Environmental Product Declaration

according to ISO 14025

Loose-laid carpet tiles

- tufted surface pile 100% PA6.6
- fleece-covered bitumen backing
- flame-proofed on the basis of aluminium hydroxide

Gemeinschaft umweltfreundlicher Teppichboden e.V.

Declaration number
EPD-GUT-2009411-E

Institut Bauen und Umwelt e.V
www.bau-umwelt.com

Institut Bauen und Umwelt e.V.

Summary

Environmental Product Declaration

Program operator

Institut Bauen und Umwelt e.V.

www.bau-umwelt.com

Owner of the declaration

Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V.
Schönebergstr. 2; 52068 Aachen; mail@gut-ev.de
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Declaration Number

EPD-GUT-2009411-E

Declared building product

Loose-laid carpet tiles
having a tufted surface pile made of 100 % polyamide 6.6 and a fleece-covered bitumen backing and flame-proofed on the basis of aluminium hydroxide

This declaration is an Environmental Product Declaration according to /ISO 14025/ and describes the environmental performance of the floor coverings indicated herein. It is designed to foster the development of ecological and healthy building.
In this validated declaration, all relevant environmental data are disclosed.

Validity

This validated declaration authorises the use of the label of Institut Bauen und Umwelt.
It is valid for a period of three years from the date of issue exclusively for the product group indicated and only in conjunction with a valid PRODIS licence.
The contents and validity of the licence may be checked online via www.pro-dis.info.

The owner of the declaration shall be liable for the underlying information and verifications.

Contents of the declaration

The declaration is complete and furnishes details of:

- the product definition and relevant building-physics-related information
- the raw materials and origin of the raw materials
- the descriptions of the product manufacture
- the information on product processing
- the information on the use stage, extraordinary influences and end-of-life stage
- the results of the life cycle assessment

Date of issue

08. January 2009

Signatures

Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt)

Examination of the declaration

This declaration and the rules on which it is based have been examined in accordance with ISO 14025 /1/ by the independent Committee of Experts (CoE).

Signatures

Prof. Dr.-Ing. Hans-Wolf Reinhardt (Chairman of the CoE)

Dr. Eva Schmincke (CoE-appointed Examiner)

Summary

Environmental Product Declaration

Product description

The declaration covers a group of textile floor coverings having the following features:

Kind of manufacture:	Tufted
Surface pile material:	100 % polyamide 6.6 (PA6.6) - fibres,
Back coating:	Bitumen finish flee-covered and flame-proofed on the basis of aluminium hydroxide

Subject to the weight of the surface pile, the textile floor covering is classified in accordance with luxury classes LC1 to LC5 (Table 1) defined in EN 1307.

Table 1: **Luxury classes**

Luxury class	**LC 1**	**LC 2**	**LC 3**	**LC 4**	**LC 5**
Weight of surface pile [g/m²]	< 400	≥ 400	≥ 600	≥ 800	≥ 1000

Range of application

As indicated on the PRODIS label, the textile floor covering may be used either in the residential or in the commercial area.
Suitability for additional uses is also indicated on the PRODIS label.

Scope of the life cycle assessment

The life cycle assessment was carried out according to /ISO 14040/ seq. in line with the requirements of the Product Declaration Rules (PCR) for "floor coverings". The data reference consisted of specific data provided by GUT member companies and of data from the "GaBi 4" database.
The life cycle assessment covers

- Part 1: Production stage including the supply chains (from cradle to factory gate)
- Part 2: Delivery/installation, use
- Part 3: End-of-life stage

Result of the life cycle assessment

The initial value for the relevant columns of the table of results is the luxury class of the textile floor covering (Table 1), which is indicated on the PRODIS label.

Table 2: **Results of the LCA for**

		Part 1 – Production stage					**Part 2**	**Part 3 – End-of-life stage**				
Categories evaluated	**Unit per m²**	**LC1**	**LC2**	**LC3**	**LC4**	**LC5**		**LC1**	**LC2**	**LC3**	**LC4**	**LC5**
Primary energy not renewable	[MJ]	165.9	213.1	260.3	307.5	354.7	For the values of the delivery/installation and use, see the long version; likewise for the underlying conditions	-51.4	-54.6	-57.7	-60.8	-63.9
Primary energy renewable	[MJ]	2.4	3.2	4.0	4.8	5.7		-0.7	-0.8	-0.8	-0.9	-0.9
Greenhouse potential -(GWP 100)	[kg CO_2-eqv.]	7.5	10.3	13.1	15.9	18.8		4.3	4.6	4.8	5.1	5.4
Ozone degradation potential (ODP)	[kg R11-eqv.]	$8.0\cdot10^{-7}$	$8.9\cdot10^{-7}$	$9.9\cdot10^{-7}$	$1.1\cdot10^{-6}$	$1.2\cdot10^{-6}$		$-1.4\cdot10^{-7}$	$-1.5\cdot10^{-7}$	$-1.6\cdot10^{-7}$	$-1.7\cdot10^{-7}$	$-1.8\cdot10^{-7}$
Acidification potential (AP)	[kg SO_2-eqv.]	$2.9\cdot10^{-2}$	$3.9\cdot10^{-2}$	$4.9\cdot10^{-2}$	$6.0\cdot10^{-2}$	$7.0\cdot10^{-2}$		$4{,}8\cdot10^{-3}$	$5.1\cdot10^{-3}$	$5.4\cdot10^{-3}$	$5.7\cdot10^{-3}$	$5.9\cdot10^{-3}$
Nutrification (NP)	[kg PO_4-eqv.]	$7.2\cdot10^{-3}$	$9.8\cdot10^{-3}$	$1.2\cdot10^{-2}$	$1.5\cdot10^{-2}$	$1.8\cdot10^{-2}$		$1.0\cdot10^{-3}$	$1.1\cdot10^{-3}$	$1.1\cdot10^{-3}$	$1.2\cdot10^{-3}$	$1.3\cdot10^{-3}$
Photochemical oxidant formation (POCP)	[kg ethene-eqv.]	$3.3\cdot10^{-3}$	$4.1\cdot10^{-3}$	$4.9\cdot10^{-3}$	$5.7\cdot10^{-3}$	$6.5\cdot10^{-3}$		$1.0\cdot10^{-4}$	$1.1\cdot10^{-4}$	$1.2\cdot10^{-4}$	$1.2\cdot10^{-4}$	$1.3\cdot10^{-4}$

The results are based on the life cycle assessment for textile floor coverings conducted by **Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V.**, Aachen,

in cooperation with::	**Textile and Flooring Institut GmbH**, Aachen,
critically reviewed by:	**Prof. Dr. Walter Klöpffer**, Int. Journal of Life Cycle Assessment, LCA CONSULT & REVIEW, Frankfurt a.M., **Dipl. Natw. ETH Roland Hischier**, Head of unit LCA, EMPA, St Gallen

Verifications and tests

In addition, the following tests are represented in the environmental declaration:

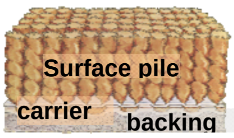
VOC emissions	GUT product testing criteria based on AgBB scheme for the evaluation of emissions from building products,
Tests for contaminants	GUT product testing criteria

0 Product definition

0.1 Product classification and description

Loose-laid carpet tiles having a tufted surface pile made of 100 % polyamide 6.6 and a fleece-covered bitumen backing, flame-proofed on the basis of aluminium hydroxide.

The environmental product declaration covers a group of textile floor coverings having the following features :



Kind of manufacture: Tufted
Material of surface pile: 100 % polyamide 6.6 (PA6.6) fibres,
Carrier material: Polypropylene (PP) or Polyester (PES),
Back coating: Bitumen finish with glass-fibre fleece, precoat flame-proofed on the basis of aluminium hydroxide, cover fleece of PP

Subject to the weight of the surface pile, the textile floor covering is classified in accordance with luxury classes LC1 to LC5 defined in EN 1307. The FCSS symbol (Floor Covering Standard Symbols) for the relevant luxury class is shown on the PRODIS label of the product (Table 3).

Table 3: **Luxury classes and symbols**

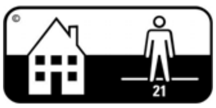
Luxury class	**LC 1**	**LC 2**	**LC 3**	**LC 4**	**LC 5**
Surface pile weight [g/m²]	< 400	≥ 400	≥ 600	≥ 800	≥ 1000
FCSS symbol					

For all values of the surface pile weight within a luxury class, the mean value of this class is considered in each case (Table 4).

0.2 Range of application

On the PRODIS label of the textile floor covering, the use class is marked by means of an FCSS symbol showing the suitability for use in residential or commercial areas.

Use in residential areas



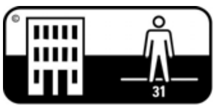
moderate/light

general/medium

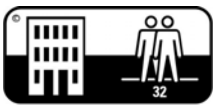
general

heavy

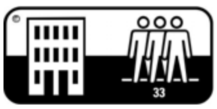
Use in commercial areas



light



general



heavy

Suitability for additional uses is also indicated on the PRODIS label with an FCSS symbol. The declaration for a textile floor covering from the product group indicated is valid for each use class.

0.3 Product standard/ Approval

The following standards apply to the present product group:

DIN EN 1307 - Textile floor coverings – Classification of pile carpets
DIN EN 685 - Resilient, textile and laminate floor coverings - classification
DIN EN 14041 - Resilient, textile and laminate floor coverings - Essential characteristics
DIN EN 13501-1 - Classification of building products and building types according to their reaction to fire

The product is approved according to the European technical approval (7-marking) as well as in accordance with the respective national approval principles for building products. E.g. the general technical approval of Deutsches Institut für Bautechnik.
For admission numbers, see the PRODIS marking (www.pro-dis.info).

0.4 Accreditation

The textile floor covering has been awarded a GUT/PRODIS test label for environment-friendly products. Within the framework of this product testing system, annual controls are made by independent test institutes.

0.5 Delivery status

On delivery, the textile floor covering features the composition and characteristics described in Table 4. The layer weights indicated are mean values relative to the respective luxury class.

Table 4: **Characteristics of the group of textile floor coverings**

Features	Luxury class					Unit
	LC 1	LC 2	LC 3	LC 4	LC 5	
Surface pile :						
Pile yarn PA 6.6	100					[%]
Weight of the surface pile	300	500	700	900	1100	[g/m²]
Carrier:						
Carrier material PP/PES	100					[%]
Backing:						
Bitumen coating with inlay of glass-fibre fleece and cover fleece of PP						
Total weight	4123	4373	4623	4873	5123	[g/m²]
Additional features according to /EN 1307/, /EN 14041/	Additional characteristics and suitable uses of the product are declared through marking with an additional symbol according to /EN 685/ and are registered in the respective PRODIS licence.					

1 Material content

1.1 Material content

Table 5 lists the raw materials contained in the textile floor covering on delivery as well as their percentage shares in the weight.

Table 5: **Material content**

Construction layer	Material	Share in weight [%]					Resource renewable	Avail-ability	Origin
		LC 1	LC 2	LC 3	LC 4	LC 5			
Pile layer and Dead Pile*	PA 6.6	9.1	14.3	18.9	23.1	26.8	no	limited	global
Carrier	PP/PES	2.6	2.4	2.3	2.2	2.1	no	limited	global
Precoat	Aluminiumhydroxide $AL(OH)_3$	18.2	17.2	16.2	15.4	14.6	no	limited	Europe
	SBR latex						no	limited	global
Bitumen finish	Chalk $CaCO_3$	67.9	64.0	60.6	57.5	54.7	no	ample	Europe
	Bitumen						no	limited	global
Glass-fibre fleece	Glass fibres	1.0	0.9	0.9	0.8	0.8	no	ample	Europe
Cover fleece	PP	1.2	1.1	1.1	1.0	1.0	no	limited	global

* Designation for the share of yarn below the carrier surface.

1.2 Production of main materials

Polyamide 6.6 (PA 6.6)
Polyamide 6.6 is a thermoplastic plastic material which is made by means of polycondensation from hexamethylene diamine and adipic acid.

Polypropylene (PP)
PP is a thermoplastic plastic material that is formed by means of catalysts through polymerisation of the monomer propene.

Polyester (PES)
Polyesters are polymers containing the ester functional group in their main chain. Above all, the term is used for the large family of plastic materials; most commonly this refers to the much used polyethylene terephthalate (PET).

Aluminium hydroxide AL(OH)3
Aluminium hydroxide is made from bauxite through digestion with sodium hydroxide solution.

Chalk (CaCO3)
Chalk is a sedimentary rock, a softer form of white or light-grey lime. Chemically, chalk consists of calcium carbonate. It is added as a filler to the latex precoating and lamination.

Styrene Butadiene Rubber (SBR-Latex)
SBR latex is made through emulsion polymerisation from the monomers styrene and butadiene.

Bitumen
Bitumen counts among the thermoplastic materials and, in addition to the natural occurrences – it is also won through vacuum distillation from petroleum.

Glass fibres
Glass fibres are long, thin fibres consisting of glass. They are manufactured by drawing melted glass into thin threads.

2 Product manufacture

2.1 Production process

The production of textile floor coverings is divided into 3 partial stages.

The production sequence depends on whether dyeing is done as yarn dyeing or as piece dyeing. This results in the following two variants:

Production with dyed yarn (yarn dyeing)

Dyeing → Tufting → Application of backing

Production with undyed (raw white) yarn (piece dyeing)

Tufting → Dyeing → Application of backing

Printing processes (piece dyeing) can also be used in combination with preceding or subsequent dyeing, so that, in case of additional yarn dyeing, both variants may be applied.

Description of the three production steps:

Tufting:

Pile threads are machine-sewn into the carrier material across the entire breadth of the product by means of a multitude of needles arranged next to each other. The resulting loops will appear on the later surface either as loops, or they are cut open during the process and appear as cut pile (velour).

Dyeing:

Colouring is done by means of **aqueous** or **non-aqueous processes**.

The **aqueous processes** are divided in

- Yarn dyeing: The yarns are coloured in the dyeing vat. Subsequently, the bobbins or hanks are rinsed, dehydrated and dried.
- Piece dyeing: The tufted raw product is piece-dyed. The following dyeing methods are employed for the purpose:

  Reel vat process: The raw product is moved over a reel and dyed in a dyeing vat. Subsequently, the merchandise is washed and dried.

  Cold pad-batch dyeing: The raw product is moistened in a steamer, subsequently the carpet is provided with a dye liquor and rolled onto a fabric roll. This remains in a curing zone in order to fix the dye. Subsequently, the merchandise is washed and dried.

  Continuous dyeing: The continuous dyeing method is used for large lots. The raw product is impregnated with dyestuff solutions, pastes or foams, and the dye liquor is pressed into the fabric through a squeegee roll. Subsequently, the dye is fixed, the merchandise rinsed, washed and dried.

  Printing: The methods employed include rotary printing, stencil flat-bed printing or spray printing. These local methods also allow the colour to be designed in combination with prior or subsequent dyeing.

The **non-aqueous methods** include spin dyeing of the yarns. A colourant in the form of pigments or concentratedly dyed granular plastic material is added to the spinning mass, these substances then combining into a homogeneous mass.

Back finish:

On the back of the tufted and dyed raw product, the x-SBR latex precoating is applied with aluminium hydroxide as flame retardant in order to anchor the bottom loop (filaments and tufts) of the pile yarn in the carrier layer. Subsequently, the hot bitumen mass, into which a glass-fibre fleece is laid to support solidification, is applied. Then, the coating is covered with a fleece made of PP. The finished carpet must be solidified in a cooling unit.

Finally, the rolled goods are cut into tiles.

2.2 Health, safety and environmental aspects during production

The applicable basic EU regulations and any stricter national-law provisions at the place of manufacture are complied with.

3 Delivery and installation

3.1 Delivery

The carpets are transported from the production plant to the end user almost exclusively by lorry. For the purposes of the life cycle assessment, a 14-20 ton lorry with an average 85% utilisation of its payload and an average transport route of 700 km from the factory gate to the place of installation is assumed.

3.2 Installation

A textile floor covering may be installed in three different ways:

Loose laying

In case of loose laying, the carpet tiles are laid in the room without adhesion onto a ready-for-installation surface and are fixed by means of a double-faced adhesive tape only along the edges and in the door area. If the carpet is heavily used, loose laying may lead to buckling, is unsuited for castor-chair use and is recommended only for areas of not more than 20 m^2 and seamless installation.

Fixing

To fix the carpet, an adhesive having limited adhesive power across the entire surface is used. Thus, removal of the floor covering without destruction of the subfloor remains possible.
As a rule, fixing agents are aqueous plastic dispersions that are uniformly applied to the subfloor either by means of a roll or by means of a toothed spatula and that are subsequently ventilated. Then, the flooring is laid and rolled with a carpet roller across the entire surface. Normal traffic is possible after about 24 hours.The fixing agent required per m² may be assumed to be 200g.

Glueing

The use of adhesives results in a solid and permanent bond between the carpet tiles and the subfloor.

The adhesive is uniformly applied to the subfloor by means of a toothed spatula and is subsequently ventilated. Then, the flooring is laid into the still wet glue bed and rolled with a carpet roller across the entire surface. Traffic on the carpet is possible after about 24 hours. The quantity of glue required per m² may be assumed to be 400g.

3.3 Health, safety and environmental aspects during installation

The textile floor covering is laid by means of pollution-free auxiliary materials (adhesives, fixing agents) that meet the requirements of emission class /EC1/.

3.4 Waste

Carpet waste occurring during installation is at least put to energetic/thermal use.

3.5 Packaging

For transport, the textile floor tiles are packed in cardboard cartons.

4 Use stage

4.1 Use

Subject to the marking on the PRODIS label, the textile floor covering may be used in residential or commercial areas. Additional suitabilities are also shown on the PRODIS label by means of an FCSS symbol. For the present product group, a minimum service life of 10 years may be assumed, fashion-related and aesthetic aspects being taken into account. Technically, wear resistance may last much longer. If, in line with the recommendation, the textile floor covering is used in its use class, the service life may be considered independent of the use class. The luxury class does not have any impact on the service life.

4.1.1 Cleaning and maintenance

The classical cleaning appliance for the daily and regular care of the textile floor covering is the vacuum cleaner either with or without a brushing device.
In the life cycle assessment, the average cleaning frequency is assumed to be two times a week in residential areas and four times a week in commercial areas. These values are mean values based on experience; the actual cleaning frequency is heavily dependent on the intensity of use and the degree of soiling.
Electrical energy is required to operate the vacuum cleaner.

For intensive cleaning, an additional wet cleaning process is employed. Here, dirt is rinsed out of the surface pile, as a rule by means of a spray extraction cleaner. A cleaning frequency of 1 time in 3 years in residential areas and 3 times in 2 years in commercial areas is recommended and taken into account in the life cycle assessment, the frequency depending on individual factors. The method requires the use of water and a cleaning agent and electrical energy is needed to operate the spray extraction cleaner.

4.1.2 Prevention of structural damage

In order to avoid excessive wear and changes in appearance during the use stage, it should be seen to it that the area of use does not require more than is permissible under the indicated use class of the individual product. Additional suitability indicated by an extra symbol according to /EN 685/ may enlarge the range of application.

4.2 Health aspects during usage

Relevant emission sources during the use stage may include the textile floor covering itself as well as the fixing agents and/or adhesives.

The emissions of the textile floor covering on delivery meet the requirements of the GUT test criteria for VOC emissions (Table 6) and contaminants.

Table 6: Limit values for volatile organic compounds

Component	Limit value	Unit
TVOC	300	µg/m³
VOC without NIK	100	µg/m³
R value	≤ 1	-
SVOC (C16 to C22)	30	µg/m³
Carcinogenic substances (EU list classes 1 and 2)	not identifiable	

Fixing agents and/or adhesives, if used, meet the requirements of emission class /EC1/.

5 Singular effects

5.1 Fire

The fire protection class is shown on the PRODIS label.

5.2 Water

The effect of major water quantities on the textile floor covering over a prolonged period of time may cause damage.

5.3 Mechanical damage

Excessive wear of the textile floor covering during its service life need not be expected if it is employed and properly used, maintained and cleaned in compliance with its declared suitability (PRODIS).

6 End-of-life stage

According to Class 20 01 11 of the ”European Waste Catalogue“ (EWC) the textile floor covering to be disposed of may be classified as “municipal solid waste – textiles”. Accordingly, disposal is carried out in compliance with local waste disposal systems.

6.1 Recycling or re-use

Re-use of the carpets to be disposed of includes thermal use in waste incineration plants or use as secondary fuels. Further methods for material usage can improve the life cycle assessment and require individual verification.

The present life cycle assessment takes into consideration the use of the old carpet in a waste incineration plant, carpet wastes are transported by lorry and the distance from the place of de-installation to the waste incineration plant is 30 km.

6.2 Disposal

According to the Technical Guidelines on Municipal Solid Waste, disposal on landfills has no longer been possible since 2005.

7 Life cycle assessment

7.1 General

The EPD is based on the life cycle assessment ‘textile floor coverings‘ conducted by GUT. For the life cycle assessment, the carpet data were related to a mean surface pile weight within the respective luxury class (Table 4).

The respective results for the product manufacture, the delivery/installation, the use stage, and the end-of-life stage are shown separately.

- The assessment of the **product manufacture** takes into consideration the indicated dyeing methods (reel vat process, continuous dyeing, rotary printing, spray printing and spin dyeing) in equal shares, as well as loop and cut pile.
- For the stages **delivery/installation** standardised conditions are assumed (see chapter 3). The assessment of the installation considers a one-third share each for loose laying, fixing and glueing.
- For the **use stage**, standardised conditions are assumed for cleaning and maintenance (see chapter 4). This usage scenario is the same for each textile floor covering; accordingly, also the life cycle assessment for each product is the same.
- For the **end-of-life stage**, the calculation considered thermal use in a waste incineration plant.

The basic data used meet the requirements according to chapter 7.6.

7.2 Functional unit

The declaration refers to 1 m² of tufted textile floor covering.

For the assessment of the use stage, the period of one year is taken into consideration. The values for deviating periods of use may be calculated by means of multiplication with the relevant factor.

7.3 Cut-off criterion

The limit of detail amounts to one per cent relative to the sum of the input streams and the energy input for the respective process. Substances used in smaller quantities but have a crucial function (e.g. the dye) are assessed as well. The sum of all neglected inputs in one process amounts to not more than 5% of the energy input and input streams.

7.4 Allocation

/ISO 14040/ defines the allocation as “ partitioning the input or output flow of a unit process to the product system under study “. In the present life cycle assessment, no relevant allocations (i.e. partitionings of environmental burdens of a process to several products) had to be made for the product manufacture, delivery, installation and use. Re-use entails an energy credit note due to the incineration of the textile waste.

7.5 Background data

The background data refer to

/GaBi 4/, Database for the Preparation of life cycle assessments and
/Ecoinvent/, Data Version 2.0.

For the electrical energy, background data from /GaBi 4/ for the EU 15 power mix are used.

7.6 Data quality

For the inventories used, for the general processes and for all production steps, the data used in the inventory analysis were collected indicating their origin, the kind of data recording, the time-related, geographical and technological reference, and their quality was verified.
Original data provided by the GUT member firms and generic data were used. As background data, European values from the /GaBi 4/ database were referred to.
Inasmuch as the framework of the assessment and the objective of the assessment are concerned, the data sets are complete and reflect representative values of the European carpet industry for the life-cycle-assessment stages production, delivery/installation, usage and disposal.

The consistency and the traceability of the data were verified within the framework of a critical review of the life-cycle-assessment study by Prof. Dr. Walter Klöpffer, Frankfurt a.M., and Dipl. Natw. Roland Hischier, St Gallen.

7.7 System boundaries

The life cycle assessment covers the entire life cycle of the textile floor covering from the cradle to the grave.

The **production stage** includes the extraction and manufacture of all raw materials used, their transport to the production facility, the entire production process and the packaging, inclusive of the packing material of the textile floor covering.

The **delivery/installation** stage includes the transport of the packed carpet to the place of installation, its installation, inclusive of the provision of the fixing and adhesive agents, their production and transport to the place of installation, also the re-use of the packing material.

The **use stage** covers the cleaning and maintenance of the carpet during the period of one year including the extraction of the raw materials, the cleaning agents, their production and transport. The treatment of the waste water occurring during spray extraction is taken into consideration.

For the **end-of-life stage**, the transport of the de-installed carpet to the waste incineration plant as well as the material and energy input of the waste incineration plant for the thermal use and all emissions are considered.

In all life cycle stages, the respective disposal processes up to final deposition, with the exception of the deposition of nuclear waste, are modelled.

7.8 Note on use stage

The actual service life of a textile floor covering depends on various impact factors such as the allocation of the area of application to the use class, the maintenance and the intensity of usage.
The comparability of textile floor coverings requires, among other things, uniform conditions of usage. For the life cycle assessment. the indicators for a defined usage scenarios were calculated as annual averages.

7.9 Result of the life cycle assessment (LCA)

The results of the life cycle assessment are shown in Tables 8 to 11 for the product manufacture, the delivery/installation, the use stage and the end-of-life stage.

7.9.1 Product manufacture

Table 8: **Results of the life cycle assessment for the product manufacture (Part 1)**

Evaluation value	Unit per m²	LC1	LC2	LC3	LC4	LC5
Primary energy non-renewable	[MJ]	165.9	213.1	260.3	307.5	354.7
Primary energy renewable	[MJ]	2.4	3.2	4.0	4.8	5.7
Global warming potential (GWP 100)	[kg CO2-eqv.]	7.5	10.3	13.1	15.9	18.8
Ozone depletion potential (ODP)	[kg R11-eqv.]	$8.0\cdot10^{-7}$	$8.9\cdot10^{-7}$	$9.9\cdot10^{-7}$	$1.1\cdot10^{-6}$	$1.2\cdot10^{-6}$
Acidification potential (AP)	[kg SO2-eqv.]	$2.9\cdot10^{-2}$	$3.9\cdot10^{-2}$	$4.9\cdot10^{-2}$	$6.0\cdot10^{-2}$	$7.0\cdot10^{-2}$
Nutrification (NP)	[kg PO4-eqv.]	$7.2\cdot10^{-3}$	$9.8\cdot10^{-3}$	$1.2\cdot10^{-2}$	$1.5\cdot10^{-2}$	$1.8\cdot10^{-2}$
Photochemical oxidant formation (POCP)	[kg ethene eqv.]	$3.3\cdot10^{-3}$	$4.1\cdot10^{-3}$	$4.9\cdot10^{-3}$	$5.7\cdot10^{-3}$	$6.5\cdot10^{-3}$

7.9.2 Delivery/ installation

Table 9: **Results of the life cycle assessment for delivery/installation (Part 2)**

Evaluation value	Unit per m²	LC1	LC2	LC3	LC4	LC5
Primary energy non-renewable	[MJ]	1.7	1.9	2.1	2.3	2.5
Primary energy renewable	[MJ]	-0.08	-0.08	-0.08	-0.08	-0.08
Global warming potential (GWP 100)	[kg CO2-eqv.]	0.50	0.52	0.53	0.55	0.56
Ozone depletion potential (ODP)	[kg R11-eqv.]	$2.2\cdot10^{-9}$	$2.2\cdot10^{-9}$	$2.2\cdot10^{-9}$	$2.2\cdot10^{-9}$	$2.3\cdot10^{-9}$
Acidification potential (AP)	[kg SO2-eqv.]	$1.5\cdot10^{-3}$	$1.6\cdot10^{-3}$	$1.7\cdot10^{-3}$	$1.8\cdot10^{-3}$	$1.9\cdot10^{-3}$
Nutrification (NP)	[kg PO4-eqv.]	$3.7\cdot10^{-4}$	$3.9\cdot10^{-4}$	$4.0\cdot10^{-4}$	$4.2\cdot10^{-4}$	$4.3\cdot10^{-4}$
Photochemical oxidant formation (POCP)	[kg ethene eqv.]	$1.7\cdot10^{-4}$	$1.8\cdot10^{-4}$	$1.9\cdot10^{-4}$	$1.9\cdot10^{-4}$	$2.0\cdot10^{-4}$

7.9.3 Use stage

Table 10: **Results of the life cycle assessment for the use stage (Part 2)**

Evaluation value	Unit per m²	Values independent of luxury classes LC1-LC5
Primary energy non-renewable	[MJ]	4.1
Primary energy renewable	[MJ]	0.3
Global warming potential (GWP 100)	[kg CO2-eqv.]	0.2
Ozone depletion potential (ODP)	[kg R11-eqv.]	$4.4\cdot10^{-8}$
Acidification potential (AP)	[kg SO2-eqv.]	$8.4\cdot10^{-4}$
Nutrification (NP)	[kg PO4-eqv.]	$9.4\cdot10^{-5}$
Photochemical oxidant formation (POCP)	[kg ethene eqv.]	$6.7\cdot10^{-5}$

7.9.4 End-of-life stage

Table 11: **Results of the life cycle assessment for the end-of-life stage (Part 3)**

Evaluation value	Unit per m²	LC1	LC2	LC3	LC4	LC5
Primary energy non-renewable	[MJ]	-51.4	-54.6	-57.7	-60.8	-63.9
Primary energy renewable	[MJ]	-0.7	-0.8	-0.8	-0.9	-0.9
Global warming potential (GWP 100)	[kg CO2-eqv.]	4.3	4.6	4.8	5.1	5.4
Ozone depletion potential (ODP)	[kg R11-eqv.]	$-1.4\cdot10^{-7}$	$-1.5\cdot10^{-7}$	$-1.6\cdot10^{-7}$	$-1.7\cdot10^{-7}$	$-1.8\cdot10^{-7}$
Acidification potential (AP)	[kg SO2-eqv.]	$4.8\cdot10^{-3}$	$5.1\cdot10^{-3}$	$5.4\cdot10^{-3}$	$5.7\cdot10^{-3}$	$5.9\cdot10^{-3}$
Nutrification (NP)	[kg PO4-eqv.]	$1.0\cdot10^{-3}$	$1.1\cdot10^{-3}$	$1.1\cdot10^{-3}$	$1.2\cdot10^{-3}$	$1.3\cdot10^{-3}$
Photochemical oxidant formation (POCP)	[kg ethene eqv.]	$1.0\cdot10^{-4}$	$1.1\cdot10^{-4}$	$1.2\cdot10^{-4}$	$1.2\cdot10^{-4}$	$1.3\cdot10^{-4}$

7.9.5 Entire life cycle

The values for the entire life cycle may be calculated as follows:

$$\text{Value}_{\text{(Tab. 8)}} + \text{value}_{\text{(Tab. 9)}} + \text{value}_{\text{(Tab. 10)}} \cdot n + \text{value}_{\text{(Tab. 11)}},$$

n representing the number of years of life considered in each case.

Product group:	Textile carpet tiles – surface pile of PA 6.6, tufted with bitumen backing and flame-proofing	Issued on
Owner of the declaration:	Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V.	07-01-2009
Declaration number:	EPD-GUT-2009411-E	

7.10 Life cycle inventory analysis (LCI)

The following chapters will describe in all detail the selected indicators of the life cycle analysis of 1 m² of textile floor covering for all life stages, taking into consideration a service life of 1 year.

7.10.1 Primary energy requirement

The primary energy here under consideration results from the energy input for all processes that are bound in the raw materials as fossil resources (oil).

Figure 1 shows the relative contributions of the life cycle stages product manufacture, including the provision of the raw materials, delivery/installation, usage per year and re-use to the primary energy consumption (regenerative and non-regenerative). The shares for the production process, including the provision of the raw materials, amount to 74% up to 83%, for the delivery/installation 0.6% up to 0.7% and for the annual usage 1% to 2%. Re-use results in an energy credit note of 15% to 23%.

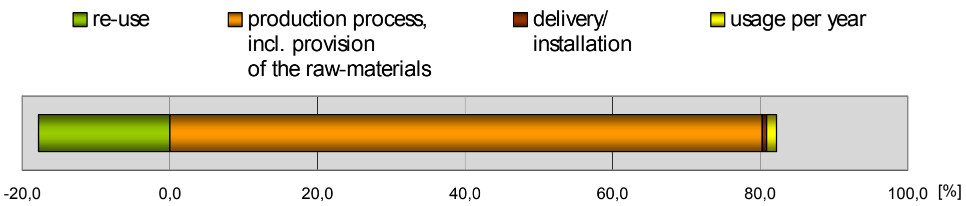


Figure 1: Relative contributions of the life cycle stages to the primary energy consumption (regenerative and non-regenerative)

Figure 2 differentiates the primary energy used from non-renewable and renewable raw materials for the production stage according to different partial processes of production. It shows that the predominant contribution to the primary energy consumption results from the provision of the raw materials for the production of the textile floor covering.
Mechanical processes give rise to energy credit notes resulting from edge-waste re-use in the waste incineration plant. The illustration applies to all luxury classes, relative deviations are in the range of 1%.

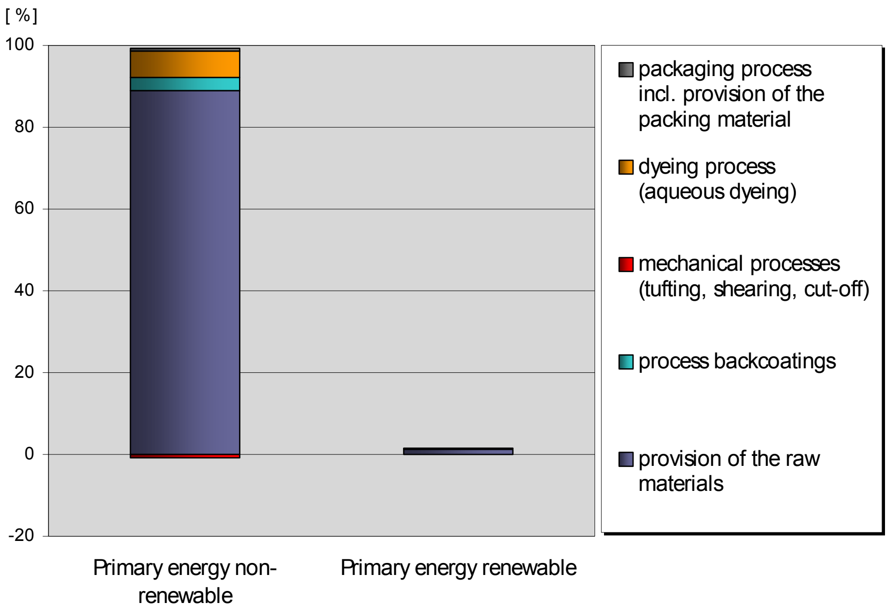


Figure 2: Relative contributions of different partial processes of production to the primary energy consumption during product manufacture

Figures 3 and 4 show the respective share of the energy carriers in the non-regenerative and in the regenerative primary energy input.

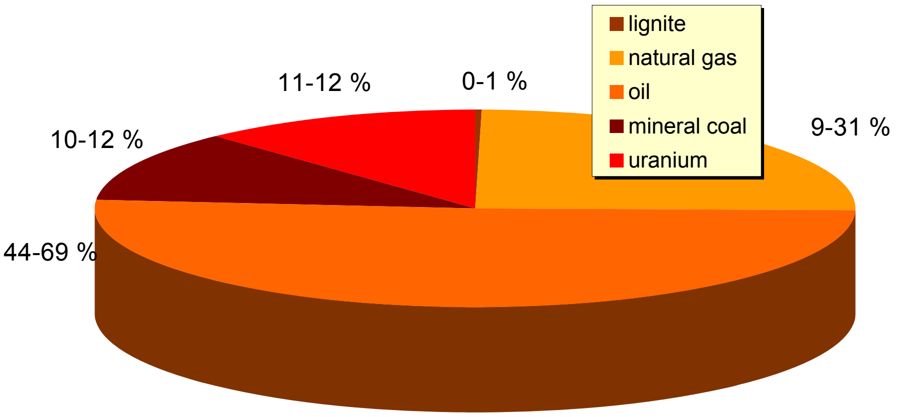


Figure 3: Shares of the non-renewable energy carriers

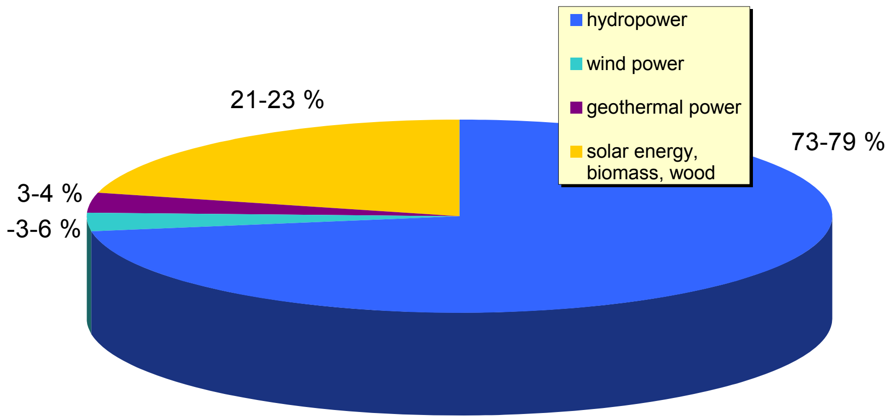


Figure 4: Shares of the renewable energy carriers

7.10.2 Non-renewable material content

The non-renewable raw materials used for the entire life cycle of the textile floor covering re fossil or mineral raw materials that are used for energy generation on the one hand and on the other hand are contained as raw material in the product such as aluminium (0.3 kg/m^2) for the manufacture of the flame retardant.

The raw materials lignite, natural gas, oil, mineral coal and uranium are primarily used for energy generation; oil is furthermore used as a raw material for the production of polymeric materials. A differentiation of the raw materials according to their use is not made; these materials are recorded in chapter 7.10.1.

Other mineral raw materials are limestone with 2.3 kg/m^2, sodium chloride (rock salt) with 0.05 to 0.10 kg/m^2, clay with 0.03 kg/m² and colemanite ore with 0.02 kg/m², besides sulphur with 0.01 to 0.02 kg/m².

The non-utilisable ores and rocks, i.e. dead rock, account for 3.6 to 7.9 kg/m², the soil removal necessary for the production of the ores amounts to 0.2 kg/m², raw gravel also to 0.2 kg/m².

The values indicated refer to product manufacture.

7.10.3 Water consumption

Table 13: **Water consumption [m^3/m^2]**

	LC 1	LC 2	LC 3	LC 4	LC 5
Production	0.28	0.43	0.59	0.75	0.90
Delivery/installation	0.004	0.004	0.004	0.004	0.004
Usage	0.005	0.005	0.005	0.005	0.005
Disposal	0.006	0.006	0.006	0.007	0.007

Water is predominantly consumed during the manufacture of raw materials (96% to 97%). The aqueous dyeing methods account 3% of the water consumption.

7.10.4 Abfall

Table 14: **Waste occurrence [kg/m^2]**

	LC 1	LC 2	LC 3	LC 4	LC 5
non-hazardous waste					
overburden/dump material					
Production	4.06	5.15	6.25	7.35	8.44
Delivery/installation	-0.15	-0.15	-0.15	-0.15	-0.15
Usage	0.53	0.53	0.53	0.53	0.53
Disposal	-4.80	-5.09	-5.38	-5.67	-5.96
municipal solid waste					
Production	0.0	0.0	0.0	0.0	0.0
Delivery/installation	0.0	0.0	0.0	0.0	0.0
Usage	0.0	0.0	0.0	0.0	0.0
Disposal	0.001	0.001	0.001	0.001	0.001
hazardous waste					
special waste					
Production	0.004	0.004	0.005	0.005	0.006
Delivery/installation	0.0	0.0	0.0	0.0	0.0
Usage	0.0	0.0	0.0	0.0	0.0
Disposal	0.001	0.002	0.002	0.002	0.002
radioactive waste					
Production	0.004	0.005	0.006	0.007	0.009
Delivery/installation	0.0	0.0	0.0	0.0	0.0
Usage	0.001	0.001	0.001	0.001	0.001
Disposal	-0.002	-0.002	-0.002	-0.002	-0.002

Dump material is mainly overburden resulting from ore production for the generation of electric power; municipal solid waste essentially is mineral waste.

Hazardous waste includes special waste containing chemicals and toxic waste, and also radioactive waste which consists primarily of residues from ore processing that occur during the provision of electric power.

7.11 Life cycle impact assessment (LCIA)

The environmental impacts resulting from the production of 1 m² of textile floor covering are expressed in impact categories based on the /CML 2002/ method.

The following categories are considered:

Global warming potential (GWP)

For the most frequent substances having an impact on the environment, the parameter GWP (global warming potential) is defined. The climate change was indicated for a time horizon of 100 years. The GWP describes the contribution of a substance to the greenhouse effect relative to the contribution of a like quantity of carbon dioxide (CO_2).

Ozone-layer depletion (ODP)

The depletion of the stratospheric ozone layer is caused primarily by chlorofluorocarbons (CFCs) and some chlorohydrocarbons and bromohydrocarbons. The reference substance used for the ozone depletion is the substance CFC R11, to which the ozone depletion potential (ODP) = 1 is allocated.

Acidification of soils and waters (AP)

The acidification potential indicates to which extent a component has an acidic effect. The acids are soluble in water and may rain down as acid rain. The various emissions within this category are related to sulphur dioxide (SO_2)-equivalents.

Nutrification (NP)

Nutrification is defined as the effect of excessive input of nutrients into the soil or water. Here, substances are considered that contain either nitrogen or phosphorus. The nutrification potential NP indicates the potential contribution of a substance to the production of biomass. The result is indicated in phosphate equivalents (PO_4).

Photochemical oxidant formation (POCP)

Summer smog is caused by the formation of photochemical oxidants in the lower troposphere. Summer smog is primarily caused through the reaction of hydrocarbons and nitrogen oxides (NOx) under solar radiation. The result is indicated in kilograms ethene equivalents, which is generated in the troposphere.

Figure 5 shows the relative contributions of the life cycle stages product manufacture, including the provision of the raw materials, delivery/installation, usage per year and re-use to the impact categories described hereinbefore for environmental impacts. The shares refer to luxury class LC3.

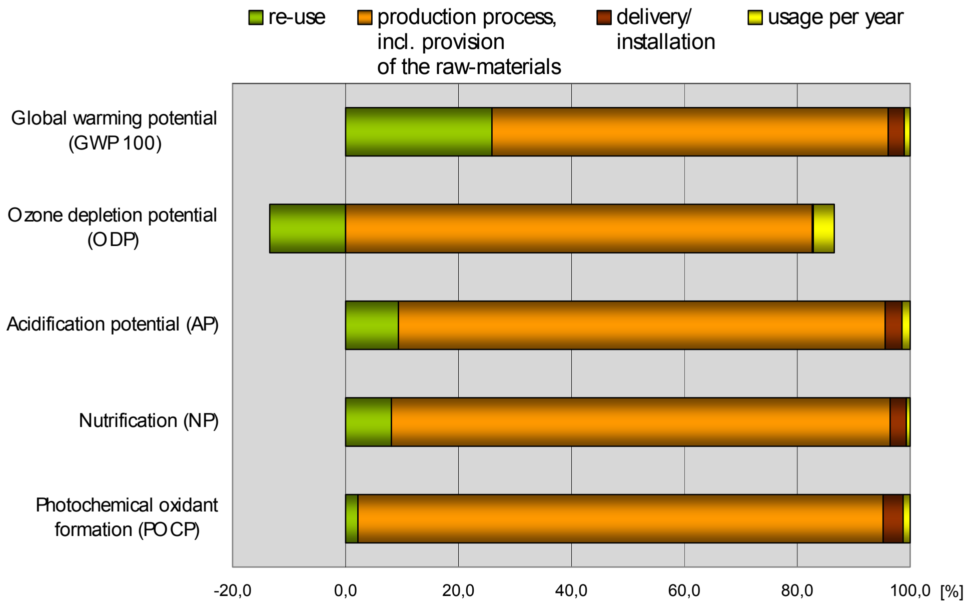


Figure 5: Relative contributions of the life cycle stages to the environmental impacts for luxury class LC3

Figure 6 differentiates the share of the environmental impacts for the product manufacture from Figure 5 according to different partial processes of production. For all impact categories, the major part of the contributions results from the provision of the raw materials. The representation applies to all luxury classes, relative deviations of the contributions are less than 1%.

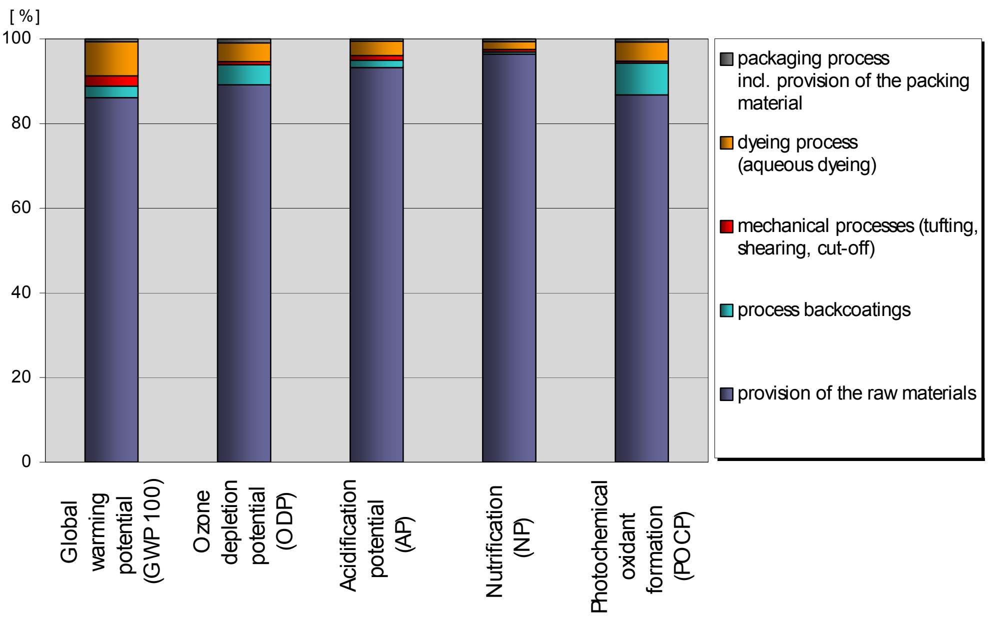


Figure 6: Relative contributions of different partial processes of production to the environmental impacts during product manufacture

7.12 Interpretation

From Figures 1 and 5 it can be seen that the **production process** (including the provision of the raw materials) accounts for the biggest share in the primary energy consumption and environmental impacts. Closer consideration (Figures 2 and 6) shows that, within this life cycle stage, by far the biggest share is caused by the provision of raw materials and not by the textile-related process steps. The environment-related factors rise approximately linearly with the material input, which is mainly accounted for by the polymer fibres.

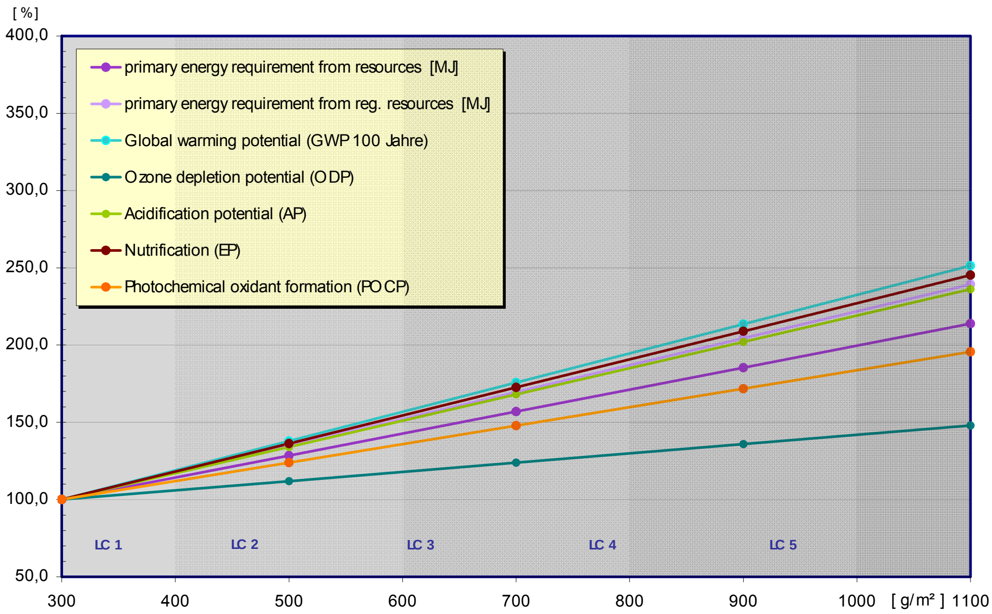


Figure 7: Dependence of the primary energy requirement and of the described impact categories for environmental impacts on the luxury classes (pile-layer weight) relative to luxury class LC1 (for the product manufacture)

The energetic **re-use** of the textile floor covering results in a primary energy credit of around 15% to 23% (Figure 1). As the ozone depletion potential is crucially dependent on the primary energy input, the result is a corresponding credit note.

In the overall assessment, the life cycle stages **delivery and installation** are of subordinate importance.

In this assessment, a **use stage** of one year is considered. For this period, the impact on the overall assessment is low. It is, however, pointed out that there is a linear rise in this share as the actual service life increases. In case of an assessment considering the entire period of service life, the values in Table 10 must be multiplied by the years of life considered.

Comparisons with other floor coverings are permissible only if comparable background data and calculation methods are used and if the floor coverings' area of application is the same.

8 Additional Information, verifications and test results

8.1 Emissions

The emissions of the textile floor covering on delivery meet the requirements of the GUT test criteria for VOC emissions (Table 6) and contaminants.

Product group: Textile carpet tiles – surface pile of PA 6.6, tufted with bitumen backing and flame-proofing
Owner of the declaration: Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V.
Declaration number: EPD-GUT-2009411-E
Issued on 07-01-2009

9 Literature

/AgBB pattern/ Evaluation pattern of the AgBB (Committee for the Health-related Evaluation of Building Products) for VOC; procedure for the health-related evaluation of the emissions of volatile organic compounds (VOC and SVOC) from building products, BAM-Az 2006-3726, version of 2006.

/CML 2002/ Method "Centrum voor Milieukunde", Leiden, NL.

/EC1/ Association for Emission-controlled Installation Materials (GEV) - identification EMICODE EC1: very low emissions

/Ecoinvent/, Datenbase, Swiss Centre for Life Cycle Inventories, Data Version 1.3.

/EN 685/ Resilient, textile and laminate floor coverings – classification

/EN 1307/ Textile floor coverings - classification of pile carpets,

/EN 14041/ Resilient, textile and laminate floor coverings – essential characteristics,

/GaBi 4/, Software and database for the preparation of life cycle assessments, Faculty of Building Physics (LBP) of the University of Stuttgart and PE International, Stuttgart, Echterdingen

/ISO 14040/ DIN EN ISO 14040: Environmental management – Life cycle assessment – Principles and frameworks.

/ISO 14025/ DIN EN ISO 14025: Environmental labels and declarations –Type III environmental declarations – Principles and procedures.

This declaration is based on the PCR document ‘Floor Coverings’.

Review of the PCR document by the committee of experts. Chairman of the CoE: Prof. Dr.-Ing. Hans-Wolf Reinhardt (University of Stuttgart, IWB)
Independent verification of the declaration according to ISO 14025: ☐ internal ☒ external
Validation of the declaration: Dr. Eva Schmincke

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Publisher:
Institut Bauen und Umwelt e.V.
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Layout:
Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V.

Picture credits:
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