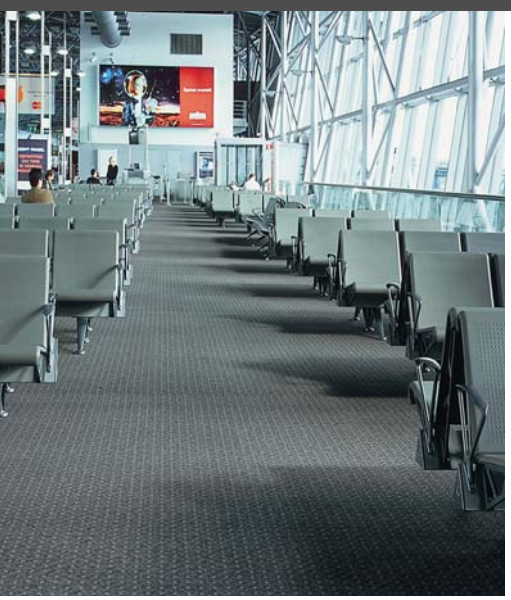
Environmental Product Declaration

according to ISO 14025



Needled floor covering

- multilayer product
- Surface layer: Polyamide 6, admixture of polypropylene
- Backing: Recycled fibres
- Binder: Latex

Gemeinschaft umweltfreundlicher Teppichboden e.V.

Declaration number
EPD-GUT-2010711-E

Institut Bauen und Umwelt e.V
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Short version

Umwelt-Produktdeklaration

Environmental Product Declaration

Institut Bauen und Umwelt e.V. www.bau-umwelt.com	**Program operator**
Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V. **Schönebergstr. 2; 52068 Aachen; mail@gut-ev.de** **www.gut-ev.org**	**Declaration holder**
EPD-GUT-2010711-E	**Declaration number**
Needled floor covering according to EN 1470, multilayer product type 2 and 3, surface layer of polyamide 6 (PA 6) with an admixture of polypropylene (PP), backing of recycled fibres, latex-binder 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. The declaration is based on the PCR document "Floor coverings", year 2008-01.	**Declared building product**
This validated declaration authorises the use of the official stamp of the IInstitut Bauen und Umwelt (IBU). 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.	**Validity**
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	**Contents of the declaration**
30 April 2010	**Date of issue**
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt)	**Signatures**
This declaration and the rules on which it is based have been examined in accordance with ISO 14025 by the independent Committee of Experts (CoE).	**Examination of the declaration**
Prof. Dr.-Ing. Hans-Wolf Reinhardt (Chairman of the CoE) / Dr. Eva Schmincke (CoE-appointed Examiner)	**Signatures**

Short version

Umwelt-Produktdeklaration

Environmental Product Declaration

Product description

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

Kind of manufacture: Needled, multilayer product as roll goods
Surface layer: Polamide 6 (PA 6) with up to 30 % polypropylen (PP).
Backing: Recycled fibres, carrier fabric of polypropylene (PP) or polyester (PES),
Binder: Latex based on styrene/butadiene- or styrene/acrylate copolymers, flame-proofed on the basis of aluminium hydroxide.

Subject to the weight of the surface layer the textile needled floor covering is classified in use classes. The FCSS symbol (Floor Covering Standard Symbols) for the respective use class is indicated on the PRODIS label.

Range of application

As indicated on the PRODIS label, the textile needled 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 (LCA) was carried out according to ISO 14040 seq. following the requirements of the IBU guideline for type III declarations. 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

This declaration is valid for products with a weight of the surface layer up to 1000 g/m^2.
The initial value for the relevant columns of the table of results is the use class or the weight of the surface layer of the textile needled floor covering, which is indicated on the PRODIS label and the product data sheet respectively. Results for part 2 are indicated in the long version of the declaration.

Table 2: **Results of the LCA subject to the use class**

		Part 1 – Production stage						Part 3 – End-of-life stage					
Categories evaluated	**Unit per m²**	**21**	**22, 22+, 31**	**23, 32**	**33**			**21**	**22, 22+, 31**	**23, 32**	**33**		
					A	**B**	**C**				**A**	**B**	**C**
					Weight of the surface layer						Weight of the surface layer		
					≥225 <500	≥500 <750	≥750 ≤1000				≥225 <500	≥500 <750	≥750 ≤1000
Primary energy not renewable	[MJ]	45,6	54,2	63,0	88,2	127,4	165,9	-6,0	-7,9	-9,6	-13,6	-17,8	-21,8
Primary energy renewable	[MJ]	0,9	1,0	1,2	1,6	2,2	2,8	-0,09	-0,1	-0,1	-0,2	-0,3	-0,3
Greenhouse potential (GWP 100)	[kg CO2-Äqv.]	2,9	3,5	4,2	6,0	8,9	11,7	0,5	0,7	0,8	1,2	1,5	1,8
Ozone degradation potential (ODP)	[kg R11-Äqv.]	$1{,}5\cdot10^{-7}$	$1{,}8\cdot10^{-7}$	$2{,}0\cdot10^{-7}$	$2{,}7\cdot10^{-7}$	$3{,}7\cdot10^{-7}$	$4{,}7\cdot10^{-7}$	$-1{,}7\cdot10^{-8}$	$-2{,}2\cdot10^{-8}$	$-2{,}7\cdot10^{-8}$	$-3{,}8\cdot10^{-8}$	$-5{,}0\cdot10^{-8}$	$-6{,}1\cdot10^{-8}$
Acidification potential (AP)	[kg SO2-Äqv.]	$8{,}6\cdot10^{-3}$	$1{,}1\cdot10^{-2}$	$1{,}3\cdot10^{-2}$	$1{,}9\cdot10^{-2}$	$2{,}8\cdot10^{-2}$	$3{,}7\cdot10^{-2}$	$5{,}6\cdot10^{-4}$	$7{,}4\cdot10^{-4}$	$9{,}0\cdot10^{-4}$	$1{,}3\cdot10^{-3}$	$1{,}7\cdot10^{-3}$	$2{,}0\cdot10^{-3}$
Nutrification (NP)	[kg PO4-Äqv.]	$1{,}2\cdot10^{-3}$	$1{,}5\cdot10^{-3}$	$1{,}8\cdot10^{-3}$	$2{,}8\cdot10^{-3}$	$4{,}2\cdot10^{-3}$	$5{,}5\cdot10^{-3}$	$1{,}2\cdot10^{-4}$	$1{,}6\cdot10^{-4}$	$1{,}9\cdot10^{-4}$	$2{,}7\cdot10^{-4}$	$3{,}5\cdot10^{-4}$	$4{,}3\cdot10^{-4}$
Photochemical oxidant formation	[kg Ethen-Äqv.]	$1{,}2\cdot10^{-3}$	$1{,}4\cdot10^{-3}$	$1{,}6\cdot10^{-3}$	$2{,}2\cdot10^{-3}$	$3{,}0\cdot10^{-3}$	$3{,}8\cdot10^{-3}$	$1{,}2\cdot10^{-5}$	$1{,}6\cdot10^{-5}$	$1{,}9\cdot10^{-5}$	$2{,}7\cdot10^{-5}$	$3{,}6\cdot10^{-5}$	$4{,}4\cdot10^{-5}$

The results are based on original data from manufacturers and on the life cycle assessment for textile floor coverings
conducted by **Gemeinschaft umweltfreundlicher Teppichboden** (GUT) e.V., Aachen, Germany
in cooperation with: **Textile and Flooring Institut GmbH**, Aachen, Germany
critically reviewed by: **Prof. Dr. Walter Klöpffer**, Int. Journal of Life Cycle Assessment, LCA CONSULT & REVIEW, Frankfurt a.M., Germany
Dipl. Natw. ETH Roland Hischier, Head of unit LCA, EMPA, St Gallen, Switzerland.

Verifications and tests

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

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

Tests for contaminants GUT product testing criteria

Product group, PCR: Textile Floor Coverings, Floor coverings, 2008-01 Issued on
Declaration holder: Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V. 30-04-2010
Declaration number: EPD-GUT-2010711-E

0 Product definition

0.1 Product classification and description

Needled floor coverings according to EN 1470, multilayer product type 2 and 3, surface layer of polyamide 6 (PA 6) with an admixture of polypropylene (PP), backing of recycled fibres, latex-binder flame-proofed on the basis of aluminium hydroxide.

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

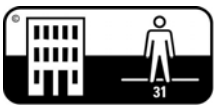
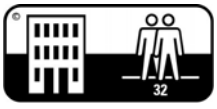
Kind of manufacture: Needled, multilayer product as roll goods.
Surface layer: Polamide 6 (PA 6) with up to 30 % polypropylen (PP).
Backing: Recycled fibres. carrier web of polypropylene (PP) or polyester (PES).
Binder: Latex on the basis of styrene-butadiene- or styrene-acrylate-copolymers flame-proofed on the basis of aluminium hydroxide (ATH).

This declaration is valid for products with a weight of the surface layer up to 1000 g/m^2.
EN 1470 defines multilayer flat needle felt as type 2 and 3, luxury class 1.
Type 2 includes products with a binder that doesn't reach the surface layer, **type 3** are products with a binder permeating the entire construction .

0.2 Range of application

Subject to the total weight the textile needled floor covering is classified in the following use classes (table 2). The FCSS symbol (Floor Covering Standard Symbols) for the relevant use class is shown on the PRODIS label of the product.

Table 2: **Use classes and symbols**

Weight of the surface layer [g/m²]		use in residential areas		use in commertial areas	
		class	FCSS-symbol/ intensity of use	class	FCSS-symbol/ intensity of use
–	–	21	 moderate/light		
≥ 130	≥ 150	22	 general/moderate	31	 light
		22+	 general		
≥ 180	≥ 200	23	 heavy	32	 general
≥ 225	≥ 250			33	 heavy

Suitability for additional uses is also indicated on the PRODIS label with an FCSS symbol.

Product group, PCR: Textile Floor Coverings, Floor coverings, 2008-01 Issued on
Declaration holder: Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V. 30-04-2010
Declaration number: EPD-GUT-2010711-E

0.3 Product standard/ Approval

The following standards apply to the present product group:

DIN EN 1470 - Textile floor coverings – Classification of needled floor coverings except for needled pile floor coverings
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 (CE-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.

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.
Content and validity of the licence can be checked online at www.pro-dis.info.

0.5 Delivery status

On delivery, the textile floor covering features the composition and characteristics described in Table 3.
Products with use class 33 represent a predominant share in the market and cover a large scope of weights of the surface layer. As the result of the LCA mainly depends on the weight of the fibres this scope is divided into 3 categories (A, B, C) and limited up to 1000 g/m^2. The indicated weights of the layer are mean values within the respective use class.

Table 3: **Characteristics of the group of textile floor coverings**

Features	use class						Unit
	21	22, 22+, 31	23, 32	33			
				A	B	C	
				Limiting value for the weight of the surface layer			
				≥ 225 < 500	≥ 500 < 750	≥ 750 ≤ 1000	[g/m²]
Mean weight of the surface layer	115	165	215	370	625	875	[g/m²]
Material of the surface layer	Polyamide 6/ polypropylene						
Backing	Recycled fibres, carrier web out of polypropylene or polyester						
Binder	Latex flame-proofed on the basis of aluminium hydroxide						
Mean total weight	**480**	**635**	**770**	**1090**	**1420**	**1740**	[g/m²]
Additional features according to /EN 1470/, /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.						

Product group, PCR: Textile Floor Coverings, Floor coverings, 2008-01 Issued on
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Declaration number: EPD-GUT-2010711-E

1 Material content

1.1 Material content

Table 4 lists the raw materials contained in the textile floor covering on delivery as well as their percentage shares in the weight.

Table 4: **Material content**

Component	Material	Share in weight [%]						Resource renewable	Resource recycled	Availability	Origin
		21	22, 22+, 31	23, 32	33A	33B	33C				
Surface layer	PA 6/ PP	24	26	28	34	44	50	no	no	limited	global
backing	Recycled fibres out of polymer material with admixture of natural fibres	56	54	52	46	36	30	no	yes	ample	global
	Carrier web out of PP or PES							no	no	limited	global
Binder	≥70% latex, ≤30% aluminium-hydroxide $Al(OH)_3$	20						no	no	limited	global

1.2 Production of main materials

Polyamide 6 (PA 6)
Polyamide 6 is a thermoplastic plastic material that is formed from caprolactam through ring-opening polymerisation.

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

Recycled fibres

The recycled fibres are shredded fibres made from post-consumer textile waste or fibre waste from carpet production processes. The predominant share of materials consists of polymeric fibres but the recycled fibres also contain also minor shares of cotton/viscose and wool.

Polyester (PES)

The term is used for a large family of polymers (plastic materials) containing the ester functional group in their main chain. Most commonly this refers to the much used polyethylene terephthalate (PET).

Latex
The applied latex is based on an aqueous dispersion of styrene-butadiene- or styrene-acrylate-copolymers.

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

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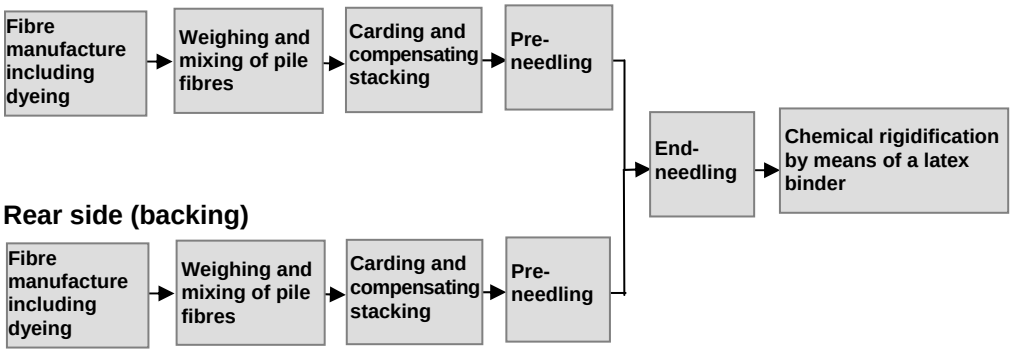
Declaration holder: Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V. 30-04-2010
Declaration number: EPD-GUT-2010711-E

2 Product manufacture

2.1 Production process

The production of textile needled floor coverings according to /EN 1470/ type 2 and 3 is divided into the following partial stages.

Top face (surface layer)



Description of the production steps:

Fibre manufacture including dyeing: The fibres are manufactured by means of the melt spinning process. The base materials are melted at high temperatures and the spinning mass thus gained is pressed through spinnerets. The filaments extruded through the spinneret are air-cooled and solidified in the process. After the subsequent stretching, the fibre reaches its final performance characteristics. The filament is cut to length and the pile fibres are pressed into bales. Colouration is conducted by adding to the spinning mass dyestuffs in the form of pigments or concentratedly dyed granular plastic material. In the process, these substances combine into a homogeneous mass.

Weighing and mixing of pile fibres: The dyed pile fibres are supplied in bales, dissolved, mixed and weighed.

Carding and compensating stacking: The weighed loose pile fibres are guided across cards (saw-toothed rolls) and set parallel in the process. Subsequently, the carded non-woven fabrics thus obtained are arranged crosswise one above the other.

Mechanical rigidification by means of needles: Needle looms lock the set and crosswise arranged fibres into a flat web. In the process, barbed needles stitch into the web with quick strokes, the fibres being taken along and being crossed and mechanically rigidified by means of the upwards and downwards movements of the needles.

- **Pre-needling:**
  For the top face the fibres of the surface layer are rigidified to web. The structural surface design may be varied through the arrangement of coarse and fine fibres.
  For the underside, the base layer fibres are solidified into a non-woven fabric, the carrier fabric that may run along as rolled merchandise being bonded with the non-woven base layer fabric.
- **End-needling:**
  The base layer and the surface layer are needled into an inseparable composite and mechanically solidified in the process.
  Behind the needle loom, longitudinal kniives are attached that cut the edges of the rolled merchandise.

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Chemical rigidification by means of a latex binder: The needled web is rigidified by means of dip impregnation, spray-on impregnation or slop padding. The binder used is latex, so that lasting fibre bonding and thus fitness for use of the needled web floor covering are ensured.

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

The use of adhesives results in a solid and permanent bond between the carpet to be installed 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

Transport is made on cardboard cores. To protect them against soiling, the carpet rolls are wrapped with PE foil.

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 adhesives.

The emissions of the textile floor covering on delivery meet the requirements of the GUT test criteria for VOC emissions (Table 5) and contaminants (version 2010). For further information see www.gut-ev.org.

Table 5: **Limit values for volatile organic compounds**

Komponente	Limit value		Unit
	3 days	28 days	
TVOC	250	100	µg/m³
VOC without NIK	100	50	µg/m³
R value	1	1	-
SVOC (C16 to C22)	30	30	µg/m³
Carcinogenic substances (EU list classes 1 and 2)	not identifiable		
Formaldehyde	10	10	µg/m³
	0,008	0,008	ppm

Adhesives at least have to 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.

The classification of product groups follows the use classes according to /EN 1470/. Products of use class 33 represent a predominant share in the market and cover a large scope of weights of the surface layer. As the result of the LCA mainly depends on the weight of the fibres this scope is divided into 3 categories (A, B, C) and limited up to 1000 g/m^2. For the life cycle assessment, the carpet data were related to a mean total weight within the respective use class (table 3).

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

- For the assessment of the **product manufacture** the fibres of the surface layer are calculated with an addition of 15 % polypropylene. The binder consists of latex with a share of 15 % $Al(OH)_3$ as flame-retardant. The calculation of the latex considers an aqueous dispersion of 50 % styrene-butadiene- and 50 % styrene-acrylate-copolymers.
- For the stages **delivery/installation** standardised conditions are assumed (see chapter 3).
- 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

Additional to the GUT-LCA for "textile floor coverings" original data from manufacturers are used for the calculation of the flat needle felt production.

The GUT-LCA is based on original data provided by the GUT member firms and generic data. 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 GUT-LCA 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 and not recycled, their transport to the production facility, the entire production process and the packaging, inclusive of the packing material of the textile floor covering.
Recycled fibres for the base layer are calculated as shredded fibres from mixed post-consumer textile waste. The calculation includes the recycling process and the waste/fibre transports.

The **delivery/installation** stage includes the transport of the packed carpet to the place of installation, its installation, inclusive of the provision of the 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 6 to 9 for the product manufacture, the delivery/installation, the use stage and the end-of-life stage. The initial value for the relevant columns of the table of results is the use class or the weight of the surface layer of the textile needled floor covering, which is indicated on the PRODIS label and the product data sheet respectively.

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Declaration holder: Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V. 30-04-2010
Declaration number: EPD-GUT-2010711-E

7.9.1 Product manufacture

Table 6: **Results of the life cycle assessment for the product manufacture (Part 1)**

Evaluation value	Unit per m²	use class					
		21	22, 22+, 31	23, 32	33		
					A	B	C
					Weight of the surface layer		
	[g/m²]				≥225 <500	≥500 <750	≥750 ≤1000
Primary energy non-renewable	[MJ]	45,6	54,2	63,0	88,2	127,4	165,9
Primary energy renewable	[MJ]	0,9	1,0	1,2	1,6	2,2	2,8
Global warming potential (GWP 100)	[kg CO_2-eqv.]	2,9	3,5	4,2	6,0	8,9	11,7
Ozone depletion potential (ODP)	[kg R11-eqv.]	$1,5 \cdot 10^{-7}$	$1,8 \cdot 10^{-7}$	$2,0 \cdot 10^{-7}$	$2,7 \cdot 10^{-7}$	$3,7 \cdot 10^{-7}$	$4,7 \cdot 10^{-7}$
Acidification potential (AP)	[kg SO_2-eqv.]	$8,6 \cdot 10^{-3}$	$1,1 \cdot 10^{-2}$	$1,3 \cdot 10^{-2}$	$1,9 \cdot 10^{-2}$	$2,8 \cdot 10^{-2}$	$3,7 \cdot 10^{-2}$
Nutrification (NP)	[kg PO_4-eqv.]	$1,2 \cdot 10^{-3}$	$1,5 \cdot 10^{-3}$	$1,8 \cdot 10^{-3}$	$2,8 \cdot 10^{-3}$	$4,2 \cdot 10^{-3}$	$5,5 \cdot 10^{-3}$
Photochemical oxidant formation (POCP)	[kg ethene-eqv.]	$1,2 \cdot 10^{-3}$	$1,4 \cdot 10^{-3}$	$1,6 \cdot 10^{-3}$	$2,2 \cdot 10^{-3}$	$3,0 \cdot 10^{-3}$	$3,8 \cdot 10^{-3}$

7.9.2 Delivery/ installation

Table 7: **Results of the life cycle assessment for delivery/installation (Part 2)**

Evaluation value	Unit per m²	use class					
		21	22, 22+, 31	23, 32	33		
					A	B	C
					Weight of the surface layer		
	[g/m²]				≥225 <500	≥500 <750	≥750 ≤1000
Primary energy non-renewable	[MJ]	5,0	5,1	5,2	5,5	5,7	6,0
Primary energy renewable	[MJ]	$1,6 \cdot 10^{-3}$	$1,7 \cdot 10^{-3}$	$1,9 \cdot 10^{-3}$	$2,2 \cdot 10^{-3}$	$2,6 \cdot 10^{-3}$	$2,9 \cdot 10^{-3}$
Global warming potential (GWP 100)	[kg CO_2-eqv.]	0,31	0,32	0,32	0,34	0,36	0,38
Ozone depletion potential (ODP)	[kg R11-eqv.]	$2,9 \cdot 10^{-8}$	$2,9 \cdot 10^{-8}$	$2,9 \cdot 10^{-8}$	$2,9 \cdot 10^{-8}$	$2,9 \cdot 10^{-8}$	$2,9 \cdot 10^{-8}$
Acidification potential (AP)	[kg SO_2-eqv.]	$1,1 \cdot 10^{-3}$	$1,2 \cdot 10^{-3}$	$1,2 \cdot 10^{-3}$	$1,3 \cdot 10^{-3}$	$1,4 \cdot 10^{-3}$	$1,5 \cdot 10^{-3}$
Nutrification (NP)	[kg PO_4-eqv.]	$3,4 \cdot 10^{-4}$	$3,5 \cdot 10^{-4}$	$3,5 \cdot 10^{-4}$	$3,7 \cdot 10^{-4}$	$3,9 \cdot 10^{-4}$	$4,1 \cdot 10^{-4}$
Photochemical oxidant formation (POCP)	[kg ethene-eqv.]	$1,7 \cdot 10^{-4}$	$1,8 \cdot 10^{-4}$	$1,8 \cdot 10^{-4}$	$1,9 \cdot 10^{-4}$	$2,0 \cdot 10^{-4}$	$2,1 \cdot 10^{-4}$

7.9.3 Use stage

Table 8: **Results of the life cycle assessment for the use stage (Part 2)**

Evaluation value	Unit per m²a	Values independent of use classes
Primary energy non-renewable	[MJ]	4,1
Primary energy renewable	[MJ]	0,3
Global warming potential (GWP 100)	[kg CO_2-eqv.]	0,2
Ozone depletion potential (ODP)	[kg R11-eqv.]	$4,4 \cdot 10^{-8}$
Acidification potential (AP)	[kg SO_2-eqv.]	$8,4 \cdot 10^{-4}$
Nutrification (NP)	[kg PO_4-eqv.]	$9,4 \cdot 10^{-5}$
Photochemical oxidant formation (POCP)	[kg ethene-eqv.]	$6,7 \cdot 10^{-5}$

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Declaration holder: Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V. 30-04-2010
Declaration number: EPD-GUT-2010711-E

7.9.4 End-of-life stage

Table 9: **Results of the life cycle assessment for the end-of-life stage (Part 3)**

Evaluation value	Unit per m²	use class					
		21	22, 22+, 31	23, 32	33		
					A	B	C
					Weight of the surface layer		
	[g/m²]				≥225 <500	≥500 <750	≥750 ≤1000
Primary energy non-renewable	[MJ]	-6,0	-7,9	-9,6	-13,6	-17,8	-21,8
Primary energy renewable	[MJ]	-0,09	-0,1	-0,1	-0,2	-0,3	-0,3
Global warming potential (GWP 100)	[kg CO_2-eqv.]	0,5	0,7	0,8	1,2	1,5	1,8
Ozone depletion potential (ODP)	[kg R11-eqv.]	$-1{,}7\cdot10^{-8}$	$-2{,}2\cdot10^{-8}$	$-2{,}7\cdot10^{-8}$	$-3{,}8\cdot10^{-8}$	$-5{,}0\cdot10^{-8}$	$-6{,}1\cdot10^{-8}$
Acidification potential (AP)	[kg SO_2-eqv.]	$5{,}6\cdot10^{-4}$	$7{,}4\cdot10^{-4}$	$9{,}0\cdot10^{-4}$	$1{,}3\cdot10^{-3}$	$1{,}7\cdot10^{-3}$	$2{,}0\cdot10^{-3}$
Nutrification (NP)	[kg PO_4-eqv.]	$1{,}2\cdot10^{-4}$	$1{,}6\cdot10^{-4}$	$1{,}9\cdot10^{-4}$	$2{,}7\cdot10^{-4}$	$3{,}5\cdot10^{-4}$	$4{,}3\cdot10^{-4}$
Photochemical oxidant formation (POCP)	[kg ethene-eqv.]	$1{,}2\cdot10^{-5}$	$1{,}6\cdot10^{-5}$	$1{,}9\cdot10^{-5}$	$2{,}7\cdot10^{-5}$	$3{,}6\cdot10^{-5}$	$4{,}4\cdot10^{-5}$

7.9.5 Entire life cycle

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

$$V_T = \text{value}_{(\text{tab. 6})} + \text{value}_{(\text{tab. 7})} + n \cdot \text{value}_{(\text{tab. 8})} + \text{value}_{(\text{tab. 9})}$$

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

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 75 % up to 84 %, for the delivery/installation 3 % up to 8 % and for the annual usage 2 % to 7 %. Re-use results in an energy credit note of 10 % to 11 %.

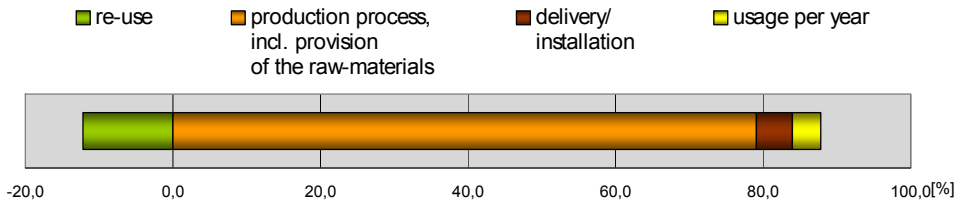

Figure 1: Relative contributions of the life cycle stages to the primary energy consumption (regenerative and non-regenerative)

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. The balance of the mechanical processes is negative because the thermal recycling of the production waste in a waste incineration plant results in a primary energy credit.

The representation applies to the lowest and the highest use class (21 and 33 C).

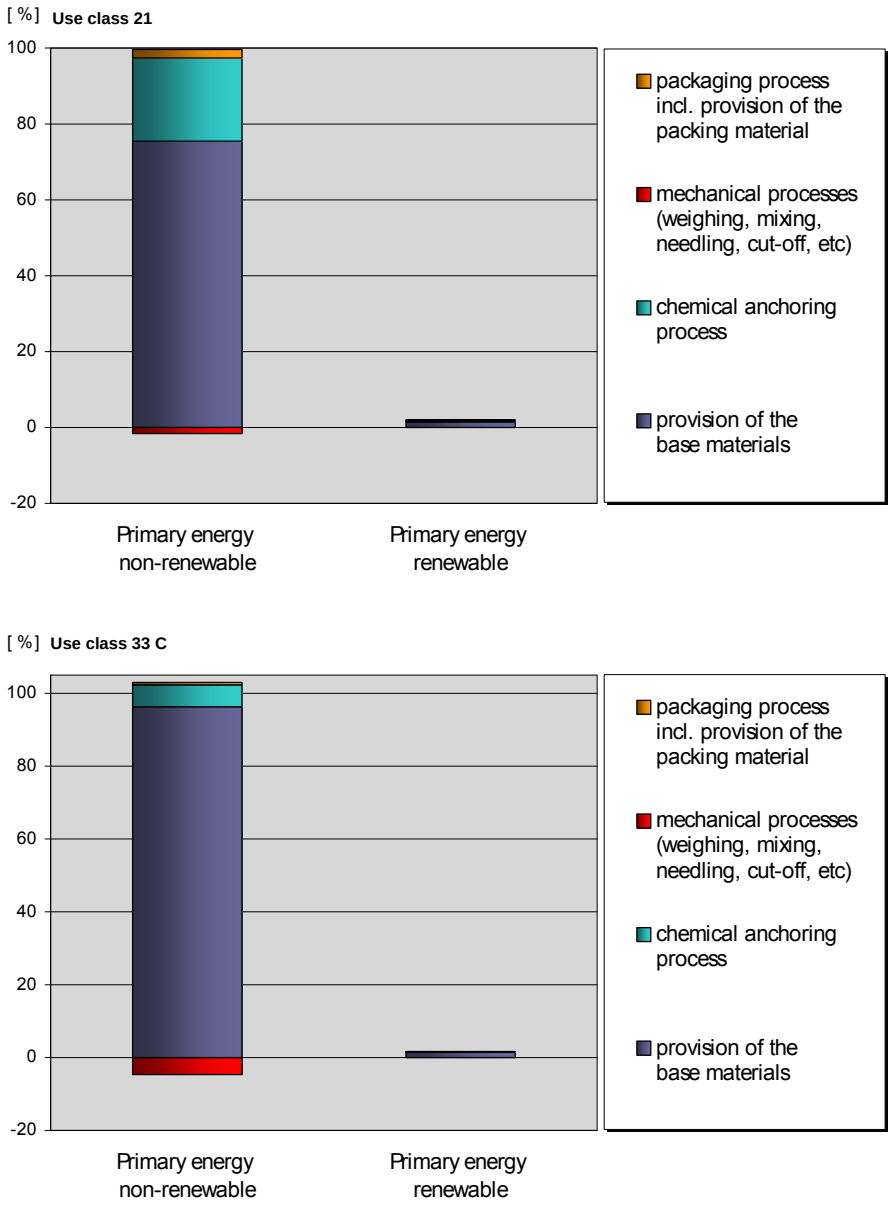

Figure 2: Relative contributions of different partial processes to the primary energy consumption during product manufacture

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Declaration holder: Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V.
Declaration number: EPD-GUT-2010711-E
Issued on 30-04-2010

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

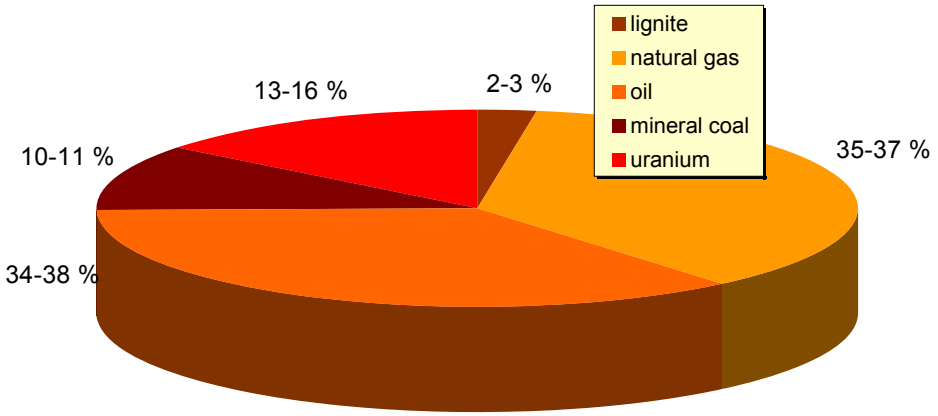

Figure 3: Shares of the non-renewable energy carriers

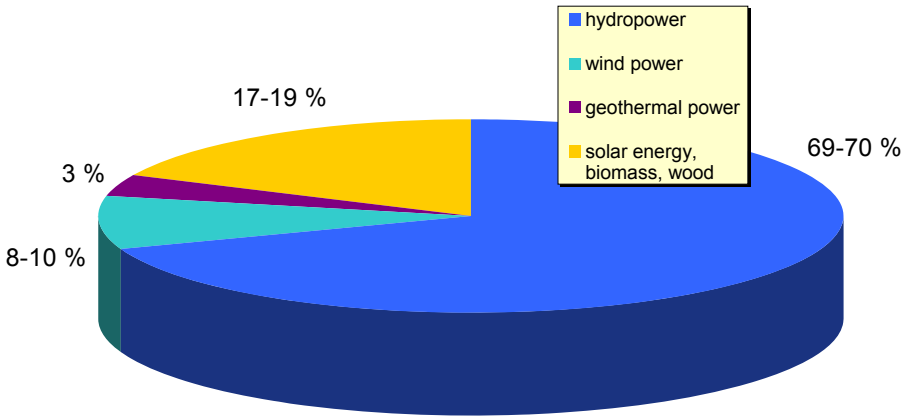

Figure 4: Shares of the renewable energy carriers

7.10.2 Non-renewable material content

The non-renewable raw materials are 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.

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.

Mineral raw materials are limestone with 0.02 to 0.07 kg/m^2 and sodium chloride (rock salt) with 0.02 to 0.1 kg/m^2, aluminium with 0.006 to 0.02 kg/m^2, iron with 0.004 up to 0.015 kg/m² and clay with 0.004 up to 0.013 kg/m². The mass of sulphur amounts to 0.03 to 0.26 kg/m².

The non-utilisable ores and rocks, i.e dead rock, account for 1.4 to 3.9 kg/m², raw gravel to 0.03 to 0.1 kg/m².

The values indicated refer to product manufacture.

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Declaration holder: Gemeinschaft umweltfreundlicher Teppichboden (GUT) e.V. 30-04-2010
Declaration number: EPD-GUT-2010711-E

7.10.3 Water consumption

Table 10: **Water consumption [m^3/m^2]**

	Use class					
	21	22, 22+, 31	23, 32	33		
				A	B	C
				Weight of the surface layer		
				≥225 <500	≥500 <750	≥750 ≤1000
Production	0,034	0,044	0,054	0,084	0,130	0,174
Delivery/installation	$7{,}3 \cdot 10^{-3}$	$7{,}3 \cdot 10^{-3}$	$7{,}3 \cdot 10^{-3}$	$7{,}3 \cdot 10^{-3}$	$7{,}3 \cdot 10^{-3}$	$7{,}3 \cdot 10^{-3}$
Usage	$5{,}4 \cdot 10^{-3}$	$5{,}4 \cdot 10^{-3}$	$5{,}4 \cdot 10^{-3}$	$5{,}4 \cdot 10^{-3}$	$5{,}4 \cdot 10^{-3}$	$5{,}4 \cdot 10^{-3}$
Disposal	$6{,}7 \cdot 10^{-4}$	$8{,}9 \cdot 10^{-4}$	$1{,}1 \cdot 10^{-3}$	$1{,}5 \cdot 10^{-3}$	$2{,}0 \cdot 10^{-3}$	$2{,}4 \cdot 10^{-3}$

Water is predominantly consumed during the manufacture of raw materials (72 % to 92 %).

7.10.4 Waste

Table 11: **Waste occurrence [kg/m^2]**

	Use class					
	21	22, 22+, 31	23, 32	33		
				A	B	C
				Weight of the surface layer		
				≥225 <500	≥500 <750	≥750 ≤1000
non-hazardous waste						
overburden/dump material						
Production	1,4	1,55	1,71	2,22	3,09	3,95
Delivery/installation	0,03	0,03	0,03	0,03	0,03	0,03
Usage	0,53	0,53	0,53	0,53	0,53	0,53
Disposal	-0,56	-0,74	-0,9	-1,27	-1,66	-2,03
municipal solid waste						
Production	0,005	0,007	0,009	0,016	0,027	0,038
Delivery/installation	$1{,}7 \cdot 10^{-7}$	$1{,}7 \cdot 10^{-7}$	$1{,}7 \cdot 10^{-7}$	$1{,}7 \cdot 10^{-7}$	$1{,}7 \cdot 10^{-7}$	$1{,}7 \cdot 10^{-7}$
Usage	0,0	0,0	0,0	0,0	0,0	0,0
Disposal	$1{,}3 \cdot 10^{-4}$	$1{,}7 \cdot 10^{-4}$	$2{,}0 \cdot 10^{-4}$	$2{,}9 \cdot 10^{-4}$	$3{,}7 \cdot 10^{-4}$	$4{,}6 \cdot 10^{-4}$
hazardous waste						
special waste						
Production	0,006	0,007	0,009	0,013	0,017	0,021
Delivery/installation	$5{,}5 \cdot 10^{-4}$	$5{,}5 \cdot 10^{-4}$	$5{,}5 \cdot 10^{-4}$	$5{,}5 \cdot 10^{-4}$	$5{,}5 \cdot 10^{-4}$	$5{,}5 \cdot 10^{-4}$
Usage	0,0	0,0	0,0	0,0	0,0	0,0
Disposal	$1{,}7 \cdot 10^{-4}$	$2{,}3 \cdot 10^{-4}$	$2{,}7 \cdot 10^{-4}$	$3{,}9 \cdot 10^{-4}$	$5{,}1 \cdot 10^{-4}$	$6{,}2 \cdot 10^{-4}$
radioactive waste						
	0,002	0,002	0,002	0,003	0,004	0,005
	$-6{,}7 \cdot 10^{-6}$	$-6{,}5 \cdot 10^{-6}$	$-6{,}3 \cdot 10^{-6}$	$-5{,}9 \cdot 10^{-6}$	$-5{,}4 \cdot 10^{-6}$	$-5{,}0 \cdot 10^{-6}$
	$5{,}8 \cdot 10^{-4}$	$5{,}8 \cdot 10^{-4}$	$5{,}8 \cdot 10^{-4}$	$5{,}8 \cdot 10^{-4}$	$5{,}8 \cdot 10^{-4}$	$5{,}8 \cdot 10^{-4}$
	$-2{,}3 \cdot 10^{-4}$	$-3{,}0 \cdot 10^{-4}$	$-3{,}7 \cdot 10^{-4}$	$-5{,}2 \cdot 10^{-4}$	$-6{,}8 \cdot 10^{-4}$	$-8{,}3 \cdot 10^{-4}$

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.

Negative values for delivery/installation and for disposal result from thermal usage of the packing material and the post consumer carpet in a waste incineration plant. This effects credits for the provision of energy.

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 use class 23/32.

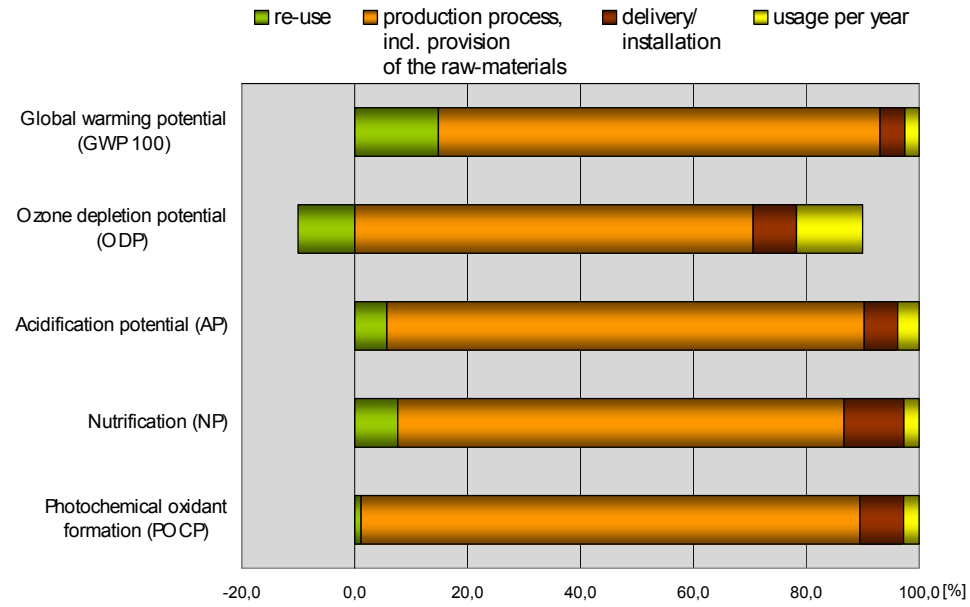
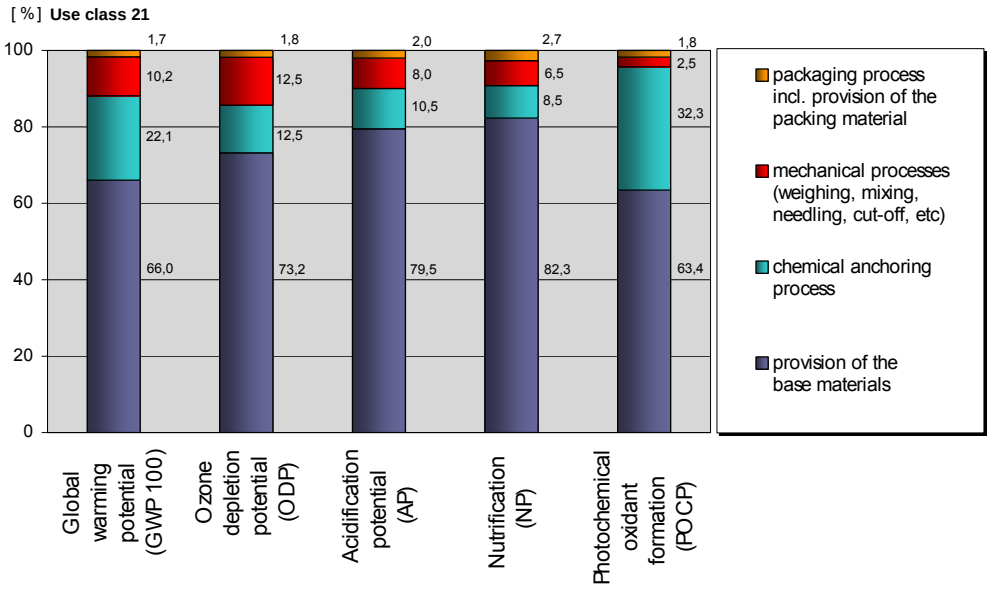


Figure 5: Relative contributions of the life cycle stages to the environmental impacts for use class 23/32

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 the lowest and the highest use class (21 and 33 C).



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Declaration number: EPD-GUT-2010711-E

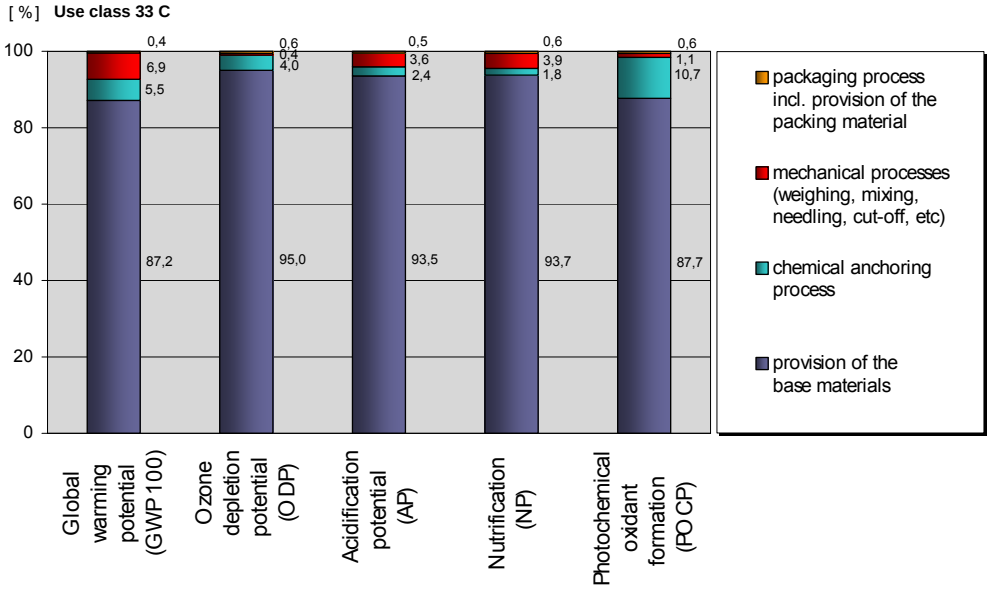

Figure 6: Relative contributions of different partial processes to the environmental impacts during product manufacture

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.

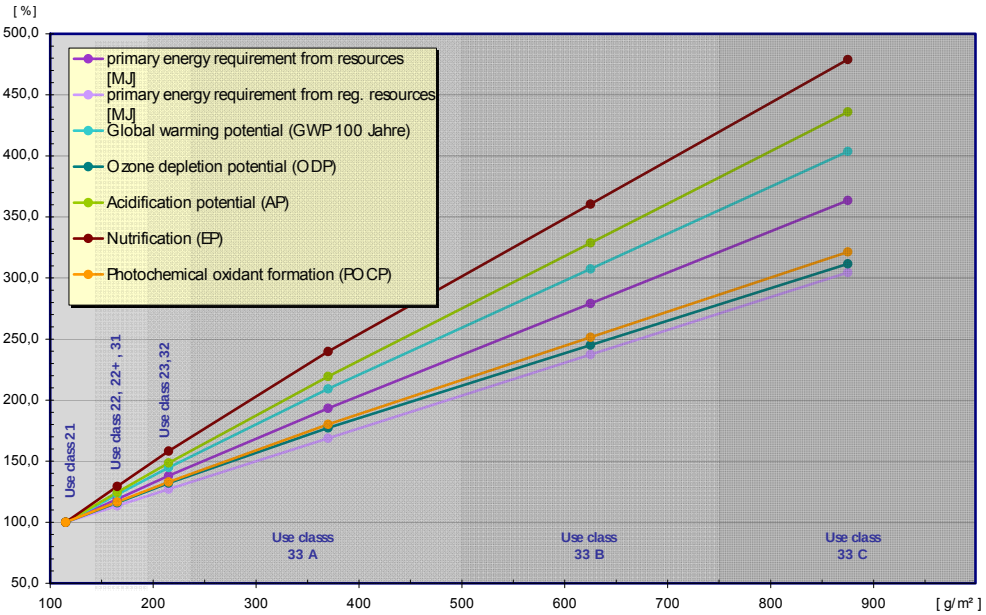

Figure 7: Primary energy and impact categories dependent on the use classes (weight of the surface layer),
for the product manufacture, relative to use class 21 (100 %)

The energetic **re-use** of the textile floor covering results in a primary energy credit of 10 % to 11 % (figure 1). The ozone depletion potential is crucially dependent on the electrical energy input. For disposal electrical energy results in a credit and furnishes negative values. The balance for the ozone depletion potential therefore is negative (figure 5)

In the overall assessment, the life cycle stages **delivery and installation** are of moderate 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 8 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 5) and contaminants.

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 1470/ Textile floor coverings – Classification of needled floor coverings except for needled pile floor coverings

/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', 2008-01.

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