PCF
PILOTPROJEKT
DEUTSCHLAND

CASE STUDY SHAMPOO BY HENKEL AG & CO. KGAA

Documentation

Case Study undertaken within the PCF Pilot Project Germany

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Content

1 Preface

The case study SCHAUMA 7 KRÄUTER SHAMPOO that follows was elaborated within the scope of the Product Carbon Footprint (PCF) Pilot Project Germany by the Henkel AG & Co. KGaA. For the PCF Pilot Project, Henkel joined nine other companies to pursue, together with the project initiators – WWF Germany, Öko-Institut (Institute for Applied Ecology), the Potsdam Institute for Climate Impact Research (PIK) and THEMA1 – the following project objectives:

1. *Gaining experience*: On the basis of concrete case studies, the project initiators and the participating companies gain experience with the practical application of current methods for determining carbon footprints and examine the efficiency of these methods (ISO[1] standards for life cycle assessment, BSI[2] PAS 2050).

2. *Deriving recommendations:* Based on the findings of the case studies, recommendations are derived for the further development and harmonisation of transparent, scientifically founded methodology for determining the carbon footprint of products. The pilot project explicitly refrains from developing its own methodology.

3. *Communicating results:* Consumers must be informed of the product carbon footprint in a scientifically sound and comprehensible manner. To this end, the project stakeholders are holding discussions on reliable communication on a sectoral, company and product level to foster climate-conscious purchase decisions and use patterns. The relevance in terms of increasing the climate consciousness of consumer decision making is crucial to these considerations. The pilot project explicitly refrains from developing its own climate-related label since the current methodological conventions are not sufficiently consistent and are still under discussion, meaning that its significance in terms of possible courses of action would therefore be low.

4. *Standardising internationally*: The findings reached and the recommendations derived contribute to a situation in which the PCF Pilot Project Germany actively helps to shape the international debate on the determination and communication of carbon footprints.

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[1] International Organization for Standardization.

[2] The British Standards Institution.

The definitions and uses of the term “product carbon footprint” differ internationally. Within the scope of the PCF Pilot Project Germany, the project stakeholders agreed on the following definition:

> *“Product carbon footprint describes the sum of greenhouse gas emissions accumulated during the full life cycle of a product (good or service) in a specified application.*”

In this context, greenhouse gas emissions are understood as all gaseous materials for which a Global Warming Potential (GWP) coefficient was defined by the Intergovernmental Panel on Climate Change (IPCC). The life cycle of a product encompasses the whole value chain – from the acquisition and transportation of raw materials and primary products over production and distribution to the use, recycling and disposal of the product. The term “product” is used as a generic term for goods and services.

The project initiators and participating companies regard the international standard for life cycle assessment (ISO 14040 and 14044) as the basic methodological framework for determining a product carbon footprint. Moreover, this standard is the most important foundation of the British PAS 2050 as well as of the above-mentioned dialogue processes of the ISO and the World Business Council for Sustainable Development/World Resources Institute.[3] Therefore, within the scope of the pilot project, ISO 14040/44 constituted an essential basis for the work carried out on methodologies and thereby for the case studies themselves.

Many of the basic methodological conditions of ISO 14040/44 can be applied in the case of the PCF methodology, but several have to be adapted. Some terms of reference of the ISO 14040/44 are loosely formulated, making it necessary to examine whether it is possible to develop less ambiguous terms of reference which have a comprehensive or product group-specific foundation. This would simplify the comparability of different PCF studies. In addition, within the course of the case studies, the significance of PCF compared to other environmental impacts in the product life cycle was analysed in varying detail. From the perspective of the PCF Pilot Project, this analysis is crucial to the securing of decisions and approaches to communication, which are made and developed on the basis of PCF. Furthermore, creating clearer terms of reference constitutes one of the greater methodological challenges in this context, also in respect of international harmonisation and all applications where public communication of the PCF is intended.

Each participating company selected at least one product from its portfolio for which a PCF was determined. In this way, methodological frameworks or rules of interpretation regarding the ISO 14040/44 could be practically tested using a specific case study. In turn, specific methodological issues also emerged from the case studies. The broad spectrum of products

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[3] With regard to the WBCSD/WRI process, a final decision has not yet been taken. However, it can be assumed, given the current status of the discussion, that a decision on the ISO 14040/44 will be taken in the coming weeks.

selected for the case studies made for a comprehensive discussion. The involvement of companies from very different sectors in the PCF Pilot Project was challenging but also fruitful, constituting an essential prerequisite for the development or optimisation of a methodology which could be used as broadly as possible. The case study Schauma 7 Kräuter Shampoo by Henkel constituted an important component of the project, on the basis of which – together with the diverse experiences gathered in terms of carbon footprinting – the findings and recommendations were developed according to the project objectives.

The most important results of the pilot project are summarized in a paper entitled "*Product Carbon Footprinting – Ein geeigneter Weg zu klimaverträglichen Produkten und deren Konsum? – Erfahrungen, Erkenntnisse und Empfehlungen aus dem Product Carbon Footprint Pilotprojekt Deutschland* ". This paper, along with much more information on product carbon footprinting and the PCF Pilot Project, can be found at: www.pcf-projekt.de

The work carried out within the pilot project should not be understood as the final word on the determination and communication of product carbon footprints. Therefore, the project partners are happy to receive intensive feedback from interested stakeholders, also with regard to the case study presented in the following. Based on this feedback and the project findings, the project initiators and partners wish to actively support international debates on the harmonisation of product carbon footprinting by virtue of their findings. Only in this way, with the help of an internationally accepted standard, can PCFs be determined, assessed and reliably communicated in a uniform and comparable fashion.

Düsseldorf, January, 26 2009

2 Executive Summary

The calculation of the Product Carbon Foorprint within the German pilot project confirmed the results of former life cycle assessments carried out by Henkel. The results of this case study clearly show that the use phase has the most significant impact on the total greenhouse gas emissions. During the use phase, parameters temperature and water usage are the main drivers for the emission of greenhouse gases and are therefore the best leverage for the reduction of the total carbon footprint. These parameters should be in the focus of further product improvements as well as communication measures. The following figure shows the results of three considered scenarios: average, intensive and sensible with respect to the climate change related behaviour of a consumer.

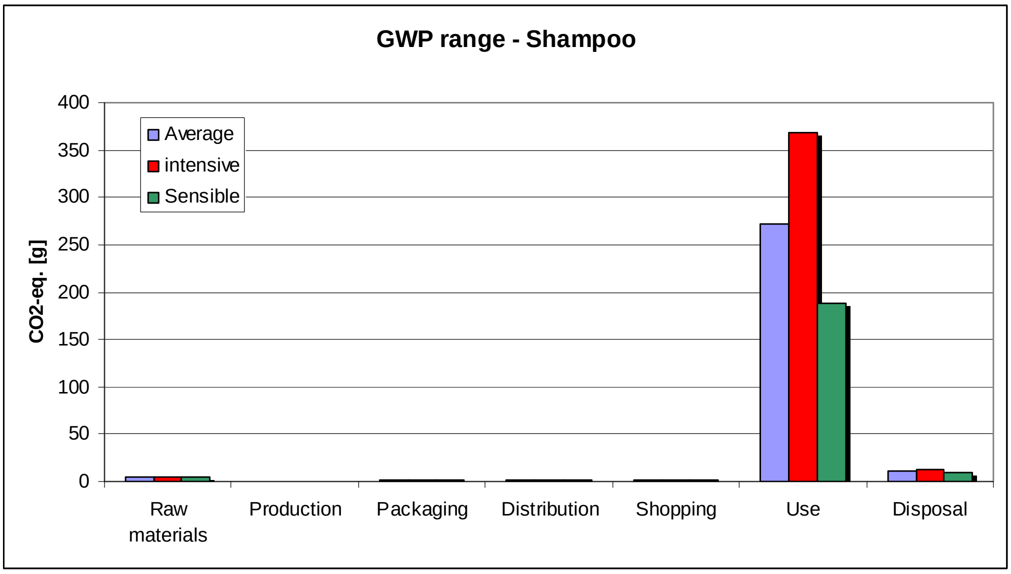

Fig. 1: Impact of all lifecycle stages of a shampoo on the climate change potential considering three scenarios

3 Company's Profile

For more than 130 years, Henkel has been a leader with brands and technologies that make people's lives easier, better and more beautiful. Henkel operates in three business areas – Home Care, Personal Care, and Adhesives Technologies – and ranks among the Fortune Global 500 companies. In fiscal 2007, Henkel generated sales of 13,074 million euros and operating profit of 1,344 million euros. Our more than 55,000 employees worldwide are dedicated to fulfilling our corporate claim, "A Brand like a Friend," and ensuring that people in more than 125 countries can trust in brands and technologies from Henkel.

Henkel considers climate change as a complex environmental issue and one of the global challenges of our time. As part of our commitment to sustainability, we take the reduction of our worldwide greenhouse gas emissions very seriously.

In addition to optimizing our own production processes, we focus on creating products and technologies that can be applied in an energy-saving manner by our customers and consumers. Through our activities we contribute to the more efficient utilization of energy resources worldwide and hence to climate protection.

At the same time, we try to influence the behavior of customers and consumers through targeted communication. Involving consumers in the debate on climate change will be crucial if we are to achieve substantial progress with regard to climate protection.

Sustainable development needs a systematic approach. As early as the 1990s Henkel started to carry out life cycle assessments. To enable us to assume responsibility as comprehensively as possible, our experts analyze and evaluate our products “from the cradle to the grave,” with the aim of further improving safety and environmental compatibility in all phases of the product life cycle. Improvement measures should be applied, in particular, at the points where the consequences for the environment are especially relevant and improvements can be realized efficiently.

4 Organisation and Procedures

The shampoo case study was carried out by our experts for life cycle assessments in close cooperation with the experts in our research and development department, in the production and packaging as well as the administration.

Goal and scope of the study was defined together with the business unit. There were no external partners involved in calculating the case study. The Öko-Institut carried out the critical review of the case study.

5 Goals and Scope

5.1 Objectives of the Case Study

As importance of communicating information on carbon dioxide emissions and intensity along value chains is increasing while there is no standardized and broadly accepted methodology for product carbon footprinting (PCF), we are participating in the German PCF pilot project.

In order to promote and contribute to the development of a scientifically sound and robust methodology for measuring carbon footprints, Henkel will bring to the discussion years of experience in the evaluation and optimization of products and processes, e.g. based on life-cycle-assessments. The calculation of a carbon footprint based on the methodology outlined in the PAS 2050 is also a good opportunity to test the PAS 2050 in practice. Thereby we aim to contribute to the further development of the methodology by feeding our results back into the international discussion and standardization process.

We will furthermore use our experience in B2B and B2C communications to develop sensible tools to convey PCF results to our customers and consumers and to enable them to consider climate-friendly options when purchasing and using our products.

Within the pilot projects, the four executing organizations as well as the participating companies offer a unique opportunity to jointly work on a robust methodology and suitable communication concepts. By participating in the project, we aim to contribute to the international harmonization of the PCF methodology and the enhancement of communication tools.

This case study was chosen in particular to gain deeper insight and resilient knowledge on the carbon footprint of our hair shampoo. Furthermore, the objective of the case study was to create transparency of the CO_2-emissions along the value chain and to find potential leverages for process optimizations and product improvement.

5.2 Product Selection and Definition of the Functional Unit

The Hair Care segment is the most important product category of Henkel's Beauty and Personal Care business unit. The Schauma shampoo is a well-known brand which serves as a good example for many other toiletries which represent a considerable part of our consumer goods business. Additionally, the Schauma shampoo case study is of particular interest for Henkel because it addresses the importance of the use phase for the calculation of the Product Carbon Footprint.

The functional unit is one application of Schauma shampoo as part of taking a shower.

5.3 System Boundaries

The study takes a "cradle to grave" approach. The following seven lifecycle phases are covered:

- Raw materials
- Production
- Packaging
- Distribution
- Shopping
- Use
- Disposal

The general material flows are considered as indicated in figure 2.

As the PAS 2050 proposes to consider also emissions from e.g. company-headquarters we estimated the influence of such overhead activities. Our approach included the evaluation of all material and energy consumption and corresponding emissions from activities related to the shampoo (R&D, Marketing, Administration) in addition to the main value chain. As a result we came to the conclusion that the overhead emissions contribute significantly less than 0.1% to the overall emissions throughout the complete lifecycle. These figures are therefore not considered within the analysis.

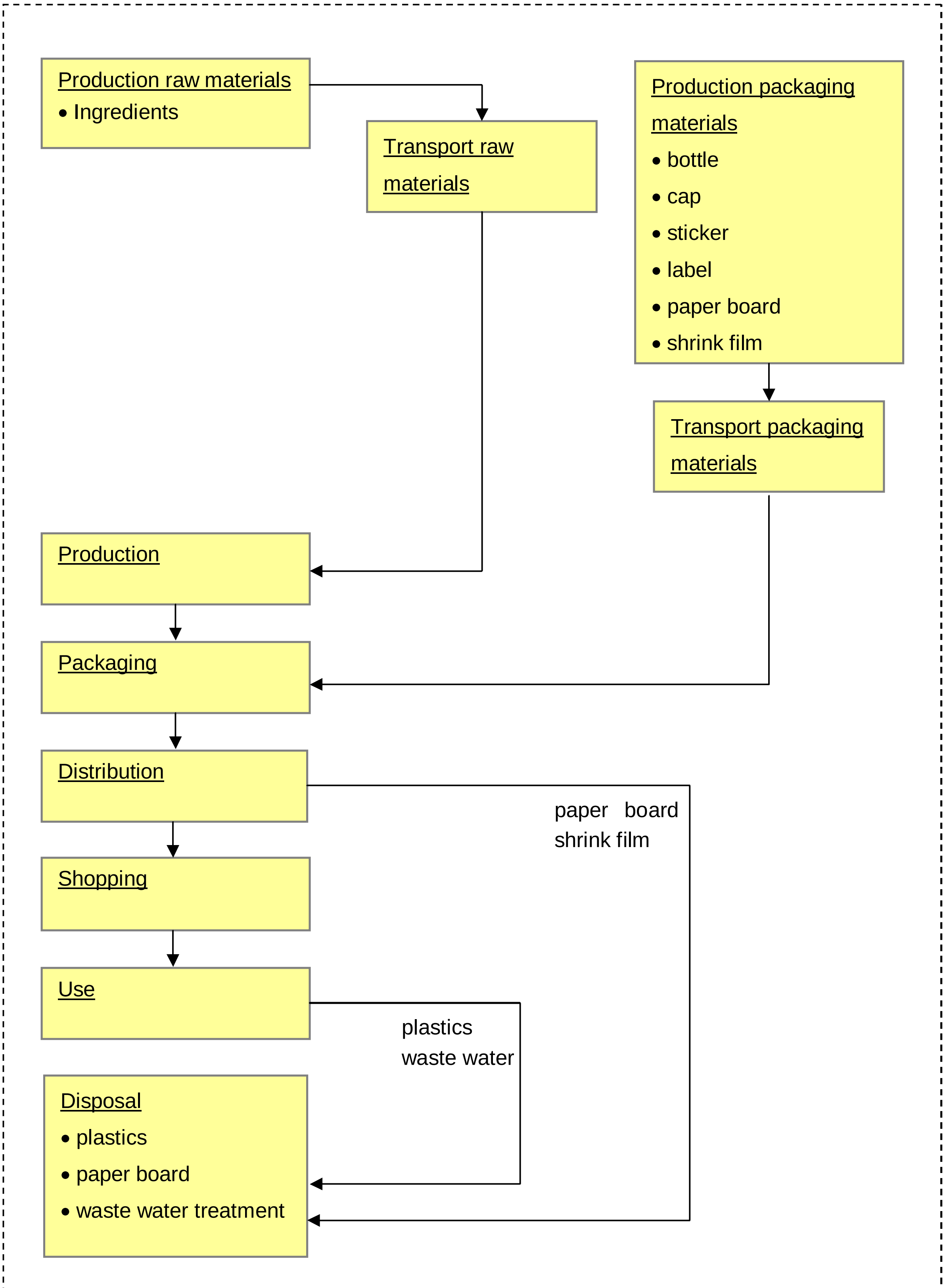

Fig.2: Material flows within the system boundaries

5.4 Data Sources and Data Quality

The majority of data and emission factors are of secondary origin. Primary data are used in case of some of the ingredients of the shampoo. The amount of energy and water used during the production of the shampoo represents the real situation at our production plant.

The source of secondary activity data and emission factors used within this study is the ecoinvent database ver. 2.01.

Mainly the materials and processes required for the study were found as such within the database. Even though these data do not reflect the authentic situation they at least represent average data or similar processes.

The applied data represents as far as possible the situation in 2007. However, no significant changes are expected for 2008 and the time being. The study is focussed on Germany as geographical scenario.

Independent from their contribution to the total emissions we considered all materials and processes if there were either primary or secondary data available. In case the contribution of certain materials or processes was estimated to be less than 1% with respect to the total lifecycle and if there were no data available these materials and processes were left out. All other data were scaled up to 100% accordingly.

5.5 Allocation

In principle allocation was done according to the mass or the energy content.

In general emissions from waste or waste water and its treatment were allocated to the functional unit and reported with the “disposal phase”. However we assumed the generation of electricity during the incineration of waste. For the total amount of electricity coming out of the incineration process a GWP-credit was calculated using the electricity-mix for Germany as given in the respective ecoinvent module.

Due to the lack of data we could not consider the recycling of e.g. packaging materials.

Henkel bought certificates from the “Renewable Energy Certificates System” (RECS) to cover the required electricity used in the production process. These certificates were not considered in the standard scenarios. Instead we applied a sensitivity analysis in order to evaluate the possible influence of such certificates.

6 Inventory and Calculation

In order to maintain as much primary data as possible, we have involved one of our main suppliers of raw materials. Up to now we did receive one data module from this company containing aggregated values for the production of one ingredient. These data are applied in the material flow network as transition.

The material flow network was set up with the software tool "umberto" ver. 5.5. We applied the database "ecoinvent" ver. 2.01 as source for secondary data, emission factors and evaluation methods.

6.1 Extraction of Raw Materials

The "raw materials" phase considers the ingredients of the shampoo, as far as possible all downstream activities related to their production and their transportation to the Henkel production facility.

One of the main components of the shampoo is water which is delivered as tap water by the local municipal utility.

Further on the shampoo consists of several complex tenside mixtures which basically descend from palm kernel, palm and coconut oil. Processes involved in the production of these tensids are amongst others sulfating and ethoxylation.

To a minor extend there are also organic acids, herb extracts and perfumes contained in the shampoo.

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About 7.5% of the data used for calculating the greenhouse gas emissions of the raw materials phase are primary data. We received these data from the respective supplier. Accordingly the share of primary data is relatively small. However, it must be taken into account that the formulation consists of more than 70% of water. Due to a lack of information from the local water suppler, secondary data was used for calculating the GWP of the tap water.

For some ingredients of the shampoo, which together account for 18.5% of the total formulation, we needed to work with assumptions. These assumptions were based on process descriptions as published e.g. in "Ullmanns Encyclopedia of industrial chemistry" or "Römpp Lexikon Chemie" and analysing partial processes on respective data provided by the "ecoinvent" database. All relevant transportation steps are considered including the delivery of the palm- and coconut based raw materials from the Asia-Pacific region.

We did not consider some ingredients, which altogether account for approximately 1% of the total formulation since there were no data available and we did also not see the chance to make reasonable assumptions. This was especially true in case of certain extracts and perfumes. All other raw materials were scaled up accordingly to 100%.

Due to the necessity of working with assumptions the possible co-production of materials together with the ingredients of the shampoo could not be covered.

With respect to the primary and secondary packaging materials we also needed to work with data from the “ecoinvent” database. The primary packaging consists of bottle, cap, sticker and label made from polypropylene or polyethylene. For secondary packaging shrink film and corrugated paper board is needed. Shipping units typically are stacked on wooden EUR flat palettes. Our suppliers informed us about the basic production technology for the packaging parts. The applied processes are injection moulding and extrusion in case of the plastics parts. Data for the materials itself and the processes were taken from the “ecoinvent” database.

From some processes we know that waste water accumulates. In the material flow network this waste water is directed to a waste water treatment process where the complete waste water of all lifecycle phases is purified. Emissions due to this step are allocated to the functional unit and reported within the “disposal” phase.

6.2 Production

Once all ingredients of a shampoo are delivered to the production facility the batchwise production process can start. The main technologies applied are mixing and pumping. Several stock solutions are generated before these pre-mixes are pumped together with all remaining ingredients into mixing vessels. The final product is delivered afterwards to the filling station.

There is a cleaning step involved after each batch which requires only water as cleaning agent.

There are several materials needed for the production process. In particular this is electricity, natural gas and water. Further on there are direct CO_2 and NOx emissions to air to be considered. The data applied within this study cover the production average in 2007. The ecoinvent data data modules “electricity mix, Germany” and “natural gas, at consumer” are used for the electricity and natural gas consumed. Henkel bought “Renewable Energy Certificates System” (RECS) which cover the complete electricity consumed in this production site. As already mentioned this is not included in the calculation of the standard scenario. We have done a sensitivity analysis in order to evaluate the influence of such certificates.

Solid wastes are collected and delivered via lorry to the local municipal waste incineration plant. The delivery and the incineration are covered. Waste water is considered to be purified in a municipal waste water treatment, class 2. The disposal of these two kinds of waste are allocated to the functional unit and reported within the "disposal" phase.

After the filling process bottles are aggregated to so called shipping units with shrink film and paper board and palletized on a EUR flat palette. The shampoo is then ready to be distributed.

6.3 Distribution

The shampoo is distributed via lorry first to an intermediate storage, then to the storage facilities of our direct customers (retailer) and from there to the point of sale (e.g. supermarket). The distance from our production site to the intermediate storage facility is approximately 420 km. We assume additional 500 km as sufficient to cover the following two transportation steps. In total 920 km transportation via lorry is implemented in the material flow network.

We have applied a conservative approach by assuming that the truck fleet on average is just in compliance with the EUR 3 standard.

The data applied for the calculation are taken out of the "ecoinvent" database without any modification. This means that a loading ratio of only 50% on average is assumed.

Due to the lack of data the energy consumption of the storage facilities is not considered.

After the distribution phase the product is available for the end consumer in shops. The secondary packaging materials (corrugated paper board, shrink film, palette) are not needed anymore and carried over to disposal or re-use (in case of the palette).

6.4 Shopping Tour

Consumers typically do not buy only a shampoo once they visit a supermarket or shop. Therefore an average amount of 20 kg of purchased goods is assumed. Since one bottle of shampoo has a weight of roughly 400 g we took a 2% allocation based on mass into consideration.

Further on the assumption is that a consumer on average drives 5 km with an average car to the shop or supermarket and also 5 km back. The total considered distance is therefore 10 km.

The applied data were taken from the "ecoinvent" database.

6.5 Product Use

The product use is defined as the hair wash and according to the functional unit we analyze one application of 7 g shampoo. Since there are no statistical data and also no product category rules available all specifications are based on assumptions or publicly available estimations. These assumptions shall reflect the typical behaviour of end consumers. If this behaviour is subject to changes in one or the other direction the calculated figures can change significantly. This issue is covered at least partially by the application of the following three different scenarios:

	Water consumption [l]	Shower temperature [°C]
1. climate average	22,5	40
2. climate intensive	27	43
3. climate sensible	18	37

Regarding the usage of the shampoo first of all we assume that hair washing is part of taking a shower. In order to wash the hair a consumer needs shampoo, water and a heating technology to heat the water up to a convenient temperature. The provision of the shampoo is part of the implemented downstream processes. The water is considered to be provided by a local municipal utility as tap water. The heating technology is mapped based on statistical data describing the share of different energy carriers in Germany [Schoer et al., 2006]. Based on this information and on the known energy content of the different materials it was possible to calculate which amount of the different energy carrier within this energy mix is necessary to heat up 1 kg of water by 1°. Since the temperature difference is important we further on assumed that the temperature of the water as it enters the house is at 18°C. This is in accordance with data describing the average temperature of soil in a depth of 1 m to be 18°C.[www.bkg.bund.de].

The use phase generates waste water and solid waste which consists of the primary packaging materials.

We have estimated the content of the waste water regarding certain tensides and parameters like biological oxygen demand and chemical oxygen demand. This estimation led to the conclusion that the applied amount of shampoo per hair wash does not influence the composition of the waste water negatively. Therefore the waste water from the use phase is treated like normal domestic waste water. The purification is carried out in a municipal waste water treatment plant.

The disposed plastics materials are assumed to be incinerated in a municipal waste incineration plant.

The treatment of the waste water and solid waste is allocated to the functional unit and reported within the “disposal” phase.

6.6 Recycling/Disposal

During the lifecycle of the shampoo there are several stages generating solid waste or waste water respectively.

We assume the waste water to be similar to typical domestic waste water since there are no exceptional substances or amounts of substances contained within. Due to our estimation the waste water produced during the use of the product can even be seen as diluted average domestic waste water. We therefore applied ecoinvent data describing the purification of waste water in a municipal waste water treatment plant, class 2.

As solid waste basically the primary and secondary packaging materials accumulate. In reality a certain share of these materials is collected and recycled. Unfortunately there are no data available describing the recycling processes and the burdens connected with these processes. Therefore we decided not to consider the recycling option for any material. Instead all waste materials are considered to be incinerated in municipal waste incineration plants. There are specific ecoinvent transitions available for the incineration of the different materials (paper, polypropylene, polyethylene). These transitions are applied in the material flow network. There is a transportation step of about 100 km considered for each waste material reflecting the collection of waste and the delivery to the incineration plant.

Waste incineration typically results not only in incinerated waste but also in heat and/or electricity. In our calculation we have allocated 100% of the burdens to the incinerated waste which in turn is connected to 100% to the functional unit. In addition we assume that there is electricity generated and supplied to the German electricity network by the incineration. We considered average amounts of electricity to be produced during the incineration since no specific figures are available for certain plastics. However the energy content of plastics is much higher than that of average waste. In this respect our approach can be seen as a conservative one.

We have calculated a GWP credit based on the generated electricity by applying the emission factors from the electricity mix in Germany as it is provided by ecoinvent. This credit was accounted to the packaging materials as they represent the largest share of incinerated materials.

7 Presentation of Results*

7.1 Overview

Figure 3 shows the carbon footprint related to the functional unit of one hair wash in an average scenario expressed in g CO_2-equivalents. The total amount of greenhouse gases released in this scenario is about 290 g.

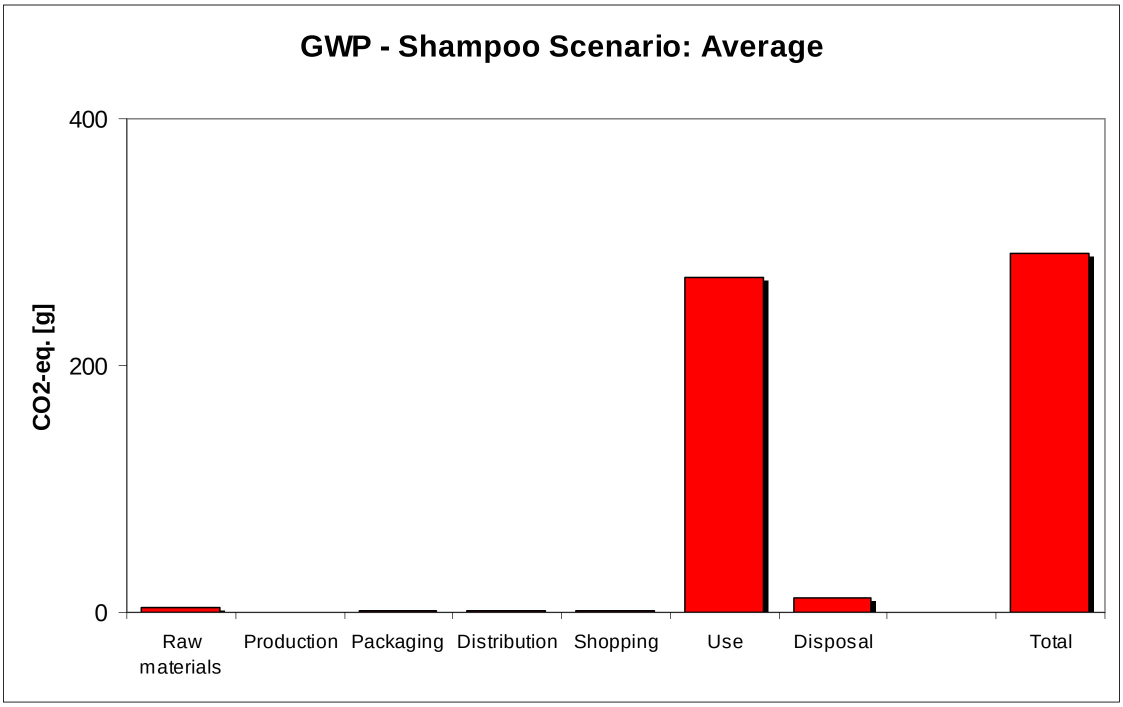

Fig.3. Global Warming Potential of the different lifecycle phases according to the average scenario for the Schauma shampoo

By far the largest share of greenhouse gas emissions is due to the use phase which accounts for more than 90% of the total emissions. The following table 1 shows the individual shares of each lifecycle stage. The disposal phase is with roughly 4% the second most important phase followed by the extraction of raw materials.

The importance of the disposal phase is mainly due to the waste water treatment which represents more than 80% of the emissions of the disposal phase.

* best guess

Table 1: The share of greenhouse gas emissions per lifecycle phase in percent

<table>
<tr><th>Lifecycle stage</th><th>Share of greenhouse gas emissions [%]</th></tr>
<tr><td>Raw materials</td><td rowspan="5">~ 2,5</td></tr>
<tr><td>Production</td></tr>
<tr><td>Packaging</td></tr>
<tr><td>Distribution</td></tr>
<tr><td>Shopping</td></tr>
<tr><td>Use</td><td>~ 93,5</td></tr>
<tr><td>Disposal</td><td>~ 4</td></tr>
</table>

It must be stated that the use phase is not only the lifecycle stage with the most significant importance but it is also the phase with the most significant uncertainties. The calculations are based on assumptions on how consumers wash their hair. Slight variations with respect to these assumptions will lead to significant changes concerning the related emissions. We have tried to address this issue by calculating different use-scenarios as indicated in chapter 8 “Assessment of the results”.

7.2 Extraction of Raw Materials

<u>Raw materials</u>

About 7.5% of the data used for calculating the greenhouse gas emissions of the raw materials phase are primary data. This is mainly due to the fact that water is the most important ingredient and that there are no primary data available from the local water supplier.

In case of roughly 19% of the ingredients we needed to work with assumptions as already indicated in chapter 6 “Extraction of raw materials”. These assumptions are probably the main source of uncertainties.

Not considering the water there is just one particular ingredient which accounts for more than 60% of raw material related emissions. This ingredient should be under consideration if an optimization of the raw material phase is intended. It must be stressed however that such an optimization of the applied raw materials is not going to contribute noteworthy to the overall greenhouse gas emissions throughout the total lifecycle.

Packaging materials

All relevant parts of the primary and secondary packaging are considered with their actual required amounts. As already mentioned above we needed to work with secondary data regarding the packaging plastics as well as the secondary packaging like paper board and shrink film. For the production technologies like extrusion or injection moulding moulding also secondary data were applied. The packaging is reported as a separate lifecycle stage in addition to the proposed standard phases.

7.3 Production

With respect to the climate change potential the production of the shampoo might almost be neglected. It comprises significantly less than 1% of the total emissions. The reason for this is the relatively simple process technology which requires only the operation of pumps and mixing devices.

Uncertainties might derive from the fact that only overall energy data are available not distinguishing between particular pumps or engines.

7.4 Distribution

The distribution of the final product is realized by lorry. In order to stick to our rather conservative calculation approach we considered the transportation with trucks which on average comply with the EUR 4 emission standard. We used unmodified ecoinvent data implying an average loading of 50%. Under these circumstances again significantly less than 1% of the overall global warming potential is due to the distribution.

7.5 Shopping Tour

The end customer is assumed to drive to the shop or supermarket with an average car in order to buy amongst other goods also the shampoo. Even though the share of the shampoo is only 2% of the total purchases of 20 kg this shopping tour accounts for nearly the same climate change potential as does the complete distribution. A share of less than 0,5% of the overall global warming potential is therefore caused by the end consumer’s shopping tour.

7.6 Product Use

With approximately 94% of all greenhouse gas emissions the use phase is by far the most important lifecycle stage. About 270 g of climate change related gases are released due to an average hair wash. The most important drivers are the water consumption and especially the process of heating up the water. The applied data with respect to the heating technology represents the average data of applied energy carriers in Germany.

Currently there is no product category rule available. Therefore the calculation is based on assumptions on the hair wash behaviour of consumers. It must be stressed that in general the contribution of the use phase is very closely related to these. Small variations with respect to the applied temperature or the consumed amount of water result in very different figures for the total carbon footprint.

7.7 Disposal/Recycling

The "disposal" phase comprises roughly 4% of the total greenhouse gas emissions and is the second most important lifecycle stage. Main driver is the waste water purification. More than 80% (approximately 10 g) of the CO_2-equivalents released in total during the disposal stage can be allocated to the waste water treatment in an average scenario.

Since there were no recycling data available all materials to be disposed or recycled were assumed to be transferred to waste incineration. A credit was calculated since waste incineration processes typically generate heat and/or electricity. The overall figure might change however when data regarding the recycling of plastics and/or paper board are available.

8 Assessment of the Results

8.1 Sensitivity Analysis

Renewable Energy

As already mentioned Henkel bought RECS certificates which cover the electricity needed during the production process. These certificates are not considered within the standard scenario. However, we have estimated the impact by replacing the consumed electricity at our production plant accordingly. If the production is considered in isolation this leads to a significant reduction of its global warming potential. Due to the marginal contribution of the production to the complete lifecycle the total GWP would only be reduced by 0.02%.

Use phase assumptions:

Since there is no Product Category Rule available we have evaluated a GWP range by applying different scenarios. These scenarios differ with respect to the assumptions describing the use phase.

As a result of this evaluation it must be stated that a consumer who is not much concerned about climate change will contribute nearly twice as much to the GWP/greenhouse gas emissions in comparison to a conscious consumer.

Such different behaviour affects mainly the use phase and to a certain degree also the disposal phase. Figure 4 shows the GWP impact in the different lifecycle stages of the three applied scenarios.

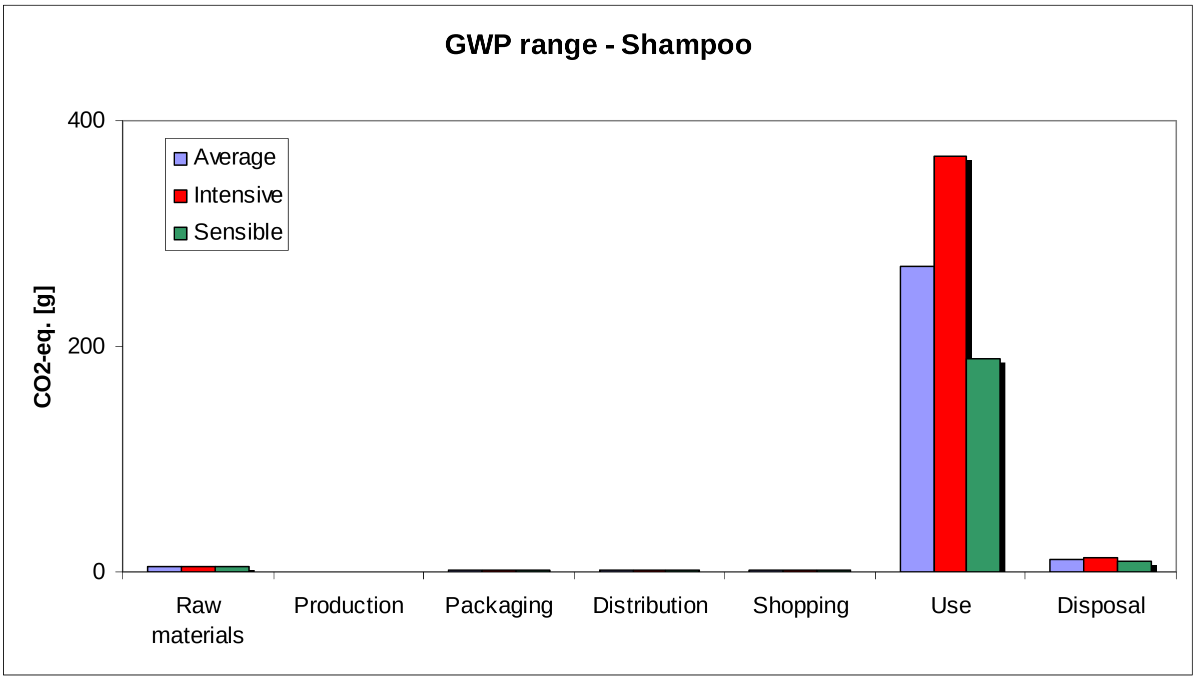

Fig. 4.: Comparison of the Global Warming Potential expressed as CO2-equivalents of three different scenarios throughout the complete lifecycle

Global Warming Potential Credit:

As mentioned above there was a GWP credit calculated to consider the fact that during the incineration process electricity is generated and supplied to the German electricity network. This credit was calculated to be 0.15 g CO_2-equivalents in case of all three scenarios. The basis for the calculation was the electricity mix in Germany as reported in the respective ecoinvent data module.

Since there are mainly packaging materials incinerated the credit was accounted for the separate “packaging” lifecycle stage. The total greenhouse gases released due to the packaging is reduced by less than 10 %. Taking into account the complete lifecycle this reduction can almost be neglected. However it shall be stressed that there are no data available describing the possible electricity production by the incineration of plastics. Therefore our approach is a conservative one.

8.2 Handling of other Environmental Impact Categories

Obviously the Global Warming Potential is just one aspect of environmental impacts a product or process can have. Attention should be paid also to other impact categories beside the GWP in order to design a study not to narrow. This seems to be especially important because some stakeholders intend to establish the carbon footprint as a tool for the consumer to compare products from similar product categories. For comparative reasons the respective study should document that a potentially low carbon footprint did not come about on the cost of higher other environmental impacts. In this study we decided to evaluate three additional environmental impact categories:

- Water consumption
- Human toxicity potential
- Eutrophication

In figures 5 – 7 the impact of one hair wash on these environmental categories is shown.

The calculations are based on the assumptions described for the average scenario.

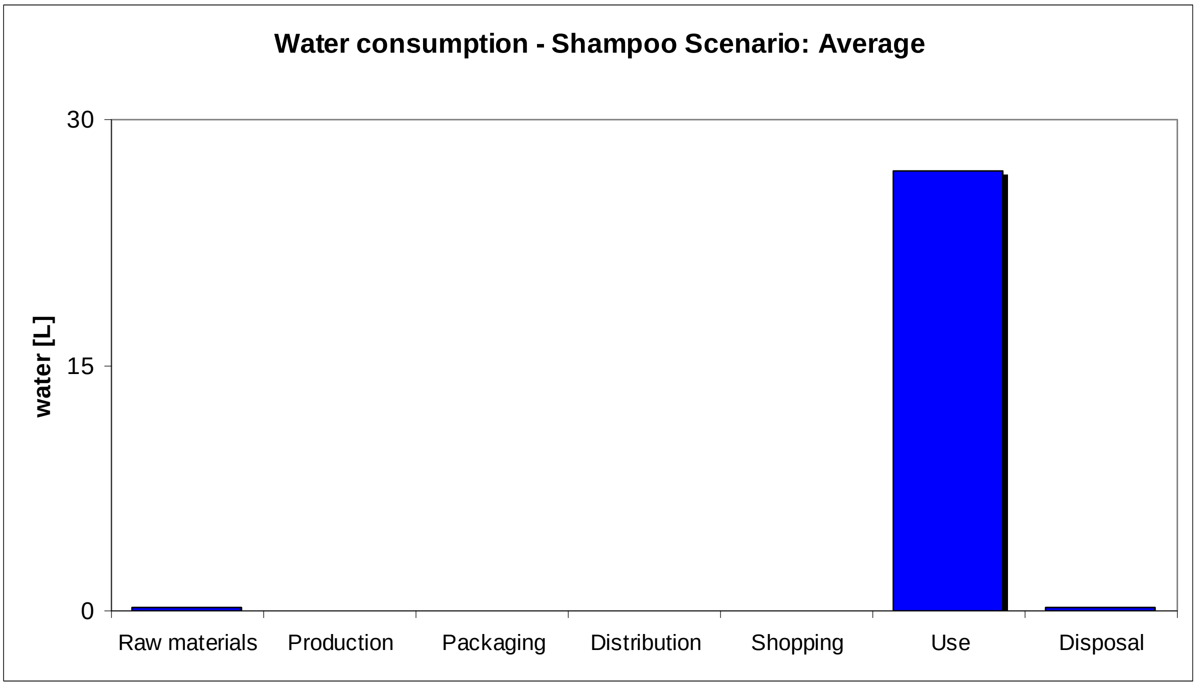

Fig. 5: Water consumption during the complete lifecycle related to one hair wash

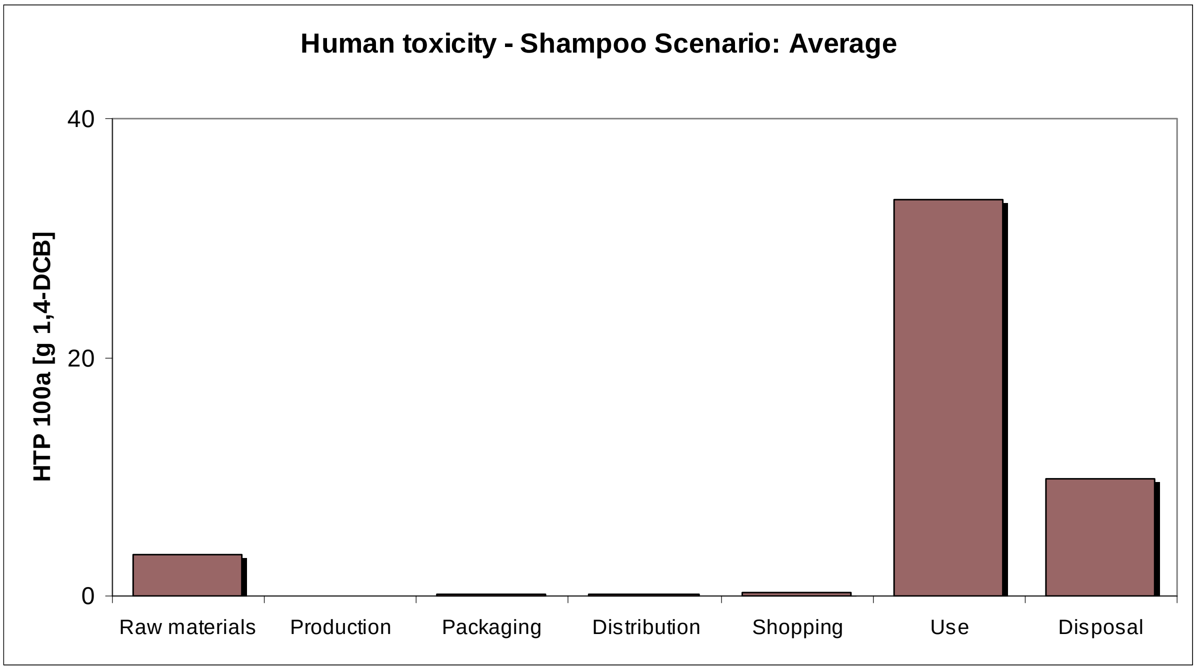

Fig. 6: Human toxicity during the complete lifecycle related to one hair wash.

The toxicity or eutrophication potential must be seen as the result of e.g. the provision and utilization of energy carriers. Following the idea of lifecycle assessment it is typically not related to direct properties of e.g. the shampoo ingredients.

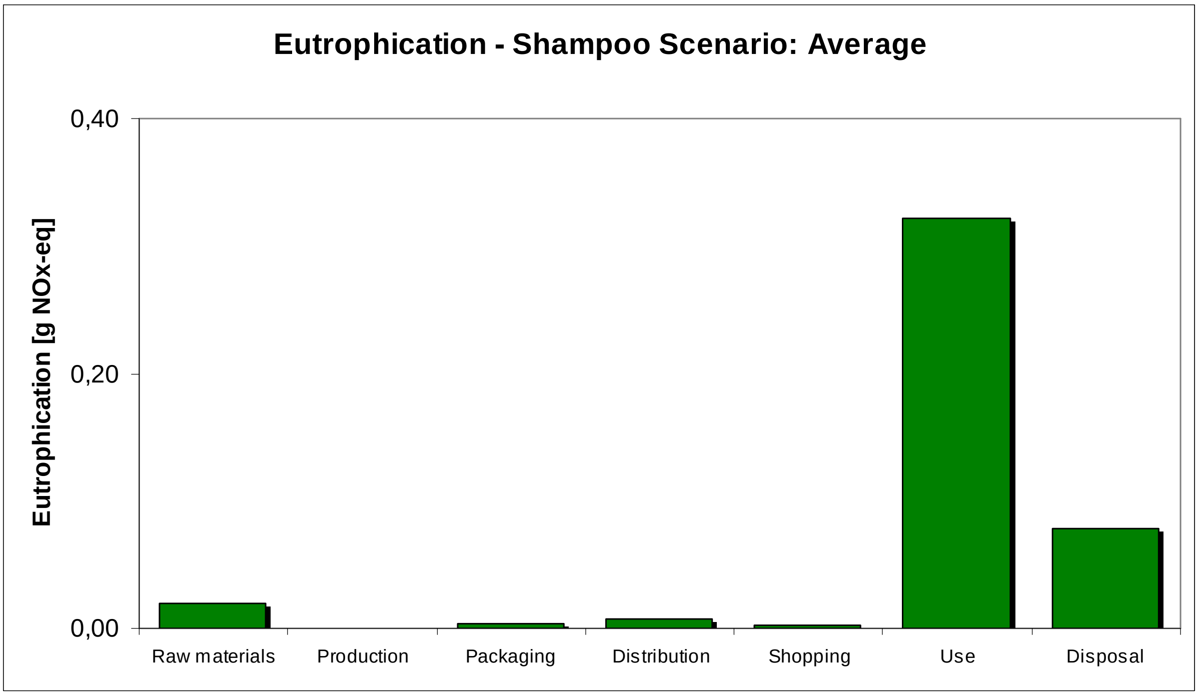

Fig. 7: Eutrophication potential during the complete lifecycle related to one hair wash

The impact assessment was done using the method of CML which is provided by the ecoinvent database [Guinée et al., 2001].

Overall the same distribution of impacts throughout the different lifecycle phases can be observed as for the Global Warming Potential. Again the use phase is the most important lifecycle stage followed by the disposal. In other respects only slight variations are to be observed.

It will be important to refer to these data if it comes to the comparison of different products or if some aspects of the lifecycle of our shampoo are subject of change.

9 Interpretation and Perspectives

9.1 Challenges of the Case Study

In the course of the study it turned out that very often primary data are quite difficult to get. The availability depends on the (LCA) know-how along the whole supply chain. In addition suppliers often have confidentiality concerns and typically lack options to provide their data in a non critical form e.g. by aggregating data from a number of sources. They don't share any original data e.g. energy data with us because they treat these data as confidential.

The outcome of a study therefore depends very much on the content and quality of commercially available databases like ecoinvent.

Logistics processes are difficult to assess due to complex business structures involving contractors and their sub-contractors as well. There is virtually no tracking in place in order to capture e.g. really driven distances instead of theoretical ranges. Further on there is nearly no information about the vehicle fleet and whether or not the vehicles comply with certain EU standards regarding their emissions to air.

Such a study is extremely time and resource consuming. It seems to be not feasible to make such an effort for every product a company might have. Especially for smaller companies this is not possible.

9.2 Identification and Assessment for Further Reduction Options of the PCF

The outcome of this study indicates that the most important lifecycle stages with respect to the carbon footprint can hardly be influenced by the manufacturer of the shampoo.

With respect to this finding the results should be considered as an opportunity to communicate to the customer the consequences of his own behaviour and decisions.

9.3 Measures under Consideration to Further Reduce the PCF

As a manufacturer of non-durable consumer products and industrial products and technologies our operations are not particularly energy and greenhouse gas intensive. Energy consumption and the associated carbon dioxide emissions during the use of our products are usually more significant. We therefore focus on creating energy efficient products and technologies while also optimizing our own production processes. This includes a continuous improvement also of our logistics together with business partners. We also evaluate relevant raw materials with regard to their cleaning performance and thus their influence on the Carbon Footprint of our detergents.

Furthermore, we set ourselves the company-wide target to reduce energy consumption and thus the related greenhouse gas emissions by 15 % in 2012 compared to a 2007 baseline.

10 Recommendations

10.1 International Methods for Calculation and Assessment of Product Carbon Footprints

If it really comes to comparisons of similar products in terms of their carbon footprint the existing standards are not sufficient. Even though it is also a lifecycle approach the existing standards like ISO 14040ff offer to much latitude. An international standard addressing the most important issues supplemented with product category rules is required.

10.2 Proposals for Product Specific Definitions and Rules (EPD, PCR)

Due to the importance of the use phase in case of a shampoo a framework of conditions (PCR) is required in order to specify this important lifecycle stage. Without a product category rule the comparison of carbon footprints of different shampoos is not possible.

10.3 Reporting, Communication and Claims of Reductions to Customers and Consumers

Climate change is a complex environmental issue and one of the major challenges of our time. As part of our commitment to sustainability, we focus on reducing the impact of our operations on climate change (Henkel Focal Area: “Energy & Climate”).

Involving consumers in the debate on climate change will be crucial if we are to achieve substantial progress with regard to climate protection, considering the important impact of the use phase on the overall Carbon Footprint.

However, looking at the product carbon labeling schemes currently presented in the market, we notice considerable short-comings regarding informative value, methodological background, transparency and meaningfulness.

To avoid consumer confusion, market distortion and extensive transaction costs, an internationally consolidated, scientifically robust methodology for PCF calculation and a meaningful approach to communicate PCF results will be necessary.

Overall, we consider product-related communication on climate change as useful only if it provides reliable guidance for customers and consumers to make sensible purchasing decisions and is a meaningful tool to drive more sustainable consumption.

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Annex

10.4 Documentation of the Data

10.4.1 Extraction of Raw Materials

					Data index			
Data Module (Output)	Processes covered	Time related coverage	Geographical specificity	Technological specificity	Place of reference: in-house (I), literature (L), other (O and specify)	Single value (S); aggregated value (A) and specify the percentage or absolute amount of each part	Measured (M); calculated (C); estimated (E)	Data source
Tap water	Water treatment and transportation to user		Switzerland / Germany		O	A	E	Ecoinvent, 2008
Fatty alcohol sulphate ester	Delivery of primary raw materials (palm + coconut oil), sulfating, ethoxylation		Germany		L	A	E	Ecoinvent 2008, Ullmanns Encyclopedia, 2008

Tenside mixture	**All relevant process steps including upstream processes**	**2006**	**Germany**		**I**	**A**	**M/C**	**Supplier**
Tenside mixture	**All known process steps**		**Germany**		**O**	**A**	**E**	**Ecoinvent 2008, Ullmanns Encyclopedia, 2008**
Sodium chloride	**All relevant process steps including upstream processes but w/o packaging**	**2000**	**Europe**		**O**	**A**	**M/C**	**Ecoinvent 2008,**
Organic acids	**All relevant process steps including upstream processes but w/o packaging**	**1999 - 2008**	**Europe**		**O**	**A**	**E**	**Ecoinvent 2008, Ullmanns Encyclopedia, 2008, Römpp Lexikon Chemie, 2008**
Fatty acids	**All relevant process steps including**	**1995**	**Europe**		**O**	**A**	**C/E**	**Ecoinvent 2008,**

Polypropylene	**All relevant process steps including upstream processes**	**1999 - 2001**	**Europe**		**O**	**A**	**M/C**	**Ecoinvent 2008, Plastics Europe**
Polyethylene	**All relevant process steps including upstream processes**	**1999 - 2001**	**Europe**		**O**	**A**	**M/C**	**Ecoinvent 2008, Plastics Europe**
Corrugated paper board	**Production of corrugated board and boxes out of this material**	**1995 - 2005**			**O**	**A**	**M/C**	**Ecoinvent 2008**
Extrusion	**Energy and material requirements**	**1993 - 1997**	**Europe**		**O**	**A**	**M/C**	**Ecoinvent 2008**
Injection moulding	**Energy and material requirements**	**1993 - 1997**	**Europe**		**O**	**A**	**M/C**	**Ecoinvent 2008**
Road transport	**Operation lorry + maintenance, disposal etc.**	**2005**	**Europe**	**Diesel**	**O**	**A**	**C**	**Ecoinvent 2008**

10.4.2 Production

					Data index			
Data Module (Output)	**Processes covered**	**Time related coverage**	**Geographical specificity**	**Technological specificity**	**Place of reference: in-house (I), literature (L), other (O and specify)**	**Single value (S); aggregated value (A) and specify the percentage or absolute amount of each part**	**Measured (M); calculated (C); estimated (E)**	**Data source**
Tap water	**Water treatment and transportation to user**		**Switzerland / Germany**		**O**	**A**	**E**	**Ecoinvent, 2008**
Electric energy	**Resource depletion, power plants, distribution**	**2004**	**Germany**	**Electricity mix**	**L**	**A**	**C**	**EcoInvent 2008**
Natural gas	**Extraction and transportation via pipeline**	**2000**	**Germany**		**L**	**A**	**C**	**EcoInvent 2008**

10.4.3 Distribution and Shopping tour

					Data index			
Data Module (Output)	**Processes covered**	**Time related coverage**	**Geographical specificity**	**Technological specificity**	**Place of reference: in-house (I), literature (L), other (O and specify)**	**Single value (S); aggregated value (A) and specify the percentage or absolute amount of each part**	**Measured (M); calculated (C); estimated (E)**	**Data source**
Examples								
Road transport	Operation lorry + maintenance, disposal etc.	2005	Europe	Diesel	O	A	C	Ecoinvent 2008
Operation passenger car	Fuel consumption + emissions	2005	Europe	average	O	A	C	Ecoinvent 2008

10.4.4 Product Use

					Data index			
Data Module (Output)	Processes covered	Time related coverage	Geographical specificity	Technological specificity	Place of reference: in-house (I), literature (L), other (O and specify)	Single value (S); aggregated value (A) and specify the percentage or absolute amount of each part	Measured (M); calculated (C); estimated (E)	Data source
Tap water	Water treatment and transportation to user		Switzerland / Germany		O	A	E	Ecoinvent, 2008
Electric energy	Resource depletion, power plants, distribution	2004	Germany	Electricity low voltage	L	A	C	EcoInvent 2008
Electric energy	Resource depletion, power plants, distribution	2004	Germany	Electricity medium voltage	L	A	C	EcoInvent 2008

Natural gas	**Extraction and transportation via pipeline**	**2000**	**Germany**		**L**	**A**	**C**	**EcoInvent 2008**
Heat from natural gas	**Operation of boiler**	**2000**	**Europe**		**L**	**A**	**C**	**EcoInvent 2008**
Light fuel oil	**Supply of oil including transport to end customer**	**1989 - 2000**	**Europe**		**L**	**A**	**C**	**EcoInvent 2008**
Heat from light fuel oil	**Operation of boiler**	**2000**	**Switzerland**		**L**	**A**	**C**	**EcoInvent 2008**
Heat from flat plate collector	**Use of a solar system incl. electricity for operation**	**2002**	**Switzerland**		**L**	**A**	**C**	**EcoInvent 2008**
Hard coal	**Supply of hard coal including transport to end customer**	**1977 - 1989**	**Western Europe**		**L**	**A**	**C**	**EcoInvent 2008**
Heat from hard coal	**Operation of stove**	**1988 - 1992**	**Europe**		**L**	**A**	**C**	**EcoInvent 2008**

10.4.5 Disposal/Recycling

					Data index			
Data Module (Output)	**Processes covered**	**Time related coverage**	**Geographical specificity**	**Technological specificity**	**Place of reference: in-house (I), literature (L), other (O and specify)**	**Single value (S); aggregated value (A) and specify the percentage or absolute amount of each part**	**Measured (M); calculated (C); estimated (E)**	**Data source**
Waste water treatment	Transportation, 3-stage Purification, infrastructure	1994 - 2000	Switzerland	Municipal waste water treatment, Class 2	L	A	C	EcoInvent 2008
Incineration of solid waste	Incineration, process energy, generation of electricity	1994 - 2000	Switzerland	Incineration of municipal waste	L	A	C	EcoInvent 2008
Incineration of polyethylene waste	Incineration, process generation of electricity	1994 - 2000	Switzerland	Incineration of PE in municipal WIP	L	A	C	EcoInvent 2008

Incineration of polypropylene waste	**Incineration, process generation of electricity**	**1994 - 2000**	**Switzerland**	**Incineration of PE in municipal WIP**	**L**	**A**	**C**	**EcoInvent 2008**
Incineration of paper board waste	**Incineration, process generation of electricity**	**1994 - 2000**	**Switzerland**	**Incineration of paper in municipal WIP**	**L**	**A**	**C**	**EcoInvent 2008**