Study into the development of Product Environmental Footprint Category Rules for shampoo

*Report prepared by **Quantis***

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PROJECT INFORMATION	
Project Title	Study into the development of Product Environmental Footprint Category Rules (PEFCR) for shampoo
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Liability Statement	Information contained in this report has been compiled from and/or computed from sources believed to be credible. Application of the data is strictly at the discretion and the responsibility of the reader. Quantis is not liable for any loss or damage arising from the use of the information in this document.
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Associated files	CosmeticsEurope_screening_shampoo_2016_04_08_Quantis.pdf

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Abbreviations and acronyms

CAS	Chemical Abstracts Service
CFC	Chlorofluorocarbons
CTUe	PAF.m3.d/kg emitted
CTUh	cases/kg emitted
DID	Detergent Ingredients Database
EC	European Commission
EOL	End-of-life
EFfCI	European Federation for Cosmetic Ingredients
EU 28	The European Union composed of 28 Member States
IEA	International Energy Agency
JRC	Joint Research Centre
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
m3/FU	Cubic meters per functional unit
MJ/FU	Mega joules per functional unit
NACE	Nomenclature Générale des Activités Economiques dans les Communautés Européennes
PCR	Product Category Rules
PE	Polyethylene
PEF	Product Environmental Footprint
PEFCR	Product Environmental Footprint Category Rules
PET	Polyethylene terephthalate
PP	Polypropylene
TS	Technical secretariat
UCTE	The Union for the Coordination of Transmission of Electricity
WWT	Wastewater treatment

1 Introduction

Cosmetics Europe submitted an application to participate in the European Commission's Product Environmental Footprint (PEF) pilot but was not among the selected projects. As a result, Cosmetics Europe decided to proceed with an internal "shadow" PEF, where the European Commission's PEF guidelines were followed as closely as possible. The PEF guidelines provide detailed and comprehensive technical guidance on how to conduct a PEF study. PEF studies may be used for a variety of purposes, including in-house management and participation in voluntary or mandatory programs.

This PEFCR Report describes the outcome of Cosmetics Europe's project to investigate the feasibility and relevance of establishing PEFCR for shampoo and, as such, is informed by the PEF guidelines. The Report was prepared to reflect the recommended structure for establishing Product Environmental Footprint Category Rules for shampoo.

2 General information about the PEFCR

2.1 Technical Secretariat

List of members of the Technical Secretariat.

- Henkel: Werner Schuh (Chairman)
- L'Oréal: Jean-Florent Campion (Vice-Chairman)
- LVMH: Alexandre Capelli
- Unilever: Francis Dekker, Henry King
- FEBEA: Virginie d'Enfert
- Chanel: Hélène Orliac
- Oriflame: Natasha Williams O'Hanlon
- Pierre Fabre: Laure Guiraud, Séverine Roullet
- Estée Lauder: Michael Krugman
- Cosmetics Europe: Manuela Coroama (Task Force Manager)
- Quantis: Lindsay Lessard, Simone Pedrazzini, Sebastien Humbert, Carole Dubois

2.2 Consultations and stakeholders

1st consultation (internal): a consultation based on the screening study and the 1st draft of this PEFCR Report was held. The stakeholders represented members of Cosmetics Europe, including the Technical Secretariat members. The PEFCR Report was improved based on the comments received and a 2nd draft was proposed.

2nd consultation (internal): a consultation based on the 2nd draft of the PEFCR Report was held. The stakeholders represented the wider membership of Cosmetics Europe, including the Technical Secretariat members. The PEFCR Report was further improved based on the feedback received.

3rd consultation (external): a consultation of 13 external stakeholders, based on the 2nd draft of the PEFCR Report, was conducted. This document takes into account the comments received during this consultation.

2.3 Date of publication and review

Date of publication: April 2016

Date of review: not applicable.

2.4 Geographic region

This PEFCR Report was developed within a European context and it is valid for all products within scope produced and sold in Europe. Information in this Report may be relevant for shampoo manufactured outside of Europe, but would need to be assessed on a case-by-case basis

2.5 Language(s) of PEFCR

The original language of this PEFCR Report is English. It is currently not foreseen to translate this document in other languages. The original English version supersedes translated versions in case of conflicts.

3 Methodological inputs and compliance

The PEFCR Report has been prepared using the following documents as references:

- European Commission (2013). 2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations. Also referred to as "Product Environmental Footprint Guide" or "PEF Guide";
- European Commission (2015c). Environmental Footprint Pilot Guidance document. Guidance for the implementation of the EU Product Environmental Footprint (PEF) during the Environmental Footprint (EF) Pilot Phase, v. 5.1, September 2015. Also referred to as "PEF Guidance (2015c)".
- BP X30-323-5 (AFNOR, 2011), *Methodology for the environmental impact assessment of shampoos*.

4 PEFCR review and background information

4.1 PEFCR review panel

The PEFCR Report has not been reviewed by an external review panel.

4.2 Review requirements for the PEFCR document

The PEFCR Report has not undergone a critical review.

4.3 Reasoning for development of PEFCR

This PEFCR Report has been developed based on an initiative of Cosmetics Europe and its members in order to follow and contribute to the European Commission's initiative a "Single Market for Green Products". It was not developed within an official PEF pilot but followed as much as possible the official guidelines and processes. Cosmetics Europe ultimately aims at providing for its members comprehensive and high quality guidelines for assessing the environmental impact of shampoos.

4.4 Conformity with the PEFCR Guidance

This document has been prepared in conformance with the "Guidance for the Implementation of the EU PEF during the Environmental Footprint (EF) pilot phase - Version 5.1 – September 2015".

5 PEFCR scope

This PEFCR Report addresses the product category "shampoo" for different types of hair; this may include, for example, shampoo for fine hair, greasy/oily hair, etc. The four main functions of shampoo considered are:

1. Hair cleansing (including a minimum of hair care efficacy)
2. Hair conditioning
3. Anti-dandruff activity
4. Protection of sensitive target groups (children, sensitive scalp)

From these four functions, five shampoo categories were defined, based on combinations of functions, which provide to the consumer a specific service. The environmental footprint must be compared only between products from the same category:

1. Hair cleansing
2. Hair cleansing and hair conditioning (2 in 1 product)
3. Hair cleansing and anti-dandruff activity
4. Hair cleansing and hair conditioning and anti-dandruff activity
5. Hair cleansing and protection of sensitive target groups (children, sensitive scalp)

5.1 Unit of analysis

The unit of analysis (the functional unit) considered is as follows:

A hair wash carried out in Europe (EU 28), on average length hair

The reference flow considered, i.e., the amount of product needed to provide the defined functions, is 10.46 grams of shampoo (Hall *et al.*, 2011). This amount refers to the average daily use by European consumers but may vary depending on the technology used, such as concentrated or powder product. Any change to this reference flow must be justified.

Any additional functions of shampoo (e.g. anti-dandruff, sensitive scalp, etc.), must be specified in the unit of analysis defined above. If the shampoo does not have any additional functions, only the original unit of analysis needs to be specified.

Additional information on the unit of analysis is described in Table 1.

Table 1. Key information regarding the unit of analysis

Aspect	Detail
[WHAT]	Shampoo
[HOW MUCH]	A 10.46 gram dose of shampoo
[HOW WELL]	Shampoo for average length hair, including additional functions
[HOW LONG]	One hair wash
[CPA/NACE code]	20.42.16.30

5.2 Representative product

The representative shampoo product is a virtual product defined to reflect the key functions and types of ingredients of shampoo and the most widely used packaging materials. The specific composition of the representative product is detailed in section "Annex I – Representative product". Justification of the deviations from the PEF guidelines in the choice of the representative product is described in "Annex IX – Deviations from EC Guidance and methodology".

5.3 Product classification (NACE/CPA)

This PEFCR Report covers shampoos as defined by the CPA code (Statistical Classification of Products by Activity in the European Economic Community, 2008 version):

C 20.42.16.30 "Shampoos"

5.4 System boundaries – life cycle stages and processes

The environmental assessment of the shampoo takes into account the life cycle stages shown in Figure 1, with descriptions of what is included in each life cycle stage. Concerning capital goods for the manufacturing stage, only the building is included in the scope of the study; all other capital goods are excluded.

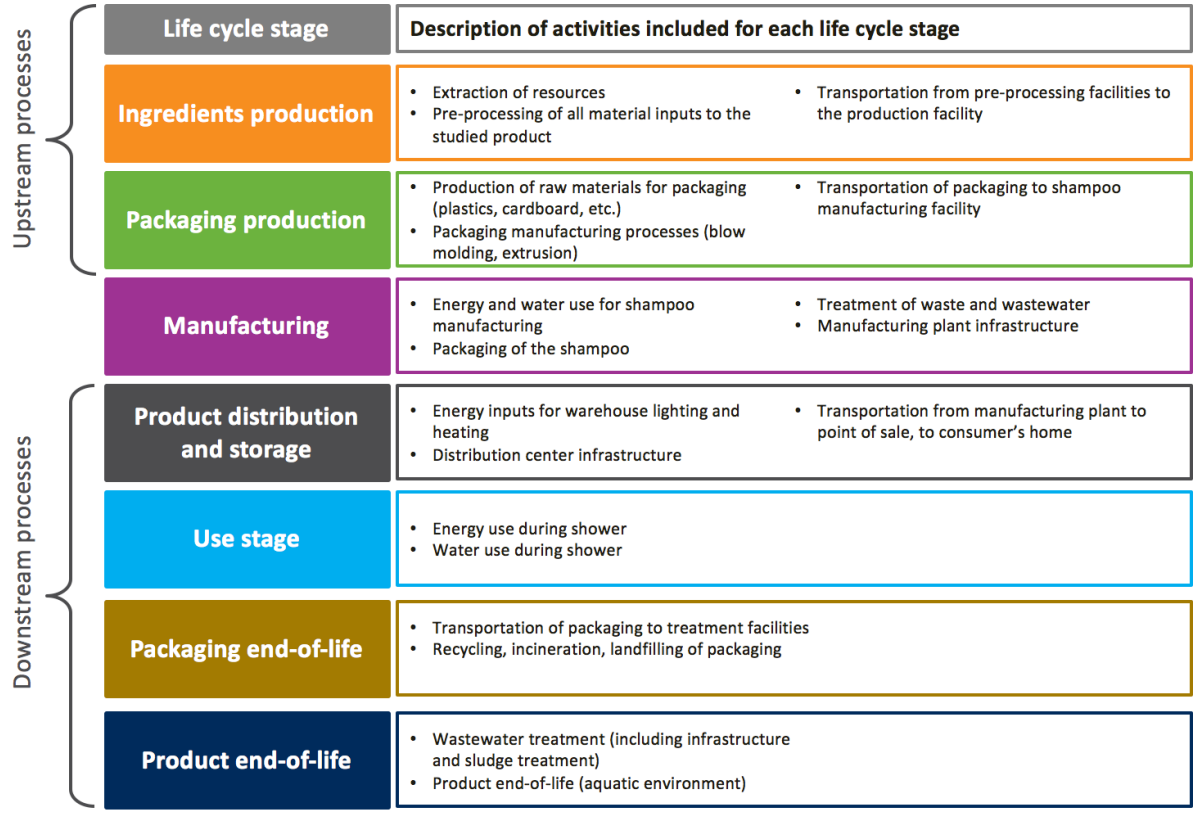

Figure 1. System boundary diagram with the main activities included per life cycle stage

Figure 2 presents the organizational boundaries of the system studied, highlighting activities that are under various levels of control of the organisation.

- Life cycle stages in dark grey are considered to be under full operational control of the company and full access to company-specific data is expected.
- Life cycle stages in medium grey contain processes with probable access to company-specific data (via direct suppliers); a high probable access to company-specific data is expected.
- Life cycle stages in light grey contain processes for which the company has potential access to company-specific data (no direct suppliers); a low to medium probable access to company-specific data is expected.
- Life cycle stages in white contain processes for which the company likely has no access to company-specific data.

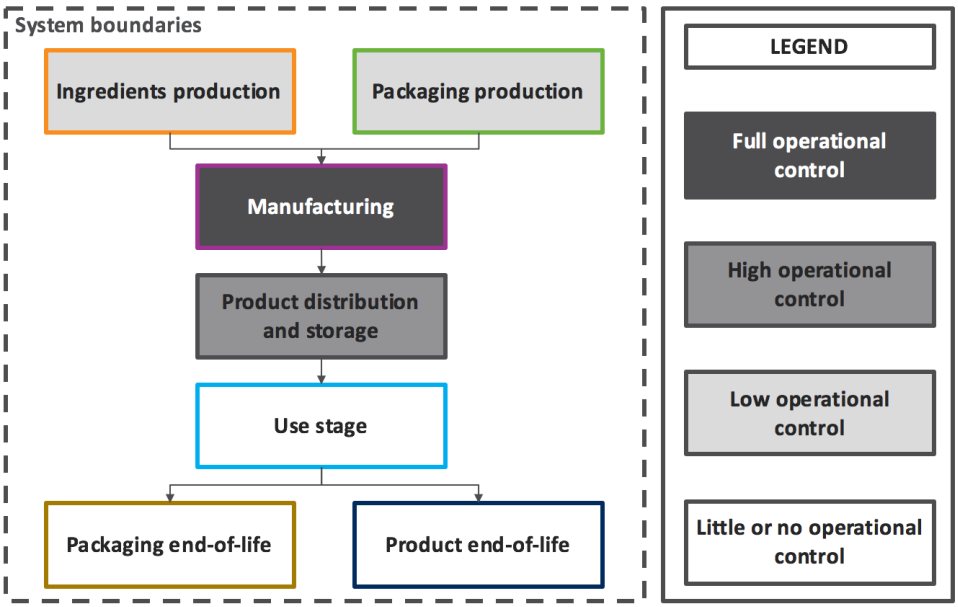

Figure 2. Organisational boundaries of the system studies

5.5 Selection of the EF Impact categories indicators

The PEF shall be performed for the full list of required impact categories in the PEF Guide (European Commission 2013), using the suggested impact categories. Table 2 provides the list of Environmental Footprint (EF) impact categories related to the assessment methods that shall be used (European Commission, 2013). For each impact category, the following information is provided:

- Impact categories
- Impact assessment model
- Impact category indicator/unit
- Source
- Classification of the methods performed in the ILCD Handbook "Recommendations for Life Cycle Impact Assessment in the European context", JRC, 2011. The recommended characterisation models and associated characterisation factors are classified into three levels according to their quality:
    - Level I: recommended and satisfactory
    - Level II: recommended, but in need of some improvements
    - Level III: recommended, but to be applied with caution

Table 2. List of impact categories and related assessment methods used

Impact category	Model	Unit	Source	Classi-fication
Climate change	Bern model – Global Warming potentials (GWP) over a 100 year time horizon	kg CO2 eq	Intergovernmental Panel on Climate Change, 2007	I
Ozone depletion	EDIP model based on the ODPs of the WMO over an infinite time horizon	kg CFC-11 eq	WMO, 1999	I
Freshwater ecotoxicity	USETox model	CTUe	Rosenbaum et al., 2008	II/III
Human toxicity – cancer effects	USETox model	CTUh	Rosenbaum et al., 2008	II/III
Human toxicity – non-cancer effects	USETox model	CTUh	Rosenbaum et al., 2008	II/III
Particulate matter	RiskPoll model	kg PM2.5 eq	Humbert, 2009	I
Ionising radiation	Human Health effect model	kg U^{235} eq	Dreicer et al., 1995	II
Ionising radiation[a]	Ecosystem quality interim model	CTUe	Garnier-Laplace et al. 2008	n/a
Photochemical ozone formation	LOTOS-EUROS model	kg NMVOC eq	van Zelm et al., 2008	II
Acidification	Accumulated Exceedance model	mol H+ eq	Seppälä et al.,2006; Posch et al., 2008	II
Terrestrial eutrophication	Accumulated Exceedance model	mol N eq	Seppälä et al.,2006; Posch et al., 2008	II
Freshwater eutrophication	EUTREND model	kg P eq	Struijs et al., 2009	II
Marine eutrophication	EUTREND model	kg N eq	Struijs et al., 2009	II
Land use	Soil Organic matter (SOM) model	kg C deficit	Milà i Canals et al., 2007	III
Water resource depletion	Swiss Ecoscarcity model	m^3 water eq	Frischknecht et al., 2008	III
Mineral, fossil, & renewable resource depletion	CML 2002 model	kg Sb eq	van Oers et al., 2002	II

[a] this is an interim model, there are no normalisation factors. This is not an official indicator recommended by the PEF pilots but the screening and supporting studies have evaluated this indicator.

For PEF pilots, according to the European Commission (2015c), for B2C communication at least the three most relevant impact categories shall be included in the assessment. Human toxicity and freshwater ecotoxicity, calculated using USEtox, are excluded from communication requirements due to concerns regarding the available data quality. For B2B communication, the minimum number of relevant impact categories shall be decided based on the outcomes of the PEFCR supporting studies and any additional environmental information available.

The indicators evaluated as relevant for a shampoo are:

- Climate change
- Water resource depletion
- Mineral and fossil resource depletion
- Freshwater ecotoxicity (subject to the availability of appropriate methodology and data)

This selection was performed based on two normalisation approaches. The process and results to identify the most relevant EF impact categories are presented in section 12.3 (Annex III – Normalisation factors).

5.6 Additional environmental information

At this time, there is no additional environmental information to provide. Currently there is a lack of data to fully assess all biodiversity impacts therefore further investigation must be performed in the future.

5.7 Assumptions/limitations

European Commission disclaimer regarding the screening studies

Within the Environmental Footprint (EF) pilot phase, normalisation and equal weighting were foreseen to be used in the EF screenings to identify the most relevant impact categories. The use of normalisation and weighting for this purpose remains the objective for the EF pilots. However, currently PEF screening results after normalisation and equal weighing present some inconsistencies stemming from errors at various levels of the assessment. Consequently, although the screening results help to identify the most relevant impact categories, they are not sufficiently robust to be used for product comparison.

Other personal care products

This PEFCR provides guidance for shampoos only (see section 5). Although other personal care products, such as shower gels, may have similar functions, these are not considered within the scope of this PEFCR.

Comparative assessments

As in any comparative life cycle assessment, care must be taken when comparing two or more products. As the shampoos under study may have additional functions (e.g. anti-dandruff, sensitive scalp, etc.), the same additional functions must be considered for all products being compared (see section 5, PEFCR Scope). Furthermore, the results' uncertainty is to be taken into account when comparing two or more products.

USEtox model limitations

The USEtox model itself is not questioned at this time by JRC, however certain limitations have been highlighted, mainly with respect to the input data for the model. While the USEtox model is relevant for screening purposes, it should not be used for communication or product comparisons. This is an ongoing topic of discussion and will continue to be closely followed.

Water resource depletion limitations

The quality of the results obtained for the water resource depletion indicator depends on the modelled water flows. The quality of the water flows in ecoinvent v2.2 are recognized as being incomplete or non existing. This limitation should be kept in mind when analysing results. Note that the quantity and quality of water flows in version 3.2 of the ecoinvent database (released November 2015) has contributed to filling these data gaps and this newest version of the database is recommended.

6 Resource use and emissions profile

6.1 Screening step

The main outcomes of the screening study are presented in the document "CosmeticsEurope_screening_shampoo_2016_04_08_Quantis.pdf". According to the screening results, the use stage dominates results or is a significant contributor for all indicators except freshwater ecotoxicity, which is dominated by product end-of-life. The production of the shampoo ingredients, as well as distribution and storage both contribute for several indicators. Manufacturing, packaging production and packaging end-of-life, relative to the other life cycle stages, do not have a large contribution to the overall results.

Table 3 presents a list of key parameters that influence most of the impacts of each life cycle stage according to the screening results. A threshold of 2.8% contribution to overall impacts was selected such that the sum of these processes represents a minimum of 80% of impacts for any of the 16 indicators (European Commission, 2015c). Note that some of the parameters have large contributions to overall impacts and are also quite sensitive such as the water use during the use stage (see screening study sensitivity analyses).

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Table 3. Identification of the most relevant processes

	Climate change	Ozone depletion	Human toxicity, cancer	Human toxicity, non-cancer	Particulate matter	Ionizing radiation HH	Ionizing radiation E	Photochemical ozone formation	Acidification	Terrestrial eutrophication	Freshwater eutrophication	Marine eutrophication	Freshwater ecotoxicity	Land use	Water resource depletion	Fossil resource depletion*
Ingredients production																
Sodium laureth sulfate	2%	1%	3%	4%	12%	2%	2%	6%	7%	7%	3%	8%	0%	11%	2%	7%
Cocamidopropyl betaine	1%	1%	1%	2%	9%	1%	1%	4%	4%	5%	1%	6%	0%	9%	1%	5%
Cocamide MEA	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%
Propylene glycol	0%	1%	1%	1%	0%	1%	1%	0%	0%	0%	1%	0%	0%	0%	0%	1%
Sodium benzoate	0%	4%	0%	1%	1%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Hydrochloric acid	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dimethicone	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Polyquaternium-10	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Glycol distearate	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fragrance	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Water	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Transport	1%	1%	1%	1%	1%	0%	0%	3%	2%	4%	0%	3%	0%	1%	0%	3%
Total	**5%**	**9%**	**6%**	**10%**	**25%**	**6%**	**6%**	**15%**	**15%**	**17%**	**7%**	**19%**	**1%**	**25%**	**3%**	**18%**
Packaging production																
Primary packaging	2%	0%	3%	2%	5%	4%	4%	4%	4%	3%	3%	3%	0%	1%	1%	1%
Secondary/tertiary packaging	0%	0%	0%	1%	2%	0%	0%	1%	1%	1%	1%	1%	0%	2%	0%	0%
Transport	0%	0%	0%	0%	0%	0%	0%	1%	0%	1%	0%	1%	0%	0%	0%	1%
Total	**2%**	**1%**	**4%**	**3%**	**7%**	**4%**	**4%**	**5%**	**5%**	**4%**	**4%**	**4%**	**0%**	**3%**	**1%**	**3%**
Manufacturing																
Electricity consumption	0%	0%	1%	1%	1%	2%	2%	1%	1%	1%	2%	1%	0%	0%	0%	1%
Natural gas consumption	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Light fuel oil consumption	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Water use	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Plant (infrastructure)	0%	0%	3%	6%	1%	1%	1%	1%	1%	1%	2%	1%	1%	1%	0%	10%
Wastewater treatment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	**1%**	**1%**	**4%**	**7%**	**2%**	**3%**	**3%**	**1%**	**2%**	**2%**	**5%**	**2%**	**1%**	**1%**	**0%**	**11%**
Distribution																
Transport to distribution center (DC)	2%	2%	3%	2%	2%	1%	1%	5%	3%	5%	1%	5%	0%	3%	0%	9%
Transport from DC to point of sale (POS)	1%	1%	2%	1%	2%	1%	1%	3%	2%	3%	0%	3%	0%	2%	0%	4%
Transport from POS to consumer's home	1%	1%	2%	2%	2%	2%	2%	3%	2%	3%	1%	2%	0%	2%	0%	5%
Building infrastructure for storage	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Distribution center electricity consumption	0%	0%	1%	1%	0%	1%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%
Shop electricity consumption	1%	0%	3%	4%	3%	6%	6%	1%	3%	2%	6%	2%	0%	0%	0%	1%
Total	**5%**	**5%**	**11%**	**11%**	**9%**	**11%**	**11%**	**12%**	**10%**	**14%**	**9%**	**13%**	**1%**	**7%**	**1%**	**20%**
Use stage																
Electricity consumptin	10%	3%	27%	29%	20%	50%	51%	12%	22%	14%	50%	16%	3%	4%	3%	12%
Natural gas consumption	60%	68%	18%	13%	16%	9%	9%	36%	26%	31%	10%	28%	1%	33%	1%	12%
Light fuel oil consumption	11%	12%	3%	3%	9%	2%	2%	10%	11%	9%	2%	8%	0%	15%	0%	3%
Water use	3%	1%	13%	10%	7%	12%	12%	4%	6%	5%	11%	5%	1%	8%	90%	4%
Total	**84%**	**84%**	**60%**	**54%**	**52%**	**74%**	**74%**	**63%**	**66%**	**58%**	**73%**	**57%**	**5%**	**59%**	**94%**	**30%**
Packaging end-of-life																
Total	**0%**	**0%**	**0%**	**2%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**0%**	**1%**	**-1%**	**0%**	**0%**
Product end-of-life																
Product end-of-life	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	90%	0%	0%	0%
Wastewater treatment	3%	1%	16%	8%	6%	3%	3%	4%	3%	5%	2%	4%	1%	6%	1%	18%
WWT sludge treatment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	**3%**	**1%**	**16%**	**13%**	**6%**	**3%**	**3%**	**4%**	**3%**	**5%**	**2%**	**4%**	**91%**	**6%**	**1%**	**18%**
Total (of most relevant processes)	86%	87%	87%	82%	85%	84%	84%	95%	87%	94%	84%	90%	93%	89%	93%	90%

Scale: 2.8% - 10% | 10% - 50% | > 50%

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In order to classify the data as specific, semi-specific or generic data, the following rules are considered (European Commission, 2015c):

- **Primary/site-specific data** are data that shall be collected specifically by each company. Primary/site-specific data are significant regarding the relevant impact categories and accessible for companies.
- **Semi-specific data** for which default values are proposed but which can be replaced with better quality data if available. Semi-specific data are significant regarding the relevant impact categories but not always easily accessible for companies.
- **Secondary/generic data** for which sources shall be defined and default data provided.

6.2 Data quality requirements

Data quality requirements are recommended for external communication. A semi-quantitative assessment of the quality criteria of a dataset is based on six characteristics:

- Technological representativeness
- Geographical representativeness
- Time related representativeness
- Completeness
- Precision/uncertainty
- Methodological appropriateness and consistency

The following formula is used to calculate the overall Data Quality Rating (DQR) of a data set.

$$DQR = \frac{TeR + GR + TiR + C + P + M}{6}$$

where, DQR = Data Quality Rating of the data set

TeR = Technological representativeness
GR = Geographical representativeness
TiR = Time-related representativeness
C = Completeness
P = Precision/uncertainty
M = Methodological appropriateness and consistency

Table 4 lists the description associated with the different ranges of data quality ratings, from “poor quality” to “excellent quality”.

Table 4. Data quality rating ranges and associated description

Overall data quality rating (DQR)	Description
≤ 1.6	"Excellent quality"
> 1.6 ≤ 2.0	"Very good quality"
> 2.0 ≤ 3.0	"Good quality"
> 3.0 ≤ 4.0	"Fair quality"
> 4.0	"Poor quality"

If we take, for example, a shampoo ingredient such as hydrochloric acid, which is modelled with the ecoinvent v2.2 dataset "hydrochloric acid, 30% in H2O, at plant/RER", the data quality criteria for this dataset are shown in Table 5. The calculated DQR, an average of these six criteria, is 2.2, which can be described as "good quality" based on Table 4.

Table 5. Example data quality information for ecoinvent v2.2 dataset "hydrochloric acid, 30% in H2O, at plant/RER"

Data quality criteria	Value
Methodological appropriateness/consistency	3
Completeness	3
Time-related representativeness	1
Geographical representativeness	1
Technological representativeness	1
Precision/uncertainty	4

The minimum recommended data quality requirements for a PEF study intended for external communication are summarised in Table 6.

Table 6. Minimum recommended data quality criteria for a PEF study intended for external communication

Criteria	Minimum data quality
Environmentally significant data covering at least 70% contribution to environmental impacts in each impact category considered.	Overall "good" data quality (DQR 2-3)
Additional environmentally significant data accounting for contributions to environmental impacts (i.e. 20-30%).	Overall "fair" data quality (DQR 3-4)
Data used for approximation and filling identified gaps (less than 10% contribution to environmental impacts)	Best available data

6.3 Requirements regarding foreground specific data collection

The formula of the shampoo as well as the primary packaging data (weight and material types) should come from primary sources of data. Primary data sources are also recommended for manufacturing data (energy and water use at the factory) using a simple allocation method (e.g. mass allocation).

6.4 Requirements regarding background generic data and data gaps

For background generic data, secondary generic data can be used. Semi-specific data should be replaced by specific data when available. See sections 6.6 to 6.12 for a description of modelling

assumptions/limitations. Version 3.2 of the ecoinvent database has recently been released and is expected to soon be available in different existing LCA software. This latest version of the database is recommended as a source for secondary generic data. The representative product screening study was mainly based on version 2.2 of the ecoinvent database since ecoinvent version 3.2 was not released at the time of modelling.

6.5 Data gaps

Data gaps should be filled by using default values provided for each life cycle stage. Refer to sections 6.6 to 6.12 for detailed assumptions for each life cycle stage.

6.6 Ingredients production

This stage includes the production and transformation of the shampoo ingredients, including raw material extraction and subsequent transport to the manufacturing site. The following steps should be followed when modelling the shampoo ingredients' production: (1) model with primary data; (2) if primary data are not available, model with corresponding references from public databases such as ecoinvent; (3) if corresponding references are not available, use a proxy; suppliers or professional associations (e.g. EFfCI, the European Federation for Cosmetic Ingredients) should be contacted in order to validate the proxy.

Table 7 summarizes common shampoo ingredients and the corresponding ecoinvent v2.2 dataset used to model each. Note that the quality of the data listed below is rather fair in terms of reliability, completeness and sample size (Frischknecht et al. 2005). It is recommended to use the recently released version 3.2 of ecoinvent for modelling. The fragrance composition should be based on primary data. If no data are available concerning the fragrance, a composition based on five substances may be assumed, 20% alpha-hexyl cinnamaldehyde, 10% beta-pinene, 50% dihydromyrcenol, 15% hexyl salicylate, 5% patchouli oil. The substances are based on the IFRM study (IFRM 2013) and the quantities are based on a consultation among the Cosmetics Europe task force. There are many variations possible of substances and compositions for a fragrance and a sensitivity analysis of the fragrance is recommended.

Table 7. Modelling of shampoo ingredients based on ecoinvent database

Ingredient	Modeling (ecoinvent v2.2 dataset)
Sodium laureth sulfate	Fatty alcohol sulphate, mix, at plant/RER
Cocamidopropyl betaine	25% Fatty alcohol, petrochemical, at plant/RER 25% Fatty alcohol, from coconut oil, at plant/RER 25% Fatty alcohol, from palm oil, at plant/RER 25% Fatty alcohol, from palm kernel oil, at plant/RER
Cocamide MEA	77% Crude coconut oil, at plant/PH 23% Monoethanolamine, at plant/RER
Propylene glycol	Propylene glycol, liquid, at plant/RER
Sodium benzoate	Benzoic-compounds, at regional storehouse/RER
Chlorhydric acid	Hydrochloric acid, 30% in H2O, at plant/RER
Fragrance[1]	Chemicals organic, at plant/GLO
Dimethicone	Silicone product, at plant/RER
Polyquaternium-10	Chemicals organic, at plant/GLO
Glycol distearate	Ethylene glycol, at plant/RER
Water	Tap water, at user/RER

[1] use "Chemicals organic, at plant/GLO" if the different fragrance ingredients do not exist in the database

If the upstream transportation distance of ingredients is not known, a distance of 500 km by truck can be assumed. Of the transported weight, 20% is assumed to be packaging (Quantis internal guidelines).

6.7 Packaging production

This stage includes the production of primary, secondary and tertiary packaging material as well as the forming of the primary packaging (e.g. injection moulding). Transport of the primary packaging to the manufacturing site is included in this stage.

The following steps should be followed when modelling the shampoo packaging production stage: (1) model with primary data; (2) if primary data are not available, model with corresponding references from public databases such as ecoinvent; (3) if corresponding references are not available, use a proxy; suppliers or professional associations should be contacted in order to validate the proxy.

The values listed in Table 8 can be used if packaging types and quantities are unknown. Likewise, if recycled material content of the packaging is unknown, values in Table 8 can be used. If the upstream transportation distance of the packaging is not known, a distance of 1500 km by truck (16-32t, EURO5) can be assumed. The density of the shampoo is assumed to be 1.036 g/ml. If we consider 10.46 g of shampoo per functional unit, there are 24.8 shampoo uses per 250 ml bottle.

Table 8. Packaging considered for a 250 ml shampoo bottle

Component	Material	% Recycled material	Composition (wt%)	Quantity (g per bottle*)
Primary packaging: data should be provided (bottle, cap, label)				
Secondary packaging				
Box	Cardboard	50	98	8.8
Foil and label	Polypropylene (PP)	0	2	0.17
Tertiary packaging				
Pallet	Wood	0	34	0.37
Anti-slip sheets	Paper	0	39	0.42
Foil	Polypropylene (PP)	0	27	0.30

Table 9 lists the corresponding ecoinvent v2.2 datasets to be used for the packaging modelling if no primary data is available.

Table 9. Modelling of packaging materials based on ecoinvent v2.2 database

Component	Material	Ecoinvent v2.2 dataset
Bottle	Polyethylene (PE)	Polyethylene, HDPE, granulate, at plant/RER Blow moulding/RER
Cap	Polypropylene (PP)	Polypropylene, granulate, at plant/RER Blow moulding/RER
Label	Polyethylene (PE)	Polyethylene, LDPE, granulate, at plant/RER Extrusion, plastic film/RER
Box	Cardboard	Corrugated board, fresh fibre, single wall, at plant/RER
Foil and label	Polypropylene (PP)	Polypropylene, granulate, at plant/RER Extrusion, plastic film/RER
Pallet	Wood	EUR-flat pallet/RER
Anti-slip sheets	Paper	Kraft paper, unbleached, at plant/RER
Foil	Polypropylene (PP)	Polypropylene, granulate, at plant/RER Extrusion, plastic film/RER

6.8 Manufacturing

This stage includes the manufacturing of the shampoo, including water use, production and delivery of the energy used and treatment of any waste generated. Manufacturing data should represent as closely as possible the actual situation. If primary data cannot be obtained, a European average can be used for manufacturing data (energy and water use). See Table 10 for a list of average manufacturing data based on four different companies manufacturing shampoo and located in Germany, Italy, United Kingdom and the United States of America. Data from three of the four companies are specific to shampoo manufacturing while data from the fourth company are for the production of shampoo, conditioner, essential oils, creams and lotions. The UCTE electricity mix is used. For water use, 95% of water withdrawn is assumed to be discharged to wastewater treatment, while the remaining 5% is assumed to be lost through evaporation or incorporated in the product. The

manufacturing plant infrastructure (i.e. the building) should be modelled based on primary data. If not available, it can be assumed that the manufacturing plant would have similar characteristics to that of the ecoinvent process *Chemical plant, organics/RER* and this can be used as a proxy, scaled by the shampoo production (i.e. for 1 kg soap, 4E-10 chemical plant, therefore for 10.46 grams of shampoo, 4.18E-12 chemical plant).

Table 10. List of manufacturing stage data per functional unit, based on average data from four companies

	Value	Units	Value	Units	Comment
Electricity consumption	4.8E-3	MJ/FU	0.45	MJ/kg	1.3E-3 kWh/FU
Natural gas consumption	0.0075	MJ/FU	0.71	MJ/kg	
Oil consumption	1.0E-6	MJ/FU	9.6E-5	MJ/kg	
Water use	1.6E-5	m3/FU	1.5E-3	m3/kg	
Wastewater treatment	1.5E-5	m3/FU	1.4E-3	m3/kg	5% consumed, 95% to WWT

6.9 Product distribution and storage

This stage includes distribution of the shampoo, from the gate of the manufacturing plant, to the point of sale, and finally to the consumer's house. Data concerning the distribution and storage should be provided. If unknown, assuming a European average distribution scenario, a distance of 1500 km by truck (16-32t, EURO5) can be considered from the manufacturing plant to the distribution centre and a distance of 700 km by truck (7.5-16t, EURO5) from the distribution centre to the point of sale (European Commission, 2015a). Of the consumer shopping trips to the point of sale, 80% are assumed to be by car (1 person per car), considering a distance of 4 km with a 5% allocation of the car trip to the product. The remaining 20% of shopping trips are assumed to be done by bus and walking; as a matter of simplification, the impacts for this part are neglected (as it would not change significantly the value provided by 80% of the persons shopping by car) (European Commission, 2015a).

If electricity consumption at the distribution centre is unknown, a value of 6 kWh/m^3.y can be used (Humbert et al. 2009); 1 shampoo bottle is assumed to occupy a volume of 2 cm x 7 cm x 20 cm (280 cm^3) and stored for a period of one month. Likewise, if electricity consumption at the point of sale is unknown a value of 700 kWh/m^2.y (European Commission, 2013a) can be used, assuming 1 bottle occupies an area of 2 cm x 7 cm (14 cm^2) and is stored for a period of one month. The UCTE electricity mix is used.

If information concerning the distribution centre infrastructure is unknown, the distribution centre can be assumed to be a *Building, multi-storey/RER (m3)*(ecoinvent v2.2). A bottle of shampoo is assumed to occupy a volume 10 times that of the bottle volume (2 cm x 7 cm x 20 cm), is stored for 1 month and the building has a lifetime of 80 years (ecoinvent v2.2).

6.10 Use stage

The use stage includes the shower water use and energy consumed to heat the water; it should represent an average situation in Europe or a specific area (e.g. country, region), if relevant. In the latter case, it should be specified explicitly in the results communicated. A default value of 15 litres can be assumed for the shower water quantity. This is based on data from a study done at a hair salon (http://eco-conception.be/fr/page/eau.html).

There exist few publicly available data concerning household water heating. The heating energy mix according to IEA (IEA, 2011) is 87% natural gas and 13% fuel oil. Knowing that the water heating energy mix for France is 43% electricity (AFNOR, 2011) and that the French population represents 12.3% of the EU-28 population[1], we can assume that the electricity mix to heat water in Europe is at least 5.6%. For the remaining 94%, we can assume the IEA breakdown of 87% natural gas and 13% fuel oil (IEA, 2011). This results in the recommended use stage assumptions presented in Table 11. Note that, according to the Eurostat website *"More detailed data for energy consumption in households (e.g. energy for space heating, space cooling, water heating and cooking) will be collected in the future under the Commission Regulation (EU) No 431/2014 of 24 April 2014 amending Regulation (EC) No 1099/2008 of the European Parliament and of the Council on energy statistics, as regards the implementation of annual statistics on energy consumption in households."*[2] Table 11 is thus a temporary recommendation, and once updated data is available, this should be used. Tap water infrastructure should be included in the modelling (supply network, treatment of potable water, losses, etc.).

[1] http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tps00001&plugin=1

[2] http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=t2020_rk200&language=en

Table 11. Assumptions related to use stage

Assumption	Value	Unit*	Comment
Shampoo used per shower	10.46	g	Hall et al. 2011, data based on daily use
Water used per shower	15	litre	European Commission (2015c), based on a single wash per shower
Energy used for heating the water	1.6	MJ	From 15°C to 38°C, assume a 90 % energy efficiency for heating systems
Energy mix for heating the water (%)			
Electricity	6		AFNOR, 2011
Natural gas	82		IEA 2011, EU-27
Heating fuel oil	12		IEA 2011, EU-27
* per unit of analysis			

6.11 Packaging end-of-life stage

The packaging end-of-life should be modelled using the end-of-life equation provided in the PEF Guide (European Commission, 2013). Figure 3 shows which terms of the equation should be included in which life cycle stage, Packaging production or Packaging end-of-life. See the PEF Guide for detailed descriptions of each element in the equation.

Packaging production

$$\left(1-\frac{R_1}{2}\right)\times E_V+\frac{R_1}{2}\times E_{recycled}$$

Packaging end-of-life

$$+\frac{R_2}{2}\times\left(E_{recyclingEoL}-E^*_V\times\frac{Q_S}{Q_P}\right)+R_3\times$$

Packaging end-of-life

$$\left(E_{ER}-LHV\times X_{ER,heat}\times E_{SE,heat}-LHV\times X_{ER,elec}\times E_{SE,elec}\right)+\left(1-\frac{R_2}{2}-R_3\right)E_D$$

Packaging production

$$-\frac{R_1}{2}\times E^*_D$$

Figure 3. PEF Guide end-of-life formula with the terms grouped by life cycle stage (see PEF Guide for detailed descriptions of each term used in the equation)

Packaging end-of-life is modelled according to recommendations provided by the European Commission to deal with multi-functionality in end-of-life situations (European Commission, 2013). The excel file named "RecyclingFormula-v1-EFPilot-ems24Jan2014.xls" (sent by e-mail on 29th January 2014) is considered, which describes the 50:50 end-of-life formula. Waste treatment at the end-of-life of the pallet is considered to be negligible and can be excluded from the system. All packaging waste not recycled can be assumed incinerated or landfilled according to the municipal solid waste treatment rates of the corresponding market. For EU-28, 45% of municipal solid waste is incinerated and 55% is landfilled (Eurostat 2011). Heat recovery is assumed for incineration, with recovery rates for electricity and for heat provided in the Excel document PEF-OEF_EOL DefaultData_V1.2_uploaded.xls (referred to hereafter as *PEF/OEF default EOL data*). For Europe, electricity and heat recovery efficiencies are 10.1% and 31%, respectively. The electricity recovery is

assumed to offset the national (or European) consumption mix and the heat recovery is assumed to offset natural gas. These assumptions should be adapted to the local context if possible. The PEF/OEF default EOL data document also provides lower heating values (LHV) for polyethylene (PE) and cardboard and are based on ecoinvent v2.2 incineration datasets; the LHVs for PE and cardboard are 42.47 MJ/kg and 15.92 MJ/kg, respectively. The LHV of polypropylene (PP), also based on the ecoinvent municipal incineration dataset is assumed to be 32.78 MJ/kg. In the case of landfilling and incineration, packaging is assumed transported 30 km. For recycling, packaging is assumed transported 100 km. These default assumptions are based on the Excel file PEF-OEF_EOL DefaultData_V1.2_uploaded.xls which provides end-of-life default assumptions for all PEFs. Table 12 summarizes the packaging end-of-life assumptions.

Table 12. End-of-life treatment assumptions for packaging

Component	Material	Recycling rate at EoL (%)[1]	% incinerated (of non recycled)	% landfilled (of non recycled)
Primary packaging				
Bottle	Polyethylene (PE)	35.5%	45%	55%
Cap	Polypropylene (PP)			
Label	Polyethylene (PE)			
Secondary packaging				
Box	Cardboard	84%	45%	55%
Foil and label	Polypropylene (PP)	0%	45%	55%
Tertiary packaging				
Pallet	Wood	50 reuses	excluded	excluded
Anti-slip sheets	Polypropylene (PP)	0%	45%	55%
Foil	Polypropylene (PP)			

[1] Based on PEF-OEF_EOL DefaultData_V1.2_uploaded.xls provided by the European Commission

6.12 Product end-of-life

The shampoo is assumed used and distributed on the European market, and therefore the product end-of-life stage modelling must represent an average situation in Europe. After use in the shower, a part of the product ingredients is assumed to go to nature and the rest to wastewater treatment. The ultimate fate of the shampoo end-of-life is calculated based on the following equation:

$$\text{Fate} = \text{substance} \times [(1 - \text{HH connectivity}) + \text{HH connectivity} \times (1 - \text{WWT efficiency})]$$

where, fate = the fate of the substance in the environment (grams)
substance = the substance that goes down the shower drain (grams)
HH connectivity = household connectivity
WWT efficiency = wastewater treatment plant efficiency

A household connectivity of 85% is assumed (OECD, 2012) for the European average.[3] This should be adapted to the local context (country specific data at minimum). A wastewater treatment plant

[3] Based on a population weighted average of European OECD countries.

removal rate for each substance or group of substances is recommended. If data is unavailable, the wastewater treatment plant can be assumed to have a default removal rate of 90%, meaning 10% of the substance entering the wastewater treatment plant is discharged to the environment (Hera, 2004). If primary data is not available for the fragrance, its composition can be assumed to be 20% alpha-hexyl cinnamaldehyde, 10% beta-pinene, 50% dihydromyrcenol, 15% hexyl salicylate and 5% patchouli oil (see section 6.6). Removal rates for alpha-hexyl cinnamaldehyde and dihydromyrcenol can be assumed to be 99.9% (based on data from five German sewage treatment plants, Klaschka et al. 2013). The removal rate for hexyl salicylate can be assumed to be 99.8% (based on data from 17 U.S. and European wastewater treatment plants between 1997 and 2000, Simonich et al. 2002).

For the freshwater ecotoxicity indicator, characterization factors based on USEtox should be used. If unavailable, the website Environmental Footprinting with USEtox can be used (http://usetox.tools4env.com). This website provides characterization factors for different chemicals. Note that despite the name of the website, not all characterization factors are from USEtox. The data source should always be specified when using this tool. A sensitivity analysis of different characterization factors is recommended. Table 13 summarizes the characterization factors and data sources for freshwater ecotoxicity for different shampoo substances.

The same website mentioned above (http://usetox.tools4env.com) can be consulted for Human toxicity characterization factors. The human and environmental safety of shampoo ingredients is managed and assured by the manufacturers.

A note about USEtox: this method is required by the EU PEF process to measure the ecotoxicity of shampoo products along their life cycle. However, it has been acknowledged by the Commission that the interpretation of USEtox results is unreliable; consequently, it is only valid for hotspot analysis and should not be used for product comparison or communication purposes. Results from the screening study have shown that the end-of-life of shampoo ingredients is a hotspot for the freshwater ecotoxicity impact category; this confirms the outcome of previous shampoo LCA studies. USEtox results will not be used for further, more detailed analyses such as any kind of comparative assessment.

Table 13. Freshwater ecotoxicity characterization factors for shampoo ingredients emitted to nature

Substance emitted	Ecotoxicity (CTUe/kg)	Source
Sodium laureth sulfate	12081	USEtox interim
Cocamidopropyl betaine	783	Cosmede
Cocamide MEA	177	Cosmede
Propylene glycol	0.92	USEtox recommended
Sodium benzoate	4.9E-11	USEtox interim
Hydrogen chloride	149.22	Cosmede
Dimethicone	72	Cosmede
Polyquaternium-10[1]	41955	Cosmede
Glycol distearate	895	Cosmede
alpha-hexyl cinnamaldehyde (fragrance)	110	Cosmede
beta-pinene[2] (fragrance)	4.2E3	USEtox interim
Dihydromyrcenol (fragrance)	135	USEtox interim
Hexyl salicylate (fragrance)	39	Cosmede
Patchouli oil (fragrance)	246	Cosmede
NOTE: it is important to check the tools4env website (usetox.tools4env.com/) regularly as the characterization factors may have been updated since publication of this PEFCR		

[1] Quaternium-18 used as a proxy for polyquaternium-10

[2] IUPAC name: Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-

7 Interpretation

Based on the screening results (see *PEF shampoo screening report*), the use stage dominates results for the indicators climate change, ozone depletion, photochemical ozone formation, acidification, land use and water resource depletion, while it has a significant contribution to all other indicators except freshwater ecotoxicity, which is dominated by product end-of-life. The ingredients production, and distribution and storage stages both contribute for several indicators. The manufacturing stage contributes for Ionizing radiation and freshwater eutrophication. The packaging production and end-of-life stages, relative to the other life cycle stages, do not have a large contribution to overall results.

The most relevant impact categories for shampoos are identified as:

- Climate change
- Water resource depletion
- Mineral and fossil resource depletion
- Freshwater ecotoxicity (subject to the availability of appropriate methodology and data)

See section 5.5 for further justification.

PEFCR can be used to compare performances of similar products, as long as they are in the same category (see section 5). In the case of shampoo products, comparisons should only be made within the five categories specified by function in section 5, and not between categories.

The main uncertainties lie in the energy mix used to heat the water as it is difficult to obtain data concerning this aspect. Shower water quantity and temperature were also determined as relevant parameters, and it is difficult to obtain data concerning user habits in the shower.

For all relevant parameters identified above, it is recommended to include a sensitivity analysis to address the uncertainty.

8 Reporting, disclosure and communication

This PEFCR Report does not specifically address reporting, disclosure and communication.

9 Verification

This PEFCR Report does not address verification.

610 # 10 Reference literature

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Sala et al. (2012)	Sala S, Wolf M, Pant R. (2012). Characterisation factors of the ILCD Recommended Life Cycle Impact Assessment methods. Database and Supporting Information. EUR 25167 EN. Luxembourg (Luxembourg): Publications Office of the European Union; 2012. JRC6825
Simonich et al. (2002)	Simonich,S, Federle, TW, Eckhoff, WS, Rottiers, A, Webb,S, Sabaliunas,D, de Wolf§, W. Removal of Fragrance Materials during U.S. and European Wastewater Treatment. *Environmental Science & Technology* 2002 *36* (13), 2839-2847
OECD (2012)	Wastewater treatment, % population connected, http://stats.oecd.org

11 Supporting information for the PEFCR

The screening study results are presented in the document entitled:

- CosmeticsEurope_screening_shampoo_2016_04_08_Quantis.pdf

The end-of-life formula and its description can be found in the document provided by the European Commission:

- RecyclingFormula-v1-EFPilot-ems24Jan2014.xls

Default end-of-life data to be used can be found in the document provided by the European Commission entitled:

- PEF-OEF_EOL DefaultData_V1.2_uploaded.xls

12 List of annexes

12.1 Annex I – Representative product

The screening results of the representative product are provided in the *PEF screening report for shampoo in the context of the EU Product Environmental Footprint Category Rules (PEFCR) Pilots.*

The representative product is a virtual product. Formulation composition of the representative product was defined using a standard formulation based on typical ingredients and functions. A representative ingredient for each function was selected with a typical composition based on market

volume. Packaging product composition was defined by selecting the most widely used material on the market for the bottle and cap. This approach was chosen to provide a product that is most representative of a real product on the market.

The information presented below is mainly based on L'Oréal internal data and consensus, Mottram et al. (2000), Arif, Making Cosmetics Inc., European Commission et al. (2012) and European Commission et al. (2012a). The ingredients considered for the representative product are listed in Table 14.

Table 14. Ingredients considered for the representative product

Function	Ingredient	CAS	DID-list N°	Concentration (wt%)
Anionic surfactant	Sodium laureth sulfate	68891-38-3	8	13.00
Amphoteric surfactant	Cocamidopropyl betaine	61789-40-0	61	8.00
Non-ionic surfactants	Cocamide MEA	68140-00-1	50	1.25
Viscosity controlling agent	Propylene glycol	57-55-6	174	1.00
Preservative	Sodium benzoate	532-32-1	95	0.30
pH-adjustor	Chlorhydric acid	7647-01-0		0.80
Fragrance	alpha-hexyl cinnamaldehyde beta-pinene Dihydromyrcenol Hexyl salicylate Patchouli oil	101-86-0 127-91-3 2436-90-0 115-95-7 84238-39-1	142	0.50
Additional ingredients for additional functions (e.g. hair conditioning agent, hypo-irritancy agent)	Dimethicone	63148-62-9	110	1.00
Additional ingredients for additional functions (e.g. hair conditioning agent, hypo-irritancy agent)	Polyquaternium-10	68610-92-4		0.40
Additional ingredient for aspect (pearlescent / opacifying agent)	Glycol distearate	627-83-8	185	0.50
Solvent	Water			73.25

12.2 Annex II – Supporting studies

Three supporting studies were performed by three different shampoo producers:

1. Henkel – hair cleansing and conditioning shampoo
2. L'Oréal – anti-dandruff shampoo
3. Pierre Fabre – hair cleansing shampoo

These are reported separately and their conclusions are consistent with the screening study.

12.3 Annex III – Normalisation factors

Two normalisation approaches were applied to inform the selection of appropriate impact categories for shampoo. Firstly, the European Commission normalisation factors were applied at the midpoint level following the PEF guidelines. Secondly, normalisation at the endpoint level was performed using methodology developed by Quantis. Details of the two approaches can be found in the Screening Study Report. The current interpretation of normalised results is difficult and subject to various limitations.

Based on an analysis of both normalisation methods, the indicators evaluated as relevant for a shampoo are:

- Climate change
- Water resource depletion
- Mineral and fossil resource depletion
- Freshwater ecotoxicity (subject to the availability of appropriate methodology and data)

12.4 Annex IV – Weighting factors

Until now, no weighting factor has been established in order to compare between impact categories. Until there is an agreed set of European weighting factors, all impact categories shall receive the same weight (weighting factor = 1). Alternative weighting approaches may be tested in addition to this baseline approach; in this case a sensitivity analysis should be carried out and the results documented and discussed.

12.5 Annex V – Foreground data

The mandatory substances/elementary flows in the foreground system to be collected are presented in Table 15.

Table 15. Mandatory substances/elementary flows to be collected in foreground system

Unit process	Activity data	Unit (per FU)
Product description	Bill of materials	Qualitative information
	Name	Qualitative information
	CAS no.	Qualitative information
	For each ingredient	g
Packaging production	Type of primary packaging	Qualitative information
	Mass of primary packaging	g
Manufacturing	Geographical location	Country scale
Use stage	Geographical location	Country/region scale
	Dosage	g

12.6 Annex VI – Background data

Different assumptions are necessary for the different life cycle stages and when primary data is not available, publicly available data can be used. The ecoinvent v2.2 database was used for all background data and modelling. Note that ecoinvent version 3.2 was released at the end of November 2015 and presents many improvements in terms of data quality, in particular with respect to water flows, which have been updated. It is recommended to use version 3.2 of the database rather than version 2.2. Table 16 summarizes for each life cycle stage where public data can typically be used. Please refer to section 6 for detailed assumptions concerning data and modelling.

675 Table 16. Public background data to be used if primary data not available

Life cycle stage	Public background data	Source
Ingredients production	n/a	n/a
Packaging production	n/a	n/a
Manufacturing	n/a	n/a
Distribution & storage	Energy use at distribution centre	Humbert et al. 2009
Use	Energy mix for heating water	IEA, 2011 (EU-27)
Packaging end-of-life	Municipal solid waste treatment Energy recovery	Eurostat 2011 ELCD database or ecoinvent v2.2
Product end-of-life	Household connectivity to WWT[1] WWT % removal	OECD Hera, 2004 or other suitable source

676 [1] WWT = wastewater treatment

677 12.7 Annex VII – EOL formulas

678 The packaging end-of-life is modelled according to recommendations provided by the European
679 Commission to deal with multi-functionality in end-of-life situations (European Commission, 2013).
680 The excel file named "RecyclingFormula-v1-EFPilot-ems24Jan2014.xls" is considered, which describes
681 the 50:50 end-of-life formula. See the PEF shampoo screening report for a sensitivity analysis of the
682 EOL formula.

683 12.8 Annex VIII - Compiled overview of existing PCRs

684 The main documents identified to be included in this overview are presented below.
685

Author	Reference
AFNOR (2011)	AFNOR (2011-2012). BP X30-323-5 12/2011, General principles for an environmental communication on mass market product - Part 5: Methodology for the environmental impacts assessment of shampoos. → *New version will be published in 2014*
European Commission et al. (2012)	European Commission, Joint Research Centre (JRC), Institute for Prospective Technological Studies (IPTS) and LEITAT (2012). Revision of the European Ecolabel Criteria for Soaps, Shampoos and Hair Conditioners: preliminary results from the technical analysis. August 2012.
European Commission et al. (2012a)	European Commission, Joint Research Centre (JRC), Institute for Prospective Technological Studies (IPTS) and LEITAT (2012). Revision of the European Ecolabel Criteria for Soaps, Shampoos and Hair Conditioners: background report including revised draft criteria proposal. August 2012.
Henkel (2008)	Henkel (2008). Case Study Shampoo by Henkel AG & CO. KGAA, Documentation Case Study undertaken within the PCF Pilot Project. 2008. Germany.

12.9 Annex IX – Deviations from EC guidance and methodology

The shampoo PEFCR, despite being a "shadow PEF" and not an official pilot PEF, followed as closely as possible the guidance and methodology proposed by the European Commission. Since the pilot PEFs are currently ongoing, this guidance and methodology may continue to evolve over the coming months and years. Listed below are any deviations that have been identified at this time.

Representative product

According to the European Commission's PEF guidelines, the representative product may be a virtual product which is identified based on average sales-weighted characteristics of all existing technologies / materials covered by the scope of the PEFCR.

Shampoos on the EU market are highly complex, aqueous surfactant-based preparations, with surfactants being the most prominent ingredients in terms of concentration and mediating the primary function (cleansing of hair and scalp). Thus, the shampoo product category is considered as technologically uniform (i.e. one-technology only).

Shampoos typically contain 20 – 50 cosmetic ingredients, some of which may be complex mixtures of natural and/or synthetic chemicals (fragrances, botanical extracts, commercially-available pre-mixtures). The overall pool of shampoo components amounts to several hundred chemicals; individual formulations differ widely with regard to their qualitative and quantitative composition.

However, shampoo formulations have common characteristics, in terms of ingredient functions: cleansing, viscosity controlling, pH adjustment, hair care/ conditioning, perfuming, preservation.

For all the reasons listed above, the technical secretariat decided to construct a virtual representative product containing commonly used ingredients from each functional group, as well as typical and realistic concentrations.

Packaging modelling

The European Commission distributed a document (PEF-OEF_EOL DefaultData_V1.2_uploaded.xls) which contains default assumptions to be used for packaging end-of-life modelling (e.g. recycling rate, energy content per type of packaging for waste heat recovery, landfill and incineration rates). At the time of publication, the shampoo PEFCR was aligned with these recommendations. Note however that there is a packaging working group and it is expected that this document may evolve over time. Discussions are ongoing across several of the different PEF pilots.

Normalisation

This PEFCR Report applies the recommended normalisation factors provided by the European Commission. However, an additional method was tested, in order to help inform the selection of the most relevant impact categories (see Annex III and the screening report for more details).

Verification of the supporting studies

For official PEF pilots, the Commission will verify at least one of the PEF supporting studies. Since the shampoo PEF study is a "shadow" pilot, the supporting studies have not been verified by the Commission.

PEFCR review

For the PEF pilots, an independent third-party panel composed of a minimum of three members (i.e., a chair and two members) will review the PEFCR. The shampoo PEFCR Report has not undergone such a review.

Reporting, disclosure and communication

The shampoo PEFCR Report does not provide recommendations concerning reporting, disclosure and communication.