

## Background Report for Products

Screening LCA of manufactured tufted textile floorcovering  
(based on information provided by the Association of  
Environmentally Friendly Carpets - Gemeinschaft  
Umweltfreundlicher Teppichboden, GUT)

## Basic assessment information

<b>General information</b>	Name of the product:	Tufted carpet with textile fabric backing	
	Date of the assessment:	4th of September, 2012	
	Name, role and affiliation of assessor:	Larisa Maya Altamira, Consultant at PE International	
	Name, role and affiliation of reviewer:	Peter Shonfield, Technical Director at PE International	
	Review type	Internal review	
	Date of the verification	26th of September, 2012	
	Client of the study:	GUT - Gemeinschaft umweltfreundlicher Teppichboden e.V., Schönebergstr. 2, 52068 Aachen, Germany	
	Authors of the study:	PE International - Hauptstraße 111-113, 70771 Leinfelden- Echterdingen, Germany	

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## Nomenclature

<b>Abbreviation</b>	<b>Explanation</b>
ADP	Abiotic Depletion Potential
ADPE	Abiotic Resource Depletion Potential for elements
ADPF	Abiotic Resource Depletion Potential of fossil fuels
AP	Acidification Potential
BLBSB	Benefits and Loads Beyond the System Boundary
CML	Centrum voor Milieukunde, Leiden (NL)
CRU	Components for re-use
EE	Exported energy per energy carrier
EP	Eutrophication Potential
EPD	Environmental Product Declaration
FW	Use of net fresh water
GWP	Global Warming Potential
HWD	Hazardous waste disposed
IBU	Institut Bauen und Umwelt e.V.
MER	Materials for energy recovery
MFR	Materials for recycling
NRSF	Use of non-renewable secondary fuels
NHWD	Non hazardous waste disposed
ODP	Ozone Layer Depletion Potential
PENRE	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
PENRM	Use of non-renewable primary energy resources used as raw materials
PENRT	Total use of non-renewable primary energy resources
PERE	Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM	Use of renewable primary energy resources used as raw materials
PERT	Total use of renewable primary energy resources
PCR	Product Category Rules
POCP	Photochemical Ozone Creation Potential
RSF	Use of renewable secondary fuels

RSL	Reference Service Life
RWD	Radioactive waste disposed
SM	Use of secondary material

## 1 Scope

This document is the background report for the life cycle assessment (LCA) results of the product. The study has been conducted in accordance with the provisions and guidelines of EeBGuide.

## 2 Content, structure and accessibility of the background report

The background report provides the systematic and comprehensive summary of the project documentation supporting the verification of an EeBGuide compliant product LCA. The project report shall record that both the LCA based information and the additional information meet the requirements of EeBGuide of the Energy-efficient Building Initiative. It will be/was made available to the verifier with the requirements on confidentiality stated in ISO 14025.

This background report contains important data and information for the data as required by the European Standard **Error! Reference source not found.** on Environmental Product Declarations (EPD's) of construction products. Special attention has been paid to transparently demonstrate how the data and accompanying information have been collected and how these are related to the declared LCA results.

## 3 General aspects in the background report

This LCA study was performed jointly by the Association of Environmentally Friendly Carpets (GUT) and PE International and has been conducted according to the requirements of the European Standard **Error! Reference source not found.**. Further details can be found in the table "General Information".

## 4 Goal/ Purpose of the study

GUT is a European association whose aim is to continuously improve all environmental and consumer protection aspects throughout the life cycle of textile floor coverings. Amongst other activities GUT compiles life cycle information from their members to produce EPD's.

GUT had already carried out the LCA of the product assessed in this study to gather data for an EPD. The data assessed is from a German manufacturer whose name cannot be disclosed due to confidentiality terms. According to GUT, this is a representative product of its type in the European market.

The aim of this study is to provide an overview of the carbon footprint of the manufactured product and compare this with its embodied energy (both renewable and non-renewable). This is intended as a first screening assessment of the product's manufacture for internal communication and to support the product design process, therefore the use and end of life stages are not considered.

PE International used GUT's data with the aim to exemplify how the guidelines of EeBGuide can be used to meet the aims of the study. The guidelines are referred at the "EeBGuide Guidance Document, Part A: PRODUCTS" (Wittstock et al., 2012).

The table "Goal/ Purpose of the study" summarises key points regarding the purpose of the study.

# Screening Life Cycle Assessment

**Table 1: Goal/ Purpose of the study**

<b>Goal/ Purpose of the study</b>	Level of complexity	<input checked="" type="checkbox"/>	Screening
		<input type="checkbox"/>	Simplified
		<input type="checkbox"/>	Complete
	related study objective	<input type="checkbox"/>	Comparative assertion
	<input checked="" type="checkbox"/>	Stand alone LCA	
object of assertion	<input checked="" type="checkbox"/>	Product	
communication purpose		<input checked="" type="checkbox"/>	Internal
		<input type="checkbox"/>	External
		<input type="checkbox"/>	For customer to customer
		<input type="checkbox"/>	Publication

## 5 Scope of the study

### 5.1 Declared / functional unit

The declared unit in this study is 1 m<sup>2</sup> of manufactured packed tufted textile floor covering, which is equal to a reference flow of 2 kg of manufactured product and 40 g of packaging material.

**Table 2: Declared unit**

<b>Functional unit</b>	Declared unit:	1 m <sup>2</sup> of manufactured packed tufted textile floor covering
	Product group:	Floor coverings
	Function in the building:	The product complies with the use class 33 according to EN 1307, meaning that they are suitable for use in areas with high traffic and can be used both in the private and the commercial sector
	Reference service life	not applicable
	Other services provided within the building	none

The function of the product is to protect the floor and maintain an acceptable visual and tactile quality over 10 years under heavy use conditions in commercial buildings. It can also be used in residential buildings. However, the service life is outside the scope of this study.

### 5.2 Declaration of construction products classes

The following table describes the product in more detail:

# Screening Life Cycle Assessment

**Table 3: Technical description of product**

<b>Technical description of the product</b>	Name of the PCR and describe the declaration type (if you follow any):	PCR 2011, Part A+B Institut Bauen und Umwelt e.V., Königswinter (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report, 2011-09 Part B: Requirements on the EPD for floor coverings, 2011-06
	Main important materials:	Polyamide 6 (PA6), polyester (PES), polypropylene (PP), limestone, latex, aluminiumhydroxide
	Statement on ability for recycling/reuse:	The carpet product can be used as secondary material and secondary fuel in cement kilns, substituting substantial inorganic material that remains in the clinker (mostly chalk & aluminum hydroxide) and original fuel needed for the kilns (hard coal, lignite and petroleum coal) - Source: Environmental Data of the German Cement Industry 2008, VDZ eV, Research Institute of Cement industry
	Description of the product:	Tufted carpet as rolls having a surface pile of 100% solution-dyed polyamide 6, a pre-coat & lamination made of limestone, latex and aluminiumhydroxide, a non-woven primary backing made of PES/PA6, and a textile fabric backing made of Polypropylene
	Designated application:	According to the use class 33 as defined in EN 1307 this product can be used in all commercial areas which require heavy use. According to the standard, this floor covering can be also used in other lower classes (i.e. in residential areas).

The technical specifications of the product are shown in **Error! Reference source not found.** and its composition in

**Table 5.**

**Table 4: Technical specifications of the product**

Information on basic construction data			
basic requirements (table 4): fulfilled		type of carpet: 1	
type of manufacture (ref 1): pile carpet acc. EN 1307 - tufted			
type of surface (ref 2): loop pile - loop pile like - patterned			
primary backing (ref 3): spunbond - PET			
secondary backing (ref 4): textile backing - woven			
pile fibre composition: 100% PA6			
total carpet weight:	2.000 [g/m <sup>2</sup> ]	surface pile mass:	410 [g/m <sup>2</sup> ]
total carpet thickness:	5,1 [mm]	surface pile thickness:	2,5 [mm]
thickness of backing:	2,6 [mm]	surface pile density:	0,164 [g/cm <sup>3</sup> ]
density of backing:	0,612 [g/cm <sup>3</sup> ]	number of tufts:	1.580 [1/dm <sup>2</sup> ]

**Table 5: Product composition**

<b>Product composition</b>	<b>Unit per m<sup>2</sup></b>	<b>Amount per m<sup>2</sup> (dry)</b>
<b>PA6 solution dyed</b>	g	<b>650</b>
<b>Primary backing total</b>	g	<b>100</b>
Share of PES	%	76
Share of PA6	%	24
<b>Pre-coat total</b>	g	<b>640</b>
Share of limestone	%	65
Share of aluminium hydroxide	%	14.3
Share of latex	%	20
Share of acrylate binding agent	%	0.06
Share of tenside	%	0.20
Share of antistatic agent	%	0.43
Share of carbon black	%	0.01
<b>Lamination total</b>	g	<b>550</b>
Share of limestone	%	70
Share of latex	%	29.9
Share of acrylate binding agent	%	0.07
Share of tenside	%	0.03
<b>PP textile fabric total</b>	g	<b>60</b>
<b>Total weight</b>	g	<b>2000</b>

### 5.3 System boundaries

The system boundaries of the product LCA follow the modular design defined by **/Error! Reference source not found./**.

The next table summarizes the included life cycle stages.

**Table 6: Included lifecycle stages**

<b>Included modules</b>	<b>Product Stage</b>	<input checked="" type="checkbox"/>	A2	Transport
			A3	Manufacturing
	<b>Construction Process</b>	<input type="checkbox"/>	A4	Transport
		<input type="checkbox"/>	A5	Construction- Installation process
		<input type="checkbox"/>	B1	Use
		<input type="checkbox"/>	B2	Maintenance
		<input type="checkbox"/>	B3	Repair
	<b>Use Stage</b>	<input type="checkbox"/>	B4	Replacement
		<input type="checkbox"/>	B5	Refurbishment
		<input type="checkbox"/>	B6	Operational Energy Use
		<input type="checkbox"/>	B7	Operational Water Use
	<b>End of Life Stage</b>	<input type="checkbox"/>	C1	Deconstruction
		<input type="checkbox"/>	C2	Transport
		<input type="checkbox"/>	C3	Waste process for reuse,
	<input type="checkbox"/>	C4	Disposal	
<b>Benefits and loads beyond the</b>	<input type="checkbox"/>	D	Reuse- Recovery- Recycling potential	

The following chapters describe the modules that are within the scope of this study. The modules included are in line with the requirements for a screening LCA study according to the following table:

**Table 7: Definitions for the different study types**

### Screening - Simplified - Complete

according to SBA Common Metrics Framework 2009 and EeBGuide adaptations

**M**

**mandatory**

**O<sub>relevance?</sub>**

**optional because of minor relevance**

**O<sub>data?</sub>**

**optional due to potentially missing data**

	Study type	Before use stage					
		Raw Materials Supply A1	Transport (to factory) A2	Manufacturing A3	Transport (to construction site) A4	Construction-Installation process A5	
<b>Product</b>	Screening	<b>O<sub>data?</sub></b>	Optional Generic data for foreground system Generic data for background system			<b>O<sub>data?</sub></b>	<b>O<sub>data?</sub></b>
	Simplified	<b>M</b>	Specific data for foreground system Generic data for background system			<b>O<sub>data?</sub></b>	<b>O<sub>data?</sub></b>
	Complete	<b>M</b>	Specific data for foreground system Generic data for background system			<b>M</b>	

# Screening Life Cycle Assessment

## Screening - Simplified - Complete

according to SBA Common Metrics Framework 2009 and EeBGuide adaptations

M

O<sub>relevance?</sub>

O<sub>data?</sub>

	Study type	Use stage							
		Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	
		B1	B2	B3	B4	B5	B6	B7	
Product	Screening	O <sub>data?</sub>	O <sub>data?</sub>	Estimations or literature specific when focus on it					
	Simplified	O <sub>data?</sub>	O <sub>data?</sub>	Literature or specific energy use					
	Complete	M	M	O <sub>data?</sub>	M	M	M	M	Literature or specific energy use

## Screening Life Cycle Assessment

### Screening - Simplified - Complete

according to SBA Common Metrics Framework 2009 and EeBGuide adaptations

M

O<sub>relevance?</sub>

O<sub>data?</sub>

	Study type	End of Life				Benefits beyond boundary
		Deconstruction C1	Transport (to disposal) C2	Waste process for reuse, recovery or/and recycling C3	Disposal C4	Reuse-/Recovery-/Recycling potential D
<b>Product</b>	Screening	O <sub>data?</sub>	O <sub>data?</sub>	O <sub>data?</sub>	Generic EoL data sets	O <sub>data?</sub> Generic LCA data sets for reuse-/recovery-/recycling potential
	Simplified	O <sub>data?</sub>	O <sub>data?</sub>	M	Specific or generic LCA data for EoL processes	M Specific or generic LCA data for reuse-/recovery- / recycling potential
	Complete	M	M	M	Specific or generic LCA data for EoL processes	M Specific or generic LCA data for reuse-/recovery- / recycling potential

### 5.3.1 A1-A3, Product stage, information modules

The product stage includes:

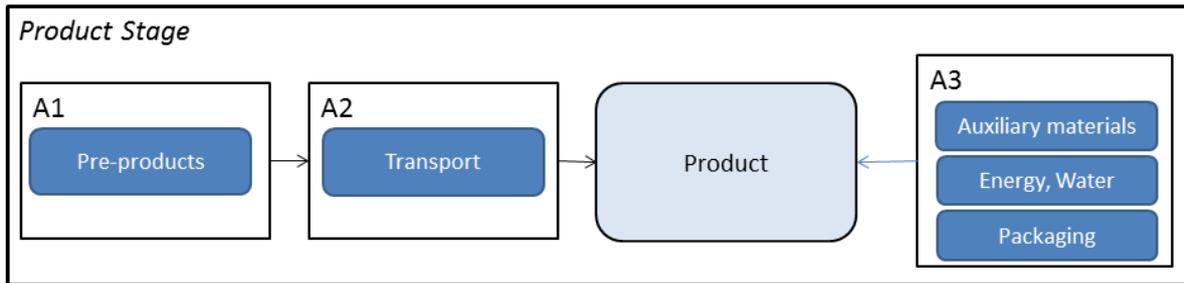
- A1, raw material extraction and processing of the next carpet's materials:
  - Polyamide 6 (PA6),
  - Polyester (PES),
  - Polypropylene (PP),
  - Limestone,
  - Latex,
  - Aluminium Hydroxide,
 and the next packaging materials:
  - Cardboard (primary and secondary), and,
  - Polyethylene film.
- A2, transport of the materials to the manufacturing site,
- A3, manufacturing, including:
  - Tufting,
  - Textile fabric backing,
  - Cutting edges, and,
  - Packaging.

## Screening Life Cycle Assessment

These including provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues during the product stage.

The calorific value used to represent recycled cardboard as packaging material was represented by the value of cardboard made of virgin fibres (primary cardboard), because the recycled cardboard goes into the system without basic material stress so no alterations to the cardboard composition are happening.

The following flowchart represents the system boundaries for the product stage:



**Figure 1: Schematic representation of the LCA system boundaries for the production module (A1-A3)**

**Table 8: Information on Module A1-A3**

<b>Module A1-A3</b>	<p>The following processes are omitted:</p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: center; width: 50px;"><input checked="" type="checkbox"/></td> <td>A- 02 "Transport of staff in the supply of raw materials "</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td>A- 03 "Transport to the manufacturer"</td> </tr> </table> <p>Explain deviations from provision in the guidance document</p> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 5px 0;">Explained in the next statement</div> <p>The following deviations from EeBGuide guidance document on data requirements occurred <b>(Only for "Complete Assessment")</b>:</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>* Infrastructure machinery &amp; capital equipment were not included in the foreground system as this was neglected under the cut-off criteria; for the background system it was included for energy generation systems according to the GaBi Database SP20 and Ecoinvent 2.2</p> <p>* Packaging waste from manufacturing was not modelled because it represents only 0.1% of the total mass through the Life Cycle</p> </div> <p>The following assumptions about other relevant background data, important for the representation of the system boundaries, were considered:</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p style="text-align: center;">GaBi Database Service Pack 20 (SP20) and Ecoinvent 2.2 have been used as background data and their data quality assessment can be found in the documentation of these databases.</p> </div>	<input checked="" type="checkbox"/>	A- 02 "Transport of staff in the supply of raw materials "	<input type="checkbox"/>	A- 03 "Transport to the manufacturer"
<input checked="" type="checkbox"/>	A- 02 "Transport of staff in the supply of raw materials "				
<input type="checkbox"/>	A- 03 "Transport to the manufacturer"				

### 5.3.2 Electric energy mix

The selection of the background data for the electricity generation is in line with EeBGuide. European average (EU-27) data was used for the pre-processing of supplied PA6 and PES to the German manufacturer, whilst German average data was used for tufting and shearing.

This was taken from GaBi 5 database Service Pack 20 [PE International, 2011] which is ILCD compliant.

For the European average electricity generation, data from 2008 official statistics on national energy carrier mixes, efficiencies, net losses and consumption were used. For the German average electricity generation, data from 2008 official statistics was included on average national specific electricity mix including main producers as well as imports energy carrier mixes, efficiencies, net losses and consumption.

The data sources for the complete system are consistent and details can be found in GaBi 5 documentation [Frischknecht et al., 2007]. The key emissions e.g. carbon dioxide, sulphur dioxide, nitrogen oxide, etc., of the power plants are based on measured operating data taken from national statistics. All other emissions from the power plants are based on literature data and/or calculated via energy carrier composition in combination with literature-based combustion models. Infrastructure data are from literature. The data on the energy carrier supply chain is based on statistics with country/region-specific transport distances, as well as industry and literature data on the inventory of exploration and extraction. Refinery data are also based on statistical data and measurements of major refineries as well as literature data. LCI modelling is fully consistent with the ILCD guidelines.

### 5.3.3 CO<sub>2</sub>-Certificates

No CO<sub>2</sub>-certificates are considered in this study.

### 5.3.4 Description of the system boundary in the background report

The definition of the system boundaries meets the requirements of EeBGuide.

## 5.4 Criteria for the exclusion of inputs and outputs

The application of the cut-off criteria for the exclusion of inputs and outputs follows the EN 15804 standard. Data gaps may be filled using conservative assumptions with average or generic data. Any assumptions for such choices shall be documented.

In case of insufficient input data or data gaps for a unit process, the cut-off criteria shall be:

- 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of that unit process, and,
- the total of neglected input flows per module, e.g. per module A1-3, A4-5, B1-5, B6-7, C1-4 and D shall be a maximum of 5% of energy usage and mass.

Particular care should be taken to include material and energy flows known to have the potential to cause significant emissions into air and water or soil related to the environmental indicators of this standard.

Conservative assumptions in combination with plausibility considerations and expert judgement can be used to demonstrate compliance with these criteria.

In this particular study, the production and use of dyes in the manufacturing of this product were excluded on the basis that their input to the PA6 yarn is less than 1%.

Packaging waste was not considered because it constitutes less than 0.1% of the total mass of the packaging.

Infrastructure machinery & capital equipment were not included in the foreground system as these are typically excluded when assessing these type of products since they are insignificant in terms of mass and energy consumption and in terms of their contribution to the potential environmental impacts.

## 6 Life cycle inventory analysis

### 6.1 Data collection and calculation procedures

Data collection followed the guidance provided in **/Error! Reference source not found./**, clause 4.3.2. The calculation procedures described in **/Error! Reference source not found./** were applied consistently throughout the study.

According to the definition of scope of the study, all relevant inputs and outputs related to the products or product systems were identified and quantified.

### 6.2 Developing product level scenarios

There were no scenarios assessed as the goal of this study is to provide an overview of the environmental impact potentials of the product during its production stage.

### 6.3 Selection of data/ background data

As a general rule, specific data or average data derived from specific production processes shall be the first choice as a basis for calculating a product LCA.

For life cycle modelling of the considered product the GaBi 5 Software-System and Databases for Life Cycle Engineering was used. All relevant background datasets were taken from GaBi 5 database Service Pack 20 (PE International, 2011) and Ecoinvent 2.2 database (Frischknecht et al., 2007) and provided by PE International and the Swiss Centre for Life Cycle Inventories.

The applied foreground datasets are based on 1 year averaged data from 2010 and have either European or country specific average coverage. The data sets for the background system are based on 1 year averaged data from a range of years varying from 2000 to 2011.

### 6.4 Data/ background data quality requirements

The requirements for data quality and background data correspond to the specifications of EeBGuide.

The datasets are complete and conform to the system boundaries and the criteria for the exclusion of inputs and outputs. All datasets are specific to the product system model to the extent possible, and when this is not the case they are generic and representing the technology and region assessed.

Specific information about their age, technologies and regions represented cannot be disclosed due to confidentiality terms between GUT and the manufacturer. However, these should be included when assessing construction products according to this guidance. In this particular case, this information has been reviewed by an external verifier before producing the Environmental Product Declaration in terms of data quality and representativeness.

The foreground system data have been assessed in terms of quality and representativeness by an external critical review (Klöpffer W. and Hirschier R., 2004).

The background data complies with data quality and representativeness requirements according to GaBi 5 database Service Pack 20 and Ecoinvent 2.2 database.

### **6.5 Allocation**

In the present study no allocation has been required.

In modules A1, A2 and A3 electricity and thermal energy is recovered from the incineration of manufacturing waste from PA6 from spinning/colouring and from cutting the edges of the carpet. This recovered energy was subtracted from the input electricity based on the European electricity grid and the input thermal energy from natural gas (EU-27), in this way reflecting the NET energy consumption.

## 7 Life cycle inventory analysis and life cycle impact assessment

The results of the screening LCA are represented in the following tables. The inventory analysis indicators to be declared and the impact assessment are in accordance with EN 15804.

### 7.1 Indicators for the life cycle inventory analysis according to EN 15804

Only the energy related LCI indicators stated in the EN 15804 were assessed in this screening study. They describe the use of renewable and non-renewable primary energy.

Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	MJ, net calorific value
Use of non renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value

### 7.2 Indicators for the life cycle impact assessment according to EN 15804

The only impact assessment category considered in this study is Global Warming Potential. This is calculated using characterisation factors from CML (Institute of Environmental Sciences Faculty of Science University of Leiden, Netherlands) referring to the EN 15804 standard:

Global warming potential (GWP);	kg CO <sub>2</sub> -equiv.
---------------------------------	----------------------------

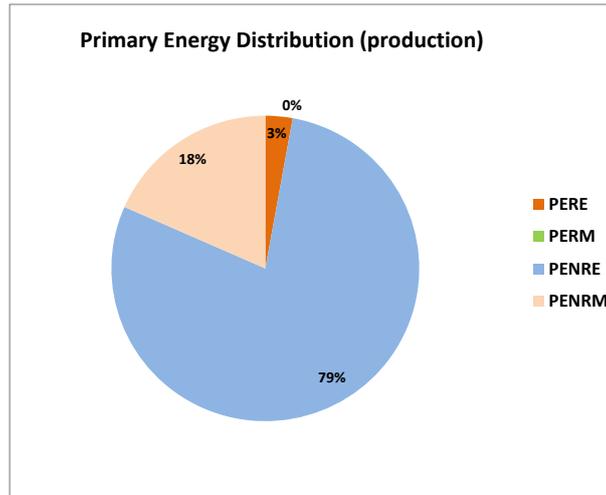
The results from the impact assessment are only relative statements which give no information about the endpoint of the impact category assessed, overstepping of threshold values, safety margins or risk.

### 7.3 Summary of assessed environmental indicators

The table below illustrates the environmental indicators assessed in this study.



**Figure 2: Share of primary energy demand over the production stage**



## 7.6 Interpretation of the results of the assessed scenario

The manufacturing of this product is energy intensive as it follows a series of steps involving tufting, primary backing, shearing, back coating, cutting and packaging, as well as other sub-stages for each manufacturing step. Most of these stages and sub-stages are carried out by machine and thus require electricity and thermal energy to function. Furthermore, many of the raw materials need to be pre-processed and transported to the manufacturing site, which increase the energy demand.

The results show that most of the global warming potential is related to the use of non-renewable primary energy excluding raw materials and to a lower degree to the production of raw materials. This indeed shows that the production stage of the carpet is strongly related to the use of electricity and thermal energy from fossil fuels, and in a lower extent to the use of non-renewable raw materials. The use of renewable energy is relatively minor and is only related to packaging cardboard as the only source of renewable raw materials used.

## 8 Conclusion

The study results show that most of the potential for improving the design of the carpet relate to the manufacturing of the product and not on the raw materials used. In particular, it is shown that increasing the use of renewable sources of electricity and thermal energy for manufacturing could improve the environmental performance of the carpet. However, it is important to remember that some renewable sources of energy also release Greenhouse Gas emissions so their Global Warming Potential should be evaluated when considering switching to renewable energy sources at the manufacturing.

Finally, switching to more renewable raw materials could also lead to a more “environmentally friendly” carpet, but caution should be taken that these changes do not negatively impact product quality (i.e. resulting in a reduced service life) or shift burdens to other life cycle stages.

## 9 References

- Gemeinschaft Umweltfreundlicher Teppichboden - GUT (2006) Ökologische Bilanzierung von Teppichböden, Teil 2, Vom Fabrikator bis zur Bahre
- Wittstock et al. (2012) EeBGuide Guidance Document, Part A: PRODUCTS, "Operational guidance for Life Cycle Assessment studies of the Energy Efficient Buildings Initiative"
- EN 15804: 2012 Sustainability of construction works – Environmental Product Declarations – Core rules for the product category of construction products
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## Annex A Documentation of additional information

### **Documentation for the calculation of the reference service life (RSL)**

The documentation of the RSL is not required for the EPD of the company since the entire life cycle is not declared. The RSL of 10 years is optionally specified.