Environmental Product Declaration

NOVALIS LVT

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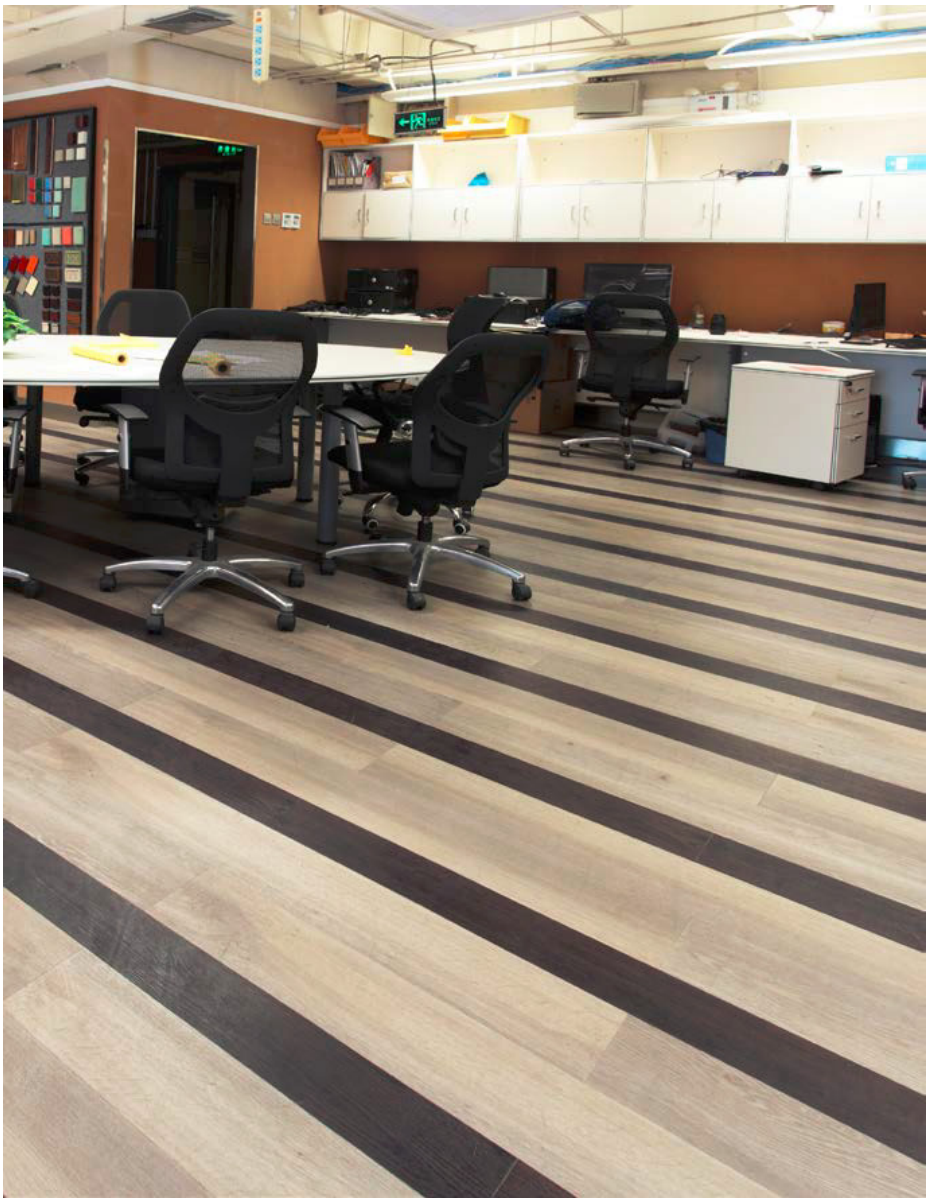

Novalis Innovative Flooring provides one of most sustainable flooring solutions on the market.

Manufactured with the best in class processes and practices, Novalis LVT meets the most stringent indoor air quality and emission standards available. It is FloorScore Certified (USA), A+ Certified (France) and DiBT Certified (Germany).

Novalis' manufacturing facility implements environmental management systems (EMS) and has achieved ISO 9001, ISO 14001 and OHSAS 18001 certifications.

Novalis is a zero-waste manufacturing facility where all production waste is recycled and utilized in an internal closed-loop recycling process

Novalis is a member of the US Green Building Council (USGBC), Resilient Floor Covering Institute (RFCI),World Floor Covering Association (WFCA) and the North American Association of Floor Covering Distributors (NAFCD).

In 2014, Novalis was winner and first recipient of Floor CoveringWeekly's GreenStep Asia Green Process Award during the inaugural year of Domotex Asia/China Floor Convention. www.novalis-intl.com

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
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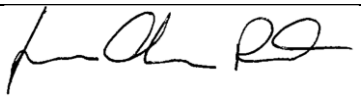
ENVIRONMENTAL PRODUCT DECLARATION

NOVALIS INNOVATIVE FLOORING

According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Novalis International Ltd.
DECLARATION NUMBER	4786462817.101.1
DECLARED PRODUCT	Novalis LVT
REFERENCE PCR	Institut Bauen und Umwelt e.V., Königswinter (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umw elt (IBU), Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report. September 2012 www.bau-umwelt.de Institut Bauen und Umwelt e.V., Königswinter (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part B: Requirements on the EPD for floorcoverings, Version 1.1 Institut Bauen und Umwelt e.V., www.bau-umwelt.com, 10/2012
DATE OF ISSUE	December 18, 2014
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics 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:	Institut Bauen und Umwelt (IBU)
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	 Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	 François Charron-Doucet

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NOVALIS LVT

Product Description

Product Classification and Description

Novalis LVT is highly durable and resilient flooring made with over 50% calcium carbonate (aka limestone, a globally abundant resource), virgin PVC resin and bio plasticizer. At the time of this EPD's publication, research has already been completed.

Novalis LVT is constructed with multiple layers as illustrated in the following diagram. All the layers are fused together into a flooring slab in a hot press. Each floor slab is then annealed and acclimated to release any built-in stress within the product. Finally each floor slab are punched and finished into floor panels of different sizes, then packaged into cartons for shipment. All production waste are granulated and put back into backing production to create an internal closed loop recycling process.

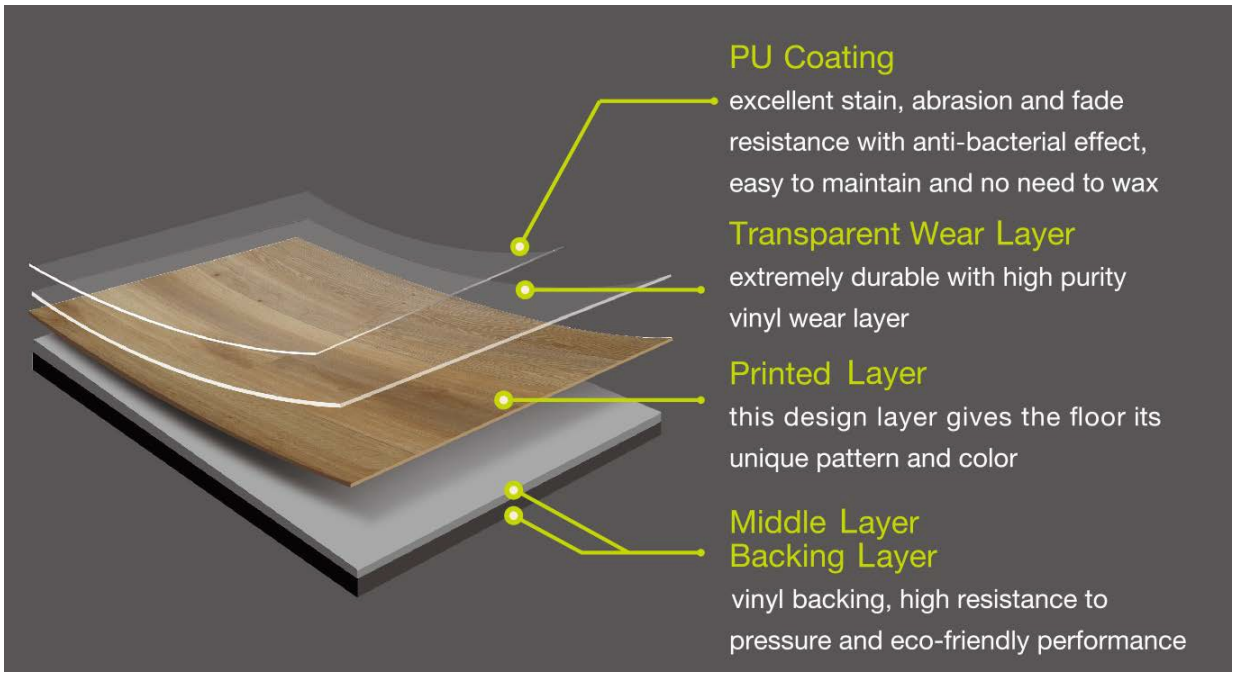

Figure 1: Diagram of Novalis LVT

Range of Application / Applicability

Novalis LVT features a highly resilient clear wear layer and is a floor covering for heavy traffic areas in domestic and commercial areas and general traffic areas in industrial applications.

High performance resilient floor covering for commercial and professional use e.g. in Retail Shops and Stores, Schools, Healthcare, Office and Administration areas.

Product Standards

Novalis LVT meets the following Technical Specifications:

EN 14041 Resilient, Textile and Laminate Floorcoverings - Essential characteristics CE-Labelling

EN 649 Resilient floor coverings - Homogeneous and heterogeneous polyvinyl chloride floor coverings - Specification

EN ISO 10874:2012 (EN 685) - Resilient, Laminate and Textile Floor coverings Classification.

EN 14085-2003: Specification for floor panels intended for loose laying.

GB/T 4085-2005 Semirigid polyvinyl chloride floor tiles

GB/T 18586-2001 Limit of harmful substances of PVC flooring

EN 13501-1 Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests.

GB 8624 Classification for burning behavior of building materials and products

Accreditations

Compliant with FloorScore Flooring Products Certification Program for Indoor Air Quality, DiBT/AgBB Ü Mark Certification (U Mark) - Resilient Floor Coverings and French VOC regulation

Characteristics

Characteristics	Average Value	Unit	Maximum Value	Minimum Value
Product thickness	2.76	mm (inch)	5.0	2.0
Wear layer thickness (where relevant)	0.25	mm (inch)	0.7	0.1
Product weight	5264.2	g/m^2 (oz/ft^2)	9010	3470
Product form: Rolls Width/Length	143.5/1132.2	mm (inch) M (feet)	228.6/1219.2	76.2/304.8
Tiles	414.6/470.2	mm (inch)	914.4/914.4	304.8/304.8
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; DiBT/AgBB Ü Mark Certification (U Mark) -Resilient Floor Coverings; French VOC regulation			

Table 1: For Novalis LVT

Product Content

Material Contents

Component	Material	Mass %	Availability			Origin of Raw Materials
			Renewable	Non-Renewable	Recycled	
Resin	PVC: Polyvinyl Chloride	22.64%		Fossil limited		China
Plasticizer	Bio plasticizer	7.47%	Abundant			China
Fillers	Calcium carbonate	67.92%		Mineral abundant		China
Filler	Epoxidized soybean oil	1. 13%	Abundant			China
Stabilizer	Calcium stearate	0.38%		Fossil limited		China
Stabilizer	Zinc stearate	0.28%		Fossil limited		China
Stabilizer	Carbon Black	0.18%		Fossil limited		China

Table 2: Material Content Table of Novalis LVT 2.5 (0.5)

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Novalis LVT

Life Cycle Assessment Stages and Reported EPD Information

Sourcing / Extraction (Raw Material Acquisition Stage)

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.

Bio plasticizer: Plasticizer are used to make vinyl soft and flexible. NP-1 is produced by the reaction of Fatty acid methyl ester and chlorine.

Calcium carbonate: powder filler sourced locally to the factory to impart strength, impact resilience and dimensional stability properties to the product. Calcium carbonate is a widely abundantly available natural mineral.

Epoxidized soybean oil: is manufactured from soybean oil through the process of epoxidation.

Calcium stearate: In rigid PVC, it can accelerate fusion, improve flow, and reduce die swell. Calcium stearate is produced by heating stearic acid, a fatty acid, and calcium oxide

Pigment: the product achieves decorative effects by using thin vinyl printed film under the resilient wear layer. The film is printed using a wide variety of standard issue-printing colours.

Manufacturing Stage

The layers are laminated together via a process of time, high pressure and high temperature inside a pressing machine, either continuous or discontinuous, to form a heterogeneous sheet. Simultaneously, the corresponding embossed texture is applied. After cooling and conditioning, a reinforced urethane coating is applied to the surface and the master sheets are annealed. In a controlled environment, the sheets are then cut into the respective plank and tile sizes with a supplementary beveled edge being added to select designs. The planks and tiles are packaged into cardboard boxes.

All waste arising during production (trimmings, cuttings, all defective product, and beveled edge cutting leftovers) are placed back into the mixing process to manufacture new flooring, in a closed loop, internal recycling system.

The factory obtains the following environmental and occupational heath and safety management certifications:

- o ISO 14001 Environmental Management System
- o OHSAS 18001 Occupational Health and Safety Management Systems

Health, Safety and Environmental Aspects During Production

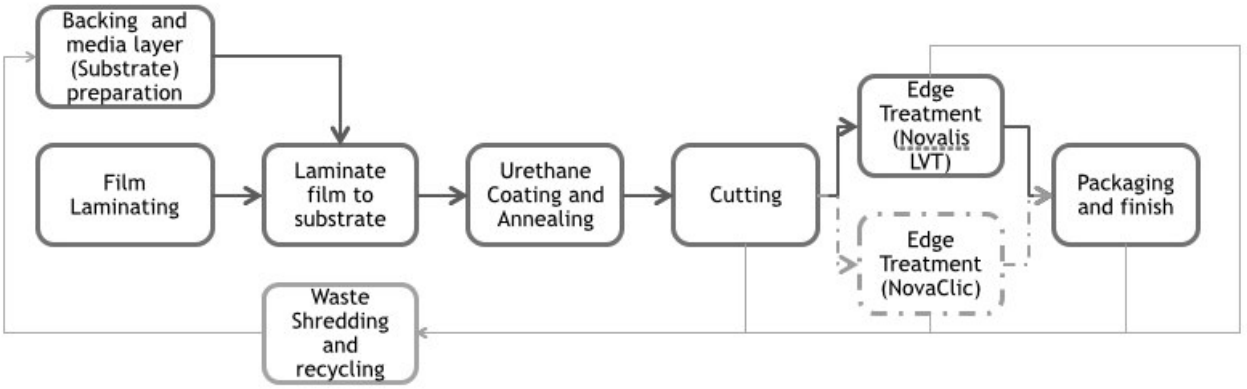

Figure 2: Production Process Flowchart of LVT

Production Waste

Air: the exhaust air resulting from production processes is cleaned according to local legal requirements. Emissions are significantly below the permitted tolerances.

Water/Soil: Contamination of water and soil is not observed occur. Effluent resulting from production is processed internally and routed back into production. The quality of water is audited on a regular basis. Water recycling and reuse systems are in place for heating and annealing.

Noise protection: noise intensive systems such as granulation are structurally enclosed and controlled.

Delivery Stage

The products are distributed domestically (freight trucks) and internationally, starting from Zhenjiang Port (Shipping Containers). Around 73.5% of LVT products are consumed in USA, and 21.8% in Europe, the remaining 4.7% is consumed in Asia, South Africa and South America markets. It is difficult to provide specific transportation distance for oceanic and road transportation for LVT product delivery, hence estimation with reference to external resources is adopted.

Installation Stage

Novalis LVT requires an application of adhesive for installation. The amount of adhesive required is 300grams per square meter with approximately 5% of the total material being cut off as waste. Though some of this waste could be recycled, this scrap is modeled as being disposed of in a landfill

Health, Safety and Environmental Aspects During Installation

It is recommended that water-based acrylic adhesives be used for installation. No harmful substances are released during installation and no specific protection or gear is required. Recommended adhesives are those that comply with the emissions requirements of California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers (also known as CA 01350), or adhesives that are FloorScore or Green Label Plus approved.

Installation and/or Post-Installation Waste

Resilient floor covering waste derived post-installation, may be recycled as floor covering through the manufacturer's facilities. Post-installation waste is collected and forwarded back to factories through the manufacturer.

Packaging

Packaging material and transportation aids such as wooden pallets, cardboard, paperboard PET strapping and recyclable PE film should be collected separately for later recycling

Category	Material
paper	wrapping,labels,cores
cardboard	boxes,cores
wood	pallets
plastics	foils,etc

Table 3: Packaging Materials

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Use Stage

The service life of vinyl tile 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.

Name	Value	Units
Reference Service Life (RSL)	LVT products with wear layers greater than 0.55mm (including 0.55) are intended for commercial use with a RSL of 10 years. LVT products with wear layers less than 0.5mm are intended for residential use with a RSL for 25 years.	a

Cleaning and Maintenance

Novalis LVT utilizes a PU coating and does not require any floor wax or floor finish after installation or during routine maintenance. Very little effort is required in order to use LVT, hence in the usage stage the focus is put on maintaining the floor tile in terms of protecting its integrity and functionality. In normal conditions, routine vacuuming, cleaning and surface conditioning is required. The energy, water and detergent consumption data is based on estimation and study of comparative product's usage data. Table 4 below demonstrates the amount used for the purposes of this LCA study.

	Amount	Units	Scenario
Water	5.2	L/m^2 /yr.	Based on weekly mopping and $10L/100m^2$ water usage assumption
Electricity	0.022	kWh/m^2 /yr.	Based on weekly vacuum use and at power rate of 250w, 5second per square meter assumption
Detergent	104	g/m^2 /yr.	Based on weekly mopping and $20g/100m^2$ detergent usage assumption

Table 4: Inputs in maintenance stage

Structural Damage During Use

For a wet-set installation:

i. It is important to allow the adhesive to set before accepting any foot traffic for a minimum of 12 to 24 hours. Failure to adhere to this guideline may result in shifting of planks, oozing of adhesive through seams or permanent indentations.

ii. Do not allow heavy loads, rolling traffic, furniture or fixtures on the floor for 24-48 hours after installation.

iii. Novalis is not responsible nor will warrant our products in the event that this is not properly followed.

For a dry-set or pressure sensitive application do not allow foot traffic on the floor for 12 hours.

In the event that the LVT flooring is not the last portion of the construction project, the floor must be protected from construction traffic and damage. Wait 24 hours and utilize a reinforced fiber protective board or heavy kraft paper (min. 60 lbs.) and cover the floor. Failure to wait 24 hours before covering can impact adhesive curing.

Health Aspects During Use

According to the current state of knowledge, hazards to water, air and soil cannot occur during the proper use of the described products. No damage or impairment to health is expected under normal use corresponding to the intended use of resilient flooring.

The flooring products in this EPD comply with the VOC emissions requirements:

i. The California Department of Public Health (CDPH) Standard Method v1.1 as certified by the FloorScore Certification Program for Indoor Air Quality.

ii. Germany DiBT/AgBB Ü Mark Certification (U Mark) - Resilient Floor Coverings.

iii. French A+ VOC regulation.

Extraordinary Effects

Fire

EN 13501-1 Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests.

Water

It is clear that water on the surface could present a potential slip hazard. Water spills should be cleared immediately. For areas where water and contaminants are frequent an EN 13845 safety floor is advised.

Mechanical destruction

Abrasion and impact loading classification see product definition in this EPD. The dragging of heavy objects across the floor can cause damage and/or the breaking of the material and present potential risk of injury.

End of Life Stage, Recycling, Reuse or Repurpose

For temporary installations, dry adhesive systems are available. Dry adhesives allow for ease of removal of vinyl tiles making them viable for reuse and/or recycling. In these scenarios, the adhesive manufacturer's instructions must be followed. When properly sorted, vinyl tiles can be recycled and put back into the manufacturing cycle to create new flooring.

Disposal

The disposal of the used LVT will adopt a country and region average disposal mode following literature review.

Life Cycle Assessment Stages and Reported EPD Information

General

A full Life Cycle Assessment has been carried out according to ISO 14040 and ISO 14044, per Product Category Rules (PCR) for Floor Coverings, as published by Institut Bauen und Umwelt e.V.

The following Life Cycle Stages are assessed:
- Product Stage (raw material extraction and processing, transportation to the manufacturer and manufacturing)
- Construction Stage (transport to the building site, installation in the building)
- Use Stage
- End of Life Stage

Description of the Function Unit

The functional unit is one square meter of installed product and the use stage is considered for one year of service life.

Cut-off Criteria

All inputs and outputs to a (unit) process will be included in the calculation for which data is available. Data gaps may be filled by conservative assumptions with average or generic data. Any assumptions for such choices will be documented.
In case of insufficient input data or data gaps for a unit process, according to the IBU PCR requirement, the cut-off criteria chosen is 1% of renewable and non-renewable primary energy usage and 1% of the total mass of that unit process. The total neglected input flows of the cradle to grave stage shall be a maximum of 5% of energy usage and mass.

Allocation

Multi-output processes

For data sets in this study, the allocation of the outputs from coupled processes is generally carried out via the mass. For literature data, the source is generally referred to.

Multi-input processes

Multi-input processes occur especially in the area of waste treatment. Relevant processes are modelled in such a way that the partial material and energy flows due to waste treatment of the used LVT materials can be apportioned in a causal way.

Background Data & Data Quality

Steps were taken to ensure that the life cycle inventory data were reliable and representative. The type of data that was used is clearly stated in the Inventory Analysis, be it measured or calculated from primary sources or whether data are from the life cycle inventory databases. In this study, generic data for certain processes were sourced from these databases in SimaPro 8.0.5.
SimaPro is the world's most widely used LCA software and the data in it comes predominantly from EcoInvent, the world's most complete and widely used set of data on industrial processes, material production, packaging production, transport and so on.

Background Data & Data Quality (cont.)

The data quality requirements for this study were as follows:

- Existing LCI data were, at most, 10 years old. Newly collected LCI data were current or up to 3 years old.
- The LCI data related to the geographical locations in which the processes occurred, e.g. electricity and transportation data from China, disposal in USA and Europe and etc.
- The technology represented the average technologies at the time of data collection.

In the study the key parameters for producer-specific foreground data are based on 1 year (March 2014 to February 2015) of averaged data. In case of gap of data from Ecoinvent, ELCD database, to avoid using dummy (empty) processes in the study, and also to use as much regional data as possible in some cases, alternative database is also referred to, including Chinese LCI database developed by Beijing University of Technology (reviewed and managed by Ecovane), Japanese Input and output database, IVAM (Dutch), USLCI and etc.

System Boundaries

The study of these LVT systems includes all life cycle stages and processes. 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.

Figure 3 below, illustrates the system boundaries for the LVT product including LVT production, installation usage and waste disposal of used LVT products. Transportation of raw material to manufacturing plant and within the factory is not shown in the figure but will be included in the LCI collection and impact assessment.

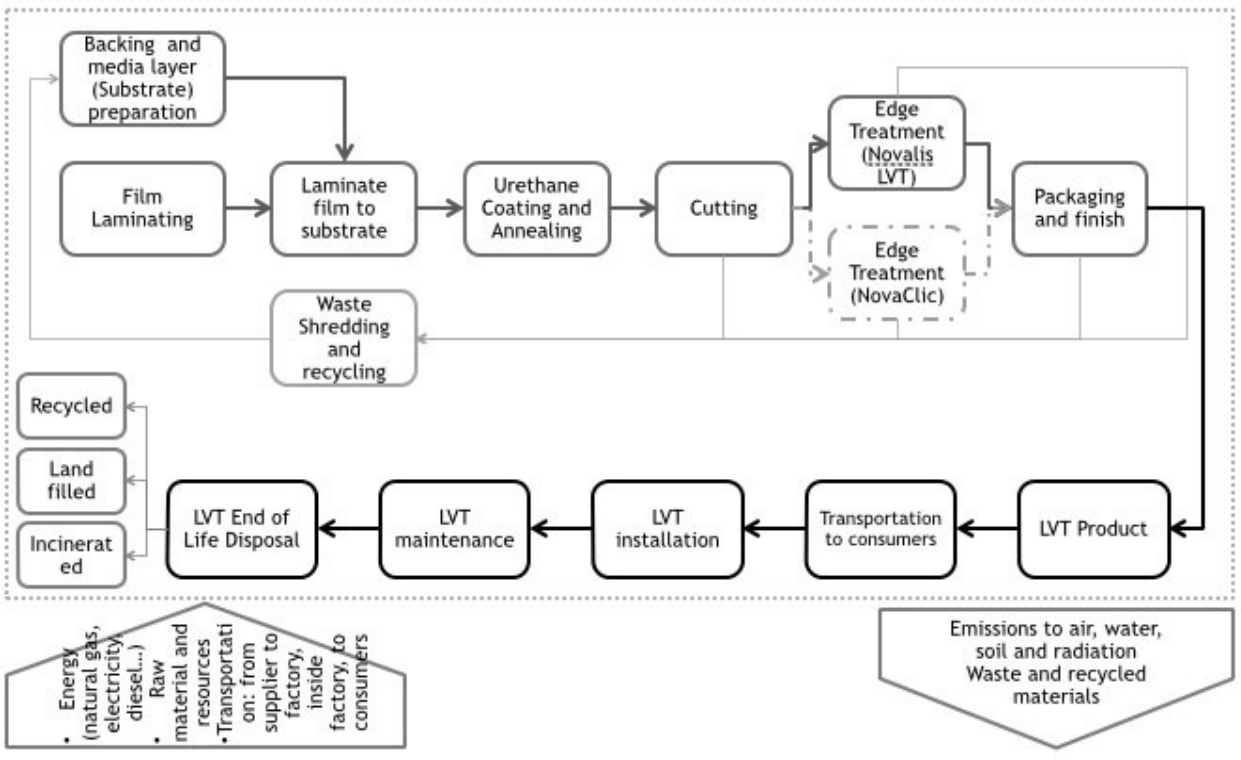

Figure 3: system boundary of LVT

Results of the Assessment

The weight averaged value of the primary renewable / non-renewable energy demand, and waste / hazardous waste as well as water is depicted in Table 5 below.

Name	Value		Unit
	Road	Ocean	
Litres of fuel	31.11 l/100km (Diesel)	10.175 t/100km (Heavy oil)	
Transport distance	1000	23536.64	km
Capacity utilization (including empty runs)	50	100	%
Gross density of products transported	688.4	688.4	kg/m3
Capacity utilization volume factor	40	40	%

Table 5 : Transport to the construction site (A4)

LCA Scenarios and Additional Technical Information

The following technical information in Table 6 and Table 7, is a basis for the declared modules.

Name	Value	Unit
Auxiliary	0.3	Kg/m2
Water consumption	0	m3/m2
Electricity consumption	0	kWh/m2
Other energy carriers	0	MJ/m2
Material loss	0.05	M2/m2
Output substances following waste treatment on site	0.05	Kg/m2
Dust in the air	0	Kg/m2

Table 6: Installation in the building (A5)

Name	Value	Unit
Name	Value	Unit
Information on maintenance		-
Maintenance cycle	10/10 ; 25/25	Number/RSL
Water consumption	0.0052	m3/m2
Auxiliary	0.104	Kg/m2
Electricity consumption	0.01805	KWh/m2
Other energy carriers	0	MJ/m2
Material loss	0	Kg/m2

Table 7: Maintenance (B2)

Life Cycle Inventory Analysis

Table 8 below, is the LCI results by stage. In this study the Novalis LVT 2.5 (0.5) is chosen to represent the whole range of Novalis LVT specifications, as this series accounts for 9.13% of the production volume, the highest ratio among the respective specifications.

Impact category	Units	Product Stage (A1-A3)	Installation (A5)	Construction Stage (A4)			Use Stage (B2)	End of Life Stage (C1-C4)	Total
				Transport to Asia	Transport to US	Transport to EU			
Non renewable fossil	MJ	1.32E+02	2.41E+01	9.14E-01	5.25E+00	2.09E+01	4.72E+00	-3.37E-01	1.87E+02
Non renewable biomass	MJ	1.70E-03	6.43E-06	1.09E-06	5.38E-06	0.00E+00	4.57E-07	1.55E-05	1.73E-03
Non renewable nuclear	MJ	7.58E+00	1.05E+00	2.38E-02	1.18E-01	6.39E-02	8.07E-01	2.82E+00	1.25E+01

Table 8: Primary energy, non-renewable for all life cycle stages (Novalis LVT Representative series Novalis Novaclic LVT2.5 (0.5))

Impact category	Units	Product Stage (A1-A3)	Installation (A5)	Construction Stage (A4)			Use Stage (B2)	End of Life Stage (C1-C4)	Total
				Transport to Asia	Transport to US	Transport to EU			
Renewable biomass	MJ	5.71E+00	7.69E-02	7.49E-04	3.63E-03	3.34E-06	4.82E-02	9.97E-02	5.94E+00
Renewable, water	MJ	1.78E+00	1.24E-01	4.48E-03	2.21E-02	1.46E-02	1.09E-01	3.47E-01	2.40E+00
Renewable, wind, solar, geothermal	MJ	1.02E-01	1.22E-02	2.92E-04	1.57E-03	2.85E-03	7.28E-03	6.89E-02	1.95E-01

Table 9: Primary energy, renewable for all life cycle stages (Novalis LVT Representative series Novalis LVT 2.5(0.5))

A contribution analysis shows that the dominant primary energy source is from none renewable energy, the ratio between primary non-renewable and renewable energy source is 24.7:1 for NovaClic 4.0 (0.1) and 23.4:1 for Novalis LVT 2.5 (0.5). There is no secondary energy or material used for the manufacturing of LVT products. Further analysis reveals that fossil fuel energy dominated the energy sources for both LVT and NovaClic product (above 90% of energy comes from fossil fueled energy sources).

A process contribution analysis on Novalis LVT is conducted to reflect the contribution from processes. The result is listed in Table 10 below.

Impact category	Units	Product Stage (A1-A3)	Construction Stage (A4)			Use Stage (B2)	End of Life Stage (C1-C4)	Total
			Transport to Asia	Transpor t to US	Transport to EU			
Sum Energy	MJ	1.42E+02	2.53E+01	9.41E-01	5.38E+00	2.09E+01	5.69E+00	2.04E+02
Ratio	%	69.56%	12.44%	0.46%	2.64%	10.28%	2.79%	100.00%
Fresh Water	MJ	1.52E-01	2.51E-02	1.90E-04	9.49E-04	8.26E-05	6.34E-03	2.48E-01
Ratio	%	61.28%	10.12%	0.08%	0.38%	0.03%	2.56%	100.00%
Waste	MJ	1.66E+00	0.00E+00	1.32E-03	7.95E-03	3.30E-02	0.00E+00	2.59E+00
Ratio	%	63.98%	0.00%	0.05%	0.31%	1.27%	0.00%	100.00%

Table 10: Other resources and wastes for all life cycle stages (Novalis LVT Representative series Novalis LVT 2.5 (0.5))

Life Cycle Impact Assessment

To analysis the contribution of processes to the environmental impact, an LCIA was conducted using CML 2001 baseline method on the chosen representative Novalis 2.5 (0.5) product, the result was allocated by stages, as shown in table below. Note that the result is based on 25 years' usage, so as to get a picture of full life cycle impact and contribution analysis of the product.

The impact assessment results are calculated using characterization factors published by the University of Leiden's CML 2001.

Note that for Use Stage, B3 Repair, the LCA findings were such that the ratio of repair was less than 1 per thousand. These findings are negligible and therefore not included.

Note that for Use Stage, B4 Replacement, the LCA findings were such that the ratio of replacement was less than 1 per thousand. These findings are negligible and therefore not included.

Note that for Use Stage, B5 Refurbishment, the LCA findings were such that the ratio of refurbishment was less than 1 per thousand. These findings are negligible and therefore not included.

Note that for Use Stage, B6 Operational Energy Use, the LVT product requires no energy or material feed stock in order to function. The value of this stage is therefore zero and not included in this report.

Note that for Use Stage, B7 Operational Water Use, the LVT product requires no water in order to function. The value of this stage is therefore zero and not included in this report.

Product Stage			Construction Stage		Use Stage							End of Life Stage				Benefits and loads beyond the product system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	X	MND	MND	MND	MND	MND	X	X	X	X	MND

A1: Raw material supply A2: Transport A3: Manufacturing A4: Transport from the gate to the site A5: Assembly
B1: Use B2: Maintenance B3: Repair B4: Replacement B5: Refurbishment B6: Operational energy use B7: Operational water use
C1: De-construction demolition C2: Transport C3: Waste processing C4: Disposal
D: Reuse-Recovery-Recycling-potential

Table 11: Description of the system boundary (X = included in the LCA; MND = Module Not Declared)

Life Cycle Impact Assessment (cont.)

Impact category	Units	Product Stage (A1-A3)	Installation (A5)	Construction Stage (A4)			Use Stage (B2)	End of Life Stage (C1-C4)	Total
				Transport to Asia	Transport to US	Transport to EU			
GWP	kg CO2- Eq.	1.66E+01	9.27E-01	6.67E-02	3.87E-01	1.64E+00	3.18E-01	2.62E+00	2.25E+01
ODP	kg CFC11-Eq.	1.63E-07	5.38E-08	3.75E-09	2.01E-08	1.85E-09	4.69E-09	1.64E-08	3.2E-07
AP	kg SO2- Eq.	1.25E-01	1.73E-03	1.54E-03	9.41E-03	3.90E-02	1.56E-03	-9.82E-04	1.78E-01
EP	kg (PO4)3-Eq.	8.52E-03	5.55E-04	1.59E-04	9.94E-04	3.89E-03	4.05E-04	9.73E-03	2.43E-02
POCP	kg Ethen-Eq.	6.17E-03	1.45E-04	4.52E-05	2.72E-04	1.38E-03	6.07E-05	-2.53E-05	8.05E-03
ADPE	kg Sb Eq.	1.11E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-06
ADPF	MJ	9.53E+01	7.89E-03	5.52E-01	3.32E+00	2.19E+01	2.54E+00	5.51E-03	1.24E+02
Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources								

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Table 12: CML results by stage (Novalis LVT Representative series Novalis LVT 2.5(0.5))

Life Cycle Impact Assessment (cont.)

Impact category	Units	Product Stage (A1-A3)	Installation (A5)	Construction Stage (A4)			Use Stage (B2)	End of Life Stage (C1-C4)	Total
				Transport to Asia	Transport to US	Transport to EU			
PERE	MJ	7.59E+00	2.13E-01	5.52E-03	2.73E-02	1.75E-02	1.65E-01	5.15E-01	8.54E+00
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	7.59E+00	2.13E-01	5.52E-03	2.73E-02	1.75E-02	1.65E-01	5.15E-01	8.54E+00
PENRE	MJ	1.34E+02	2.51E+01	9.35E-01	5.35E+00	2.09E+01	5.52E+00	2.48E+00	1.95E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.34E+02	2.51E+01	9.35E-01	5.35E+00	2.09E+01	5.52E+00	2.48E+00	1.95E+02
SM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	1.52E-01	2.51E-02	1.90E-04	9.49E-04	8.26E-05	6.34E-02	6.34E-02	3.05E-01
Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of nonrenewable primary energy excluding nonrenewable primary energy resources used as raw materials; PENRM = Use of nonrenewable primary energy resources used as raw materials; PENRT = Total use of nonrenewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of nonrenewable secondary fuels; FW = Use of net fresh water								

Table 13: Resource Use (Novalis LVT Representative series Novalis LVT 2.5(0.5))

Life Cycle Impact Assessment (cont.)

Impact category	Units	Product Stage (A1-A3)	Installation (A5)	Construction Stage (A4)			Use Stage (B2)	End of Life Stage (C1-C4)	Total
				Transport to Asia	Transport to US	Transport to EU			
HWD	[kg]	1.36E+00	0.00E+00	4.39E-08	2.64E-07	1.09E-06	0.00E+00	0.00E+00	1.36E+00
NHWD	[kg]	2.99E-01	0.00E+00	1.32E-03	7.95E-03	3.30E-02	0.00E+00	8.92E-01	1.23E+00
RWD	[kg]	3.60E-10	0.00E+00	9.94E-09	5.97E-08	2.47E-07	0.00E+00	0.00E+00	3.17E-07
CRU	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.85E-01	3.85E-01
MER	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Caption	HWD = Hazardous waste disposed; NHWD = Nonhazardous waste disposed; RWD = Radioactive CRU=Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy								

Table 14: Output flows and waste categories (Novalis LVT Representative series Novalis LVT 2.5(0.5))

Interpretation

Assumption and substitution are used widely in this LCA study, the main assumption includes:

The assumption of utilizing rate of LVT product during installation (95%), the glue usage for installation of Novalis LVT Series (300g/M2), the energy, water and detergent use during maintenance, and the use of substitution process for missing data, etc.

The end of life disposal of waste LVT products in Europe adopts Netherlands' waste disposal approach as default, the results reported in this study will be based on this scenario; the waste to energy efficiency factor are based on recent years' average figure from USA and Europe, Asia and other region follow USA's model as default.

Transportation: the distance of delivery of LVT products in the market of USA, Europe and the rest regions; the distance of collection of waste LVT products.

A stage contribution analysis on various impact categories reveals that end of life treatment of PVC tile using land fill and incineration, transportation (oceanic and road) as well as manufacturing stages are the main contributions to environment impact categories. The process contribution analysis reveals that

transportation, raw PVC material supply and incineration process for waste treatment contributes to most of the environmental impacts. End of life disposal scenario analysis reflect that increasing recycling will greatly improve the overall environmental impacts, even without considering the benefit from recycling use of LVT product.

Interpretation (cont.)

Sensitivity analysis shows that change in assumptions such as transportation distance, maintenance inputs and end of life treatment scenarios of used products and changes on data and model quality can lead to certain fluctuation of the final LCA results, hence it is recommended to update the model to get up-to-date results in case the assumption or process parameters change in the future, or if better data can be provided.

The LCA study has been carried out based on available data, information, regional and global knowledge and experience to achieve the most accurate and complete results possible.

Transparency Documentation

This sector provides rationale on how the results of LCA for the EPD purpose are obtained, based on the declared unit of one square meter of LVT product for both conventional Novalis LVT and NovaClic.

As luxury vinyl tiles are normally produced in series with various size (length*width) and thickness (LVT layer and wearing layer), for various application purposes in commercial and residential floor. In this case using a hypothetical average product from the manufacturer is adopted for the analysis, i.e. an average Novalis LVT product and an average NovaClic product.

There are 19 specifications of Novalis LVT product and 7 specifications of NovaClic product produced from March 2013 to February 2014. To get the result of an averaged Novalis NovaClic LVT product, the result for each 7 specifications is obtained and then weight-averaged to calculate the average LCA score for each category of impact in CML baseline 2001 with its updated method version CML-IA (2013).

An additional detailed transparency documentation listing the assumption and calculations for the distribution of the results among product series and product stages are provided for further reference in the end of this report.

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DIBt Deutsches Institut für Bautechnik