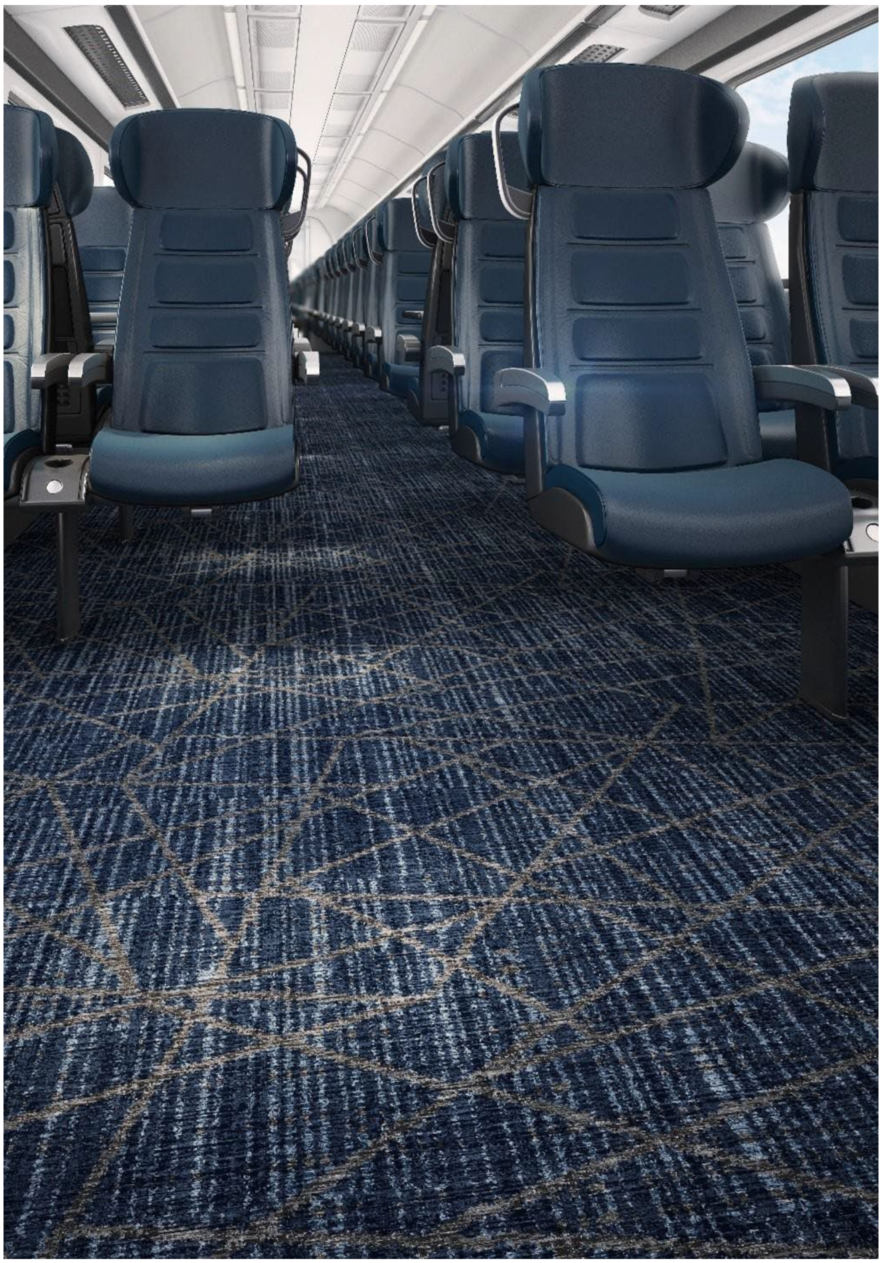
ENVIRONMENTAL PRODUCT DECLARATION

FLOTEX FR

FORBO FLOORING SYSTEMS
FLOCKED FLOOR COVERING

Flotex Vision FR 000225FR Web storm



FLOORING SYSTEMS

Flotex is a unique flooring Flotex that offers a warm, comfortable, hygienic floor covering that is suitable for any commercial specification. It is made by electrostatically flocking 80 million nylon fibers in a watertight backing. This build up combines the practicality of a resilient flooring with the slip resistant and acoustic properties usually associated with textiles. Flotex is strong and hygienic, and, being completely waterproof, Flotex is also the only truly washable textile floor covering. It is the only textile flooring that has been awarded with a British Allergy Foundation seal.

Forbo was the first flooring manufacturer to publish a complete Life Cycle Assessment (LCA) report verified by CML in 2000.In addition Forbo is now to publish Environmental Product Declarations (EPD) for all products including full LCA reports. This EPD is using all recognized flooring Product Category Rules and is including additional information to show the impacts on human health and eco-toxicity. By offering the complete story we hope that our stakeholders will be able to use this document as a tool that will translate the environmental performance of Flotex FR into the true value and benefits to all our customers and stakeholders alike.

For more information visit;
www.forbo-flooring.com

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

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 333 Pfingsten Road Northbrook, IL 60611
DECLARATION HOLDER	Forbo Flooring B.V. Industrieweg 12 P.O. Box 13 NL-1560 AA Krommenie
DECLARATION NUMBER	4790334130.101.1
DECLARED PRODUCT	Flotex FR Flocked Floor Covering
REFERENCE PCR	EN 16810 : Resilient, Textile and Laminate floor coverings – Environmental product declarations – Product category rules
DATE OF ISSUE	January 1, 2023
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:	European Standards CEN/TC 134 https://www.en-standard.eu/
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories	Cooper McC

FLOORING SYSTEMS

Flotex FR
Flocked Floor Covering

According to ISO 14025 and EN 15804

☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

This EPD conforms with EN 15804

Product Definition

Product Classification and description

This declaration covers a broad range of designs and colors. Flotex is a unique flooring Flotex that offers a warm, comfortable, hygienic floor covering that is suitable for any commercial specification.

It is made by electrostatically flocking 80 million nylon fibers in a watertight backing. This build up combines the practicality of a resilient flooring with the slip resistant and acoustic properties usually associated with textiles. Flotex is strong and hygienic, and, being completely waterproof, Flotex is also the only truly washable textile floor covering. It is the only textile flooring that has been awarded with a British Allergy Foundation seal. Flotex FR complies with all requirements of EN1307: Textile Floor Coverings - Classification of Pile Carpets.

Flotex FR has been manufactured for over 40 years and is a well-known brand sold worldwide. This declaration refers to Flotex FR covering a broad range of designs and colors :

Flotex Colour FR, Flotex Vision FR, Flotex Designer/Artist FR (Starck / Tibor / Sottsass / Hemingway Design, Flotex FR Bespoke design).

Flotex FR is comprised of a Nylon 6.6 pile above a glass fiber reinforced PVC cushioned backing. Flotex FR is built up in 4 layers as illustrated in the following image:

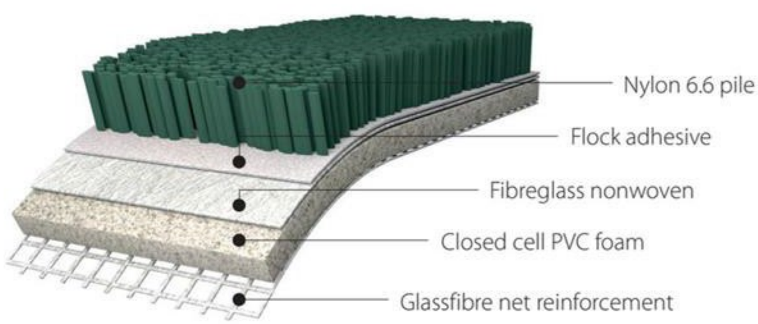


Figure 1: Typical construction

1. **Surface layer:** This layer gives Flotex FR its design, color and wear properties
2. **Adhesive layer:** This layer bonds the surface layer to the backing.
3. **Glass fiber layer:** This layer provides strength and dimensional stability to the product
4. **Backing/Reinforcing Net Layer:** This layer provides cushioning and acoustic properties

This declaration refers to the declared/functional unit of 1 m^2 installed flooring product.

Flotex FR
Flocked Floor Covering

According to ISO 14025 and EN 15804

Range of application

Flotex FR is classified in accordance with EN1307 to be installed in the following use areas defined in EN-ISO 10874:

Area of application	Flotex FR
Domestic	Class 23
Commercial	Class 33

Product Standard

The product considered in this EPD has the following technical specifications:

- Meets or exceeds all requirements of EN1307: Textile Floor Coverings - Classification of Pile Carpets.

Flotex FR meets or exceeds the requirements for:

- IMO Wheelmark
- US Coastguard Approval
- EN45545-2 HL-2
- ASTM E648
- ASTM E662

Accreditation

- ISO 9001 Quality Management System
- ISO 14001 Environmental Management System
- British Allergy Foundation
- AgBB/ABG
- French act Grenelle: A+

Flotex FR
Flocked Floor Covering

According to ISO 14025 and EN 15804

Delivery Status

Table 1: Specification of delivered product

Characteristics	Nominal Value	Unit
Product thickness	3.3	mm
Product Weight	1225	g/m^2
Rolls Width Length	2.00 30	meter meter

Material Content

Material Content of the Product

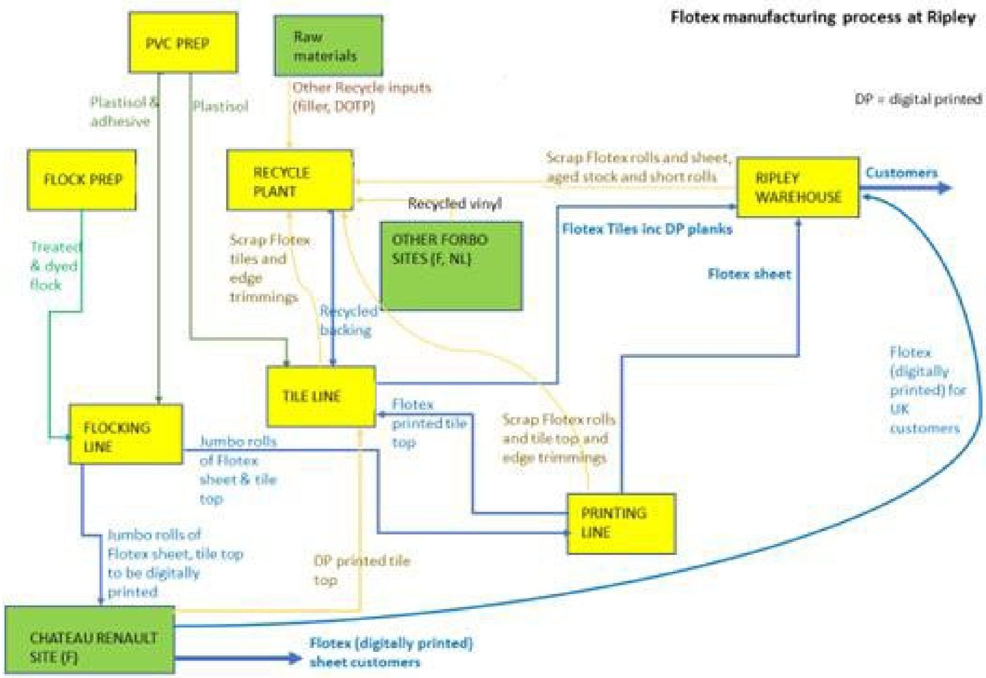
Table 2: Composition of Flotex FR

Component	Material	Mass %	Availability	Origin of raw material
Polymer	Emulsion PVC	20	Non-renewable	Europe
Polymer	Acrylic Polymer	9.4	Non-renewable	Europe
Plasticizer	DOTP	13.3	Non-renewable	Europe
FR Plasticizer	Phosphate based plasticizer	8.9	Non-renewable	Europe
FR Additives	Proprietary information	1.7	Non-renewable	Europe
Filler	Calcium carbonate	15.4	Abundant mineral	Europe
Substrate	Glass tissue	4.7	Non-renewable	Europe
Reinforcement	Glass net	2.2	Non-renewable	Europe
Carpet Pile	Polyamide 6.6	20.1	Non-renewable	Europe/USA
Additives	Various chemicals	4.3	Non-renewable	Europe/Asia

Production of Main Materials

Emulsion PVC: Polymer which is manufactured by the polymerisation of vinyl chloride monomer.
Acrylic Polymer: Polymer which is manufactured by the polymerisation of methyl methacrylate.
DOTP: A non-phthalate plasticiser, being the diester of terephthalic acid and the branched-chain 2-ethylhexanol. This colorless viscous liquid used for softening PVC plastics is known for chemical similarity to general purpose phthalates such as DEHP and DINP, but without any negative regulatory pressure.
FR Plasticiser: A phosphate based fire retardant plasticiser.
FR Additives: Mineral based additives providing improved fire retardancy.
Calcium carbonate: An abundant mineral found in all parts of the world as the chief substance in rocks (i.e., marble and limestone). It can be ground to varying particle sizes and is widely used as filler.
Glass tissue: A non-woven sheet material comprising chopped glass fiber filaments bound together with a binder imparts dimensional stability and lay-flat properties
Glass net: A non-woven grid structure comprising glass filament yarn bound together with a binder. Increases tear resistance of finished flooring
Nylon 6.6: Synthetic yarn made from the condensation reaction of hexamethylene diamine and adipic acid. Forms the pile surface of Flotex and gives excellent abrasion resistance and durability.
Various chemicals: Minor components including – conductive fibre, pigments, fire retardant, heat stabiliser

Production of the Floor Covering



Flotex FR is produced in several stages starting with PVC Prep, where the compounding of PVC emulsion polymers with plasticizer and other functional additives is carried out to produce PVC plastisols. These plastisols are then spread-coated onto a glass substrate on the Flocking Line. The top surface of Flotex FR is based on Nylon-6.6 tow, which is cut into 2mm fibers in the Flock Prep area. These fibers are scoured and dyed to give the desired color base shade before electrostatically flocking into the wet PVC plastisol on the Flocking Line. The flocked fibers form the surface pile of Flotex FR. After flocking the plastisols are fully cured at elevated temperature on the Flocking Line.

A proportion of the finished sheet is then transported to our Chateau Renault site where specific designs can be applied to the surface layer using a digital printing process. The majority of finished sheet product is processed on the Ripley Printing Line where specific designs are applied to the surface layer using a rotary screen technique. The printed carpet is steamed to fix dyestuffs then washed and dried. The product edges are trimmed and after inspection the sheet is cut into rolls of approximately 30 linear meters. The trimmings and the rejected product can be recycled.

Health, Safety and Environmental Aspects during Production

- ISO 14001 Environmental Management System
- SA 8000 Social Accountability standard
- ISO 45001 Health & Safety Management System

Production Waste

Rejected material and the cuttings of the trimming stage are recycled. Packaging materials are collected separately and externally recycled.

Delivery and Installation of the Floor Covering

Delivery

A worldwide distribution by truck and container ship is considered. On average every square meter of Flotex FR is transported as follows:

○ Transport distance 40 t truck	760 km
○ Transport distance 7.5t truck (Fine distribution)	246 km
○ Capacity utilization trucks (including empty runs)	85 %
○ Transport distance Ocean ship	800 km
○ Capacity utilization Ocean ship	48%

Installation

Because of the specific techniques used during the installation of Flotex FR, approximately 4% of the material is cut off as installation waste. For installation of Flotex FR on the floor a scenario has been modeled assuming 0.25 kg/m^2 of flooring adhesive is applied to the sub-floor.

Waste during the installation process may be recycled as floor covering through the manufacturers' facilities or thermally recycled in a waste incineration plant. Since the major part of Flotex FR is sold in Europe, the European electricity grid mix is used in the calculations for the energy recovery during incineration.

Health, Safety and Environmental Aspects during Installation

Forbo flooring recommends to use (low) zero emission adhesives for installing Flotex FR floorcovering.

Waste

Waste during the installation process may be recycled as floor covering through the manufacturers' facilities or disposed of via land fill or thermally recycled in a waste incineration plant.

Packaging

PE-foil can be collected separately and should be used in a local recycling process.

Use stage

The service lifetime of a floor covering for a certain application on a floor is too widespread to give one common number. For this EPD model the reference service lifetime (RSL) is set to one year. This means that all impacts for the use phase are based on the cleaning and maintenance model for one year. Depending on the area of use, the technical lifetime advised by the manufacturer and the estimated time on the floor by the customer, the service lifetime can be determined. The use phase impacts should be calculated with the foreseen service life to arrive at the total environmental impact.

Cleaning and Maintenance

Level of use	**Cleaning Process**	**Cleaning Frequency**	**Consumption of energy and resources**
Commercial/Residential/Industrial	Vacuuming	Daily	Electricity
	Spot/spill clean	As spill occcurs	Spotting agent
	Dry fusion clean Hot water extraction	Four times each year	Hot water Neutral detergent

For the calculations the following cleaning regime is considered:

- Dry cleaning with a 1.5 kW vacuum cleaner for 0.21 min/m^2 every day. This equates to 1.92 kWh/m^2*year.
- Four times a year wet cleaning with 0.062 l/m^2 water and 0.0008 kg/m^2 detergent. This result in the use of 0.248 l/m^2*year water and 0.0032 kg/m^2*year detergent. The wet cleaning takes place without power machine usage. The waste water treatment of the arising waste water from cleaning is considered (Data source from Forbo GaBi model).

The cleaning regime that is recommended in practice will be 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. The use of an entrance mat of at least four steps will reduce the cleaning frequency.
The cleaning regime used in the calculations is suitable for high traffic areas.

Prevention of Structural Damage

All newly laid floor covering should be covered and protected with a suitable non-staining protective covering if other building activities are still in progress. Castor wheels should be suitable for textile floor coverings.

Health Aspects during Usage

Flotex FR is in compliance with:
- AgBB/ABG requirements
- French act Grenelle: A+
- British Allergy Foundation

Low emissions & phthalate free manufacturing ensures Flotex FR can contribute to a healthy indoor environment

End of Life

The deconstruction of installed Flotex FR from the floor is a manual process.
For the End of Life stage 100% incineration is taken into account, the average distance to the incineration plant per lorry is set to 200 km.

Life Cycle Assessment

A full Life Cycle Assessment has been carried out according to ISO 14040 and ISO 14044.

The following Life Cycle Stages are assessed :

- A1-3 : Product Stage (Raw material acquisition, transportation to Manufacturing and Manufacturing)
- A4-5 : Construction stage (Transport Gate to User, Installation flooring)
- B2 : Use Stage (Maintenance of the floor). For floor coverings the modules B1, B3 to B7 are not relevant to the environmental performance of a product.
- C1-4 : End of Life Stage (Deconstruction, transport, waste processing, disposal)
- D : Benefits and loads beyond the system boundary (Reuse, recovery, recycling potential)

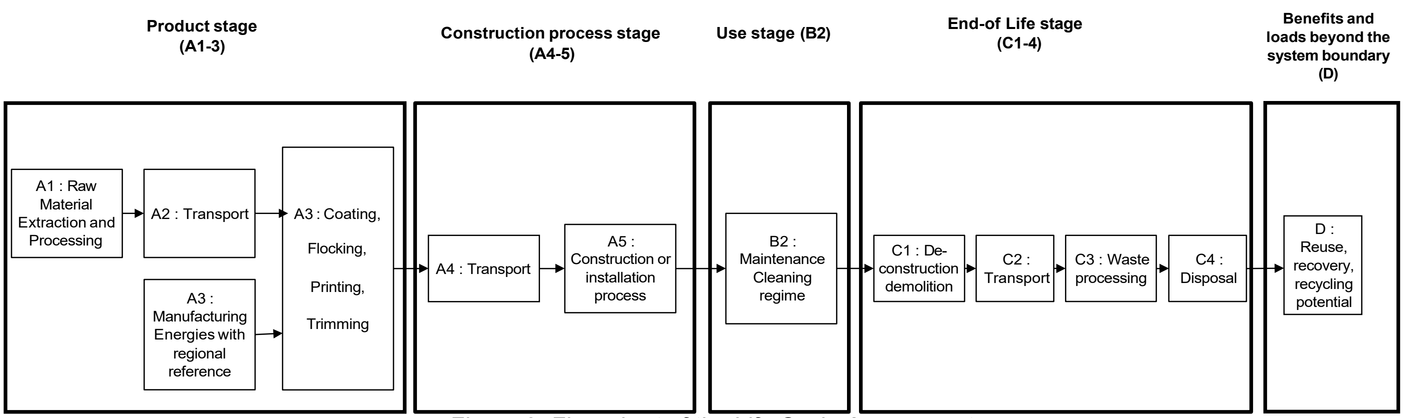


Figure 2: Flow chart of the Life Cycle Assessment

Comparisons of different floor coverings are only allowed, where EN 15804 consistent and/or preverified background data and EN 15804 consistent calculation methods and database versions are used and when the building context is taken into account, i.e. on the basis of the same use-classification (EN ISO 10874), same service life and comparable assumptions for the end of life.

Description of the Declared Functional 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

The cut-off criteria shall be 1% of renewable and non-renewable primary energy usage and 1% of the total mass of the unit process. The total neglected input flows per module shall be a maximum of 5% of energy usage and mass.

In practice, in this assessment, all data from the production data acquisition are considered, i.e. all raw materials used as per formulation, use of water, electricity and other fuels, the required packaging materials, and all direct production waste. Transport data on all considered inputs and output material are also considered.

Allocations

In the present study some allocations have been made. Detailed explanations can be found in the chapters below.

Co-product allocation

No co-product allocation occurs in the product system.

Allocation of multi-input processes

The Production and End of Life stage include incineration plants. In these processes different products are treated together within a process. The allocation procedures followed in these cases are based on a physical classification of the mass flows or calorific values.

Credits from energy substitution are allocated to the production stage, because the gained energy from energy substitution is lower than the energy input in this stage. The same quality of energy is considered.

Allocation procedure of reuse, recycling and recovery

The installation waste and end of life waste is fed into incineration processes. Incineration processes include cogeneration processes which give thermal and power energy as outputs. It is assumed that this recovered energy offsets that produced by the European average grid mix and thermal energy generation from natural gas. The gained energy is declared in module D as avoided environmental burden. Generated electricity and steam due to the incineration of installation and end of life waste are listed in the result table as exported energy.

Description of the allocation processes in the LCA report

The description of allocation rules in of this LCA report meets the requirements of the PCR.

LCA Data

As a general rule, specific data derived from specific production processes or average data derived from specific production processes have been used as the first choice as a basis for calculating an EPD.

For life cycle modeling of the considered products, the Gabi 10.6 Software System for Life Cycle Engineering, developed by Sphera has been used. All relevant LCA datasets are taken from the Gabi 10.6 software database. The datasets from the database GaBi are documented in the online documentation. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

Data Quality

The requirements for data quality and LCA data correspond to the specifications of the PCR.

Foreground data are based on 1 year averaged data (year 2021). The reference ages of LCA datasets vary but are given in the table in the Appendix. The time period over which inputs to and outputs from the system is accounted for is 100 years from the year for which the data set is deemed representative. The technological LCA of the collected data reflects the physical reality of the declared product. The datasets are complete, conform to the system boundaries and the criteria for the exclusion of inputs and outputs and are geographical representative for the supply chain of Forbo flooring.

For life cycle modeling of the considered products the Gabi 10.6 Software System for Life Cycle Engineering, developed by Sphera, is used. All relevant LCA datasets are taken from the Gabi 10.6 software database. The last revision of the used data sets took place within the last 10 years.

System Boundaries

Production Stage 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.

Transport and Installation Stage includes provision of all materials, products and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the construction stage. These information modules also include all impacts and aspects related to any losses during this construction stage (i.e. production, transport, and waste processing and disposal of the lost products and materials). For the transportation a worldwide distribution is considered.

Use Stage 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).

End of Life Stage includes provision and all transports, provision of all materials, products and related energy and water use. It also includes any declared benefits and loads from net flows leaving the product system that have not been allocated as co-products and that have passed the end-of-waste state in the form of reuse, recovery and/or recycling potentials.

ower mix

The selection of LCA data for the electricity generation is in line with the PCR.

The products are manufactured in Ripley, the United Kingdom. The Gabi 10.6 Wind power dataset has therefore been used (reference year 2022). The energy supplier is providing Forbo with a certificate every year.

CO_2-Certificates

No CO_2-certificates are considered in this study.

Life Cycle Inventory Analysis

In table 3 the environmental impacts for one lifecycle are presented for Flotex FR. In table 4 the environmental impacts are presented for all the lifecycle stages.

Table 3: Results of the LCA – Environmental impacts one lifecycle (one year) – Flotex FR

Impact Category : EN 15804+A2	Flotex FR	Unit
Global Warming Potential – total (GWP-total)	8,12E+00	kg CO2-Equiv.
Global Warming Potential – fossil (GWP-fossil fuel only)	6,51E+00	kg CO2-Equiv.
Global Warming Potential – biogenic (GWP-biogenic)	1,61E+00	kg CO2-Equiv.
Global Warming Potential – luluc (GWP-land use only)	8,11E-04	kg CO2-Equiv.
Ozone Depletion Potential (ODP)	2,14E-08	kg CFC-11 eq.
Acidification Potential (AP- terrestrial and freshwater)	1,53E-02	Mole of H+ eq.
Eutrophication Potential – freshwater (EP-freshwater)	1,08E-05	kg P eq.
Eutrophication Potential – marine (EP-marine)	4,53E-03	kg N eq.
Eutrophication Potential – terrestrial (EP-terrestrial)	4,77E-02	Mole of N eq.
Photochemical Ozone Creation Potential (POCP)	1,52E-02	kg NMVOC eq.
Abiotic Depletion Potential Fossil (ADPF)	1,20E+02	MJ
Abiotic Depletion Potential Element (ADPE)	4,07E-06	kg Sb eq.
Water Scarcity (WDP)	1,00E+00	m³ world equiv.

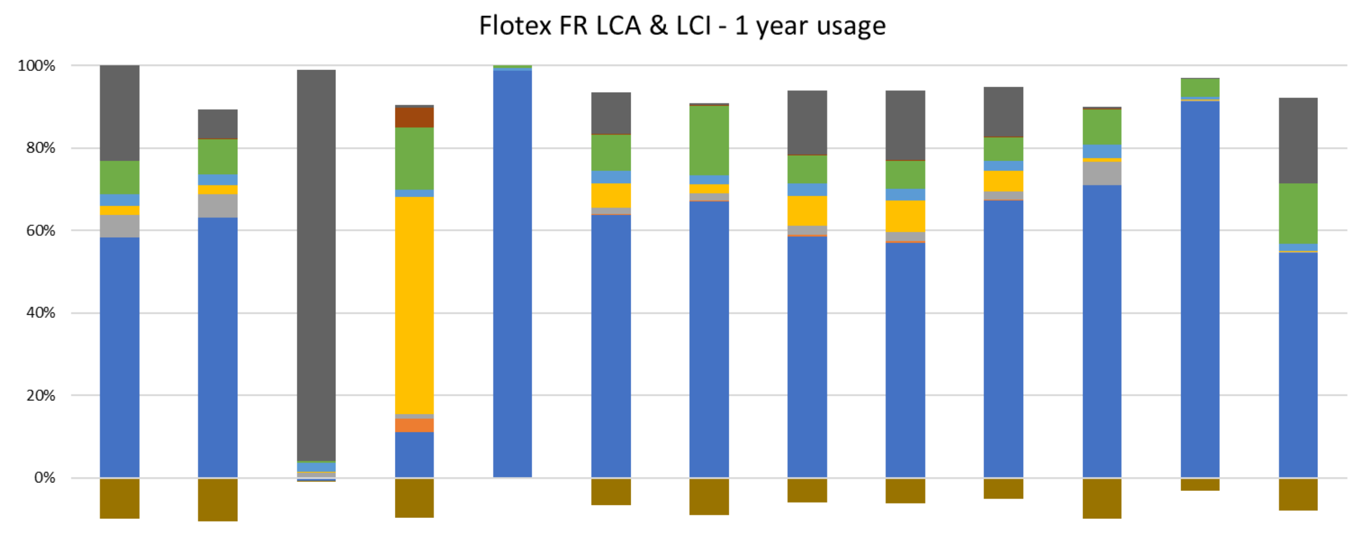
Table 4: Results of the LCA – Environmental impact for Flotex FR (one year)

Parameter	A1	A2	A3	A4	A5	B2	C1	C2	C3	D
GWP – total	5,18E+00	8,43E-03	4,86E-01	1,95E-01	2,44E-01	7,20E-01	0,00E+00	8,85E-03	2,15E+00	-8,77E-01
GWP – fossil	5,20E+00	8,40E-03	4,66E-01	1,90E-01	2,08E-01	7,13E-01	0,00E+00	8,81E-03	5,83E-01	-8,72E-01
GWP – biogenic	-1,22E-02	1,42E-06	1,97E-02	4,08E-03	3,59E-02	6,57E-03	0,00E+00	-1,21E-05	1,56E+00	-4,46E-03
GWP - luluc	1,12E-04	3,16E-05	1,22E-05	5,27E-04	1,92E-05	1,50E-04	0,00E+00	4,88E-05	6,24E-06	-9,59E-05
ODP	2,12E-08	1,06E-15	8,92E-14	6,48E-15	1,02E-10	1,36E-10	0,00E+00	5,25E-16	2,22E-13	-5,90E-12
AP	1,12E-02	4,98E-05	2,86E-04	1,03E-03	5,23E-04	1,56E-03	0,00E+00	2,88E-05	1,76E-03	-1,15E-03
EP – freshwater	8,88E-06	1,75E-08	2,29E-07	2,85E-07	3,04E-07	2,23E-06	0,00E+00	2,61E-08	5,96E-08	-1,20E-06
EP – marine	3,02E-03	1,76E-05	1,21E-04	3,72E-04	1,51E-04	3,52E-04	0,00E+00	1,33E-05	7,99E-04	-3,11E-04
EP – terrestrial	3,10E-02	1,95E-04	1,25E-03	4,12E-03	1,59E-03	3,68E-03	0,00E+00	1,49E-04	9,06E-03	-3,33E-03
POCP	1,14E-02	4,00E-05	3,54E-04	8,30E-04	4,38E-04	9,50E-04	0,00E+00	2,61E-05	2,06E-03	-8,71E-04
ADPF	1,06E+02	1,11E-01	8,34E+00	1,44E+00	4,78E+00	1,29E+01	0,00E+00	1,17E-01	7,99E-01	-1,48E+01
ADPE	3,96E-06	7,98E-10	1,20E-08	8,42E-09	2,28E-08	1,93E-07	0,00E+00	7,32E-10	6,02E-09	-1,32E-07
WDP	6,48E-01	3,90E-05	4,05E-03	8,73E-04	2,25E-02	1,72E-01	0,00E+00	7,85E-05	2,47E-01	-9,29E-02

Caption: GWP - total = global warming potential; GWP - fossil = global warming potential (fossil fuel only); GWP - biogenic = global warming potential (biogenic); GWP - luluc = global warming potential (land use only); ODP = ozone depletion; AP = acidification terrestrial and freshwater; EP - freshwater = eutrophication potential (freshwater); EP - marine = eutrophication potential (marine); EP- terrestrial = eutrophication potential (terrestrial); POCP = photochemical ozone formation; ADPE = abiotic depletion potential (element), ADPF = abiotic depletion potential (fossil) WDP = water scarcity

The relative contribution of each process stage to each impact category for Flotex FR is shown in figure 3.

Figure 3: relative contribution of each process stage to each impact category for Flotex FR for a one year usage.



	GWP - total	GWP - fossil	GWP - biogenic	GWP - luluc	ODP	AP	EP - fw	EP - marine	EP - terrestrial	POCP	ADPF	ADPE	WDP
D	-10%	-11%	0%	-10%	0%	-7%	-9%	-6%	-6%	-5%	-10%	-3%	-8%
C3	24%	7%	95%	1%	0%	10%	0%	15%	17%	12%	1%	0%	21%
C2	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%
C1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
B2	8%	9%	0%	15%	1%	9%	17%	7%	7%	6%	9%	4%	14%
A5	3%	3%	2%	2%	0%	3%	2%	3%	3%	3%	3%	1%	2%
A4	2%	2%	0%	53%	0%	6%	2%	7%	8%	5%	1%	0%	0%
A3	5%	6%	1%	1%	0%	2%	2%	2%	2%	2%	6%	0%	0%
A2	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
A1	58%	63%	-1%	11%	99%	64%	67%	59%	57%	67%	71%	91%	55%

Interpretation

The interpretation of the results has been carried out considering the assumptions and limitations declared in the EPD, both methodology- and data-related for a one year usage.

In almost all of the impact categories the production stage (A1-A3) has the main contribution to the overall impact. The raw material supply, in particular PA 6.6, PVC and DOTP are the key contributors for these impact categories.

Forbo declares in the EPD a worldwide distribution which has a limited effect on most of the impact categories. For AP, EP-marine & terrestrial and POCP there is a minor share of 5-8% of the total mainly caused by the ships and trucks used to transport the product. For GWP-luluc there is a share of 53% which is completely caused by the diesel used for the trucks.

The installation of Flotex FR has for all the environmental indicators a minor impact of 0 – 3% of the total environmental impact, caused by the adhesive and the disposal of the cutting waste.

In the Use stage the electricity needed to vacuum the floor is the main contributor. The cleaning regime used in the calculations is a worst-case scenario which will be in practice almost always be lower.

For the End of Life stage an 100% incineration scenario is used which has a significant and negative impact specifically for POCP and GWP & EP categories if compared to a landfill scenario.

Energy recovery from incineration and the respective energy substitution at the end of life results in most cases in a small credit in the End of Life stage.

Resource use

In table 5 the parameters describing resource use are presented for all the lifecycle stages for a one year usage.

Table 5: Results of the LCA – Resource use for Flotex FR (one year)

	A1	A2	A3	A4	A5	B2	C1	C2	C3	D
PERE [MJ]	4,68E+00	6,08E-03	8,57E-02	7,25E-02	2,34E-01	7,13E+00	0,00E+00	6,65E-03	1,33E-01	-4,07E+00
PERM [MJ]	0,00E+00	-	-	-	-	-	-	-	-	-
PERT [MJ]	4,68E+00	6,08E-03	8,57E-02	7,25E-02	2,34E-01	7,13E+00	0,00E+00	6,65E-03	1,33E-01	-4,07E+00
PENRE [MJ]	1,06E+02	1,11E-01	8,34E+00	1,44E+00	4,78E+00	1,29E+01	0,00E+00	1,17E-01	7,99E-01	-1,48E+01
PENRM [MJ]	0,00E+00	-	-	-	-	-	-	-	-	-
PENRT [MJ]	1,06E+02	1,11E-01	8,34E+00	1,44E+00	4,78E+00	1,29E+01	0,00E+00	1,17E-01	7,99E-01	-1,48E+01
SM [kg]	-	-	-	-	-	-	-	-	-	-
RSF [MJ]	-	-	-	-	-	-	-	-	-	-
NRSF [MJ]	-	-	-	-	-	-	-	-	-	-
FW [m3]	1,64E-02	5,61E-06	2,09E-04	8,22E-05	8,49E-04	6,81E-03	0,00E+00	7,52E-06	5,81E-03	-3,92E-03

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 non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

Waste categories and output flows

In table 6 other environmental information describing different waste categories and output flows are presented for all the lifecycle stages.

Table 6: Results of the LCA – Output flows and Waste categories for Flotex FR (one year)

	A1	A2	A3	A4	A5	B2	C1	C2	C3	D
HWD [kg]	5,83E-04	5,10E-13	8,80E-10	6,77E-12	4,14E-10	1,11E-09	0,00E+00	5,62E-13	1,02E-10	-2,01E-09
NHWD [kg]	4,55E-02	1,69E-05	1,15E-02	1,98E-04	2,25E-03	9,95E-03	0,00E+00	1,68E-05	2,78E-02	-7,50E-03
RWD [kg]	1,99E-03	1,15E-07	1,11E-05	1,76E-06	3,50E-05	2,06E-03	0,00E+00	1,44E-07	3,02E-05	-1,17E-03
CRU [kg]	-	-	-	-	-	-	-	-	-	-
MFR [kg]	-	-	-	-	-	-	-	-	-	-
MER [kg]	-	-	-	-	-	-	-	-	-	-
EEE [MJ]	-	-	-	-	8,56E-02	-	-	-	3,84E+00	-
EET [MJ]	-	-	-	-	1,54E-01	-	-	-	6,90E+00	-
Caption: HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy										

Biogenic Carbon content

Table 7: Information describing the biogenic carbon content at the factory gate

Biogenic carbon content	Unit (kg C/m²)
Biogenic carbon content in product	0.179
Biogenic carbon content in accompanying packaging	0.001
Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO_2	

Additional Environmental Impact Indicators

To be fully transparant Forbo Flooring does not only want to declare the environmental impacts required in the PCR, but also the additional environmental impact indicators according to the European Standard EN15804.

Table 8: Results of the LCA – Environmental impacts one lifecycle (one year) – Flotex FR

Impact Category : EN 15804+A2	Flotex FR	Unit
Particulate matter emissions – PM	2,57E-07	Disease incidences
Ionizing radiation, human health - IR	5,40E-01	kBq U235 eq.]
Eco-toxicity (freshwater) - ETF-fw	6,14E+01	CTUe
Human toxicity, cancer effects – HTP-c	2,48E-09	CTUh
Human toxicity, non-cancer effects – HTP-nc	1,21E-07	CTUh
Soil quality potential/ Land use related impacts - SQP	7,84E+02	Pt

In the following table the impacts are subdivided into the lifecycle stages.

Table 9: Results of the LCA – Environmental impact for Flotex FR (one year)

	A1	A2	A3	A4	A5	B2	C1	C2	C3	D
PM [Disease incidences]	1,25E-07	5,76E-10	3,00E-09	1,16E-08	3,12E-09	1,29E-08	0,00E+00	1,58E-10	5,45E-09	-9,50E-09
IR [kBq U235 eq.]	1,05E+00	1,24E-05	1,54E-03	2,57E-04	9,74E-03	3,48E-01	0,00E+00	2,12E-05	4,77E-03	-1,98E-01
ETF-fw [CTUe]	3,38E+01	8,57E-02	6,99E-01	9,96E-01	1,39E+00	5,65E+00	0,00E+00	8,12E-02	2,77E-01	-3,26E+00
HTP-c [CTUh]	2,27E-09	1,70E-12	3,77E-11	1,99E-11	5,19E-11	1,62E-10	0,00E+00	1,64E-12	6,18E-11	-1,50E-10
HTP-nc [CTUh]	3,89E-08	9,63E-11	9,55E-10	1,27E-09	3,18E-09	5,93E-09	0,00E+00	9,77E-11	6,05E-09	-5,75E-09
SQP [Pt]	2,75E+00	3,29E-02	4,66E-02	4,35E-01	1,73E-01	4,63E+00	0,00E+00	4,03E-02	1,56E-01	-2,65E+00
Caption: PM = Particulate matter emissions; IR = Ionizing radiation, human health; ETF-fw = Eco-toxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects, SQP = Soil quality potential/ Land use related impacts										

Interpretation

The interpretation of the results has been carried out considering the assumptions and limitations declared in the EPD, both methodology- and data-related for a one year usage.

For almost all impact categories the production stage is the main contributor to the total overall impact. The raw material supply has a major share of 97-100% of the production stage, mainly caused by the manufacturing of polyamide 6.6, PVC and glass fiber.
For Eco-toxicity (freshwater) the main share of 62% results from the packaging used to pack the finished product in the manufacturing stage A3.

The transport stage is negligible for most of the additional impact indicators, only PM has a slightly significant share of 7% of the total impact.

The adhesive used for the installation of Flotex FR is the dominant contributor for all categories which results in a minor contribution of 1-5% of the total impact.

The Use stage has a minor impact for 4 of the 6 additional impacts between 6 and 12%, for IR and SQP the impact is rather high with a share of respectively 22 and 42%.
The main contributor for all impact categories is the use of electricity for the cleaning of the floor. The cleaning regime used in the calculations is a worst-case scenario which will be in practice almost always be lower.

Energy recovery from incineration and the respective energy substitution at the end of life results in a (small) credit for all three of the impact categories.

Disclaimers to the declaration of core and additional environmental impact indicators

According to the "ILCD Handbook: Recommendations for Life Cycle Impact Assessment in the European context" the recommended characterization models and associated characterization factors are classified according to their quality into three levels:

- Type 1 (recommended and satisfactory),
- Type 2 (recommended but in need of some improvements)
- Type 3 (recommended, but to be applied with caution).

Table 10: Classification of disclaimers to the declaration of core and additional environmental impact indicators

ILCD classification	Indicator	Disclaimer
ILCD Type 1	Global Warming Potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 2	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user)deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans HTP-c)	2
	Potential Comparative Toxic Unit for humans HTP-nc)	2
	Potential Soil quality index (SQP)	2
Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator		
Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.		

References

GaBi 10 2012	SPHERA; GaBi 10: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2017.
GaBi 10 2012D	GaBi 10: Documentation of GaBi 10: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2017. http://documentation.gabi-software.com/
UL Environment	UL Environment's Program Operator Rules
PE 2012 ILCD Handbook: General guide for Life Cycle Assessment - Detailed guidance	Description of Selected Impact Categories, Sphera, 2012 European Commission-Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook- Recommendations for Life Cycle Impact Assessment in the European context. First edition November 2011. EUR 24571 EN. Luxemburg. Publications Office of the European Union; 2011
Standards and laws	
DIN EN ISO 14044	Environmental management - Life cycle assessment - Requirements and guidelines (ISO 14044:2006); German and English version EN ISO 14044
ISO 14025 2006	DIN EN ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures
ISO 14040 2006	Environmental management - Life cycle assessment - Principles and framework (ISO 14040); German and English version EN ISO 14040
CEN/TR 15941	Sustainability of construction works - Environmental product declarations - Methodology for selection and use of generic data; German version CEN/TR 15941
EN 15804 + A2	EN 15804+A2: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products
CPR	REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonized conditions for the marketing of construction products and repealing Council Directive 89/106/EEC
EN-ISO 10874 EN 1307	Resilient, textile and laminate floor coverings – Classification Textile floor coverings – Classification

Life Cycle Assessment

Flotex FR

LCA study conducted by:
Forbo Flooring
Industrieweg 12
1566 JP Assendelft
The Netherlands

September 2022

Environment

Authors:
Floris Zeitler, Forbo

Forbo Flooring BV

Industrieweg 12
1566 JP Assendelft, The Netherlands
Tel. +31 (0) 75 6477477
Fax +31 (0) 75 6477707
E-mail floris.zeitler@forbo.com
Internet www.forbo-flooring.com

Nomenclature

Abbreviation	Explanation
ADPF	Abiotic Depletion Potential Fossil
ADPE	Abiotic Depletion Potential Elements
AP	Acidification Potential
BLBSB	Benefits and Loads Beyond the System Boundary
CRU	Components for re-use
EE	Exported energy per energy carrier
EP	Eutrophication Potential
EPD	Environmental Product Declaration
FCSS	Floor Covering Standard Symbol
FW	Use of net fresh water
GWP	Global Warming Potential
HWD	Hazardous waste disposed
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory analysis
LCIA	Life Cycle Impact Assessment
MER	Materials for energy recovery
MFR	Materials for recycling
NRSF	Use of non-renewable secondary fuels
ODP	Ozone Layer Depletion Potential
PENRE	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
PENRM	Use of non-renewable primary energy resources used as raw materials
PENRT	Total use of non-renewable primary energy resources
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
PCR	Product Category Rules
POCP	Photochemical Ozone Creation Potential
RSF	Use of renewable secondary fuels
RSL	Reference Service Life
RWD	Radioactive waste disposed
SM	Use of secondary material

General

The present LCA study of the company Forbo Flooring, a manufacturer of resilient floor coverings, has been performed by Forbo Flooring and has been conducted according to the requirements of the European Standard EN15804 and EN16810 “Resilient, textile and laminate floor coverings – Environmental product declarations – Product category rules. The LCA report was sent to verification on 30/09/22.

Scope

This document is the LCA report for the “Environmental Product Declaration” (EPD) of "Flotex FR".
The provision of an LCA report is required for each EPD of the EPD-program holder (UL Environment). This document shows how the calculation rules were applied and describes additional LCA information on the Life Cycle Assessment in accordance with the requirements of ISO 14040 series.

Content, structure and accessibility of the LCA report

The LCA report provides a systematic and comprehensive summary of the project documentation supporting the verification of an EPD.
The report documents the information on which the Life Cycle Assessment is based, while also ensuring the additional information contained within the EPD complies with the requirements of ISO 14040 series.
The LCA report contains all of the data and information of importance for the details published in the EPD. Care is been given to all explanations as to how the data and information declared in the EPD arises from the Life Cycle Assessment.
The verification of the EPD is aligned towards the structure of the rule document based on ISO 14025, EN15804 and EN 16810.

Goal of the study

The reason for performing this LCA study is to publish an EPD based on EN 16810, EN 15804 and ISO 14025.
This study contains the calculation and interpretation of the LCA results for Flotex FR complying with EN 1307 Textile floor coverings – Specification.

Manufactured by
Forbo Flooring UK Ltd
High Holborn Road
Ripley
Derbyshire
DE5 3NT
United Kingdom

The following life cycle stages were considered:

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

The main purpose of EPD is for use in business-to-business communication. As all EPD are publicly available on the website of UL Environment and therefore are accessible to the end consumer they can also be used in business-to-consumer communication.
The intended use of the EPD is to communicate environmentally related information and LCA results to support the assessment of the sustainable use of resources and of the impact of construction works on the environment

Scope of the study

Declared / functional unit

The declaration refers to the declared/functional unit of 1m² installed flooring product.

Declaration of construction products classes

The LCA report refers to a manufacturer declaration of type 1a): Declaration of a specific product from a manufacturer's plant.
Flotex FR Textiles are also known under the following brand names:

Flotex Colour, Flotex Linear, Flotex Vision, Flotex Sottsass/Tibor/Starck and Flotex HD Bespoke

Flotex FR is produced at the following manufacturing site:
Forbo Flooring UK Ltd
High Holborn Road
Ripley
Derbyshire
DE5 3NT
United Kingdom

Product Definition

Product Classification and description

This declaration covers a broad range of designs and colors. Flotex is a unique flooring Flotex that offers a warm, comfortable, hygienic floor covering that is suitable for any commercial specification.

It is made by electrostatically flocking 80 million nylon fibers in a watertight backing. This build-up combines the practicality of a resilient flooring with the slip resistant and acoustic properties usually associated with textiles. Flotex is strong and hygienic, and, being completely waterproof, Flotex is also the only truly washable textile floor covering. It is the only textile flooring that has been awarded with a British Allergy Foundation seal. Flotex FR complies with all requirements of EN1307: Textile Floor Coverings - Classification of Pile Carpets.

Flotex FR has been manufactured for over 40 years and is a well-known brand sold worldwide. This declaration refers to Flotex FR covering a broad range of designs and colors :

Flotex Colour FR, Flotex Vision FR, Flotex Designer/Artist FR (Starck / Tibor / Sottsass / Hemingway Design, Flotex FR Bespoke design.

Flotex FR is comprised of a Nylon 6.6 pile above a glass fiber reinforced PVC cushioned backing. Flotex FR is built up in 4 layers as illustrated in the following image:

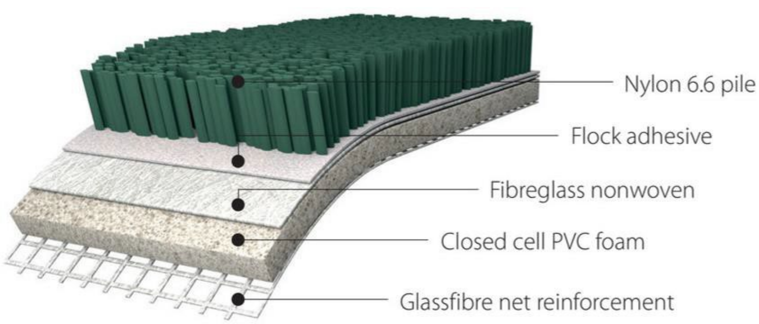


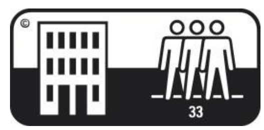
Figure 1: Typical construction

1. **Surface layer:** This layer gives Flotex FR its design, color and wear properties
2. **Adhesive layer:** This layer bonds the surface layer to the backing.
3. **Glass fiber layer:** This layer provides strength and dimensional stability to the product
4. **Backing/Reinforcing Net Layer:** This layer provides cushioning and acoustic properties

This declaration refers to the declared/functional unit of 1 m^2 installed flooring product.

Range of application

Flotex FR is classified in accordance with EN1307 to be installed in the following use areas defined in EN-ISO 10874:

Area of application	Flotex FR
Domestic	Class 23 
Commercial	Class 33 

Product Standard

The product considered in this EPD has the following technical specifications:

- Meets or exceeds all requirements of EN1307: Textile Floor Coverings - Classification of Pile Carpets.

Flotex FR meets or exceeds the requirements for:

- IMO Wheelmark
- US Coastguard Approval
- EN45545-2 HL-2
- ASTM E648
- ASTM E662

Accreditation

- ISO 9001 Quality Management System
- ISO 14001 Environmental Management System
- British Allergy Foundation
- AgBB/ABG
- French act Grenelle: A+

Delivery status

Characteristics	Nominal Value	Unit
Product thickness	3.30	mm
Product Weight	1225	g/m^2
Rolls Width Length	2.00 30	meter

Material Content

Component	Material	Mass %	Availability	Origin of raw material
Polymer	Emulsion PVC	20	Non-renewable	Europe
Polymer	Acrylic Polymer	9.4	Non-renewable	Europe
Plasticizer	DOTP	13.3	Non-renewable	Europe
FR Plasticizer	Phosphate based plasticiser	8.9	Non-renewable	Europe
FR Additives	Proprietary information	1.7	Non-renewable	Europe
Filler	Calcium carbonate	15.4	Abundant mineral	Europe
Substrate	Glass tissue	4.7	Non-renewable	Europe
Reinforcement	Glass net	2.2	Non-renewable	Europe
Carpet Pile	Polyamide 6.6	20.1	Non-renewable	Europe/USA
Additives	Various chemicals	4.3	Non-renewable	Europe/Asia

Production of Main Materials

Emulsion PVC: Polymer which is manufactured by the polymerisation of vinyl chloride monomer.

Acrylic Polymer: Polymer which is manufactured by the polymerisation of methyl methacrylate

DOTP: A non-phthalate plasticiser, being the diester of terephthalic acid and the branched-chain 2-ethylhexanol. This colorless viscous liquid used for softening PVC plastics is known for chemical similarity to general purpose phthalates such as DEHP and DINP, but without any negative regulatory pressure.

FR Plasticiser: A phosphate based fire retardant plasticiser.

FR Additives: Mineral based additives providing improved fire retardancy.

Calcium carbonate: An abundant mineral found in all parts of the world as the chief substance in rocks (i.e., marble and limestone). It can be ground to varying particle sizes and is widely used as filler.

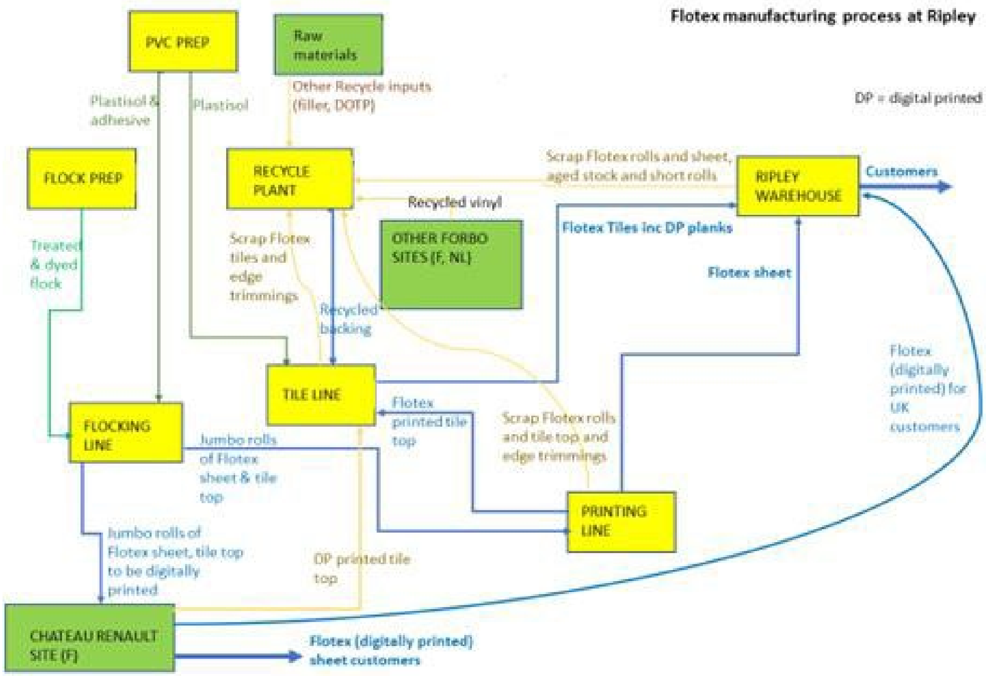
Glass tissue: A non-woven sheet material comprising chopped glass fiber filaments bound together with a binder imparts dimensional stability and lay-flat properties

Glass net: A non-woven grid structure comprising glass filament yarn bound together with a binder. Increases tear resistance of finished flooring

Nylon 6.6: Synthetic yarn made from the condensation reaction of hexamethylene diamine and adipic acid. Forms the pile surface of Flotex and gives excellent abrasion resistance and durability.

Various chemicals: Minor components including – conductive fibre, pigments, fire retardant, heat stabiliser

Production of the Floor Covering



Flotex FR is produced in several stages starting with PVC Prep, where the compounding of PVC emulsion polymers with plasticizer and other functional additives is carried out to produce PVC plastisols. These plastisols are then spread-coated onto a glass substrate on the Flocking Line. The top surface of Flotex FR is based on Nylon-6.6 tow, which is cut into 2mm fibers in the Flock Prep area. These fibers are scoured and dyed to give the desired color base shade before electrostatically flocking into the wet PVC plastisol on the Flocking Line. The flocked fibers form the surface pile of Flotex FR. After flocking the plastisols are fully cured at elevated temperature on the Flocking Line.

A proportion of the finished sheet is then transported to our Chateau Renault site where specific designs can be applied to the surface layer using a digital printing process. The majority of finished sheet product is processed on the Ripley Printing Line where specific designs are applied to the surface layer using a rotary screen technique. The printed carpet is steamed to fix dyestuffs then washed and dried. The product edges are trimmed and after inspection the sheet is cut into rolls of approximately 30 linear meters. The trimmings and the rejected product can be recycled

Health, Safety and Environmental Aspects during Production

- ISO 14001 Environmental Management System
- SA 8000 Social Accountability standard
- ISO 45001 Health & Safety Management System

Production Waste

Rejected material and the cuttings of the trimming stage are recycled. Packaging materials are collected separately and externally recycled.

Delivery and Installation of the Floor Covering

Delivery

A worldwide distribution by truck and container ship is considered. On average every square meter of Flotex FR is transported as follows:

- Transport distance 40 t truck 760 km
- Transport distance 7.5t truck (Fine distribution) 246 km
- Capacity utilization trucks (including empty runs) 85 %
- Transport distance Ocean ship 800 km
- Capacity utilization Ocean ship 48%

Installation

Because of the specific techniques used during the installation of Flotex FR, approximately 4% of the material is cut off as installation waste. For installation of Flotex FR on the floor a scenario has been modeled assuming 0.25 kg/m^2 of flooring adhesive is applied to the sub-floor.

Waste during the installation process may be recycled as floor covering through the manufacturers' facilities or thermally recycled in a waste incineration plant. Since the major part of Flotex FR is sold in Europe, the European electricity grid mix is used in the calculations for the energy recovery during incineration.

Health, Safety and Environmental Aspects during Installation

Forbo flooring recommends to use (low) zero emission adhesives for installing Flotex FR floorcovering.

Waste

Waste during the installation process may be recycled as floor covering through the manufacturers' facilities or disposed of via land fill or thermally recycled in a waste incineration plant.

Packaging

PE-foil can be collected separately and should be used in a local recycling process.

Use stage

The service lifetime of a floor covering for a certain application on a floor is too widespread to give one common number. For this EPD model the reference service lifetime (RSL) is set to one year. This means that all impacts for the use phase are based on the cleaning and maintenance model for one year. Depending on the area of use, the technical lifetime advised by the manufacturer and the estimated time on the floor by the customer, the service lifetime can be determined. The use phase impacts should be calculated with the foreseen service life to arrive at the total environmental impact.

Cleaning and Maintenance

Level of use	Cleaning Process	Cleaning Frequency	Consumption of energy and resources
Commercial/Residential/Industrial	Vacuuming	Daily	Electricity
	Spot/spill clean	As spill occcurs	Spotting agent
	Dry fusion clean Hot water extraction	Four times each year	Hot water Neutral detergent

For the calculations the following cleaning regime is considered:

- Dry cleaning with a 1.5 kW vacuum cleaner for 0.21 min/m^2 every day. This equates to 1.92 kWh/m^2*year.
- Four times a year wet cleaning with 0.062 l/m^2 water and 0.0008 kg/m^2 detergent. This result in the use of 0.248 l/m^2*year water and 0.0032 kg/m^2*year detergent. The wet cleaning takes place without power machine usage. The waste water treatment of the arising waste water from cleaning is considered (Data source from Forbo GaBi model).

The cleaning regime that is recommended in practice will be 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. The use of an entrance mat of at least four steps will reduce the cleaning frequency.
The cleaning regime used in the calculations is suitable for high traffic areas.

Prevention of Structural Damage

All newly laid floor covering should be covered and protected with a suitable non-staining protective covering if other building activities are still in progress. Castor wheels should be suitable for resilient floor coverings

Health Aspects during Usage

Flotex FR is complying with:

- AgBB requirements
- French act Grenelle: A+
- British Allergy Foundation

Low emissions & phthalate free manufacturing ensures Flotex FR can contribute to a healthy indoor environment

End of Life

The deconstruction of installed Flotex FR from the floor is a manual process.
For the End of Life stage 100% incineration is taken into account, the average distance to the incineration plant per lorry is set to 200 km.

Life Cycle Assessment

A full Life Cycle Assessment has been carried out according to ISO 14040 and ISO 14044.

The following Life Cycle Stages are assessed :

- A1-3 : Product Stage (Raw material acquisition, transportation to Manufacturing and Manufacturing)
- A4-5 : Construction stage (Transport Gate to User, Installation flooring)
- B2 : Use Stage (Maintenance of the floor). For floor coverings the modules B1, B3 to B7 are not relevant to the environmental performance of a product.
- C1-4 : End of Life Stage (Deconstruction, transport, waste processing, disposal)
- D : Benefits and loads beyond the system boundary (Reuse, recovery, recycling potential)

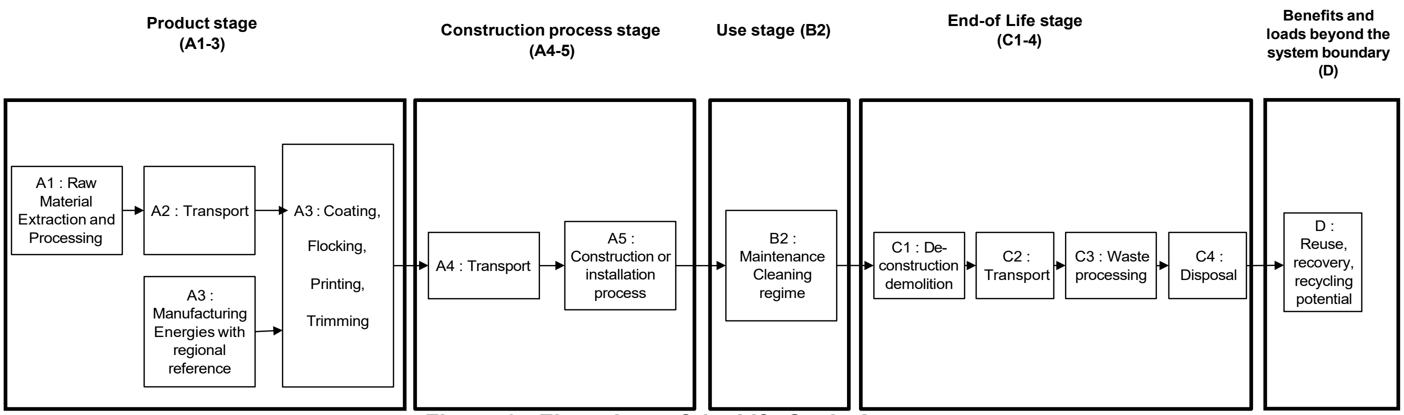


Figure 2 : Flow chart of the Life Cycle Assessment

Comparisons of different floor coverings are only allowed, where EN 15804 consistent and/or preverified background data and EN 15804 consistent calculation methods and database versions are used and when the building context is taken into account, i.e. on the basis of the same use-classification (EN ISO 10874), same service life and comparable assumptions for the end of life.

Description of the declared Functional 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

The cut-off criteria shall be 1% of renewable and non-renewable primary energy usage and 1% of the total mass of the unit process. The total neglected input flows per module shall be a maximum of 5% of energy usage and mass.

In practice, in this assessment, all data from the production data acquisition are considered, i.e. all raw materials used as per formulation, use of water, electricity and other fuels, the required packaging materials, and all direct production waste. Transport data on all considered inputs and output material are also considered.

LCA Data

As a general rule, specific data derived from specific production processes or average data derived from specific production processes have been used as the first choice as a basis for calculating an EPD.

For life cycle modeling of the considered products, the Gabi 10.6 Software System for Life Cycle Engineering, developed by SPHERA, has been used. All relevant LCA datasets are taken from the Gabi 10.6 software database. The datasets from the database GaBi are documented in the online documentation. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

Data Quality

The requirements for data quality and LCA data correspond to the specifications of the PCR.

Foreground data are based on 1 year averaged data (year 2021). The reference ages of LCA datasets vary but are given in the table in the Appendix. The time period over which inputs to and outputs from the system is accounted for is 100 years from the year for which the data set is deemed representative. The technological LCA of the collected data reflects the physical reality of the declared product. The datasets are complete, conform to the system boundaries and the criteria for the exclusion of inputs and outputs and are geographical representative for the supply chain of Forbo flooring.

For life cycle modeling of the considered products the Gabi 10.6 Software System for Life Cycle Engineering, developed by SPHERA, is used. All relevant LCA datasets are taken from the Gabi 10.6 software database. The last revision of the used data sets took place within the last 10 years.

Table 1: LCA datasets used in the LCA model

Data set	Region	Reference year
Polyvinyl chloride granulate	Germany	2022
Di-Isononyl Phthalate (DOTP)	Germany	2020
Acrylic polymer	Europe	2020
Polyamide 6.6 fibers	Europe	2022
FR additives	Europe	2022
Inorganic pigment	Germany	2020
Calcium-Zinc Stearate	Europe	2020
Calcium carbonate	Germany	2022
Glass net	Germany	2020
Glass fiber tissue	Germany	2022
Fatty acid ester	Europe	2020
Proprietary mixtures & lubricants	Global	2020
Water (desalinated; deionized)	Germany	2022
Detergent (ammonia based)	Germany	2020
Tap water	Germany	2022
Adhesive for resilient flooring	Germany	2020
Waste incineration of Textiles	Europe	2022
Electricity from Wind power	United Kingdom	2022
Power grid mix	Europe	2022
Thermal energy from natural gas	United Kingdom	2022
Thermal energy from natural gas	Europe	2022
Trucks	Global	2022
Municipal waste water treatment (Sludge incineration).	Europe	2022
Container ship	Global	2022
Diesel mix at refinery	Europe	2022
Heavy fuel oil at refinery (1.0wt.% S)	Europe	2022
Polyethylene film	Germany	2022

The documentation of the LCA data sets can be taken from the GaBi documentation.

System Boundaries

Production Stage 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.

Transport and Installation Stage includes provision of all materials, products and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the construction stage. These information modules also include all impacts and aspects related to any losses during this construction stage (i.e. production, transport, and waste processing and disposal of the lost products and materials). For the transportation a worldwide distribution is considered.

Use Stage 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).

End of Life Stage includes provision and all transports, provision of all materials, products and related energy and water use. It also includes any declared benefits and loads from net flows leaving the product system that have not been allocated as co-products and that have passed the end-of-waste state in the form of reuse, recovery and/or recycling potentials.

Power mix

The selection of LCA data for the electricity generation is in line with the PCR.

The products are manufactured in Ripley, the United Kingdom. The Gabi 10.6 Hydro power datasets has therefore been used (reference year 2022). The energy supplier is providing Forbo with a certificate every year.

CO_2-Certificates

No CO_2-certificates are considered in this study.

Allocations

In the present study some allocations have been made. Detailed explanations can be found in the chapters below.

Co-product allocation

No co-product allocation occurs in the product system.

Allocation of multi-Input processes

The Production and End of Life stage include incineration plants. In these processes different products are treated together within a process. The allocation procedures followed in these cases are based on a physical classification of the mass flows or calorific values.

Credits from energy substitution are allocated to the production stage, because the gained energy from energy substitution is lower than the energy input in this stage. The same quality of energy is considered.

Allocation procedure of reuse, recycling and recovery

The installation waste and end of life waste can be fed into incineration processes. Incineration processes include cogeneration processes which give thermal and power energy as outputs. It is assumed that this recovered energy offsets that produced by the European average grid mix and thermal energy generation from natural gas. The gained energy is declared in module D as avoided environmental burden. Generated electricity and steam due to the incineration of installation and end of life waste are listed in the result table as exported energy.

Description of the allocation processes in the LCA report

The description of allocation rules in of this LCA report meets the requirements of the PCR.

Description of the unit processes in the LCA report

The modeling of the unit processes reported for the LCA are documented in a transparent way, respecting the confidentiality of the data present in the LCA report.

In the following tables the type and amount of the different input and output flows are listed for 1m² produced flooring; installed flooring includes the material loss during installation (4%):

Table 2: Composition of Flotex FR

Process data	Unit	Flotex FR
Emulsion PVC	kg/m2	0.248
Acrylic Polymer	kg/m2	0.116
DOTP	kg/m2	0.165
Phosphate based plasticiser	kg/m2	0.110
Proprietary information	kg/m2	0.021
Calcium carbonate	kg/m2	0.191
Glass tissue	kg/m2	0.058
Glass net	kg/m2	0.027
Polyamide 6.6	kg/m2	0.249
Various chemicals	kg/m2	0.053

Table 3: Production related inputs/outputs

Process data	Unit	Flotex FR
INPUTS		
Flotex FR	kg	1.36
Electricity	MJ	3.85
Thermal energy from natural gas	MJ	15.70
OUTPUTS		
Flotex FR	kg	1.24
Waste	kg	0.12

Table 4: Packaging requirements (per m^2 manufactured product)

Process data	Unit	Flotex FR
Polyethylene	kg	0.02

Table 5: Transport distances

Process data	Unit	Road	Truck size	Ship
Calcium carbonate	km	431	14 - 20t gross weight / 11,4t payload capacity	743
Polyamide 6.6	km	253		385
PVC	km	188		-
DOTP	km	100		-
Ethoxylated Fatty acid	km	120		-
CaZn-stabilizer	km	120		-
Various chemicals	km	635		54
Glass tissue	km	129		-
Glass net	km	253		385
Acrylic polymer	km	1254		54
Polyethylene film	km	261		-
Transport to construction site : -Transport distance 40 t truck -Transport distance 7.5t truck (Fine distribution)	km	1006 760 246	34 - 40 t gross weight / 27t payload capacity 7,5 t - 12t gross weight / 5t payload capacity	800
Waste transport to incineration	km	200	7,5 t - 12t gross weight / 5t payload capacity	-

Table 6: Inputs/outputs from Installation

Process data	Unit	Flotex FR
INPUTS		
Flotex FR	kg	1.29
Adhesive (30% water content) - Water - Acrylate co-polymer - Styrene Butadiene co-polymer - Limestone flour - Sand	kg	0.25
OUTPUTS		
Installed Flotex FR	kg	1.24
Installation Waste	kg	0.05

Table 7: Inputs from use stage (per m^2.year of installed product)

Process data	Unit	Flotex FR
Detergent	kg/year	0.003
Electricity	kWh/year	1.92
Water	kg/year	0.25

Table 8: Disposal

Process data	Unit	Flotex FR
Post-consumer Flotex FR to incineration	%	100

Life Cycle Inventory Analysis

In table 9 the environmental impacts for one lifecycle are presented for Flotex FR. In the table 10 the environmental impacts are presented for all the lifecycle stages.

Table 9: Results of the LCA – Environmental impacts one lifecycle (one year) – Flotex FR

Impact Category : EN 15804+A2	Flotex FR	Unit
Global Warming Potential – total (GWP-total)	8,12E+00	kg CO2-Equiv.
Global Warming Potential – fossil (GWP-fossil fuel only)	6,51E+00	kg CO2-Equiv.
Global Warming Potential – biogenic (GWP-biogenic)	1,61E+00	kg CO2-Equiv.
Global Warming Potential – luluc (GWP-land use only)	8,11E-04	kg CO2-Equiv.
Ozone Depletion Potential (ODP)	2,14E-08	kg CFC-11 eq.
Acidification Potential (AP- terrestrial and freshwater)	1,53E-02	Mole of H+ eq.
Eutrophication Potential – freshwater (EP-freshwater)	1,08E-05	kg P eq.
Eutrophication Potential – marine (EP-marine)	4,53E-03	kg N eq.
Eutrophication Potential – terrestrial (EP-terrestrial)	4,77E-02	Mole of N eq.
Photochemical Ozone Creation Potential (POCP)	1,52E-02	kg NMVOC eq.
Abiotic Depletion Potential Fossil (ADPF)	1,20E+02	MJ
Abiotic Depletion Potential Element (ADPE)	4,07E-06	kg Sb eq.
Water Scarcity (WDP)	1,00E+00	m³ world equiv.

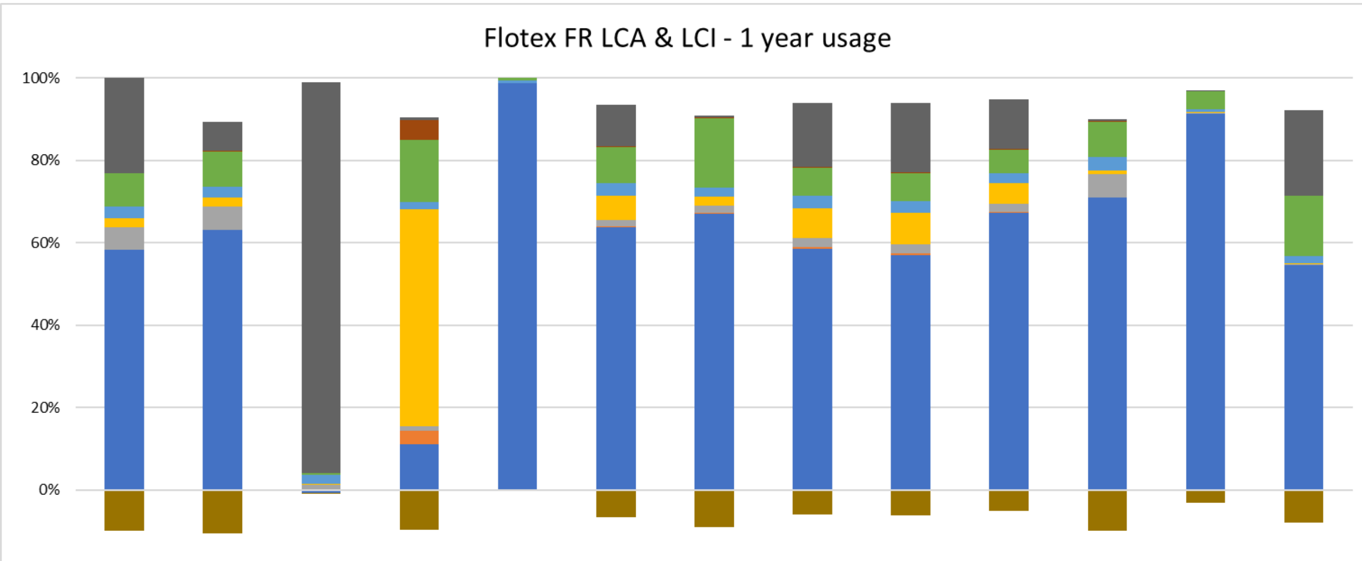
Table 10: Results of the LCA – Environmental impact for Flotex FR (one year)

Parameter	A1	A2	A3	A4	A5	B2	C1	C2	C3	D
GWP – total	5,18E+00	8,43E-03	4,86E-01	1,95E-01	2,44E-01	7,20E-01	0,00E+00	8,85E-03	2,15E+00	-8,77E-01
GWP – fossil	5,20E+00	8,40E-03	4,66E-01	1,90E-01	2,08E-01	7,13E-01	0,00E+00	8,81E-03	5,83E-01	-8,72E-01
GWP – biogenic	-1,22E-02	1,42E-06	1,97E-02	4,08E-03	3,59E-02	6,57E-03	0,00E+00	-1,21E-05	1,56E+00	-4,46E-03
GWP - luluc	1,12E-04	3,16E-05	1,22E-05	5,27E-04	1,92E-05	1,50E-04	0,00E+00	4,88E-05	6,24E-06	-9,59E-05
ODP	2,12E-08	1,06E-15	8,92E-14	6,48E-15	1,02E-10	1,36E-10	0,00E+00	5,25E-16	2,22E-13	-5,90E-12
AP	1,12E-02	4,98E-05	2,86E-04	1,03E-03	5,23E-04	1,56E-03	0,00E+00	2,88E-05	1,76E-03	-1,15E-03
EP – freshwater	8,88E-06	1,75E-08	2,29E-07	2,85E-07	3,04E-07	2,23E-06	0,00E+00	2,61E-08	5,96E-08	-1,20E-06
EP – marine	3,02E-03	1,76E-05	1,21E-04	3,72E-04	1,51E-04	3,52E-04	0,00E+00	1,33E-05	7,99E-04	-3,11E-04
EP – terrestrial	3,10E-02	1,95E-04	1,25E-03	4,12E-03	1,59E-03	3,68E-03	0,00E+00	1,49E-04	9,06E-03	-3,33E-03
POCP	1,14E-02	4,00E-05	3,54E-04	8,30E-04	4,38E-04	9,50E-04	0,00E+00	2,61E-05	2,06E-03	-8,71E-04
ADPF	1,06E+02	1,11E-01	8,34E+00	1,44E+00	4,78E+00	1,29E+01	0,00E+00	1,17E-01	7,99E-01	-1,48E+01
ADPE	3,96E-06	7,98E-10	1,20E-08	8,42E-09	2,28E-08	1,93E-07	0,00E+00	7,32E-10	6,02E-09	-1,32E-07
WDP	6,48E-01	3,90E-05	4,05E-03	8,73E-04	2,25E-02	1,72E-01	0,00E+00	7,85E-05	2,47E-01	-9,29E-02

Caption: GWP - total = global warming potential; GWP - fossil = global warming potential (fossil fuel only); GWP - biogenic = global warming potential (biogenic); GWP - luluc = global warming potential (land use only); ODP = ozone depletion; AP = acidification terrestrial and freshwater; EP - freshwater = eutrophication potential (freshwater); EP - marine = eutrophication potential (marine); EP- terrestrial = eutrophication potential (terrestrial); POCP = photochemical ozone formation; ADPE = abiotic depletion potential (element), ADPF = abiotic depletion potential (fossil) WDP = water scarcity

The relative contribution of each process stage to each impact category for Flotex FR is shown in figure 3.

Figure 3: relative contribution of each process stage to each impact category for Flotex FR for a one year usage.



	GWP - total	GWP - fossil	GWP - biogenic	GWP - luluc	ODP	AP	EP - fw	EP - marine	EP - terrestrial	POCP	ADPF	ADPE	WDP
D	-10%	-11%	0%	-10%	0%	-7%	-9%	-6%	-6%	-5%	-10%	-3%	-8%
C3	24%	7%	95%	1%	0%	10%	0%	15%	17%	12%	1%	0%	21%
C2	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%
C1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
B2	8%	9%	0%	15%	1%	9%	17%	7%	7%	6%	9%	4%	14%
A5	3%	3%	2%	2%	0%	3%	2%	3%	3%	3%	3%	1%	2%
A4	2%	2%	0%	53%	0%	6%	2%	7%	8%	5%	1%	0%	0%
A3	5%	6%	1%	1%	0%	2%	2%	2%	2%	2%	6%	0%	0%
A2	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
A1	58%	63%	-1%	11%	99%	64%	67%	59%	57%	67%	71%	91%	55%

Interpretation

The interpretation of the results has been carried out considering the assumptions and limitations declared in the EPD, both methodology- and data-related for a one year usage.

In almost all of the impact categories the production stage (A1-A3) has the main contribution to the overall impact. The raw material supply, in particular PA 6.6, PVC and DOTP are the key contributors for these impact categories.

Forbo declares in the EPD a worldwide distribution which has a limited effect on most of the impact categories. For AP, EP-marine & terrestrial and POCP there is a minor share of 5-8% of the total mainly caused by the ships and trucks used to transport the product. For GWP-luluc there is a share of 53% which is completely caused by the diesel used for the trucks.

The installation of Flotex FR has for all the environmental indicators a minor impact of 0 – 3% of the total environmental impact, caused by the adhesive and the disposal of the cutting waste.

In the Use stage the electricity needed to vacuum the floor is the main contributor. The cleaning regime used in the calculations is a worst-case scenario which will be in practice almost always be lower.

For the End of Life stage an 100% incineration scenario is used which has a significant and negative impact specifically for POCP and GWP & EP categories if compared to a landfill scenario.

Energy recovery from incineration and the respective energy substitution at the end of life results in most cases in a small credit in the End of Life stage.

Resource use

In table 11 the parameters describing resource use are presented for all the lifecycle stages for a one year usage.

Table 11: Results of the LCA – Resource use for Flotex FR (one year)

	A1	A2	A3	A4	A5	B2	C1	C2	C3	D
PERE [MJ]	4,68E+00	6,08E-03	8,57E-02	7,25E-02	2,34E-01	7,13E+00	0,00E+00	6,65E-03	1,33E-01	-4,07E+00
PERM [MJ]	0,00E+00	-	-	-	-	-	-	-	-	-
PERT [MJ]	4,68E+00	6,08E-03	8,57E-02	7,25E-02	2,34E-01	7,13E+00	0,00E+00	6,65E-03	1,33E-01	-4,07E+00
PENRE [MJ]	1,06E+02	1,11E-01	8,34E+00	1,44E+00	4,78E+00	1,29E+01	0,00E+00	1,17E-01	7,99E-01	-1,48E+01
PENRM [MJ]	0,00E+00	-	-	-	-	-	-	-	-	-
PENRT [MJ]	1,06E+02	1,11E-01	8,34E+00	1,44E+00	4,78E+00	1,29E+01	0,00E+00	1,17E-01	7,99E-01	-1,48E+01
SM [kg]	-	-	-	-	-	-	-	-	-	-
RSF [MJ]	-	-	-	-	-	-	-	-	-	-
NRSF [MJ]	-	-	-	-	-	-	-	-	-	-
FW [m3]	1,64E-02	5,61E-06	2,09E-04	8,22E-05	8,49E-04	6,81E-03	0,00E+00	7,52E-06	5,81E-03	-3,92E-03

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 non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

Waste categories and output flows

In table 12 other environmental information describing different waste categories and output flows are presented for all the lifecycle stages.

Table 12: Results of the LCA – Output flows and Waste categories for Flotex FR (one year)

	A1	A2	A3	A4	A5	B2	C1	C2	C3	D
HWD [kg]	5,83E-04	5,10E-13	8,80E-10	6,77E-12	4,14E-10	1,11E-09	0,00E+00	5,62E-13	1,02E-10	-2,01E-09
NHWD [kg]	4,55E-02	1,69E-05	1,15E-02	1,98E-04	2,25E-03	9,95E-03	0,00E+00	1,68E-05	2,78E-02	-7,50E-03
RWD [kg]	1,99E-03	1,15E-07	1,11E-05	1,76E-06	3,50E-05	2,06E-03	0,00E+00	1,44E-07	3,02E-05	-1,17E-03
CRU [kg]	-	-	-	-	-	-	-	-	-	-
MFR [kg]	-	-	-	-	-	-	-	-	-	-
MER [kg]	-	-	-	-	-	-	-	-	-	-
EEE [MJ]	-	-	-	-	8,56E-02	-	-	-	3,84E+00	-
EET [MJ]	-	-	-	-	1,54E-01	-	-	-	6,90E+00	-
Caption: HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy										

Biogenic Carbon content

Table 13: Information describing the biogenic carbon content at the factory gate

Biogenic carbon content	Unit (kg C/m^2)
Biogenic carbon content in product	0.179
Biogenic carbon content in accompanying packaging	0.001
Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO_2	

Additional Environmental Impact Indicators

To be fully transparant Forbo Flooring does not only want to declare the environmental impacts required in the PCR, but also the additional environmental impact indicators according to the European Standard EN15804.

Table 14: Results of the LCA – Environmental impacts one lifecycle (one year) – Flotex FR

Impact Category : EN 15804+A2	Flotex FR	Unit
Particulate matter emissions – PM	2,57E-07	Disease incidences
Ionizing radiation, human health - IR	5,40E-01	kBq U235 eq.]
Eco-toxicity (freshwater) - ETF-fw	6,14E+01	CTUe
Human toxicity, cancer effects – HTP-c	2,48E-09	CTUh
Human toxicity, non-cancer effects – HTP-nc	1,21E-07	CTUh
Soil quality potential/ Land use related impacts - SQP	7,84E+02	Pt

In the following table the impacts are subdivided into the lifecycle stages.

Table 15: Results of the LCA – Environmental impact for Flotex FR (one year)

	A1	A2	A3	A4	A5	B2	C1	C2	C3	D
PM [Disease incidences]	1,25E-07	5,76E-10	3,00E-09	1,16E-08	3,12E-09	1,29E-08	0,00E+00	1,58E-10	5,45E-09	-9,50E-09
IR [kBq U235 eq.]	1,05E+00	1,24E-05	1,54E-03	2,57E-04	9,74E-03	3,48E-01	0,00E+00	2,12E-05	4,77E-03	-1,98E-01
ETF-fw [CTUe]	3,38E+01	8,57E-02	6,99E-01	9,96E-01	1,39E+00	5,65E+00	0,00E+00	8,12E-02	2,77E-01	-3,26E+00
HTP-c [CTUh]	2,27E-09	1,70E-12	3,77E-11	1,99E-11	5,19E-11	1,62E-10	0,00E+00	1,64E-12	6,18E-11	-1,50E-10
HTP-nc [CTUh]	3,89E-08	9,63E-11	9,55E-10	1,27E-09	3,18E-09	5,93E-09	0,00E+00	9,77E-11	6,05E-09	-5,75E-09
SQP [Pt]	2,75E+00	3,29E-02	4,66E-02	4,35E-01	1,73E-01	4,63E+00	0,00E+00	4,03E-02	1,56E-01	-2,65E+00

Caption: PM = Particulate matter emissions; IR = Ionizing radiation, human health; ETF-fw = Eco-toxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects, SQP = Soil quality potential/ Land use related impacts

Interpretation

The interpretation of the results has been carried out considering the assumptions and limitations declared in the EPD, both methodology- and data-related for a one year usage.

For almost all impact categories the production stage is the main contributor to the total overall impact. The raw material supply has a major share of 97-100% of the production stage, mainly caused by the manufacturing of polyamide 6.6, PVC and glass fiber.
For Eco-toxicity (freshwater) the main share of 62% results from the packaging used to pack the finished product in the manufacturing stage A3.

The transport stage is negligible for most of the additional impact indicators, only PM has a slightly significant share of 7% of the total impact.

The adhesive used for the installation of Flotex FR is the dominant contributor for all categories which results in a minor contribution of 1-5% of the total impact.

The Use stage has a minor impact for 4 of the 6 additional impacts between 6 and 12%, for IR and SQP the impact is rather high with a share of respectively 22 and 42%.
The main contributor for all impact categories is the use of electricity for the cleaning of the floor. The cleaning regime used in the calculations is a worst-case scenario which will be in practice almost always be lower.

Energy recovery from incineration and the respective energy substitution at the end of life results in a (small) credit for all three of the impact categories.

Disclaimers to the declaration of core and additional environmental impact indicators

According to the "ILCD Handbook: Recommendations for Life Cycle Impact Assessment in the European context" the recommended characterization models and associated characterization factors are classified according to their quality into three levels:

- Type 1 (recommended and satisfactory),
- Type 2 (recommended but in need of some improvements)
- Type 3 (recommended, but to be applied with caution).

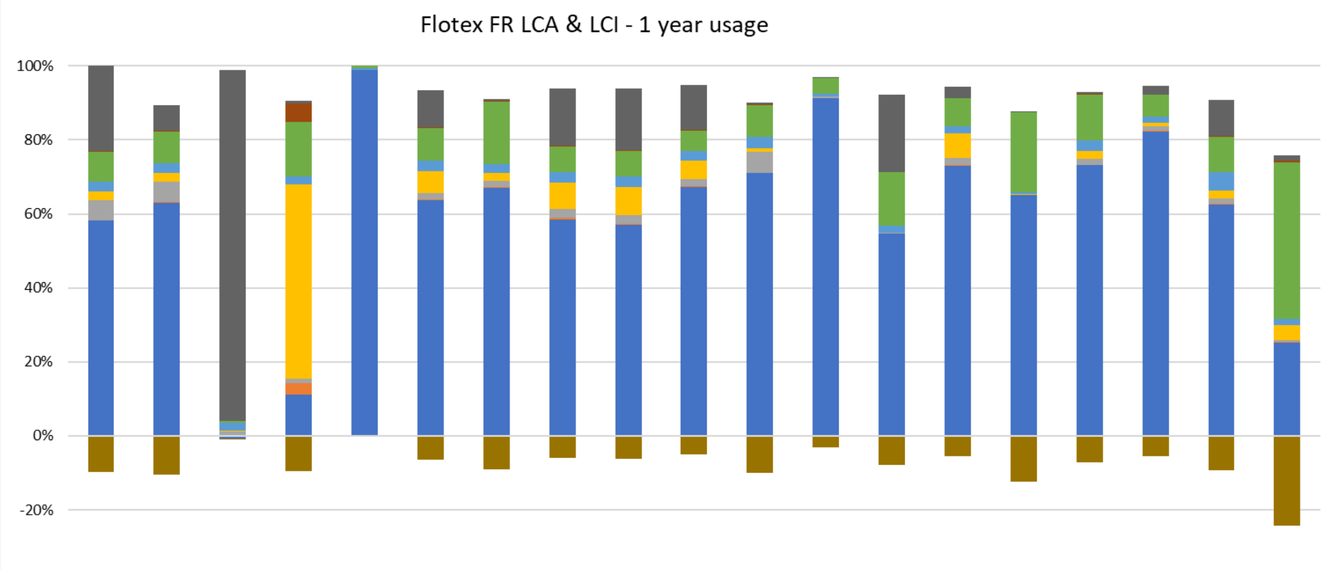
Table 16: Classification of disclaimers to the declaration of core and additional environmental impact indicators

ILCD classification	Indicator	Disclaimer
ILCD Type 1	Global Warming Potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 2	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user)deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans HTP-c)	2
	Potential Comparative Toxic Unit for humans HTP-nc)	2
	Potential Soil quality index (SQP)	2
Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator		
Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.		

Interpretation main modules and flows

The interpretation of the main modules and flows contributing to the total impact in each category is presented in following figure and table.

Figure 4: relative contribution of each process stage to each impact category for Flotex FR for a one year usage.



	GWP - total	GWP - fossil	GWP - biogenic	GWP - luluc	ODP	AP	EP - fw	EP - marine	EP - terrestrial	POCP	ADPF	ADPE	WDP	PM	IR	ETF-fw	HTP-c	HTP-nc	SQP
D	-10%	-11%	0%	-10%	0%	-7%	-9%	-6%	-6%	-5%	-10%	-3%	-8%	-6%	-12%	-7%	-5%	-9%	-24%
C3	24%	7%	95%	1%	0%	10%	0%	15%	17%	12%	1%	0%	21%	3%	0%	1%	2%	10%	1%
C2	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
C1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
B2	8%	9%	0%	15%	1%	9%	17%	7%	7%	6%	9%	4%	14%	8%	22%	12%	6%	10%	42%
A5	3%	3%	2%	2%	0%	3%	2%	3%	3%	3%	3%	1%	2%	2%	1%	3%	2%	5%	2%
A4	2%	2%	0%	53%	0%	6%	2%	7%	8%	5%	1%	0%	0%	7%	0%	2%	1%	2%	4%
A3	5%	6%	1%	1%	0%	2%	2%	2%	2%	2%	6%	0%	0%	2%	0%	2%	1%	2%	0%
A2	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
A1	58%	63%	-1%	11%	99%	64%	67%	59%	57%	67%	71%	91%	55%	73%	65%	73%	82%	63%	25%

Table 15: Main modules and flows contributing to the total impact in each impact category for Flotex FR for a one year usage

Impact Category	Stage	Module		Main contributor	Main contributing flows
GWP-total	Production	Raw Material Extraction (A1)	5.2 kg CO_2-equiv.	PA 6.6 (2.46 kg CO_2-eq.) PVC (1.25 kg CO_2-eq.) DOTP (1.01 kg CO_2-eq.)	Production : Inorganic emissions to air, Carbon dioxide Organic emissions to air (Group VOC), Methane
		Transport of Raw materials (A2)	0.008 kg CO_2-equiv.	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	0.49 kg CO_2-equiv.	0.44 Thermal energy	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Inorganic emissions to air, Carbon dioxide
	Installation	Installation (A5)		80% Adhesive 20% Disposal of Carpet installation waste	
	Use	Use (B2)		99% Electricity	Use : Inorganic emissions to air, Carbon dioxide
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Inorganic emissions to air, Carbon dioxide, Carbon dioxide (Biotic)
GWP—fossil	Production	Raw Material Extraction (A1)	92%	47% PA 6.6 24% PVC 20% DOTP	Production : Inorganic emissions to air, Carbon dioxide Organic emissions to air (Group VOC), Methane
		Transport of Raw materials (A2)	<0.2%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	8%	93% Thermal energy	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Inorganic emissions to air, Carbon dioxide
	Installation	Installation (A5)		94% Adhesive	
	Use	Use (B2)		99% Electricity	Use : Inorganic emissions to air, Carbon dioxide
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL: Inorganic emissions to air, Carbon dioxide
GWP-biogenic	Production	Raw Material Extraction (A1)	38%	27% PA 6.6 -30% PVC -38% Fatty acid ester	Production : Inorganic emissions to air, Carbon dioxide (biotic), Methane (biotic) Production : Renewable resources, Carbon dioxide
		Transport of Raw materials (A2)	<0.05%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	62%	98% Waste processing	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation: Inorganic emissions to air, Carbon dioxide (biotic) Transport & Installation: Renewable resources, Carbon dioxide
	Installation	Installation (A5)		97% Processing cutting waste	
	Use	Use (B2)		99% Electricity	Use : Inorganic emissions to air, Carbon dioxide (biotic) Use : Renewable resources, Carbon dioxide
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL: Inorganic emissions to air, Carbon dioxide (biotic) EOL : Renewable resources, Carbon dioxide
GWP-luluc	Production	Raw Material	72%	94% PA 6.6	Production : Inorganic emissions to air,

Impact Category	Stage	Module		Main contributor	Main contributing flows
		Extraction (A1)			Carbon dioxide (Land use change)
		Transport of Raw materials (A2)	20%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	8%	49% Thermal energy 47% Packaging	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Inorganic emissions to air, Carbon dioxide (Land use change)
	Installation	Installation (A5)		94% Adhesive	
	Use	Use (B2)		100% Electricity	Use : Inorganic emissions to air, Carbon dioxide (Land use change)
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Inorganic emissions to air, Carbon dioxide (Land use change)
ODP	Production	Raw Material Extraction (A1)	100%	94% DOTP	Production : Halogenated organic emissions to air, R11 (trichlorofluoromethane), R114 (dichlorotetrafluoromethane), R12 (dichlorodifluoromethane)
		Transport of Raw materials (A2)	0%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	0%	60% Packaging 38% Thermal energy	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Halogenated organic emissions to air, R114 (dichlorotetrafluoromethane)
	Installation	Installation (A5)		100% Adhesive	
	Use	Use (B2)		92% Detergent	Use : Halogenated organic emissions to air, R11 (trichlorofluoromethane), R114 (dichlorotetrafluoromethane)
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Halogenated organic emissions to air, R141b (dichloro-1-fluoroethane)
AP	Production	Raw Material Extraction (A1)	97%	39% PA 6.6 24% PVC 19% DOTP	Production : Inorganic emissions to air, Ammonia, Nitrogen oxides, Sulphur dioxide
		Transport of Raw materials (A2)	0.5%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	2.5%	80% Thermal energy	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Inorganic emissions to air, Ammonia, Nitrogen oxides, Sulphur dioxide
	Installation	Installation (A5)		92% Adhesive	
	Use	Use (B2)		99% Electricity	Use : Inorganic emissions to air, Ammonia, Nitrogen oxides, Sulphur dioxide
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Inorganic emissions to air, Ammonia, Nitrogen oxides, Sulphur dioxide
EP-freshwater	Production	Raw Material Extraction (A1)	97%	34% PA 6.6 30% PVC 10% Acrylate resin	Production : Inorganic emissions to fresh water, Phosphate, Phosphorus
		Transport of Raw materials (A2)	<0.2%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	3%	81% Waste processing	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Inorganic emissions to fresh water, Phosphate,

Impact Category	Stage	Module		Main contributor	Main contributing flows
	Installation	Installation (A5)		99% Adhesive	Phosphorus
	Use	Use (B2)		93% electricity	Use : Inorganic emissions to fresh water, Phosphate, Phosphorus
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Inorganic emissions to fresh water, Phosphate, Phosphorus
EP-marine	Production	Raw Material Extraction (A1)	96%	53% PA 6.6 21% PVC 11% DOTP	Production : Inorganic emissions to air, Nitrogen oxides Production: Inorganic emissions to fresh water. Ammonium/Ammonia, Nitrate
		Transport of Raw materials (A2)	< 1%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	4%	80% Thermal energy	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & installation : Inorganic emissions to air, Nitrogen oxides
	Installation	Installation (A5)		88% Adhesive	
	Use	Use (B2)		99% Electricity	Use : Inorganic emissions to air, Nitrogen oxides
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Inorganic emissions to air, Nitrogen oxides
EP-terrestrial	Production	Raw Material Extraction (A1)	95%	52% PA 6.6 22% PVC 12% DOTP	Production : Inorganic emissions to air, Ammonia, Nitrogen oxides
		Transport of Raw materials (A2)	1%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	4%	86% Thermal energy	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Inorganic emissions to air, Ammonia, Nitrogen oxides
	Installation	Installation (A5)		87% adhesive	
	Use	Use (B2)		99% Electricity	Use : Inorganic emissions to air, Ammonia, Nitrogen oxides
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Inorganic emissions to air, Ammonia, Nitrogen oxides
POCP	Production	Raw Material Extraction (A1)	97%	48% PA 6.6 26% PVC 13% DOTP	Production : Inorganic emissions to air, Nitrogen oxides Production : Halogenated organic emissions to air, NMVOC (unspecified), Propane
		Transport of Raw materials (A2)	< 0.5%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	3%	79% Thermal energy 18% Packaging	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation Inorganic emissions to air, Nitrogen oxides
	Installation	Installation (A5)		89% adhesive	
	Use	Use (B2)		99% electricity	Use : Inorganic emissions to air, Nitrogen oxides
	EOL	EOL (C1-C4)		Incineration of post-consumer	EOL : Inorganic emissions to air, Nitrogen

Impact Category	Stage	Module		Main contributor	Main contributing flows
				Flotex FR Energy substitution from incineration	oxides
ADPF	Production	Raw Material Extraction (A1)	93%	41% PA 6.6 26% PVC 26% DOTP	Production : Nonrenewable energy resources, Crude oil, Natural gas
		Transport of Raw materials (A2)	< 0.1%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	7%	86% Thermal energy	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Nonrenewable energy resources, Crude oil, Natural gas
	Installation	Installation (A5)		99% adhesive	
	Use	Use (B2)		99% Electricity	Use : Nonrenewable energy resources, Crude oil, Natural gas, Uranium
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Nonrenewable energy resources, Crude oil, Natural gas
ADPE	Production	Raw Material Extraction (A1)	100%	88% Zinc oxide	Production : Nonrenewable elements, Lead, Zinc, Copper
		Transport of Raw materials (A2)	< 0.05%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	< 0.5%	60% Thermal energy 39% Packaging	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Nonrenewable elements, Lead, Sulphur
	Installation	Installation (A5)		99% adhesive	
	Use	Use (B2)		100% electricity	Use : Nonrenewable elements, Lead, Sulphur, Silver
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Nonrenewable elements, Lead, Sulphur
WDP	Production	Raw Material Extraction (A1)	99%	51% PA 6.6 32% PVC	Production : Renewable resources Water, Ground water, River water, River water to turbine, Lake water, Lake water to turbine Production: Other emissions to fresh water, Turbined water to river
		Transport of Raw materials (A2)	< 0.01%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	1%	67% Packaging 31% Thermal energy	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Renewable resources Water, River water, River water to turbine Transport & Installation: Other emissions to fresh water, Cooling water to river, Turbined water to river
	Installation	Installation (A5)		76% adhesive	
	Use	Use (B2)		94% Electricity	Use : Renewable resources Water, River water, River water to turbine Use: Other emissions to fresh water, Cooling water to river, Turbined water to river
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from	EOL : Renewable resources Water, River water, River water to turbine EOL: Other emissions to fresh water,

Impact Category	Stage	Module		Main contributor	Main contributing flows
				incineration	Cooling water to river, Turbined water to river
PM	Production	Raw Material Extraction (A1)	97%	42% Glass fiber 19% PA 6.6 19% PVC	Production : Inorganic emissions to air, Nitrogen oxides, Sulphur dioxides Production : Particles to air, Dust (PM 2.5)
		Transport of Raw materials (A2)	1%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	2%	81% Thermal energy	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Inorganic emissions to air, Nitrogen oxides, Sulphur dioxides Transport & Installation: Particles to air, Dust (PM 2.5)
	Installation	Installation (A5)		96% adhesive	
	Use	Use (B2)		99% electricity	Use : Inorganic emissions to air, Nitrogen oxides, Sulphur dioxides Use: Particles to air, Dust (PM 2.5)
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Inorganic emissions to air, Nitrogen oxides, Sulphur dioxides EOL: Particles to air, Dust (PM 2.5)
IR	Production	Raw Material Extraction (A1)	100%	73% PVC 12% Glass fiber	Production : Radioactive emissions to air, Carbon (C14) Production: Radioactive emissions to fresh water, Cesium (Cs137), Iodine (I129), Cobalt (Co60)
		Transport of Raw materials (A2)	< 0.01%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	< 0.2%	37% Thermal energy 62% Packaging	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Radioactive emissions to air, Carbon (C14)
	Installation	Installation (A5)		99% adhesive	
	Use	Use (B2)		100% Electricity	Use : Radioactive emissions to air, Carbon (C14)
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL : Radioactive emissions to air, Carbon (C14)
ETF-fw	Production	Raw Material Extraction (A1)	30%	62% PA 6.6 22% PVC	Production : Inorganic emissions to air, Hydrogen sulphide Production : Inorganic emissions to fresh water, Chloride, Aluminium
		Transport of Raw materials (A2)	8%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	62%	87% Packaging	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation : Inorganic emissions to air, Hydrogen sulphide Transport & Installation: Inorganic emissions to fresh water, Chloride, Aluminium
	Installation	Installation (A5)		99% adhesive	
	Use	Use (B2)		100% electricity	Use : Inorganic emissions to air, Hydrogen sulphide Use: Inorganic emissions to fresh water, Chloride, Aluminium
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL Inorganic emissions to air, Hydrogen sulphide EOL: Inorganic emissions to fresh water, Chloride, Aluminium
HTP-c	Production	Raw Material	98%	24% PA 6.6	Production: Halogenated organic emissions

Impact Category	Stage	Module		Main contributor	Main contributing flows
		Extraction (A1)		69% PVC	to air, Vinyl chloride (VCM chloroethene) Production: Group NMVOC to air, Formaldehyde (Methanal) Production: Heavy metals to fresh water, Chromium
		Transport of Raw materials (A2)	< 0.1%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	2%	62% Thermal energy 37% Packaging	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation: Group NMVOC to air, Formaldehyde (Methanal) Transport & Installation: Heavy metals to fresh water, Chromium
	Installation	Installation (A5)		93% adhesive	
	Use	Use (B2)		100% Electricity	Use: Group NMVOC to air, Formaldehyde (Methanal), Polychlorinated di-benzo-p furans (2, 3, 7, 8 TCDD)
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL: Heavy metals to air, Mercury EOL: Group NMVOC to air, Formaldehyde (Methanal) EOL: Heavy metals to fresh water, Chromium
HTP-nc	Production	Raw Material Extraction (A1)	97%	21% PVC 58% PA 6.6	Production: Heavy metals to air, Mercury Production: Inorganic emissions to air, Carbon monoxide Production: Heavy metals to fresh water, Arsenic (+V) Production: Inorganic emissions to fresh water, Chloride, Chlorine (dissolved), Fluoride
		Transport of Raw materials (A2)	< 0.5%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	3%	27% Thermal energy 64% Packaging	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation: Heavy metals to air, Mercury Transport & Installation: Inorganic emissions to air, Carbon monoxide
	Installation	Installation (A5)		96% adhesive	
	Use	Use (B2)		100% electricity	Use: Heavy metals to air, Mercury Use: Inorganic emissions to air, Carbon monoxide
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL: Heavy metals to air, Mercury EOL: Inorganic emissions to air, Carbon monoxide
SQP	Production	Raw Material Extraction (A1)	97%	63% PA 6.6 28% PVC	Production: Land use, Occupation, Arable, Arable irrigated intensive, Arable non irrigated, Forest used
		Transport of Raw materials (A2)	1%	Means of transport (truck, container ship) and their fuels	
		Manufacturing (A3)	2%	46% Thermal energy 53% Packaging	
	Transport	Transport Gate to User (A4)		Means of transport (truck, container ship) and their fuels	Transport & Installation: Land use, Occupation, Arable, Arable irrigated intensive, Arable non irrigated, Forest used
	Installation	Installation (A5)		98% adhesive	
	Use	Use (B2)		100% Electricity	Use: Land use, Occupation, Arable, Arable irrigated intensive, Arable non irrigated, Forest used
	EOL	EOL (C1-C4)		Incineration of post-consumer Flotex FR Energy substitution from incineration	EOL: Land use, Occupation, Arable, Arable irrigated intensive, Arable non irrigated, Forest used

Description of Selected Impact Categories

Abiotic Depletion Potential

The abiotic depletion potential covers all natural resources such as metal containing ores, crude oil and mineral raw materials. Abiotic resources include all raw materials from non-living resources that are non-renewable. This impact category describes the reduction of the global amount of non-renewable raw materials. Non-renewable means a time frame of at least 500 years. This impact category covers an evaluation of the availability of natural elements in general, as well as the availability of fossil energy carriers.

ADP (elements) describes the quantity of non-energetic resources directly withdrawn from the geosphere. It reflects the scarcity of the materials in the geosphere and is expressed in Antimony equivalents. The characterization factors are published by the CML, Oers 2010.

Are fossil energy carriers included in the impact category, it is ADP (fossil). Fossil fuels are used similarly to the primary energy consumption; the unit is therefore also MJ. In contrast to the primary fossil energy ADP fossil does not contain uranium, because this does not count as a fossil fuel.

Primary energy consumption

Primary energy demand is often difficult to determine due to the various types of energy source. Primary energy demand is the quantity of energy directly withdrawn from the hydrosphere, atmosphere or geosphere or energy source without any anthropogenic change. For fossil fuels and uranium, this would be the amount of resource withdrawn expressed in its energy equivalent (i.e. the energy content of the raw material). For renewable resources, the energy-characterized amount of biomass consumed would be described. For hydropower, it would be based on the amount of energy that is gained from the change in the potential energy of water (i.e. from the height difference). As aggregated values, the following primary energies are designated:

The total **"Primary energy consumption non-renewable"**, given in MJ, essentially characterizes the gain from the energy sources natural gas, crude oil, lignite, coal and uranium. Natural gas and crude oil will both be used for energy production and as material constituents e.g. in plastics. Coal will primarily be used for energy production. Uranium will only be used for electricity production in nuclear power stations.

The total **"Primary energy consumption renewable"**, given in MJ, is generally accounted separately and comprises hydropower, wind power, solar energy and biomass. It is important that the end energy (e.g. 1 kWh of electricity) and the primary energy used are not miscalculated with each other; otherwise the efficiency for production or supply of the end energy will not be accounted for. The energy content of the manufactured products will be considered as feedstock energy content. It will be characterized by the net calorific value of the product. It represents the still usable energy content.

Waste categories

There are various different qualities of waste. For example, waste can be classed according to German and European waste directives. The modeling principles have changed with the last GaBi4 database update in October 2006. Now all LCA data sets (electricity generation, raw material etc.) already contain the treatment of the waste with very low waste output at the end of the stage. So the amount of waste is predominantly caused by foreground processes during the production phase. This is important for the interpretation of waste amounts.

From a balancing point of view, it makes sense to divide waste into three categories. The categories overburden/tailings, industrial waste for municipal disposal and hazardous waste will be used.

Overburden / tailings in kg: This category consists of the layer which must be removed in order to access raw material extraction, ash and other raw material extraction conditional materials for disposal. Also included in this category are tailings such as inert rock, slag, red mud etc.

Industrial waste for municipal disposal in kg: This term contains the aggregated values of industrial waste for municipal waste according to 3. AbfVwV TA SiedlABf.

Hazardous waste in kg: This category includes materials that will be treated in a hazardous waste incinerator or hazardous waste landfill, such as painting sludge's, galvanic sludge's, filter dusts or other solid or liquid hazardous waste and radioactive waste from the operation of nuclear power plants and fuel rod production.

Global Warming Potential (GWP)

The mechanism of the greenhouse effect can be observed on a small scale, as the name suggests, in a greenhouse. These effects are also occurring on a global scale. The occurring short-wave radiation from the sun comes into contact with the earth's surface and is partly absorbed (leading to direct warming) and partly reflected as infrared radiation. The reflected part is absorbed by so-called greenhouse gases in the troposphere and is re-radiated in all directions, including back to earth. This results in a warming effect on the earth's surface.

In addition to the natural mechanism, the greenhouse effect is enhanced by human activities. Greenhouse gases that are considered to be caused, or increased, anthropogenically are, for example, carbon dioxide, methane and CFCs. *Figure A1* shows the main processes of the anthropogenic greenhouse effect. An analysis of the greenhouse effect should consider the possible long term global effects.

The global warming potential is calculated in carbon dioxide equivalents (CO_2-Eq.). This means that the greenhouse potential of an emission is given in relation to CO_2. Since the residence time of the gases in the atmosphere is incorporated into the calculation, a time range for the assessment must also be specified. A period of 100 years is customary.

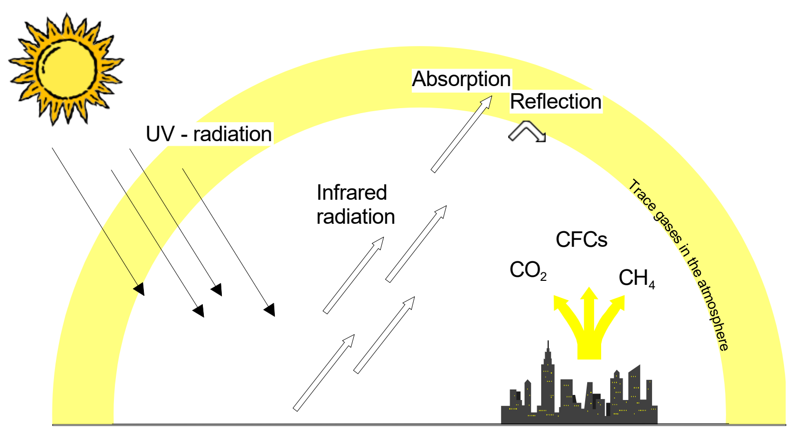


Figure A1: Greenhouse effect (KREISSIG 1999)

Acidification Potential (AP)

The acidification of soils and waters predominantly occurs through the transformation of air pollutants into acids. This leads to a decrease in the pH-value of rainwater and fog from 5.6 to 4 and below. Sulphur dioxide and nitrogen oxide and their respective acids (H_2SO_4 and HNO_3) produce relevant contributions. This damages ecosystems, whereby forest dieback is the most well-known impact.

Acidification has direct and indirect damaging effects (such as nutrients being elutriated from soils or an increased solubility of metals into soils). But even buildings and building materials can be damaged. Examples include metals and natural stones which are corroded or disintegrated at an increased rate.

When analyzing acidification, it should be considered that although it is a global problem, the regional effects of acidification can vary. *Figure A2* displays the primary impact pathways of acidification.

The acidification potential is given in sulphur dioxide equivalents (SO2-Eq.). The acidification potential is described as the ability of certain substances to build and release H+ - ions. Certain emissions can also be considered to have an acidification potential, if the given S-, N- and halogen atoms are set in proportion to the molecular mass of the emission. The reference substance is sulphur dioxide.

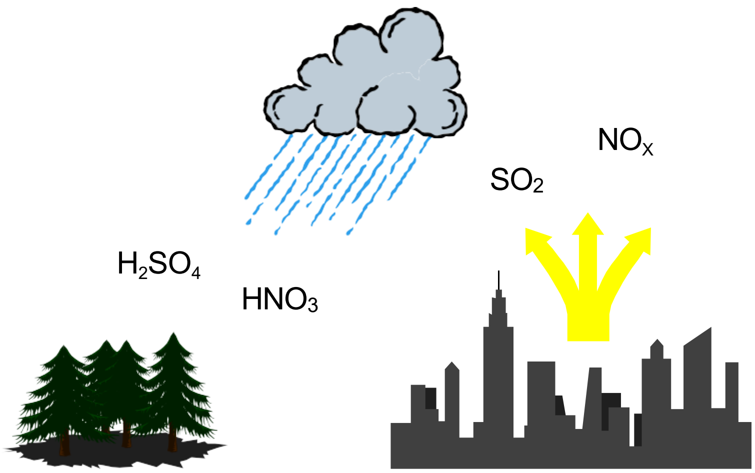


Figure A2: Acidification Potential (KREISSIG 1999)

Eutrophication Potential (EP)

Eutrophication is the enrichment of nutrients in a certain place. Eutrophication can be aquatic or terrestrial. Air pollutants, waste water and fertilization in agriculture all contribute to eutrophication.

The result in water is an accelerated algae growth, which in turn, prevents sunlight from reaching the lower depths. This leads to a decrease in photosynthesis and less oxygen production. In addition, oxygen is needed for the decomposition of dead algae. Both effects cause a decreased oxygen concentration in the water, which can eventually lead to fish dying and to anaerobic decomposition (decomposition without the presence of oxygen). Hydrogen sulphide and methane are thereby produced. This can lead, among others, to the destruction of the eco-system.

On eutrophicated soils, an increased susceptibility of plants to diseases and pests is often observed, as is a degradation of plant stability. If the nutrification level exceeds the amounts of nitrogen necessary for a maximum harvest, it can lead to an enrichment of nitrate. This can cause, by means of leaching, increased nitrate content in groundwater. Nitrate also ends up in drinking water.

Nitrate at low levels is harmless from a toxicological point of view. However, nitrite, a reaction product of nitrate, is toxic to humans. The causes of eutrophication are displayed in Figure A3. The eutrophication potential is calculated in phosphate equivalents (PO4-Eq). As with acidification potential, it's important to remember that the effects of eutrophication potential differ regionally.

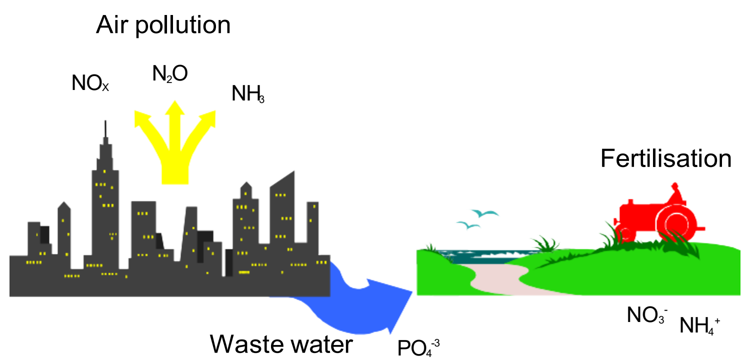


Figure A3: Eutrophication Potential (KREISSIG 1999)

Photochemical Ozone Creation Potential (POCP)

Despite playing a protective role in the stratosphere, at ground-level ozone is classified as a damaging trace gas. Photochemical ozone production in the troposphere, also known as summer smog, is suspected to damage vegetation and material. High concentrations of ozone are toxic to humans.

Radiation from the sun and the presence of nitrogen oxides and hydrocarbons incur complex chemical reactions, producing aggressive reaction products, one of which is ozone. Nitrogen oxides alone do not cause high ozone concentration levels. Hydrocarbon emissions occur from incomplete combustion, in conjunction with petrol (storage, turnover, refueling etc.) or from solvents. High concentrations of ozone arise when the temperature is high, humidity is low, when air is relatively static and when there are high concentrations of hydrocarbons. Today it is assumed that the existence of NO and CO reduces the accumulated ozone to NO_2, CO_2 and O_2. This means, that high concentrations of ozone do not often occur near hydrocarbon emission sources. Higher ozone concentrations more commonly arise in areas of clean air, such as forests, where there is less NO and CO (*Figure A4*).

In Life Cycle Assessments, photochemical ozone creation potential (POCP) is referred to in ethylene-equivalents (C_2H_4-Äq.). When analyzing, it's important to remember that the actual ozone concentration is strongly influenced by the weather and by the characteristics of the local conditions.

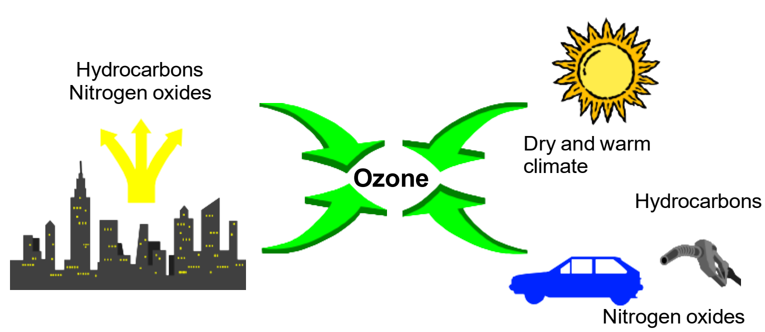


Figure A4: Photochemical Ozone Creation Potential

Ozone Depletion Potential (ODP)

Ozone is created in the stratosphere by the disassociation of oxygen atoms that are exposed to short-wave UV-light. This leads to the formation of the so-called ozone layer in the stratosphere (15 - 50 km high). About 10 % of this ozone reaches the troposphere through mixing processes. In spite of its minimal concentration, the ozone layer is essential for life on earth. Ozone absorbs the short-wave UV-radiation and releases it in longer wavelengths. As a result, only a small part of the UV-radiation reaches the earth.

Anthropogenic emissions deplete ozone. This is well-known from reports on the hole in the ozone layer. The hole is currently confined to the region above Antarctica, however another ozone depletion can be identified, albeit not to the same extent, over the mid-latitudes (e.g. Europe). The substances which have a depleting effect on the ozone can essentially be divided into two groups; the fluorine-chlorine-hydrocarbons (CFCs) and the nitrogen oxides (NOX). *Figure A5* depicts the procedure of ozone depletion.

One effect of ozone depletion is the warming of the earth's surface. The sensitivity of humans, animals and plants to UV-B and UV-A radiation is of particular importance. Possible effects are changes in growth or a decrease in harvest crops (disruption of photosynthesis), indications of tumors (skin cancer and eye diseases) and decrease of sea plankton, which would strongly affect the food chain. In calculating the ozone depletion potential, the anthropogenically released halogenated hydrocarbons, which can destroy many ozone molecules, are recorded first. The so-called Ozone Depletion Potential (ODP) results from the calculation of the potential of different ozone relevant substances.

This is done by calculating, first of all, a scenario for a fixed quantity of emissions of a CFC reference (CFC 11). This results in an equilibrium state of total ozone reduction. The same scenario is considered for each substance under study whereby CFC 11 is replaced by the quantity of the substance. This leads to the ozone depletion potential for each respective substance, which is given in CFC 11 equivalents. An evaluation of the ozone depletion potential should take the long term, global and partly irreversible effects into consideration.

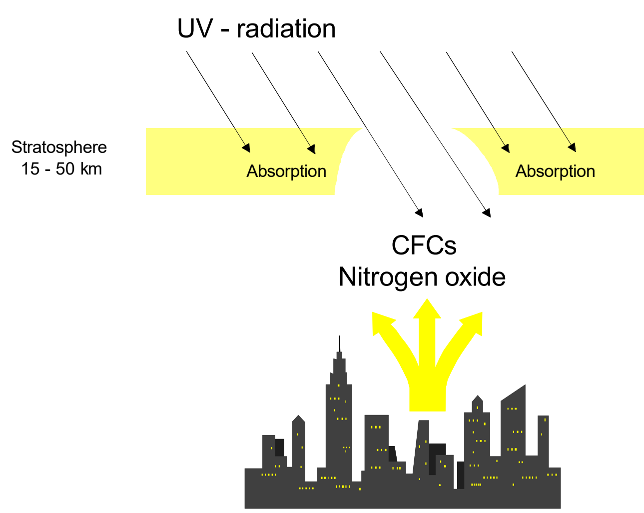


Figure A5: Ozone Depletion Potential (KREISSIG 1999)

References

GABI 10.6 2012	SPHERA AG; Gabi 10.6: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2017.
GABI 10.6 2012D	Gabi 10.6: Documentation of Gabi 10.6: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2017. http://documentation.gabi-software.com/
UL ENVIRONMENT	UL Environment's Program Operator Rules
PE 2012 ILCD Handbook: General guide for Life Cycle Assessment - Detailed guidance	Description of Selected Impact Categories, SPHERA AG, 2012 European Commission-Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook- Recommendations for Life Cycle Impact Assessment in the European context. First edition November 2011. EUR 24571 EN. Luxemburg. Publications Office of the European Union; 2011
STANDARDS AND LAWS	
DIN EN ISO 14044	Environmental management - Life cycle assessment - Requirements and guidelines (ISO 14044:2006); German and English version EN ISO 14044
ISO 14025 2006	DIN EN ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures
ISO 14040 2006	Environmental management - Life cycle assessment - Principles and framework (ISO 14040); German and English version EN ISO 14040
CEN/TR 15941	Sustainability of construction works - Environmental product declarations - Methodology for selection and use of generic data; German version CEN/TR 15941
EN 16810	Resilient, textile and laminate floor coverings - Environmental product declarations - Product category rules
EN 15804	EN 15804: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products
CPR	REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonized conditions for the marketing of construction products and repealing Council Directive 89/106/EEC
EN-ISO 10874 EN 1307	Resilient, textile and laminate floor coverings – Classification Textile floor coverings - Specification