

PürTerra PVC-Free Resilient Flooring

In accordance with ISO 14025:2006

Twelve Oaks Forest Product Inc.



Twelve Oaks Forest Product Inc. is pleased to present this environmental product declaration (EPD) for **PürTerra PVC-Free Resilient Flooring**. This EPD was developed in compliance with ISO 14025 and ISO 21930 and has been verified by Thomas Gloria, Ph.D.

The EPD includes life cycle assessment (LCA) results for cradle-to-grave.

For more information about Twelve Oaks Forest Product Inc., please visit <https://twelveoaks.ca/>



PürTerra PVC-Free Resilient Flooring

Twelve Oaks Forest Product Inc.
Environmental Product Declaration: EPD 1153



1 GENERAL INFORMATION

EPD GENERAL INFORMATION	
EPD Program and Program Operator	ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959, USA https://www.astm.org/
General Program Instructions and Version Number	ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs) General Program Instructions v8.0, April 29, 2020.
Manufacturer Name and Address	Twelve Oaks Forest Product Inc. 80 Tiverton Court, Suite 100, Markham, ON, L3R 0G4 
Declaration Number	EPD 1153
Declared Product & Functional Unit	PürTerra PVC-Free Resilient Flooring with functional unit of 1 m ² of PVC-free resilient flooring for a period of 75 years.
Reference PCR and Version Number	Product Category Rules for Building Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 4.0. UL Environment, conforming to ISO 21930:2017. PCR Guidance for Building-Related Products and Services Part B: Flooring EPD Requirements, Version 2.0. UL Environment, conforming to ISO 21930:2017.
Description of Product's Intended Application and Use	For interior residential and commercial floor covering applications, including areas with moderate to high foot traffic.
Product RSL Description	30 years, based on manufacturer information and applicable reference use conditions as defined in the EPD.
Market of Applicability	North America
Date of Issue	March 18, 2026
Period of Validity	5 Years
EPD Type	Product and Manufacturer Specific
EPD Scope	Cradle to Grave
Year of Reported Manufacturer Primary data	2025
LCA Software & Version Number	OpenLCA 2.4.1
LCA Database(s) & Version Number	Ecoinvent 3.11
LCA Methodology & Version Number	TRACI v2.1, CML-baseline v4.7
The sub-category PCR review was conducted by:	Part A: Lindita Bushi, PhD, Chair Athena Sustainable Materials Institute lindita.bushi@athenasmi.org Part B: Jack Geibig, Chair Ecoform jgeibig@ecoform.com
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Dr. Shiva Zargar at Build Neutral Inc. Calgary, AB, Canada https://www.buildneutral.ca/ 
VERIFICATION AND AUTHORIZATION OF THE DECLARATION	
This declaration and the rules on which this EPD is based have been examined by an independent external verifier in accordance with ISO 14025 and ISO 21930.	Timothy S Brooke ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428 tbrooke@astm.org Signature: 
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Ph. D. Industrial Ecology Consultants 35 Bracebridge Rd. Newton, MA 02459-1728 t.gloria@industrial-ecology.com Signature: 



ADVANCING STANDARDS
TRANSFORMING MARKETS

LIMITATIONS

Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of Flooring Products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR.

Full conformance with the PCR for Products allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

2 TWELVE OAKS FOREST PRODUCT INC.

2.1 DESCRIPTION OF THE COMPANY

Twelve Oaks Forest Product Inc. ("Twelve Oaks") is a 100% Canadian-owned and family-run designer and distributor of flooring products serving residential and commercial markets across Canada and the United States. The portfolio spans engineered hardwood, luxury vinyl, and laminate collections developed to pair contemporary design with durable performance for residential and commercial use. Twelve Oaks's PürTerra is manufactured at a facility located in China. Twelve Oaks highlights product stewardship and indoor air quality. Products carry FloorScore® indoor-air-quality certification and stringent in-house testing for scratch resistance, water resilience and temperature tolerance, and certified VOC testing to assure indoor air quality. Twelve Oaks supports customers through regional facilities, including Markham, Ontario (Eastern/Central Canada) and Calgary, Alberta (Western Canada).

2.2 PRODUCT DESCRIPTION

PürTerra is a PVC-free, resilient flooring line available in two main product categories: PürTerra Dryback and PürTerra Click. PürTerra Dryback is designed for glue-down installation in residential and commercial interiors and is the focus of this EPD project. The product is a polypropylene (PP) with a factory-applied 2-pass UV-cured urethane finish. The construction and finish are durable and come with a lifetime residential warranty and 15-year commercial warranty when installed with Twelve Oaks specified adhesive. The primary United Nations Standard Products and Services Code (UNSPSC) code for this flooring product is 30161700, and the Construction Specification Institute (CSI) code is 09 65 00.

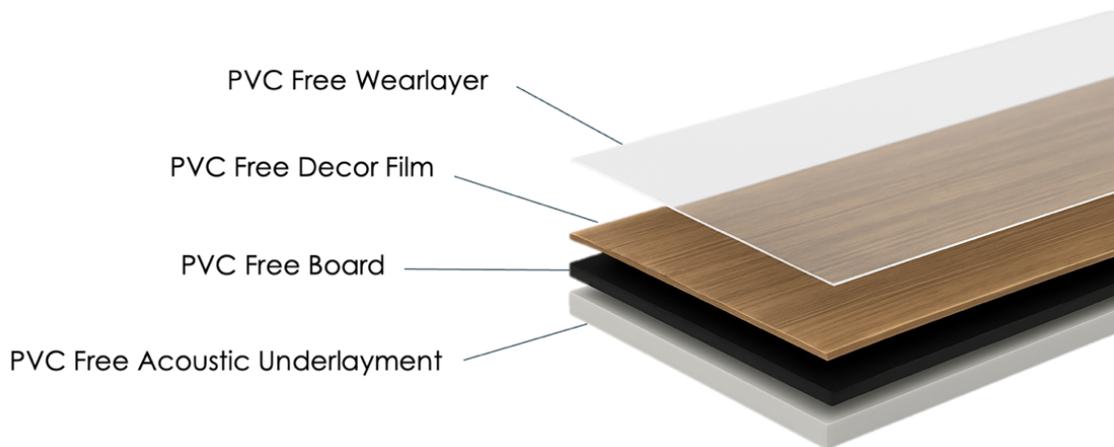


Figure 1 Structure of PürTerra PVC-free resilient flooring

2.3 APPLICATION FIELD

Interior floor coverings for dry, conditioned spaces in residential and commercial applications; glue-down installation using compatible water-based adhesive per Twelve Oaks installation instructions.

2.4 DECLARATION OF METHODOLOGICAL FRAMEWORK

This EPD is product and manufacturer specific and is based on an attributional LCA conducted in accordance with ISO 14025, ISO 14040/14044, ISO 21930, UL PCR Part A (v4.0), and UL PCR Part B – Flooring (v2.0). The scope is cradle-to-grave and includes all required life cycle stages (A1–A3, A4–A5, B1–B7, and C1–C4); Module D is not declared. The functional unit is 1 m² of PürTerra manufactured in China, installed in a representative North American building, and assessed over a 75-year building service life with a 30-year product reference service life.

Cut-off rules follow ISO 21930 and UL PCR Part A; no known flows were deliberately excluded. Infrastructure, capital goods, and incoming raw material packaging are excluded per PCR allowances. Allocation follows ISO 14044 and UL PCR Part A; no co-products are generated, and the product is produced on dedicated lines, so allocation within manufacturing is not required. Mass-based allocation is applied only where prescribed by the PCR for waste and packaging disposal.

2.5 MARKET PLACEMENT/APPLICATION RULES

PürTerra PVC-Free Resilient Flooring – Dryback is placed on the North American market as an interior resilient floor covering for residential and commercial applications. The product is evaluated and documented against applicable product performance, health, and safety frameworks relevant to resilient flooring. PürTerra PVC-Free Resilient Flooring – Dryback meets or exceeds the following technical specifications:

- ASTM E662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
- ASTM F3261 Standard Specification for Resilient Flooring in Modular Format with Rigid Polymeric Core

2.6 MATERIAL COMPOSITION

Table 1 Material composition

Product components	Amount per FU (mass %)
Stone powder	64.5%
Polypropylene	23.6%
Wearlayer-PVC free	9.2%
Other additives	2%
UV coating	0.2%
Lubricant	0.2%
Film-PVC free	0.2%
Carbon black	0.1%
Total	100%

2.7 MANUFACTURING

The manufacturing of PürTerra PVC-Free Resilient Flooring takes place at the manufacturing facility located in Changzhou, Jiangsu Province, China. The manufacturing of PürTerra PVC-Free resilient flooring is a step-by-step process. The PVC-free resilient flooring is produced in a

continuous, electrically powered extrusion and finishing line. Polypropylene raw materials and additives are metered by feeders into an extruder, where they are melted, mixed, and shaped under controlled temperature using a mold temperature controller. The extruded board, which incorporates the PVC-free core and surface layers, is drawn forward by a tractor unit at an average rate of approximately 100 m of product per hour. After extrusion, the continuous board passes through UV coating equipment where the surface finish is applied and cured, then through grooving and cutting stations where it is profiled into individual planks and, where applicable, micro-bevels are formed and bevel edges are painted. For products with an attached underlayment, a PVC-free acoustic pad is laminated to the back of the planks before final inspection and packaging.

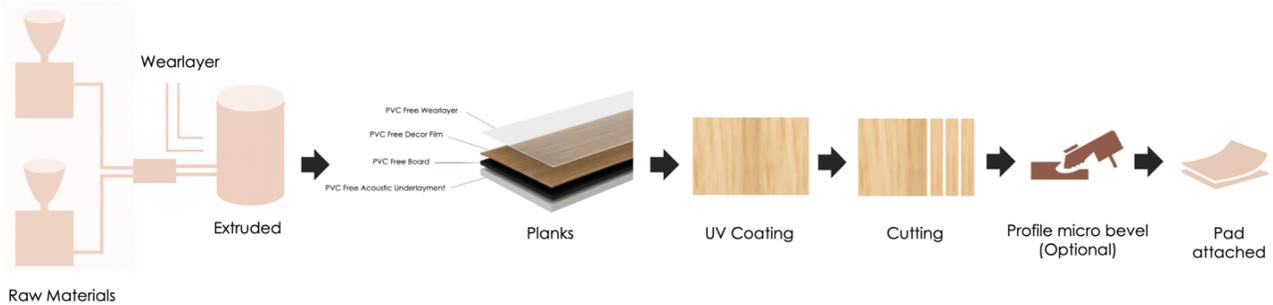


Figure 2 PürTerra PVC-free resilient flooring manufacturing process

2.8 PACKAGING

PürTerra Dryback is packaged for shipment using a combination of paper-based and polymer-based materials. Packaging materials and their composition are presented in Table 2. Packaging quantities are reported per 1 m² of flooring. Cardboard based packaging materials contain biogenic carbon and are reported accordingly. Packaging materials are not reused. All packaging components are removed at the point of installation and disposed of according to local waste management practices. No reuse or return of packaging materials occurs within the distribution or installation chain.

Table 2 Amount of packaging materials per 1 m² of flooring

Packaging materials	Material composition	Weight, kg/FU	Weight biogenic carbon, kg C/FU
Packaging box	Corrugated cardboard	0.146	0.051
Tray	Corrugated cardboard	0.095	0.047
Wrapping film	Low density polyethylene	0.019	0
Packing belt	Polypropylene	0.01	0

2.9 PRODUCT INSTALLATION

Installation of PürTerra PVC-free resilient flooring – Dryback is performed using a fully adhered (glue-down) installation method. Installation requires the use of a manufacturer-approved flooring adhesive (e.g., Twelve Oaks TOAD adhesive or equivalent approved adhesive). The manufacturer has created detailed installation instructions available upon request. According to Twelve Oaks, installation of the flooring product is relatively simple and requires only basic hand tools such as cutting instruments (e.g., utility knife), tape measure, carpenter square, and safety glasses.

Installation waste consists primarily of offcuts and trimming losses of flooring material, as well as packaging waste generated at the construction site. Flooring installation waste is assumed to be treated according to regional waste management practices. Packaging waste generated during installation is assumed to be collected and treated according to regional disposal and recycling rates, as specified in the PCR assumptions. No reuse of packaging materials at the installation site is assumed.

2.10 USE CONDITIONS

PürTerra PVC-free resilient flooring is intended for residential and light-commercial indoor environments with stable temperature (65–80°F / 18–27°C) and relative humidity (35–55%). Routine maintenance consists of sweeping or vacuuming and periodic damp mopping with a neutral cleaner. Spills should be cleaned promptly to prevent moisture-related issues. No repairs or refurbishment are assumed during the use phase, and replacement occurs at the end of the declared RSL. Detailed care and maintenance guidance is available from Twelve Oaks.

2.11 PRODUCT REFERENCE SERVICE LIFE AND BUILDING ESTIMATED SERVICE LIFE

The product reference service life (RSL) for PürTerra PVC-free resilient flooring – Dryback is 30 years, as specified by Twelve Oaks based on warranty conditions, product testing, and expected performance under normal residential and commercial use. For this study, the flooring is installed in a representative North American building with an estimated service life (ESL) of 75 years, consistent with the UL PCR. The RSL and ESL combination implies 1.5 replacement cycles of the flooring over the building's lifetime.

2.12 DISPOSAL

At the end of life, PürTerra PVC-free resilient flooring is typically removed manually and does not entail powered equipment under normal practice. The end-of-life is modelled based on the UL PCR disposal assumptions (regional mix with limited recycling). It reflects the regional end-of-life mix defined in the UL PCR, applied to the product's installed distribution.

2.13 FURTHER INFORMATION

Further information about PürTerra PVC-free resilient flooring is available upon request.

3 LIFE CYCLE ASSESSMENT CALCULATION RULES

3.1 FUNCTIONAL UNIT

The functional unit of PürTerra PVC-free resilient flooring is 1 (m²) according to UL PCR. Table 3 presents the technical data details of the PVC-free resilient flooring covered by this EPD, including product mass and dimensional parameters. Average values are calculated as the arithmetic mean of reported minimum and maximum values and are provided for reference only. Min value and max value represent representative nominal product configurations corresponding to the manufacturer’s standard production specifications. Variations in thickness and wear layer are custom options and are not representative of typical production. The mass associated with the functional unit is representative of the typical production using the highest-mass product variant to ensure impacts are not underestimated.

Table 3 Technical details

Name		Average Value		Unit	Min Value	Max Value
Product thickness		2.25		mm	2	2.5
Wear layer thickness (where applicable)		0.4		mm	0.3	0.5
Product weight		3617		g/m ²	3614	3617
Product Form	Rolls	Width	N/A	mm	N/A	N/A
		Length	N/A	m	N/A	N/A
	Tiles	917*247		mm	607*307	1227*187
	Planks	988*352		mm	470*470	1507*235

Tiles are available in multiple discrete formats. Table 4 presents the functional unit and the weighted average mass.

Table 4 Functional unit for the PVC-free resilient flooring

Name	Value	Unit
Functional unit	1	m ²
Mass	3.617	kg

3.2 SYSTEM BOUNDARY

According to (UL Environment, 2022, 2018), the EPD shall be specified as cradle-to-grave. Table 5 presents the life cycle stages and their modules included in the system boundaries analyzed in accordance with (ISO 21930, 2017).

Table 5 Life cycle stages and their information modules included in the system boundary

Product stage			Construction process stage		Use stage							End of life stage				Benefits beyond system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Bldg. Operational energy use during	Bldg. Operational water use during product use	Deconstruction	Transport	Waste processing	Disposal	Reuse, recovery, recycling potential
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MND

(X = Included in the LCA, MND - Module not declared)

The product stage (A1-A3) for the product includes extraction and processing of raw materials, transportation to the factory and manufacturing processes with packaging. The construction process stage (A4-A5) includes the transportation of PürTerra PVC-free resilient flooring to the building site from the factory and the installation phase. The use stage (B1-B7) includes the maintenance of the PürTerra PVC-free resilient flooring as well as the replacement according to the RSL of the product and ESL of the building. The end-of-life stage (C1-C4) includes deconstruction, transportation of waste products to the final disposition site, and disposal. Throughout the life cycle stages of products, all energy and material inputs have been traced back to the extraction of resources, emissions from the whole system have been quantified, and waste management scenarios have also been included. For the recovery, reuse, and recycling process at the end of the life stage, to be conservative, the benefits of recycling and recovery are beyond the boundaries of the product system, according to PCR Part A, hence, module D is not reported. Capital goods and infrastructure flows for flooring do not significantly affect the results and conclusions of the LCA or additional environmental information, hence are excluded from unit processes used to model the LCIA per PCR Part B recommendation.

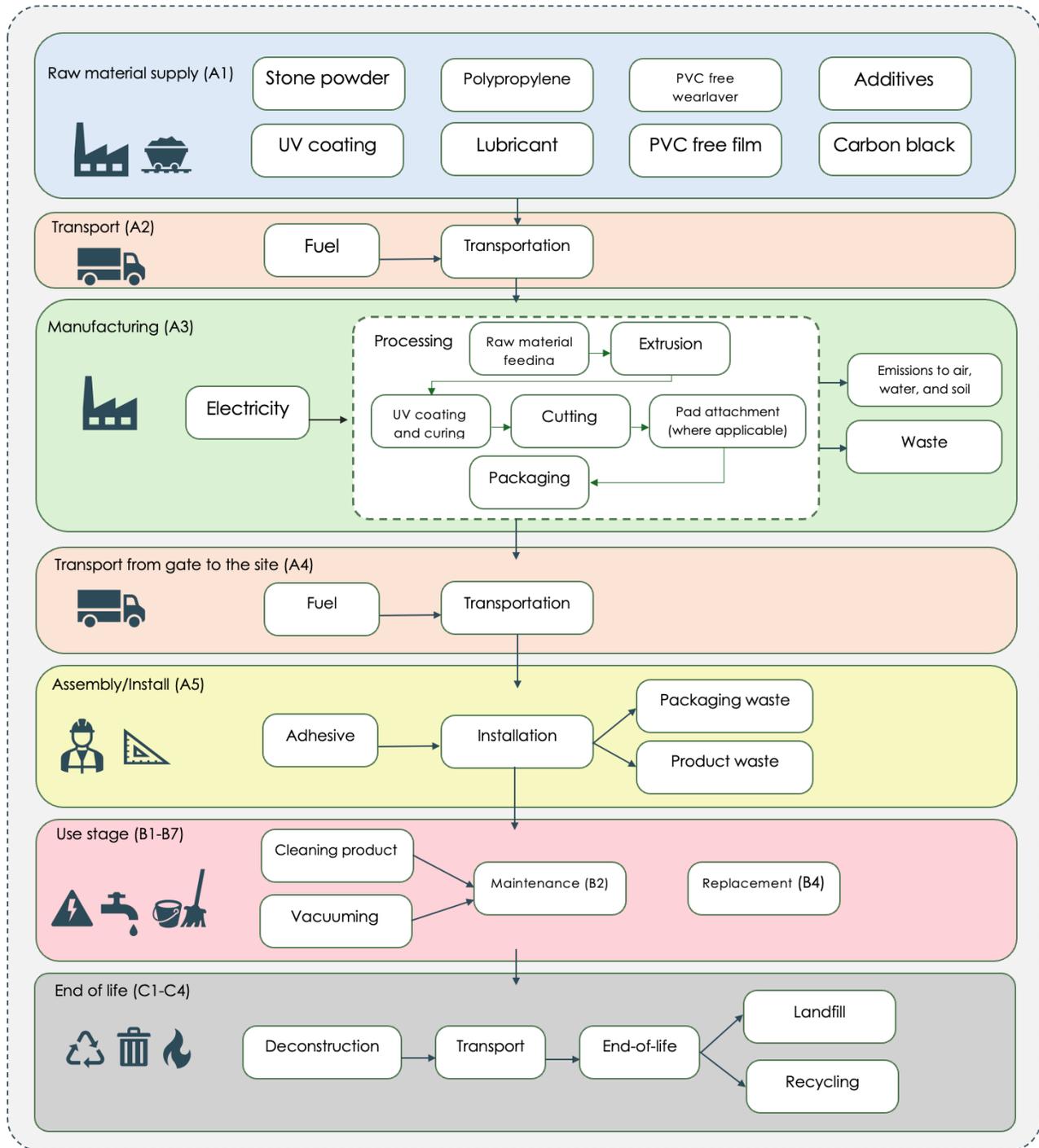


Figure 3 Cradle-to-grave system boundary for PürTerra PVC-free resilient flooring

3.3 PRODUCT USE PHASE (MODULES B1-B7)

During the use stage, PürTerra PVC-Free Resilient Flooring – Dryback does not require operational energy or water use beyond routine cleaning and maintenance. Repair (B3) and refurbishment (B5) are not considered for this product. Routine cleaning consists of weekly vacuuming or

sweeping and periodic damp mopping using a neutral, diluted cleaning detergent, in accordance with manufacturer recommendations.

3.4 UNITS

All data and results are presented using SI units.

3.5 ESTIMATES AND ASSUMPTIONS

The LCA for PürTerra Dryback is based on a structured set of data, assumptions, and modelling choices. The following key assumptions were made due to data limitations. For missing background data, the substitution of missing data using a similar background data approach as a proxy was considered. Information on formulation, production, packaging, and adhesive use was supplied by Twelve Oaks. Wherever these data were incomplete, for example, detailed additive recipes, representative datasets from ecoinvent v3.11 were selected as engineering proxies. Those proxies describe typical technologies rather than the exact suppliers in the PürTerra supply chain. Transport assumptions according to c-PRC were made where it was not possible to obtain the specific data, for instance, product transport from the building site to the waste processing, and it is clearly stated in this EPD when it occurred. These choices are technically justified, but they also introduce limitations that users of this EPD should keep in mind.

3.6 CUT-OFF CRITERIA

Cut-off rules follow ISO 21930 and UL PCR Part A. Flows contributing less than 1% of total mass or energy may be excluded if environmentally insignificant, and all emissions contributing more than 1% to any impact category are included. No known flows were deliberately excluded.

Infrastructure and capital equipment, incoming raw-material packaging, storage and sales activities, abnormal product losses, and warehouse handling are excluded in accordance with PCR allowances, as their contributions are negligible at the declared-unit scale.

3.7 DATA SOURCES

Primary data is provided by the manufacturing facility. Production volumes, raw and auxiliary material inputs, manufacturing scrap and waste were provided for 12 months representative of normal operation. All background unit processes were modelled using the ecoinvent v3.11 database (Cut-off system model), which served as the primary source of secondary data.

3.8 DATA QUALITY

Primary data is provided by the contracted manufacturing facilities of Twelve Oaks. Production volumes, raw and auxiliary material inputs, and manufacturing waste were provided for 12 months representative of normal operation. All background unit processes were modelled using the ecoinvent v3.11 database (Cut-off system model), which served as the primary source of secondary data.

3.9 PERIOD UNDER REVIEW

The period under review is December 2024 to November 2025.

3.10 ALLOCATION

Allocation procedures follow ISO 14044, ISO 21930, and UL PCR Part A. Allocation is avoided wherever possible through the use of product-specific primary data and process subdivision. System expansion is not applied, consistent with PCR guidance for EPDs.

No allocation within manufacturing is required because the declared products are produced on dedicated lines and no co-products, by-products, or multi-input processes occur in the foreground system. Secondary materials are not used as raw material inputs.

Allocation is applied only where required by the PCR for waste and packaging flows at installation and end-of-life. These flows are distributed across regional waste treatment routes (e.g., landfill, recycling) using mass-based allocation. Background datasets follow the allocation rules inherent to the ecoinvent database.

3.11 COMPARABILITY AND BENCHMARKING

This report is not intended to support standalone comparative assertions between products. Consistent with ISO 21930 and ISO 14025, meaningful comparison of construction products requires that EPDs are developed under the same core and sub-category PCR and use the same functional unit and reference service life, while covering the same modules and applying the equivalent technical assumptions and scenarios for installation, use, maintenance, and end of life in the context of the specific building application as well as consistent use of background datasets, LCIA methods, and LCA software, and apply cut-off and data quality rules in the same way. Hence, the user of the EPD should take care when comparing EPDs from different companies.

4 LCA: SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

The following information is reported for declared modules.

4.1 TRANSPORT TO SITE (A4)

Products are shipped from the manufacturing site in Jiangsu, China, by rail to the Port of Shanghai, then by ocean container to the Port of Vancouver. From Vancouver, freight moves by rail to regional distribution and is then delivered by truck to Twelve Oaks warehouses. All shipments are delivered to a warehouse before customer distribution. Product transport from the point of purchase to the building site was assumed to be via diesel-powered truck/trailer as a mode of transport, and an 800 km distance in accordance with the c-PCR estimates and assumptions guideline.

4.2 ASSEMBLY/INSTALLATION (A5)

The manufacturer has created detailed installation instructions available upon request. According to Twelve Oaks, installation of the flooring product is relatively simple and requires only basic hand tools such as cutting instruments (e.g., utility knife), tape measure, carpenter square, and safety glasses. In this LCA, it is assumed that the subfloor is already level; therefore, any energy or materials associated with floor preparation are excluded. Because installation

tools are reusable and used across many projects, the production and end-of-life stages of these tools are also omitted from the system boundary.

A 10% installation waste rate is assumed based on manufacturer recommendations and typical industry practice. Installation waste is transported 161 km by diesel-powered truck to regional waste facilities, consistent with c-PCR requirements. Installed product distribution is assumed to be 50% in Eastern Canada, 30% in Western Canada, and 20% in the United States.

4.3 USE STAGE (B1-B7)

During the use stage, the product doesn't require operational energy or water use. Also, repair and refurbishment are not considered for this product. Hence, the environmental impacts of modules B1, B3, B5, B6, and B7 are considered as zero. Once PürTerra PVC-free resilient flooring has been installed and started to be lived on, routine vacuuming, sweeping, and/or dust mopping is usually sufficient to keep the floor clean. The RSL only applies to these reference in-use conditions.

4.4 MAINTENANCE (B2)

A common and periodic maintenance schedule should be followed during the use stage. A detailed maintenance guide is available upon request. The energy and detergent consumption information is based on estimation and guidance provided by the manufacturer for routine cleaning practices and representative use conditions.

Table 6 Inputs in the maintenance stage

	Amount	Units	Scenario
Electricity	0.052	kWh/m ² /yr.	Based on weekly vacuuming and 0.001kWh/m ² square assumption
Detergent	0.052	kg/m ² /yr.	Based on weekly mopping and 0.001kg/m ² detergent usage assumption

4.5 REPLACEMENT (B4)

Replacement impacts are modelled as re-installation of PürTerra PVC-free resilient flooring with the same bill of materials, transport and packaging as modules A1-A5, scaled by the number of replacements (n = 1.5).

4.6 END-OF-LIFE STAGE (C1-C4)

At the end of life, PürTerra PVC-free resilient flooring is typically removed manually and does not entail powered equipment under normal practice. As a result, no operational energy or water use is quantified in C1 (de-construction), consistent with typical practice for resilient flooring. The mass of flooring entering the end-of-life stage is based on the installed product and associated ancillary materials, excluding installation waste already accounted for in A5.

5 LCA: RESULTS

Life cycle assessment results must be presented per FU (Heijungs et al., 1992). This section presents impact assessment results for the declared modules, which are calculated using the U.S. EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts, TRACI v2.1 and CML-baseline (US EPA, 2012). It is noted that the LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. The impact categories reported in this study should be understood as potential impacts. They are estimates of environmental effects that could arise if the modelled emissions (a) follow the assumed impact pathways and (b) encounter specific conditions in the receiving environment while doing so. Moreover, the life cycle inventory reflects only the share of total environmental burdens associated with the defined functional unit, i.e., it is a relative rather than an absolute description. As a result, the LCIA outcomes are comparative indicators only; they do not quantify real-world damage, indicate whether regulatory thresholds are exceeded, or describe safety margins or risk levels.

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Table 7 LCIA results for 1 m² of 2.5 mm thickness PürTerra PVC-free resilient flooring over a 75-year time horizon.

Impact Category	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
GWP Global Warming Potential (kg CO ₂ - eq)	5.98E+00	3.26E-01	5.74E+00	1.36E+00	3.02E+00	0.00E+00	2.86E+00	0.00E+00	2.54E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-01	8.34E-02	3.53E-01
ODP Ozone Depletion Potential (kg CFC 11 eq)	1.49E-07	4.65E-09	2.44E-08	1.87E-08	1.24E-07	0.00E+00	5.51E-08	0.00E+00	4.86E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-09	9.03E-10	1.14E-09
AP Acidification Potential (kg SO ₂ eq)	2.37E-02	6.88E-04	2.89E-02	1.55E-02	1.15E-02	0.00E+00	1.24E-02	0.00E+00	1.22E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.49E-04	2.01E-04	2.72E-04
EP Eutrophication Potential (kg N eq)	7.14E-02	4.59E-04	6.15E-02	2.20E-03	4.86E-02	0.00E+00	1.85E-02	0.00E+00	5.59E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E-04	7.18E-04	1.88E-01
SFP Smog Formation Potential (kg O ₃ eq)	3.16E-01	1.27E-02	4.40E-01	3.66E-01	1.67E-01	0.00E+00	1.49E-01	0.00E+00	1.98E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-02	2.41E-03	7.77E-03
ADP _{fossil} Abiotic Resource Depletion Potential of Non-renewable (fossil) energy sources (MJ, LHV)	1.39E+02	4.48E+00	5.80E+01	1.76E+01	4.99E+01	0.00E+00	4.00E+01	0.00E+00	4.07E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E+00	4.85E-01	9.38E-01

Resource use and waste flow indicators complement the impact assessment by showing how much energy, water, and material are required to deliver 1 m² of PürTerra PVC-free resilient flooring over the 75-year ESL, and how much waste is generated at each life cycle stage, which are shown in Tables 8 and 9. The LCI flows were calculated using the American Center for Life Cycle Assessment's (ACLCA) guidance to the ISO 21930:2017 metrics (ACLCA, 2019).

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Table 8 Resource use indicators for 1 m² of 2.5 mm thickness PürTerra PVC-free resilient flooring over a 75-year time horizon.

Parameter	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
RPR _E (MJ)	3.83E+00	6.55E-02	8.86E+00	3.42E-01	2.58E+00	0.00E+00	1.70E+01	0.00E+00	2.38E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-02	1.39E-01	1.26E-02
RPR _M (MJ)	0.00E+00															
NRPR _E (MJ)	1.53E+02	4.83E+00	6.57E+01	1.90E+01	5.66E+01	0.00E+00	6.40E+01	0.00E+00	4.53E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.61E+00	7.64E-01	1.01E+00
NRPR _M (MJ)	0.00E+00															
SM (kg)	0.00E+00															
RSF (MJ)	0.00E+00															
NRSF (MJ)	0.00E+00															
RE (MJ)	0.00E+00															
FW (m ³)	2.35E-02	3.31E-04	2.67E-02	1.39E-03	1.43E-02	0.00E+00	1.09E-01	0.00E+00	1.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-04	3.60E-04	1.51E-04

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Table 9 Output flows and waste categories for 1 m² of 2.5 mm thickness PürTerra PVC-free resilient flooring over a 75-year time horizon.

Parameter	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
HWD (kg)	2.10E-03	3.15E-05	2.28E-04	1.17E-04	1.22E-03	0.00E+00	1.03E-03	0.00E+00	6.35E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-05	5.14E-04	6.92E-06
NHWD (kg)	4.52E+00	2.57E-01	8.57E+00	7.80E-01	2.97E+00	0.00E+00	2.11E+00	0.00E+00	3.18E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E-01	4.78E-02	3.93E+00
HLRW (kg or m ³)	0.00E+00															
ILLRW (kg)	4.41E-05	9.06E-07	5.35E-05	4.57E-06	4.15E-05	0.00E+00	5.26E-04	0.00E+00	2.23E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.13E-07	3.51E-06	1.87E-07
CRU (kg)	0.00E+00															
MR (kg)	0.00E+00	0.00E+00	4.25E-02	0.00E+00	9.01E-02	0.00E+00	0.00E+00	0.00E+00	5.47E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E-01	0.00E+00
MER (kg)	0.00E+00															
EE (MJ, LHV)	0.00E+00															

6 LCA: INTERPRETATION

For PürTerra PVC-free resilient flooring, the total cradle-to-grave GWP for 1 m² is 45.254 kg CO₂-eq. The replacement stage B4 is the dominant contributor, accounting for 25.438 kg CO₂-eq (56% of total GWP) due to the 1.5 replacement cycles over the 75-year ESL. Raw material supply (A1) and manufacturing (A3) are the next largest contributors, at 5.975 and 5.737 kg CO₂-eq, respectively (each 13%). Installation (A5) and maintenance (B2) contribute 3.015 and 2.857 kg CO₂-eq (together 13%), while transport stages (A2, A4, C2) and end-of-life processing (C3, C4) are comparatively minor.

A similar pattern is observed for most other midpoint indicators. For ozone depletion potential, acidification potential, smog formation potential, and fossil resource use (ADP_{fossil}), module B4 again dominates, contributing more than half of the total indicator value (e.g., 407.135 MJ of the total 718.596 MJ ADP_{fossil}). Upstream processes, particularly A1 and A3, are the second order drivers across these categories. Overall, the results show that extending the service life of the floor, reducing the mass or impact intensity of replacement materials, and improving end of life management are the most effective levers for reducing the life cycle impacts of PürTerra PVC-free resilient flooring.

A contribution analysis was conducted in accordance with PCR Part B to identify the life cycle stages that contribute most significantly to the environmental impacts of the declared product. The results are used to support the interpretation of the LCA results and to identify key methodological assumptions and data inputs requiring further evaluation through sensitivity analyses. Figure 4 shows the contribution analysis for life cycle stages for PürTerra PVC-free resilient flooring.

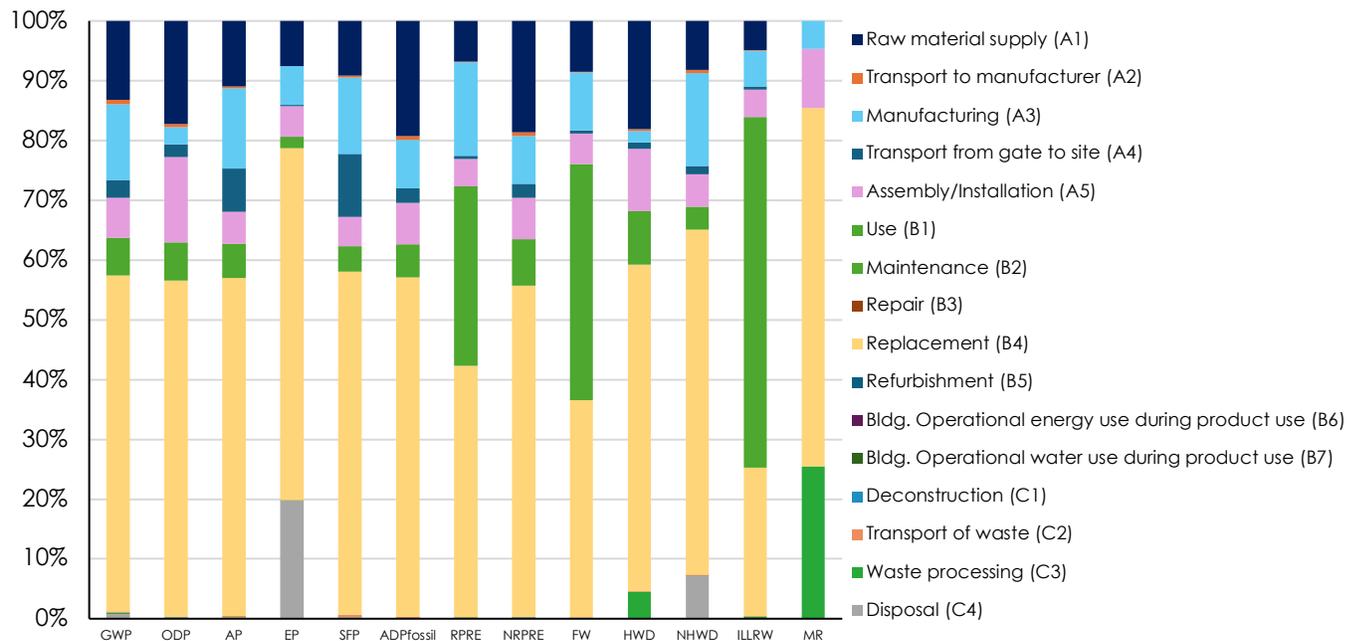


Figure 4 Contribution analysis of life cycle stages for PürTerra PVC-free resilient flooring

The results of the contribution analysis (Figure 4) shows that the replacement stage B4 is the dominant contributor, accounting for 25.438 kg CO₂-eq (56% of total GWP) for PürTerra PVC-free resilient flooring, due to the 1.5 replacement cycles over the 75-year ESL. Raw material supply (A1), manufacturing (A3), and Installation (A5) are the next largest contributors to the total impact. For example, A1 resulted in a significant amount of GWP (5.975 kg CO₂-eq/m²), and A3 and A5 resulted in 5.737 and 3.015 kg CO₂-eq/m², respectively. This reflects the fact that the raw materials contribute most to the total GWP, with the polypropylene production making the highest contribution, followed by stone powder and wear layer. The maintenance (B2) accounted for 2.857 kg CO₂-eq/m² mainly through cleaning energy and detergent consumption. Compared to the stages above, transport stages (A2, A4, and C2) and end-of-life processing (C3, C4) are comparatively minor. For ozone depletion potential, acidification potential, and smog formation potential, module B4 again dominates, contributing more than half of the total indicator value. Upstream processes, particularly A1 and A3, are the second order drivers across these categories. For fossil resource use (ADPfossil) impact category B4 again dominates (e.g., 407.135 MJ of the total 718.596 MJ ADPfossil), and then the next largest contributors are A1 and A3.

From a decision-support and product strategy perspective, the results indicate that the greatest opportunities for environmental improvement lie in product design optimization, particularly through material formulation refinement. Extending product service life represents a particularly effective lever, as reductions in replacement frequency would directly lower B4-driven impacts and substantially improve the total environmental performance.

7 ADDITIONAL ENVIRONMENTAL INFORMATION

7.1 ENVIRONMENT AND HEALTH DURING INSTALLATION AND USE

All Twelve Oaks products are tested and certified by FloorScore®. No substances required to be reported as hazardous are associated with the production of this product. PürTerra PVC-free resilient flooring contains no dangerous or regulated substances that impact human health or the environment,

7.2 FURTHER INFORMATION

Technical data sheets for PürTerra PVC-free resilient flooring can be found by contacting Twelve Oaks on their website at: <https://twelveoaks.ca/>

8 REFERENCES

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The LCA and EPD presented herein were developed by Build Neutral Inc., an Indigenous-owned Canadian research organization dedicated to advancing sustainability.