stearate dataset was used to represent a number of stabilizers. 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 10 - 14 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 loss 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. In the case of secondary raw material inputs, we only considered burdens from the point of recovery forward. The original production of recycled materials was outside the system boundary.
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-life 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, it 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.
Industry-Wide EPD
Homogeneous Vinyl Flooring

According to ISO 14025

Results

It is important to note that results reported in the tables below represent an average of the four 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 other homogeneous vinyl flooring to the averages in this EPD as the thickness of floors will influence the environmental impacts. Although the environmental impacts should be less 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 homogeneous 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 homogeneous flooring for one year

<table>
<thead>
<tr>
<th>Non-Renewable Energy Resources</th>
<th>Units</th>
<th>Sourcing / Extraction</th>
<th>Manufacturing</th>
<th>Installation</th>
<th>Use (1-year)</th>
<th>End-of-Life</th>
<th>Total Life Cycle</th>
<th>Percentage of total(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total resources</td>
<td>MJ</td>
<td>146</td>
<td>23.1</td>
<td>19.5</td>
<td>1.74</td>
<td>3.89</td>
<td>194</td>
<td>100%</td>
</tr>
<tr>
<td>Crude Oil</td>
<td>MJ</td>
<td>52.4</td>
<td>4.2</td>
<td>12</td>
<td>0.408</td>
<td>1.08</td>
<td>70.2</td>
<td>36%</td>
</tr>
<tr>
<td>Hard Coal</td>
<td>MJ</td>
<td>8.22</td>
<td>1.43</td>
<td>0.388</td>
<td>0.27</td>
<td>0.394</td>
<td>10.7</td>
<td>6%</td>
</tr>
<tr>
<td>Lignite</td>
<td>MJ</td>
<td>7.1</td>
<td>1.01</td>
<td>0.277</td>
<td>0.0407</td>
<td>0.196</td>
<td>8.63</td>
<td>4%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>MJ</td>
<td>70.5</td>
<td>5.41</td>
<td>6.37</td>
<td>0.909</td>
<td>2.02</td>
<td>85.2</td>
<td>44%</td>
</tr>
<tr>
<td>Uranium</td>
<td>MJ</td>
<td>7.36</td>
<td>11</td>
<td>0.453</td>
<td>0.112</td>
<td>0.204</td>
<td>19.2</td>
<td>10%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Renewable Energy Resources</th>
<th>Units</th>
<th>Sourcing / Extraction</th>
<th>Manufacturing</th>
<th>Installation</th>
<th>Use (1-year)</th>
<th>End-of-Life</th>
<th>Total Life Cycle</th>
<th>Percentage of total(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total resources</td>
<td>MJ</td>
<td>5.2</td>
<td>9.74</td>
<td>1.63</td>
<td>0.0476</td>
<td>0.171</td>
<td>16.8</td>
<td>100%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>MJ</td>
<td>0.0115</td>
<td>0.00116</td>
<td>0.00268</td>
<td>0.00278</td>
<td>0.00257</td>
<td>0.0206</td>
<td>0%</td>
</tr>
<tr>
<td>Hydro power</td>
<td>MJ</td>
<td>0.873</td>
<td>5.44</td>
<td>0.0659</td>
<td>0.0181</td>
<td>0.0411</td>
<td>6.44</td>
<td>38%</td>
</tr>
<tr>
<td>Solar energy</td>
<td>MJ</td>
<td>2.62</td>
<td>3.75</td>
<td>1.49</td>
<td>0.0146</td>
<td>0.0892</td>
<td>7.97</td>
<td>47%</td>
</tr>
<tr>
<td>Wind power</td>
<td>MJ</td>
<td>1.69</td>
<td>0.541</td>
<td>0.0699</td>
<td>0.0122</td>
<td>0.0376</td>
<td>2.36</td>
<td>14%</td>
</tr>
</tbody>
</table>
Industry-Wide EPD
Homogeneous Vinyl Flooring

According to ISO 14025

Renewable Primary Energy
(8% of total Primary Energy Demand)

- Windpower, 14%
- Solar energy, 47%
- Hydropower, 38%
- Geothermal, 0%

Non-Renewable Primary Energy
(92% of total Primary Energy Demand)

- Uranium, 10%
- Crude oil, 36%
- Natural gas, 44%
- Hard coal, 6%
- Lignite, 4%

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 homogeneous flooring for one year

<table>
<thead>
<tr>
<th>Resources</th>
<th>Units</th>
<th>Sourcing / Extraction</th>
<th>Manufacturing</th>
<th>Installation</th>
<th>Use (1-year)</th>
<th>End-of-Life</th>
<th>Total Life Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-renewable material</td>
<td>kg</td>
<td>13.5</td>
<td>1.69</td>
<td>0.6</td>
<td>0.102</td>
<td>0.9</td>
<td>16.7</td>
</tr>
<tr>
<td>Secondary material</td>
<td>kg</td>
<td>0.548</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.548</td>
</tr>
<tr>
<td>Secondary fuel, fossil</td>
<td>MJ</td>
<td>0.0343</td>
<td>0.0072</td>
<td>0.00433</td>
<td>0.00367</td>
<td>0.00597</td>
<td>0.0555</td>
</tr>
<tr>
<td>Secondary fuel, renewable</td>
<td>MJ</td>
<td>0.00335</td>
<td>6.99E-04</td>
<td>5.62E-04</td>
<td>3.51E-04</td>
<td>0.00246</td>
<td>0.00742</td>
</tr>
<tr>
<td>Hazardous waste</td>
<td>kg</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-hazardous waste</td>
<td>kg</td>
<td>11.1</td>
<td>1.61</td>
<td>0.691</td>
<td>0.103</td>
<td>3.34</td>
<td>16.9</td>
</tr>
<tr>
<td>Radioactive waste</td>
<td>kg</td>
<td>0.003</td>
<td>0.00457</td>
<td>1.85E-04</td>
<td>4.58E-05</td>
<td>8.32E-05</td>
<td>0.00788</td>
</tr>
</tbody>
</table>
Life Cycle Impact Assessment

CML 2010 impact assessment results for 1-year use and 60-years use are presented in Table 6. Since the RSL for this product is 35 years, it must be produced 1.71 times in a 60 year period.

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1-year Use</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acidification Potential</td>
<td>kg SO$_2^-$ eq.</td>
<td>0.0135</td>
<td>0.00194</td>
<td>1.00E-02</td>
<td>2.82E-04</td>
<td>7.67E-04</td>
<td>0.0265</td>
</tr>
<tr>
<td>Eutrophication Potential</td>
<td>kg PO$_4^{3-}$ eq.</td>
<td>0.00153</td>
<td>0.00021</td>
<td>1.17E-03</td>
<td>6.65E-05</td>
<td>8.18E-04</td>
<td>0.00379</td>
</tr>
<tr>
<td>Global Warming Potential</td>
<td>kg CO$_2$ eq.</td>
<td>6</td>
<td>0.818</td>
<td>1.02</td>
<td>0.108</td>
<td>0.258</td>
<td>8.21</td>
</tr>
<tr>
<td>Ozone Depletion Potential</td>
<td>kg R11- eq.</td>
<td>1.46E-08</td>
<td>1.26E-08</td>
<td>3.41E-09</td>
<td>1.01E-09</td>
<td>1.45E-09</td>
<td>3.32E-08</td>
</tr>
<tr>
<td>Photochem. Oxidant Formation Potential</td>
<td>kg Ethene- eq.</td>
<td>0.00412</td>
<td>2.78E-04</td>
<td>7.80E-04</td>
<td>4.50E-05</td>
<td>1.11E-04</td>
<td>0.00534</td>
</tr>
<tr>
<td>Abiotic Depletion, Elements</td>
<td>kg Sb- eq.</td>
<td>1.59E-05</td>
<td>3.32E-07</td>
<td>2.92E-07</td>
<td>6.92E-08</td>
<td>4.52E-08</td>
<td>1.66E-5</td>
</tr>
<tr>
<td>Abiotic Depletion, Fossil</td>
<td>MJ</td>
<td>138</td>
<td>12.1</td>
<td>19</td>
<td>1.62</td>
<td>3.69</td>
<td>175</td>
</tr>
<tr>
<td><strong>60-years Use</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acidification Potential</td>
<td>kg SO$_2^-$ eq.</td>
<td>0.0231</td>
<td>0.00333</td>
<td>0.0172</td>
<td>0.0169</td>
<td>0.00131</td>
<td>0.0618</td>
</tr>
<tr>
<td>Eutrophication Potential</td>
<td>kg PO$_4^{3-}$ eq.</td>
<td>0.00262</td>
<td>0.000361</td>
<td>0.002</td>
<td>0.00399</td>
<td>0.0014</td>
<td>0.0104</td>
</tr>
<tr>
<td>Global Warming Potential</td>
<td>kg CO$_2$ eq.</td>
<td>10.3</td>
<td>1.4</td>
<td>1.76</td>
<td>6.45</td>
<td>0.442</td>
<td>20.3</td>
</tr>
<tr>
<td>Ozone Depletion Potential</td>
<td>kg R11- eq.</td>
<td>2.51E-08</td>
<td>2.17E-08</td>
<td>5.85E-09</td>
<td>6.09E-08</td>
<td>2.49E-09</td>
<td>1.16E-07</td>
</tr>
<tr>
<td>Photochem. Oxidant Formation Potential</td>
<td>kg Ethene- eq.</td>
<td>0.00707</td>
<td>4.76E-04</td>
<td>0.00134</td>
<td>0.0027</td>
<td>1.91E-04</td>
<td>0.0118</td>
</tr>
<tr>
<td>Abiotic Depletion, Elements</td>
<td>kg Sb- eq.</td>
<td>2.72E-05</td>
<td>5.68E-07</td>
<td>5.00E-07</td>
<td>4.15E-06</td>
<td>7.75E-08</td>
<td>3.25E-05</td>
</tr>
<tr>
<td>Abiotic Depletion, Fossil</td>
<td>MJ</td>
<td>237</td>
<td>20.7</td>
<td>32.5</td>
<td>97.4</td>
<td>6.32</td>
<td>394</td>
</tr>
</tbody>
</table>

The impact assessment results are calculated using characterization factors published by the University of Leiden’s CML 2001 – Nov. 2010 as well as the US EPA’s Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) version 2.0.
Industry-Wide EPD
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Figure 9: CML 2001 – Nov. 2010 impact assessment results for 1-year use

Figure 10: CML 2001 – Nov. 2010 impact assessment results for 60-years use
Table 7: CML 2001 –2010 and TRACI 2.0 impact assessment results for 1 square meter of homogeneous sheet flooring – cumulative impacts after 1 year and 60 years

<table>
<thead>
<tr>
<th>Impact Assessment Method: CML 2001 – Nov. 2010</th>
<th>Impact Category</th>
<th>Units</th>
<th>1-year</th>
<th>60-years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidification Potential</td>
<td>kg SO$_2$-eq.</td>
<td>0.0265</td>
<td>0.0618</td>
<td></td>
</tr>
<tr>
<td>Eutrophication Potential</td>
<td>kg PO$_4^-$-eq.</td>
<td>0.00379</td>
<td>0.0104</td>
<td></td>
</tr>
<tr>
<td>Global Warming Potential</td>
<td>kg CO$_2$-eq.</td>
<td>8.21</td>
<td>20.3</td>
<td></td>
</tr>
<tr>
<td>Ozone Depletion Potential</td>
<td>kg R11-eq.</td>
<td>3.32E-08</td>
<td>1.16E-07</td>
<td></td>
</tr>
<tr>
<td>Photochem. Oxidant Formation Potential</td>
<td>kg Ethene-eq.</td>
<td>0.00534</td>
<td>0.0118</td>
<td></td>
</tr>
<tr>
<td>Abiotic Depletion, Elements</td>
<td>kg Sb-eq.</td>
<td>1.66E-05</td>
<td>3.25E-05</td>
<td></td>
</tr>
<tr>
<td>Abiotic Depletion, Fossil</td>
<td>MJ</td>
<td>175</td>
<td>394</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Impact Assessment Method: TRACI 2.0</th>
<th>Impact Category</th>
<th>Units</th>
<th>1-year</th>
<th>60-years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidification Potential</td>
<td>kg H+ eq.</td>
<td>1.48</td>
<td>3.37</td>
<td></td>
</tr>
<tr>
<td>Eutrophication Potential</td>
<td>kg PO$_4^-$-eq.</td>
<td>0.0021</td>
<td>0.00999</td>
<td></td>
</tr>
<tr>
<td>Global Warming Potential</td>
<td>kg CO$_2$-eq.</td>
<td>8.21</td>
<td>20.3</td>
<td></td>
</tr>
<tr>
<td>Ozone Depletion Potential</td>
<td>kg CFC11-eq.</td>
<td>4.11E-09</td>
<td>7.04E-09</td>
<td></td>
</tr>
<tr>
<td>Smog Formation Potential</td>
<td>kg O$_3$-eq.</td>
<td>0.454</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

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.
Industry-Wide EPD
Homogeneous Vinyl Flooring

According to ISO 14025

References

GaBi 5 2012

GaBi 5 2012D

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