# PRODUCT ENVIRONMENTAL FOOTPRINT CATEGORY RULES

## Leather

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## Acronyms

| | |
|---|---|
| **ABS** | Alkyl Benzene Sulfonate |
| **ADEME** | Agence de l'Environnement et de la Maîtrise de l'Energie |
| **AF** | Allocation Factor |
| **AICC** | Associazione Italiana Chimici del Cuoio |
| **APIC** | Associação Portuguesa dos Industriais de Curtumes |
| **APPBR** | Asociatia Producatorilor de Piele si Blana din Romana |
| **AR** | Allocation Ratio |
| **ASTM** | American Society for Testing and Materials International |
| **B2B** | Business to Business |
| **B2C** | Business to Consumer |
| **BAT** | Best Available Techniques |
| **BLC** | Former British Leather Confederation, currently BLC Leather Technology Centre Ltd. |
| **BoC** | Bill of Components |
| **BoM** | Bill of Materials |
| **BP** | Bonne Practique |
| **BREF** | Best Available Techniques (BAT) Reference documents |
| **BSC** | Biogenic Stored Carbon |
| **BSI** | British Standards Institution |
| **BULFFHI** | Branch Union of Leather, Furriers, Footwear and Haberdashery Industries |
| **CAS** | Chemical Abstracts Service |
| **CEN** | European Committee for Standardization |
| **CEN TS** | Technical Specifications |
| **CF** | Characterisation Factor |
| **CFCs** | Chlorofluorocarbons |
| **CFF** | Circular Footprint Formula |
| **CFF-M** | Circular Footprint Formula – Modular form |
| **CIV** | Centre d'Information des Viandes |
| **CMWG** | Cattle Model Working Group |
| **COD** | Chemical Oxygen Demand |
| **COTANCE** | Confédération des Associations Nationales de Tanneurs et Mégissiers de la Communauté Européenne |
| **CPA** | Classification of Products Activity |
| **CSV** | Comma-Separated Values |
| **CTC** | Technical Centre of Footwear and Leather |
| **CuPc** | Copper Phthalocyanine |
| **CWA** | Clean Water Act |
| **DC** | Distribution Centre |
| **DDS** | Dihydroxydiphenyl-sulfone |
| **DG** | Directorate-General |
| **DIN** | Deutsches Institut für Normung |
| **DMI** | Dry Matter Intake |

| | |
|---|---|
| **DNM** | Data Needs Matrix |
| **DQA** | Data Quality Assessment |
| **DQR** | Data Quality Rating |
| **DTI** | Danish Technological Institute |
| **DU** | Declared unit |
| **EDTA** | Ethylenediaminetetraacetic Acid |
| **EA** | Economic Allocation |
| **EC** | European Commission |
| **EF** | Environmental Footprint |
| **EI** | Environmental Impact |
| **EIA** | Environmental Impact Assessment |
| **ELCD** | European Reference Life Cycle Database |
| **EMAS** | Eco-Management and Audit Schemes |
| **EMS** | Environmental Management Schemes |
| **EN** | European standards |
| **ENV** | Environment |
| **EoL** | End-of-Life |
| **EPA** | Environmental Protection Agency |
| **EPD** | Environmental Product Declaration |
| **ETP** | Effluent Treatment Plant |
| **EU** | European Union |
| **EWC** | European Waste Catalogue |
| **FAOSTAT** | Food and Agriculture Organization of the United Nations Statistics division |
| **FFTM** | Fédération Française de la Tannerie-Mégisserie |
| **FLIA** | Finnish Leather Industry Association |
| **FNL** | Federatie van Nederlandse Lederfabrikanten |
| **FoC** | Free of Chrome |
| **GE** | Gross Energy Intake |
| **GHG** | Greenhouse Gas |
| **GLO** | Global |
| **GR** | Geographical Representativeness |
| **GRI** | Global Reporting Initiative |
| **GWP** | Global Warming Potential |
| **HD** | Helpdesk |
| **HFC** | Hydrofluorocarbons |
| **HH** | Human Health |
| **ICLT** | Institute for Creative Leather Technologies |
| **ICT** | International Council of Tanners |
| **ID** | Identifier |
| **IDF** | International Dairy Federation |
| **IES** | Institute for Environment and Sustainability |
| **ILCD** | International Reference Life Cycle Data System |
| **INRA** | Institut National de la Recherche Agronomique |

| | |
|---|---|
| **IPCC** | Intergovernmental Panel on Climate Change |
| **IPPC** | Integrated Pollution Prevention and Control |
| **ISBN** | International Standard Book Number |
| **ISIC** | International Standard Industrial Classification |
| **ISO** | International Organization for Standardization |
| **IUCN** | International Union for Conservation of Nature and Natural Resources |
| **IULTCS** | International Union of Leather Technologists and Chemists Societies |
| **IULTCS/IUC** | Chemical Test Methods Commission |
| **IULTCS/IUE** | Environment Commission |
| **JALCA** | Journal of American Leather Chemists Association |
| **JRC** | Joint Research Centre |
| **JSLTC** | Journal of Society of Leather Technologists and Chemists |
| **LCA** | Life Cycle Assessment |
| **LCDN** | Life Cycle Data Network |
| **LCI** | Life Cycle Inventory |
| **LCIA** | Life Cycle Impact Assessment |
| **LCT** | Life Cycle Thinking |
| **LT** | Lifetime |
| **LU** | Land Use |
| **LW** | Live-Weight |
| **NACE** | Nomenclature Générale des Activités Economiques dans les Communautés Européennes |
| **NDA** | Non Disclosure Agreement |
| **NGO** | Non-Governmental Organization |
| **NL** | Netherlands |
| **NMVOC** | Non-Methane Volatile Organic Compound |
| **NPK** | Nitrogen-Phosphorus-Potassium |
| **NZ** | New Zealand |
| **OEF** | Organisation Environmental Footprint |
| **OIT** | 2-Octyl-2H-isothiazol-3-one |
| **OPP** | Ortho-Phenylphenol and Sodium |
| **P** | Precision |
| **PAS** | Public Available Specification |
| **PERC** | Perchloroethylene |
| **PCMS** | Polycarbamoyl Sulfonate |
| **PCR** | Product Category Rule |
| **PEF** | Product Environmental Footprint |
| **PEFCR** | Product Environmental Footprint Category Rule |
| **PI** | Province of Pisa |
| **QR** | Quick Response |
| **RER** | Rest of Europe |
| **RF** | Reference Flow |
| **RP** | Representative Product |
| **SA** | Sociedad Anónima |

| | |
|---|---|
| **SB** | System Boundary |
| **SC** | Steering Committee |
| **SCC** | Stored Carbon from Chemicals |
| **SDDC** | Sodium Dimethyldithiocarbamate |
| **SDS-PAGE** | Sodium Dodecyl Sulphate - PolyAcrylamide Gel Electrophoresis |
| **SG** | Svenska Garveriidkareforeningen |
| **SLG** | Scottish Leather Group Ltd. |
| **SMRS** | Sustainability Measurement & Reporting System |
| **SS** | Supporting Study |
| **SSIP** | Stazione Sperimentale per l'Industria delle Pelli e delle Materie Concianti |
| **TAB** | Technical Advisory Board |
| **TCMTB** | (Benzothiazol-2-ylthio)methylthiocyanat |
| **TeR** | Technological Representativeness |
| **TiR** | Time Representativeness |
| **TKN** | Total Kjedahl Nitrogen |
| **TS** | Technical Secretariat |
| **UKLF** | United Kingdom Leather Federation |
| **UNE** | Spanish Standard |
| **UNI** | Ente Nazionale Italiano di Unificazione |
| **UNI/TS** | Specifica Tecnica |
| **UNIC** | Unione Nazionale Industria Conciaria |
| **UNIDO** | United Nations Industrial Development Organization |
| **UNITAN** | Union de la Tannerie et de la Mégisserie Belge |
| **UNPAC** | Unione Nazionale Produttori Italiani Ausiliari Conciari |
| **UPC** | Universitat Politècnica de Catalunya |
| **USA** | United States of America |
| **UUID** | Universally Unique Identifier |
| **VDL** | Verband der Deutschen Lederindustrie e.V |
| **VOC** | Volatile Organic Compounds |
| **WRI** | World Resources Institute |
| **WBCSD** | World Business Council for Sustainable Development |

## Definitions

**Activity data** - This term refers to information which is associated with processes while modelling Life Cycle Inventories (LCI). In the PEF Guide it is also called “non-elementary flows”. The aggregated LCI results of the process chains that represent the activities of a process are each multiplied by the corresponding activity data[1] and then combined to derive the environmental footprint associated with that process (See Figure 1). Examples of activity data include quantity of kilowatt-hours of electricity used, quantity of fuel used, output of a process (e.g. waste), number of hours equipment is operated, distance travelled, floor area of a building, etc. In the context of PEF the amounts of ingredients from the bill of material (BOM) shall always be considered as activity data.

**Aggregated dataset** - This term is defined as a life cycle inventory of multiple unit processes (e.g. material or energy production) or life cycle stages (cradle-to-gate), but for which the inputs and outputs are provided only at the aggregated level. Aggregated datasets are also called "LCI results", “cumulative inventory” or “system processes” datasets. The aggregated dataset can have been aggregated horizontally and/or vertically. Depending on the specific situation and modelling choices a "unit process" dataset can also be aggregated. See Figure 1[2].

**Application specific** – It refers to the generic aspect of the specific application in which a material is used. For example, the average recycling rate of PET in bottles.

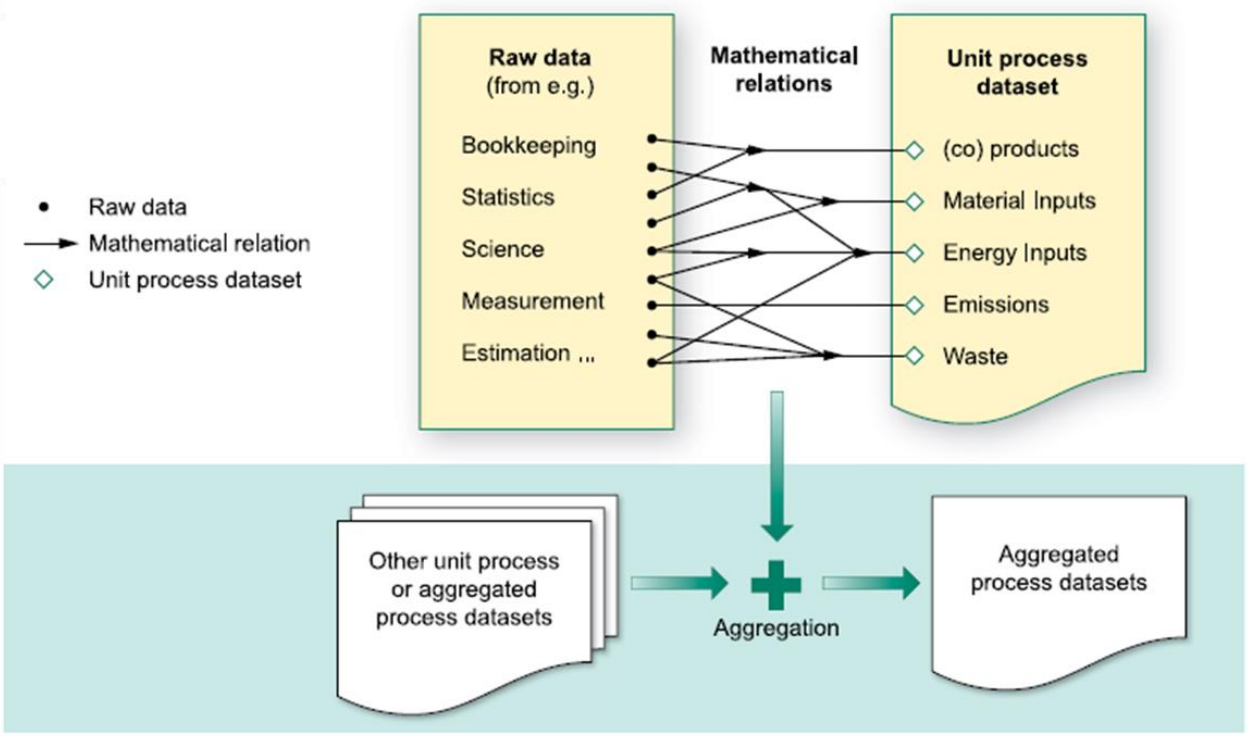
**Benchmark** – A standard or point of reference against which any comparison can be made. In the context of PEF, the term ‘benchmark’ refers to the *average* environmental performance of the representative product sold in the EU market. A benchmark may eventually be used, if appropriate, in the context of communicating environmental performance of a product belonging to the same category.

**Bill of materials** – A bill of materials or product structure (sometimes bill of material, BOM or associated list) is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts and the quantities of each needed to manufacture an end product.

[1] Based on GHG protocol scope 3 definition from the Corporate Accounting and Reporting Standard (World resources institute, 2011).

[2] Source: UN Environment /SETAC “Global Guidance Principles for LCA Databases"

**Figure 1 Definition of a unit process dataset and an aggregated process dataset**




**Business to Business (B2B)** – Describes transactions between businesses, such as between a manufacturer and a wholesaler, or between a wholesaler and a retailer.

**Business to Consumers (B2C)** – Describes transactions between business and consumers, such as between retailers and consumers. According to ISO 14025:2006, a consumer is defined as "an individual member of the general public purchasing or using goods, property or services for private purposes".

**By-Product**[3] – Output other than the principal product(s) of an industrial process, such as sawdust or woodchips generated in processing lumber. Unlike joint-products, byproducts have low value in comparison with the principal product(s) and may be discarded or sold either in their original state, or after further processing.

**Commissioner of the EF study** - Organisation (or group of organisations) that finances the EF study in accordance with the PEF Guide, PEFCR Guidance and the relevant PEFCR, if available (definition adapted from ISO 14071/2014, point 3.4).

**Company-specific data** – It refers to directly measured or collected data from one or multiple facilities (site-specific data) that are representative for the activities of the company. It is synonymous to "primary data". To determine the level of representativeness a sampling procedure can be applied.

[3] http://www.businessdictionary.com/definition/byproduct.html

**Comparative assertion** – An environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function (adapted from ISO 14025:2006).

**Comparison** – A comparison, not including a comparative assertion, (graphic or otherwise) of two or more products based on the results of a PEF study and supporting PEFCRs or the comparison of one or more products against the benchmark, based on the results of a PEF study and supporting PEFCRs.

**Co-Product**[4]– Product manufactured along with a different product, in a process in which both are required in the production of another product. In comparison, a by-product is usually an undesirable product.

**Data Quality Rating (DQR)** - Semi-quantitative assessment of the quality criteria of a dataset based on Technological representativeness, Geographical representativeness, Time-related representativeness, and Precision. The data quality shall be considered as the quality of the dataset as documented.

**Direct elementary flows** (also named elementary flows) – All output emissions and input resource use that arise directly in the context of a process. Examples are emissions from a chemical process, or fugitive emissions from a boiler directly onsite. See Figure 2.

**Disaggregation** – The process that breaks down an aggregated dataset into smaller unit process datasets (horizontal or vertical). The disaggregation can help making data more specific. The process of disaggregation should never compromise or threat to compromise the quality and consistency of the original aggregated dataset

**Edible** - Products which are covered by EU food legislation and comply with all relevant regulatory requirements for being placed on the market as suitable or fit for human consumption, notably with regard to the corresponding sanitary certification.

**EF communication vehicles** – It includes all the possible ways that can be used to communicate the results of the EF study to the stakeholders. The list of EF communication vehicles includes, but it is not limited to, labels, environmental product declarations, green claims, websites, infographics, etc.

**EF report** – Document that summarises the results of the EF study. For the EF report the template provided as annex to the PECFR Guidance shall be used. In case the commissioner of the EF study decides to communicate the results of the EF study (independently from the communication vehicle used), the EF report shall be made available for free through the commissioner's website. The EF report shall not contain any information that is considered as confidential by the commissioner, however the confidential information shall be provided to the verifier(s).

**EF study** – Term used to identify the totality of actions needed to calculate the EF results. It includes the modelisation, the data collection, and the analysis of the results.

**Electricity tracking**[5] – Electricity tracking is the process of assigning electricity generation attributes to electricity consumption.

[4] http://www.businessdictionary.com/definition/coproduct.html
[5] https://ec.europa.eu/energy/intelligent/projects/en/projects/e-track-ii

**Elementary flow** - Material or energy entering the system being studied that has been drawn from the environment without previous human transformation, or material or energy leaving the system being studied that is released into the environment without subsequent human transformation.

**Environmental aspect** – Element of an organization's activities or products or services that interacts or can interact with the environment (ISO 14001:2015)

**External Communication** – Communication to any interested party other than the commissioner or the practitioner of the study.

**Foreground elementary flows -** Direct elementary flows (emissions and resources) for which access to primary data (or company-specific information) is available.

**Grain** - The surface of a hide or skin exposed by removal of the hair or wool and epidermis.

**Hide** - The outer covering of a mature, or fully grown, animal of the larger kind.

**Independent external expert** – Competent person, not employed in a full-time or part-time role by the commissioner of the EF study or the practitioner of the EF study, and not involved in defining the scope or conducting the EF study (adapted from ISO 14071/2014, point 3.2).

**Input flows** – Product, material or energy flow that enters a unit process. Products and materials include raw materials, intermediate products and co-products (ISO 14040:2006).

**Intermediate product** - An intermediate product is a product that requires further processing before it is saleable to the final consumer.

**Lead verifier** – Verifier taking part in a verification team with additional responsibilities compared to the other verifiers in the team.

**Leather** - hide or skin with its original fibrous structure more or less intact, tanned to be imputrescible, where the hair or wool may or may not have been removed, whether or not the hide or skin has been split into layers or segmented either before or after tanning and where any surface coating or surface layer, however applied, is not thicker than 0.15 mm.

**Life Cycle Inventory (LCI)** - The combined set of exchanges of elementary, waste and product flows in a LCI dataset.

**Life Cycle Inventory (LCI) dataset** - A document or file with life cycle information of a specified product or other reference (e.g., site, process), covering descriptive metadata and quantitative life cycle inventory. A LCI dataset could be a unit process dataset, partially aggregated or an aggregated dataset.

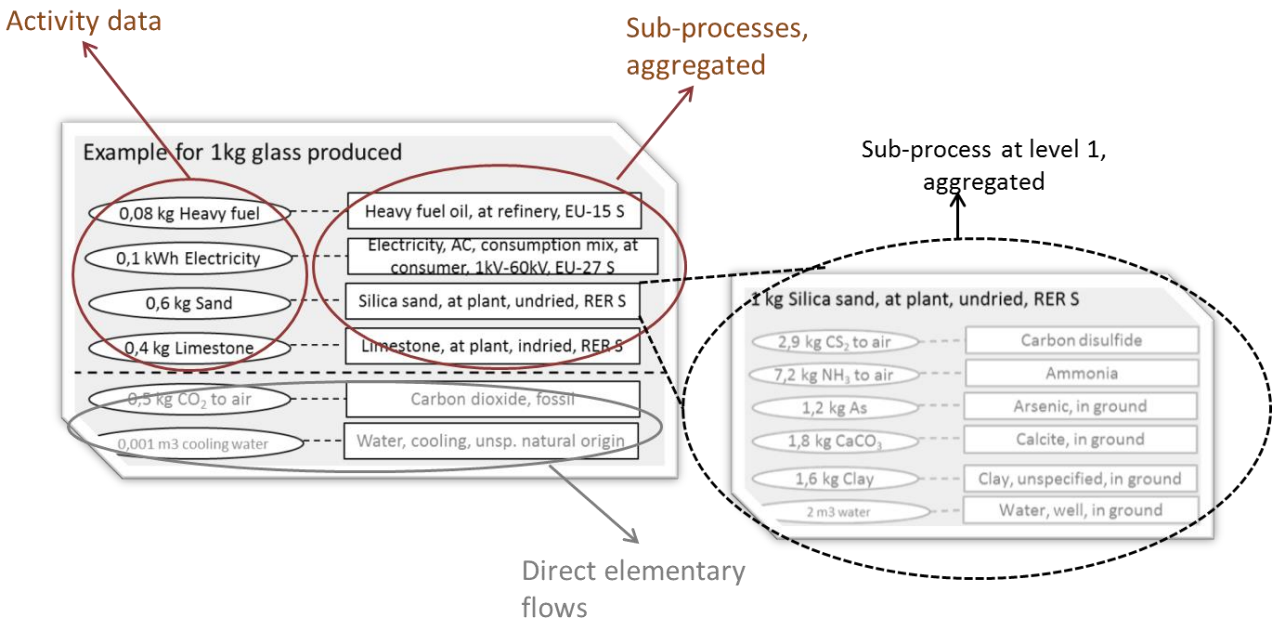
**Material-specific** – It refers to a generic aspect of a material. For example, the recycling rate of PET.

https://ec.europa.eu/energy/intelligent/projects/en/projects/e-track-ii

**Output flows** – Product, material or energy flow that leaves a unit process. Products and materials include raw materials, intermediate products, co-products and releases (ISO 14040:2006).

**Partially disaggregated dataset** - A dataset with a LCI that contains elementary flows and activity data, and that only in combination with its complementing underlying datasets yield a complete aggregated LCI data set. We refer to a partially disaggregated dataset at level 1 in case the LCI contains elementary flows and activity data, while all complementing underlying dataset are in their aggregated form (see an example in Figure 2).

**Figure 2 An example of a partially aggregated dataset, at level 1. The activity data and direct elementary flows are to the left, and the complementing sub-processes in their aggregated form are to the right. The grey text indicates elementary flows**




**PEFCR Supporting study** – The PEF study done on the basis of a draft PEFCR. It is used to confirm the decisions taken in the draft PEFCR before the final PEFCR is released.

**PEF Profile** – The quantified results of a PEF study. It includes the quantification of the impacts for the various impact categories and the additional environmental information considered necessary to be reported.

**PEF screening** – A preliminary study carried out on the representative product(s) and intended to identify the most relevant life cycle stages, processes, elementary flows, impact categories and data quality needs to derive the preliminary indication about the definition of the benchmark for the product category/sub-categories in scope, and any other major requirement to be part of the final PEFCR.

**Population -** Any finite or infinite aggregation of individuals, not necessarily animate, subject to a statistical study.

**Practitioner of the EF study** – Individual, organisation or group of organisations that performs the EF study in accordance with the PEF Guide, PEFCR Guidance and the relevant PEFCR if available. The practitioner of

the EF study can belong to the same organisation as the commissioner of the EF study (adapted from ISO 14071/2014, point 3.6).

**Primary data**[6] - This term refers to data from specific processes within the supply-chain of the company applying the PEFCR. Such data may take the form of activity data, or foreground elementary flows (life cycle inventory). Primary data are site-specific, company-specific (if multiple sites for the same product) or supply-chain-specific. Primary data may be obtained through meter readings, purchase records, utility bills, engineering models, direct monitoring, material/product balances, stoichiometry, or other methods for obtaining data from specific processes in the value chain of the company applying the PEFCR. In this Guidance, primary data is synonym of "company-specific data" or "supply-chain specific data".

**Product category** – Group of products (or services) that can fulfil equivalent functions (ISO 14025:2006).

**Product Category Rules (PCR)** – Set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories (ISO 14025:2006).

**Product Environmental Footprint Category Rules (PEFCRs)** – Product category-specific, life-cycle-based rules that complement general methodological guidance for PEF studies by providing further specification at the level of a specific product category. PEFCRs help to shift the focus of the PEF study towards those aspects and parameters that matter the most, and hence contribute to increased relevance, reproducibility and consistency of the results by reducing costs versus a study based on the comprehensive requirements of the PEF guide.

**Refurbishment** – It is the process of restoring components to a functional and/or satisfactory state to the original specification (providing the same function), using methods such as resurfacing, repainting, etc. Refurbished products may have been tested and verified to function properly.

**Representative product (model)** - The “representative product” may or may not be a real product that one can buy on the EU market. Especially when the market is made up of different technologies, the “representative product” can be a virtual (non-existing) product built, for example, from the average EU sales-weighted characteristics of all technologies around. A PEFCR may include more than one representative product if appropriate.

**Representative sample** – A representative sample with respect to one or more variables is a sample in which the distribution of these variables is exactly the same (or similar) as in the population from which the sample is a subset

**Sample** – A sample is a subset containing the characteristics of a larger population. Samples are used in statistical testing when population sizes are too large for the test to include all possible members or observations. A sample should represent the whole population and not reflect bias toward a specific attribute.

[6] Based on GHG protocol scope 3 definition from the Corporate Accounting and Reporting Standard (World resources institute, 20011).

**Secondary data**[7] - It refers to data not from specific process within the supply-chain of the company applying the PEFCR. This refers to data that is not directly collected, measured, or estimated by the company, but sourced from a third party life-cycle-inventory database or other sources. Secondary data includes industry-average data (e.g., from published production data, government statistics, and industry associations), literature studies, engineering studies and patents, and can also be based on financial data, and contain proxy data, and other generic data. Primary data that go through a horizontal aggregation step are considered as secondary data.

**Site-specific data** – It refers to directly measured or collected data from one facility (production site). It is synonymous to "primary data".

**Skin** - The more or less thick, tough, flexible covering of human and other animal bodies.

**Split** - Leather made from the middle or under layer split from a hide or skin.

**Sub-population** – In this document this term indicates any finite or infinite aggregation of individuals, not necessarily animate, subject to a statistical study that constitutes a homogenous sub-set of the whole population. Sometimes the word "stratum" can be used as well.

**Sub-processes** - Those processes used to represent the activities of the level 1 processes (=building blocks). Sub-processes can be presented in their (partially) aggregated form (see Figure 2).

**Sub-sample -** In this document this term indicates a sample of a sub-population.

**Supply-chain** – It refers to all of the upstream and downstream activities associated with the operations of the company applying the PEFCR, including the use of sold products by consumers and the end-of-life treatment of sold products after consumer use.

**Supply-chain specific** – It refers to a specific aspect of the specific supply-chain of a company. For example the recycled content value of an aluminium can produced by a specific company.

**Type III environmental declaration** – An environmental declaration providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information (ISO 14025:2006). The predetermined parameters are based on the ISO 14040 series of standards, which is made up of ISO 14040 and ISO 14044.

**Unit process dataset** - Smallest element considered in the life cycle inventory analysis for which input and output data are quantified (ISO 14040:2006). In LCA practice, both physically not further separable processes (such as unit operations in production plants, then called "unit process single operation") and also whole production sites are covered under "unit process", then called "unit process, black box" (ILCD Handbook).

**Validation statement** – Conclusive document aggregating the conclusions from the *verifiers* or the verification team regarding the EF study. This document is mandatory and shall be electronically or physically

[7] Based on GHG protocol scope 3 definition from the Corporate Accounting and Reporting Standard (World resources institute, 20011)

signed by the *verifier or in case of a* verification panel, by the lead verifier. The minimum content of the validation statement is provided in this document.

**Verification report** – Documentation of the verification process and findings, including detailed comments from the *Verifier(s)*, as well as the corresponding responses. This document is mandatory, but it can be confidential. However, it shall be signed, electronically or physically, by the *verifier or in case of a* verification panel, by the lead verifier.

**Verification team** – Team of verifiers that will perform the verification of the EF study, of the EF report and the EF communication vehicles.

**Verifier** – Independent external expert performing a verification of the EF study and eventually taking part in a verification team.

# 1. Introduction

The Product Environmental Footprint (PEF) Guide provides 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 programmes.

For all requirements not specified in this PEFCR the applicant shall refer to the documents this PEFCR is in conformance with (see chapter 2.7 Conformance to other documents).

The compliance with the present PEFCR is optional for PEF in-house applications, whilst it is mandatory whenever the results of a PEF study or any of its content is intended to be communicated.

**Terminology: shall, should and may**

This PEFCR uses precise terminology to indicate the requirements, the recommendations and options that could be chosen when a PEF study is conducted.

- The term "shall" is used to indicate what is required in order for a PEF study to be in conformance with this PEFCR.
- The term "should" is used to indicate a recommendation rather than a requirement. Any deviation from a "should" requirement has to be justified when developing the PEF study and made transparent.
- The term "may" is used to indicate an option that is permissible. Whenever options are available, the PEF study shall include adequate argumentation to justify the chosen option.

# 2. General information about the PEFCR

## 2.1 Technical secretariat

The organisations listed in Table 1 were the Technical Secretariat (TS), which is responsible for the development of the PEFCRs for the leather sector, at the time of final opinion expressed by the Environmental Footprint Steering Committee. All listed entities are members of the TS as of the start of the initiative except "Gremi de Blanquers d'Igualada" joining on the 4th of September 2015 and the Igualada Engineering School joining on the 2nd of December 2015.

**Table 1 List of the organizations in the TS**

| Name of the organization | Type of organization |
|---|---|
| **APIC: Associação Portuguesa dos Industriais de Curtumes** | Industrial association |
| **APPBR: Asociatia Producatorilor de Piele si Blana din Romana** | Industrial association |
| **BULFFHI: Branch Union of Leather, Furriers, Footwear and Haberdashery Industries** | Industrial association |

| Name of the organization | Type of organization |
|---|---|
| **COTANCE: Confédération des Associations Nationales de la Communauté Européenne** | Industrial association |
| **FFTM: Fédération Française de la Tannerie-Mégisserie** | Industrial association |
| **FLIA: Finnish Leather Industry Association** | Industrial association |
| **FNL: Federatie van Nederlandse Lederfabrikanten** | Industrial association |
| **Gremi de Blanquers d'Igualada** | Industrial association |
| **ICT: International Council of Tanners** | Industrial association |
| **Igualada Engineering School, UPC: Universitat Politècnica de Catalunya** | Academia |
| **IKEA** | Industry |
| **IULTCS / IUE: International Union of Leather Technologists and Chemists Societies / Environment Commission** | Industrial association |
| **Pittards Plc.** | Industry |
| **SG: Svenska Garveriidkareforeningen** | Industrial association |
| **SLG: Scottish Leather Group Ltd.** | Industry |
| **Spin 360** | Consultant |
| **Stahl** | Industry |
| **UKLF: UK Leather Federation** | Industrial association |
| **UNIC: Unione Nazionale Industria Conciaria** | Industrial association |
| **UNITAN: Union de la Tannerie et de la Mégisserie Belge** | Industrial association |
| **University of Northampton, ICLT: Institute for Creative Leather Technologies** | Academia |
| **University of Pisa, Department of Civil & Industrial Engineering** | Academia |
| **VDL: Verband der Deutschen Lederindustrie e.V.** | Industrial association |
| **World Leather, World Trades Publishing Ltd.** | Publishing company |

## 2.2 Consultations and stakeholders[8]

During the pilot phase were held three public consultation during which comments were collected through the dedicated template and were then addressed and eventually implemented in the new draft of the Product Environmental Footprint Category Rules (PEFCR).

[8] A web page is available to see the evolution of leather PEFCR: https://webgate.ec.europa.eu/fpfis/wikis/display/EUENVFP/PEFCR+Pilot%3A+Leather

Table 2 Information on public consultations

| Public consultation # | Opening date | Closing date | Comments received | Organisations providing comments |
|---|---|---|---|---|
| **1** | 12 January 2015 | 12 February 2015 | 16 | Aequilibria, EPD International AB (programme operator of the International EPD System), GME (Gelatine Manufacturers of Europe) |
| **2** | 11 November 2015 | 9 December 2015 | 35 | Associazione Conciatori Santa Croce sull'Arno, Consorzio conciatori Ponte a Egola and Polo Tecnologico Conciario on behalf of the pilot group of the fashion cluster in Tuscany region, constituted during the Life + PREFER project, HUGO BOSS, I-T-G GmbH on behalf of the VDL, thinkstep AG, UPC-Igualada and Igualada Leather Cluster Barcelona Igualada |
| **3** | 1 August 2016 | 16 September 2016 | 158 | 2.-0 LCA consultants, European Commission (EC), ENEA also on behalf of the Italian Ministry of Environment, Fédération Française Tannerie Mégisserie - Paris – France, Institute For Industrial Technologies And Automation – Italy, Kering, Silvateam Spa, Spin 360, Stahl, UK Leather Federation |

## 2.3 Review panel and review requirements of the PEFCR

The review panel was composed as depicted in Table 3. The first review was performed before the remodelling phase and the final one took place at the end of the pilot phase.

Table 3 Members of the review panel

| Name of the member | Affiliation | Role |
|---|---|---|
| **Ugo Pretato** | Studio Fieschi & soci Srl | Review panel Chair / Life Cycle Assessment (LCA) expert |
| **Carlo Brondi**[9] | Consiglio Nazionale delle Ricerche (CNR) | Life Cycle Assessment (LCA) expert |
| **Gianluigi Calvanese** | Stazione Sperimentale per l'Industria delle Pelli e delle Materie Concianti Srl (SSIP) | Industry expert |
| **Antonino Morabito**[9] | LEGAMBIENTE Onlus - Direzione Nazionale | Non-Governmental Organization (NGO) representative |

The reviewers have verified that the following requirements have been fulfilled:

- The PEFCR has been developed in accordance with the requirement provided in the PEFCR Guidance version 6.3, and where appropriate in accordance with the requirements provided in the

[9] Mr. Morabito contributed to the first review only and was substituted by Mr. Brondi for the final one.

most recent approved version of the PEF Guide, and supports creation of credible and consistent PEF profiles,

- The declared unit, allocation and calculation rules are adequate for the product category under consideration,
- Company-specific and secondary datasets used to develop this PEFCR are relevant, representative, and reliable,
- The selected LCIA indicators and additional environmental information are appropriate for the product category under consideration and the selection is done in accordance with the guidelines stated in the PEFCR Guidance version 6.3 and the most recent approved version of the PEF Guide,
- The benchmark(s) is(are) correctly defined, and
- Both LCA-based data and the additional environmental information prescribed by the PEFCR give a description of the significant environmental aspects associated with the product.

The detailed review report is provided in ANNEX 3 - Critical review report of the PEFCR of this PEFCR.

## 2.4 Review statement

This PEFCR has been developed in compliance with Version 6.3 of the PEFCR Guidance, and with the PEF Guide adopted by the Commission on 9 April 2013.

The representative product(s) correctly describes the average product(s) sold in Europe for the product group in scope of this PEFCR.

PEF studies carried out in compliance with this PEFCR would reasonably lead to reproducible results, but the information included therein may not be used to make comparisons, unless the complete product life cycle is included in the system boundaries and a consistent declared unit is defined (see chapter 3.6 Limitations).

Furthermore PEF studies provide the basis to systematize environmental knowledge in the foreground sectors (e.g. fashion sector). PEF review has been intended to provide transparency and clearness to PEF studies in order to be modularly implemented within other sectoral PEF.

The panel members confirm that they have sufficient knowledge and experience of the industrial sector involved and of the relevant methods and guidance to carry out this review and that they have performed the review tasks at the best of their capacity.

The panel members confirm that they have been independent in their role as reviewers, they have not been involved in the development of the PEFCR and they do not have conflicts of interest regarding this review.

## 2.5 Geographic validity

This PEFCR is valid for products in scope sold/consumed in the European Union + EFTA.

Each PEF study shall identify its geographical validity listing all the countries where the product object of the PEF study is consumed/sold with the relative market share. In case the information on the market for the

specific product object of the study is not available, Europe +EFTA shall be considered as the default market, with an equal market share for each country.

### 2.6 Language

The PEFCR is written in English. The original in English supersedes translated versions in case of conflicts.

### 2.7 Conformance to other documents

This PEFCR has been prepared in conformance with the following documents (in prevailing order):

- PEFCR Guidance 6.3;
- Product Environmental Footprint (PEF) Guide; Annex II to the Recommendation 2013/179/EU, 9 April 2013. Published in the official journal of the European Union Volume 56, 4 May 2013.

## 3. PEFCR scope

These PEFCR cover leathers meeting the following definition:

"Finished leathers produced from raw hides and skins of bovine, ovine and caprine animals, which have been raised mainly for the production of milk, meat or wool, and slaughtered mainly for human consumption purposes, notably meat production."

Are excluded from the present PEFCR all leathers produced from hides or skins of animals other than those slaughtered for human consumption, as well as any synthetic substitute material to leather.

Therefore, the product categories included in this work apply to finished leathers manufactured from adult bovine hides, calf, ovine and caprine skins. These are the predominant industrial products of tanneries, representing more than 99% of global finished leather production (source ICT). Downstream end users (leather articles manufacturers) buy leather as an external input processing material. The related Statistical Classification of Products by Activity (CPA) codes for these product categories are reported in Table 4.

### 3.1 Product classification

The CPA codes for the products included in this PEFCR are:

**Table 4 Classification of Products by Activity (CPA) for the products included in this PEFCR**

| C | MANUFACTURED PRODUCTS |
|---|---|
| **15** | Leather and related products |
| **15.1** | Tanned and dressed leather; luggage, handbags, saddlery and harness; dressed and dyed fur |
| **15.11.3** | Leather, of bovine or equine animals, without hair |
| **15.11.4** | Leather of sheep, goat or swine, without hair |

Leather is the result of activities performed that are classified in the Statistical Classification of Economic Activities in the European Community (NACE) Rev.2 under code 15.11 Tanning and dressing of leather;

dressing and dyeing of fur, corresponding to International Standard Industrial Classification (ISIC) Rev.4 to code 1511.

## 3.2 Representative product(s)

The RPs are virtual products defined on the basis of European market share of the different kind of leather.

The following four RPs, one for each of the main application and uses of finished leather, have been identified:

RP1. Leather for automotive interiors and furniture upholstery;
RP2. Leather for upper footwear and leather goods (e.g. bags, belts, wallets, …);
RP3. Leather for garment and gloves;
RP4. Sole leather.

Each RP cover all animal origins and technologies variants for the specific end use.

The characteristics of the RPs, in terms of tanning technologies and animal origins, are reported in ANNEX 5 – Representative Products. We present below the summary table of the RPs.

**Table 5 Representative Products**

| RP ID | End use | Chrome-Tanned | Vegetable-Tanned | Free of Chrome (FoC) | Animal Origin[10] |
|---|---|---|---|---|---|
| **RP1** | Automotive and upholstery | 63% | 0% | 37% | Bovine (100%) |
| **RP2** | Footwear and leather goods | 75% | 22% | 3% | Bovine (66%), Calf (12%), Caprine (11%), Ovine (11%) |
| **RP3** | Garments and Gloves | 100% | 0% | 0% | Calf (20%), Caprine (16%), Ovine (64%) |
| **RP4** | Sole leather | 0% | 100%[11] | 0% | Bovine (100%) |

The screening study is available upon request to the TS coordinator that has the responsibility of distributing it with an adequate disclaimer about its limitations.

## 3.3 Declared unit and reference flow

The Declared Unit (DU) is a square meter ($m^2$) of finished leather, measured according to ISO 11646 standard or EN ISO 19076.

For finished sole leather, which is routinely measured and sold by weight (kg), an appropriate conversion factor from weight of finished product to surface area of finished product ($kg/m^2$) shall be used. The conversion factor shall be calculated based on tannery primary data, considering that the thickness of sole leather significantly influences the weight per surface unit. If a conversion factor to transform kg of sole

[10] The percentages are taken from "UNIC Annual Report 2013" for the Italian production.
[11] Full vegetable tanning

leather into $m^2$ of sole leather is not available as primary data from the tannery, a default value of 4.63 $kg/m^2$ shall be used (average value that cover all ranges of thickness). The default values have been established in an open consultation process with the producers of sole leathers producing more than 80% of the sole European leather tested in the screening phase. The use of the default value shall be justified and be subject to strict review by the verifier, since it greatly influence the results of the study.

Table 6 defines the key aspects used to define the DU.

**Table 6 Key aspects of the DU**

| | |
|---|---|
| **What?** | Leather as defined by EN15897:2014: "hide or skin with its original fibrous structure more or less intact, tanned to be imputrescible, where the hair or wool may or may not have been removed, whether or not the hide or skin has been split into layers or segmented either before or after tanning and where any surface coating or surface layer, however applied, is not thicker than 0.15 mm". |
| **How much?** | 1 square metre of finished leathers, as routinely measured at Tannery |
| **How well?** | The following standards define fitness for use:<br>• EN 13336:2012, Leather - Upholstery leather characteristics - Guide for selection of leather for furniture<br>• EN 16223:2012, Leather - Requirements for the designation and description of leather in upholstery and automotive interior applications<br>• EN 16419:2014, Leather - Chamois leather for cleaning purposes - Classification and requirements<br>• EN ISO 14931:2015, Leather - Guide to the selection of leather for apparel (excluding furs)<br>• ISO 14930:2012, Leather - Leather for dress gloves – Specification<br>• ISO 16131:2012, Leather - Upholstery leather characteristics - Selection of leather for furniture<br>• ISO 5431:2013, Leather - Wet blue goat skins - Specification<br>• ISO 5432:2013, Leather - Wet blue sheep skins – Specification<br>• ISO 5433:2013, Leather - Bovine wet blue - Specification<br>• UNI 10594:2010, Leather - Features of leathers for the footwear industry<br>• UNI 10740:2008, Leather - Suede for drying - Classification and requirements<br>• UNI 10826:2012, Leather - Features of leathers intended for leather goods and accessories industry<br>• UNI 10885:2012, Vegetable tanned leather - definition, characteristics and requirements<br>• UNI 10886:2000, Characteristics and requirements of leather used for the manufacture of gloves<br>• UNI/TS 11268:2008, Leather - Characteristics and requirements for leather upholstery UNI/TS 11268 (Saddlery Leather)<br>• ISO 16131: 29012 & UNI EN 13336:2012, Upholstery Leathers<br>• CEN TS 14906:2005, Automotive Leathers<br>• EN ISO 14931:2013, Apparel leather – excluding Furs<br>• UNI 10885:2012, Vegetable Tanned Leathers |

| | |
|---|---|
| **How long?** | It is necessary to declare which standard is followed and the related level of compliance. The animal origin shall be reported. |
| | Leather is an intermediate product and has no expiry date. Its life span depends from its final use but considering that use phase is beyond the system boundaries of these PEFCR, "how long?" specification cannot be defined. |

The reference flow is the amount of product needed to fulfil the defined function and shall be measured in kg of raw hide or skin/$m^2$. All quantitative input and output data collected in the study shall be calculated in relation to this reference flow.

Declared units of different leather products shall not be compared, unless additional specifications that ensure comparability are set.

Leather is an intermediate product elaborated to customers' specifications that define the intended application and therefore the function it fulfils. However, whether a leather is actually used for the intended function can only be fully established in a cradle to grave approach where the use and EoL stages are identified.

When reporting the results, the final use of leather, the animal origin and the percentages of the different ranges of thickness that constitute the finished leather shall be reported.

The company shall declare also the kg of finished leather per $m^2$ for the specific product.

Unless specific conversion factors from weight of raw hides and skins to surface of finished leather are available, the ones reported in Table 7 shall be used. The conversion factors provided are average for each kind of animals and do not differentiate for different provenience or different species.

**Table 7 Reference flows per Representative Product**

| Final Use | Animal origin, mix | Kg raw hides or skins / $m^2$ finished leather |
|---|---|---|
| **RP1 - Automotive and upholstery** | Bovine | 7,06 |
| **RP2 - Footwear and leather goods** | Bovine | 7,41 |
| **RP2 - Footwear and leather goods** | Calf | 5,74 |
| **RP2 - Footwear and leather goods** | Caprine | 2,42 |
| **RP2 - Footwear and leather goods** | Ovine | 3,06 |
| **RP3 - Garments and gloves** | Calf | 5,74 |
| **RP3 - Garments and gloves** | Caprine | 2,42 |
| **RP3 - Garments and gloves** | Ovine | 3,79 |
| **RP4 - Sole leather** | Bovine | 7,71 |

## 3.4 System boundary

The leather industry at Global level claims that the life cycle of leather made from hides or skins of slaughter animals starts as of the moment that these are generated at the slaughterhouse. In this PEFCR the system boundary includes, however, the livestock and slaughter phases, as prescribed in the PEFCR Guidance version 6.3.

As finished leather is an intermediate product, downstream processes such as B2B distribution, further manufacturing into finished consumer products, distribution to customers, use phase and end-of-life treatment of used products are out of scope.

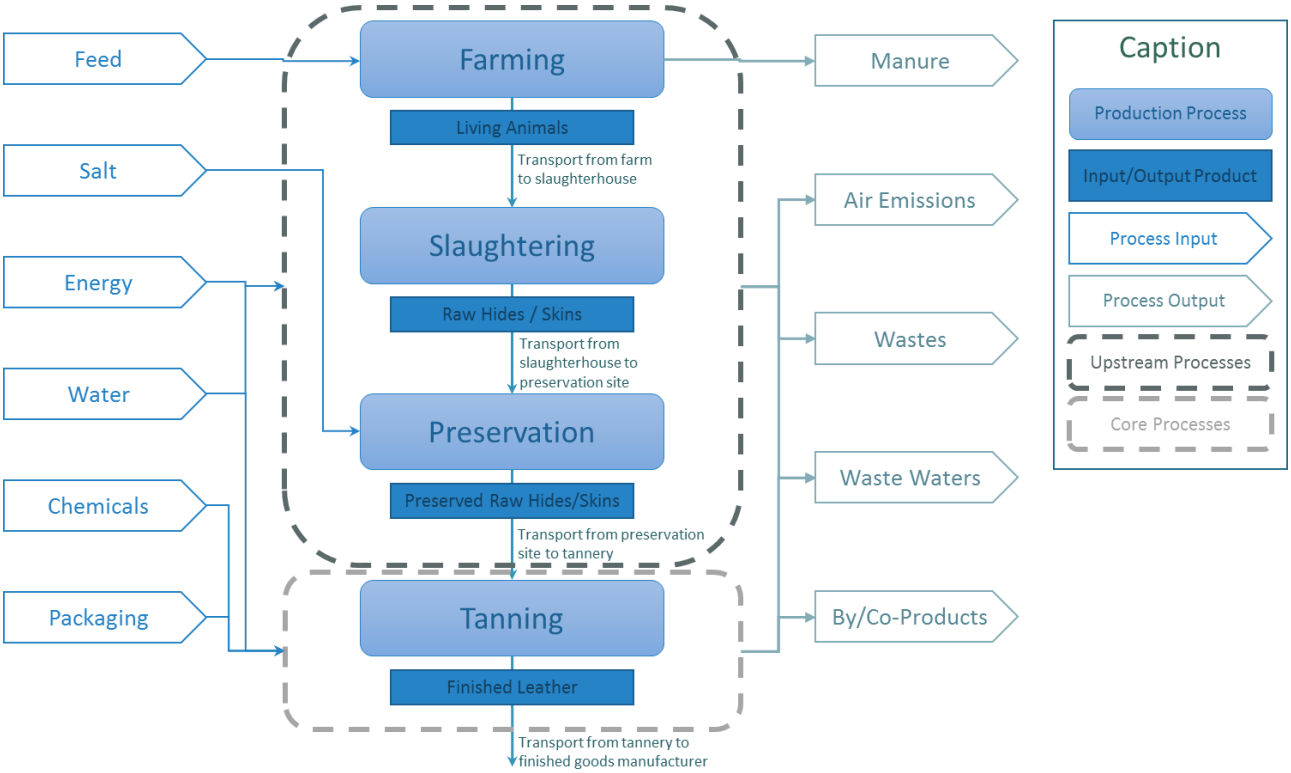
The following life cycle stages and processes shall be included in the system boundary:

**Table 8 Life cycle stages**

| Life cycle stage | Short description of the processes included |
|---|---|
| **Farming** | Breeding of animals, including:<br><br>• Feed cultivation<br>• Feed products preparation;<br>• Animal breeding;<br>• Energy and water consumption for animal raising;<br>• Manure management. |
| **Slaughtering** | Animals are professionally slaughtered and flayed (separating the hides or skins from the carcases). |
| **Transport** | Transportation of raw hides / skins from slaughterhouse to tannery. |
| **Preservation** | Immediately after the animal has been slaughtered, the flayed skin is subjected to preservation processes to avoid putrefaction. Preservation, salting or drying, is carried out in the slaughterhouse or by specialized companies. |
| **Tanning** | Transformation of hides/skins in finished leathers through production processes that can take place at different locations depending on the mix of in-house production and third parties commissioned work. Within the core processes, all tanning activities shall be considered.<br><br>From the input side:<br><br>• Raw hides and skins supply and consumption;<br>• Energy production and consumption;<br>• Water consumption;<br>• Chemical production, supply and consumptions;<br>• Packaging materials production, supply and consumption;<br><br>From the output side:<br><br>• Wastewater generation<br>• Wastewater treatment, either performed inside or outside the organization;<br>• Waste generation and treatment;<br>• Air Emissions;<br>• Splits when applicable (flesh and middle splits, i.e. when destined to leather). |

System boundaries are schematically illustrated in Figure 3.

**Figure 3 System boundaries**




All upstream processes require the collection of background data with the exception of the supply transportation of raw hides and skins to tanneries, which requires foreground data.

All of the distribution processes occurring within the system boundaries are part of the scope. Transportation of finished leather to downstream stages and all of the subsequent distribution processes are out of the scope of this document.

According to this PEFCR, no cut-off is applicable.

Each PEF study done in accordance with this PEFCR shall provide in the PEF study a diagram indicating the organizational boundary, to highlight those activities under the control of the organization and those falling into Situation 1, 2 or 3 of the data need matrix.

## 3.5 EF impact assessment

Each PEF study carried out in compliance with this PEFCR shall calculate the PEF-profile[12] including all PEF impact categories listed in the Table below.

[12] The full list of normalization factors and weighting factors are available in ANNEX 1 – List of EF normalisation and weighting factors.

169 **Table 9 List of the impact categories to be used to calculate the PEF profile**

| Impact category | Indicator | Unit | Recommended default LCIA method |
|---|---|---|---|
| **Climate change** | Radiative forcing as Global Warming Potential (GWP100) | kg $CO_{2\ eq}$ | Baseline model of 100 years of the IPCC (based on IPCC 2013) |
| **Climate change-biogenic**[13] | | | |
| **Ozone depletion** | Ozone Depletion Potential (ODP) | kg CFC-11 $_{eq}$ | Steady-state ODPs 1999 as in WMO assessment |
| **Human toxicity, cancer*** | Comparative Toxic Unit for humans ($CTU_h$) | CTUh | USEtox model (Rosenbaum et al, 2008) |
| **Human toxicity, non-cancer*** | Comparative Toxic Unit for humans ($CTU_h$) | CTUh | USEtox model (Rosenbaum et al, 2008) |
| **Particulate matter** | Impact on human health | disease incidence | **UN Environment recommended model (Fantke et al 2016)** |
| **Ionising radiation, human health** | Human exposure efficiency relative to $U^{235}$ | kBq $U^{235}$ $_{eq}$ | Human health effect model as developed by Dreicer et al. 1995 (Frischknecht et al, 2000) |
| **Photochemical ozone formation, human health** | Tropospheric ozone concentration increase | kg NMVOC $_{eq}$ | LOTOS-EUROS model (Van Zelm et al, 2008) as implemented in ReCiPe |
| **Acidification** | Accumulated Exceedance (AE) | mol $H^+$ $_{eq}$ | Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008) |
| **Eutrophication, terrestrial** | Accumulated Exceedance (AE) | mol N $_{eq}$ | Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008) |
| **Eutrophication, freshwater** | Fraction of nutrients reaching freshwater end compartment (P) | kg P $_{eq}$ | EUTREND model (Struijs et al, 2009b) as implemented in ReCiPe |
| **Eutrophication, marine** | Fraction of nutrients reaching marine end compartment (N) | kg N $_{eq}$ | EUTREND model (Struijs et al, 2009b) as implemented in ReCiPe |
| **Ecotoxicity, freshwater*** | Comparative Toxic Unit for ecosystems ($CTU_e$) | CTUe | USEtox model, (Rosenbaum et al, 2008) |
| **Land use** | • Soil quality index[14]<br>• Biotic production<br>• Erosion resistance | • Dimensionless (pt)<br>• kg biotic production[15]<br>• kg soil | • **Soil quality index based on LANCA (EC-JRC)[16]**<br>• **LANCA (Beck et al. 2010)** |

The full list of characterization factors (EC-JRC, 2017a) is available at this link: http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml

[13] The sub-indicator 'Climate change - biogenic' shall be reported separately because its contribution to the total climate change impact, based on the benchmark results, is more than 5%

[14] This index is the result of the aggregation, performed by JRC, of the 4 indicators provided by LANCA model as indicators for land use

[15] This refers to occupation. In case of transformation the LANCA indicators are without the year (a)

[16] Forthcoming document on the update of the recommended Impact Assessment methods and factors for the EF

| Impact category | Indicator | Unit | Recommended default LCIA method |
|---|---|---|---|
| | • Mechanical filtration<br>• Groundwater replenishment | • $m^3$ water<br>• $m^3$ groundwater | • **LANCA (Beck et al. 2010)**<br>• **LANCA (Beck et al. 2010)**<br>• **LANCA (Beck et al. 2010)** |
| **Water use** | User deprivation potential (deprivation-weighted water consumption) | $m^3$ world $_{eq}$ | **Available WAter REmaining (AWARE) Boulay et al., 2016** |
| **Resource use, minerals and metals** | Abiotic resource depletion (ADP ultimate reserves) | kg Sb $_{eq}$ | **CML 2002 (Guinée et al., 2002) and van Oers et al. 2002.** |
| **Resource use, fossils** | **Abiotic resource depletion – fossil fuels (ADP-fossil)** | **MJ** | **CML 2002 (Guinée et al., 2002) and van Oers et al. 2002** |

*The results for water use might be overestimated and shall therefore be interpreted with caution. Some of the EF datasets tendered during the pilot phase and used in this PEFCR/OEFSR include inconsistencies in the regionalization and elementary flow implementations. This problem has nothing to do with the impact assessment method or the implementability of EF methods, but occurred during the technical development of some of the datasets. The PEFCR/OEFSR remains valid and usable. The affected EF datasets will be corrected by mid-2019. At that time it will be possible to review this PEFCR/OEFSR accordingly, if seen necessary.

*Long-term emissions (occurring beyond 100 years) shall be excluded from the toxic impact categories. Toxicity emissions to this sub-compartment have a characterisation factor set to 0 in the EF LCIA (to ensure consistency). If included by the applicant in the LCI modelling, the sub-compartment 'unspecified (long-term)' shall be used.

### 3.6 Limitations

The main limitations in performing a PEF study on leather are:

- The incomplete knowledge on chemicals effectively used in the tanning processes, in terms of composition, active substances and provenience, such safety data sheet do not provide a full disclosure;
- The current lack in commercial databases of some LCI for chemicals used in tanning processes and the difficulties in collecting primary data from chemicals producers;
- The difficulties in collecting primary data on animal farming and the current lack in commercial databases of some LCI for animal farming (i.e. goats);
- The difficulties in having tannery specific conversion factors from weight of raw hides and skins (kg) to surface ($m^2$) of finished leather;
- Lack in commercial database of data for dismissal of specific chemical waste flow.

In case primary data on chemicals production and animal farming are made available from the producers and overall LCIs data quality is appropriate for the study (see 5.4 Data quality requirements), the use of primary data shall be preferred.

In case primary specific conversion factor from weight of raw hides and skins (kg) to surface ($m^2$) of finished leather are available, their use should be preferred and clearly reported in the PEF report.

In case primary data are not available, assumptions to be made to overcome these known limitations are reported in ANNEX 7 – Default values.

## 4. Most relevant impact categories, life cycle stages and processes

The most relevant impact categories for the sub-categories RP1 (automotive and upholstery) and RP2 (footwear and leather goods) in scope of this PEFCR are the following:

- Acidification
- Climate change
- Climate change – biogenic[17]
- Eutrophication, terrestrial
- Particulate matter
- Resource use, fossils
- Water use

The most relevant impact categories for the sub-categories RP3 (garments and gloves) in scope of this PEFCR are the following:

- Acidification
- Climate change
- Climate change – biogenic[17]
- Eutrophication, terrestrial
- Particulate matter
- Resource use, fossils
- Resource use, mineral and metals

The most relevant impact categories for the sub-categories RP4 (sole leather) in scope of this PEFCR are the following:

- Acidification
- Climate change
- Climate change – biogenic[17]
- Eutrophication, terrestrial
- Land use
- Particulate matter
- Resource use, fossils

[17] The sub-indicator 'Climate change - biogenic' shall be reported separately because its contribution to the total climate change impact, based on the benchmark results, is more than 5%..

Climate change shall always be reported as the sum of the three sub-indicators (biogenic, fossil and land use and transformation).

The most relevant life cycle stages for the sub-category RP1 (automotive and upholstery) and RP2 (footwear and leather goods) in scope of this PEFCR are the following:

- Acidification:
  - Farming & slaughtering
- Climate change:
  - Farming & slaughtering
  - Tanning
- Climate change – biogenic:
  - Farming & slaughtering
  - Tanning
- Eutrophication, terrestrial:
  - Farming & slaughtering
- Particulate matter:
  - Farming & slaughtering
  - Tanning
- Resource use, fossils:
  - Farming & slaughtering
  - Tanning
- Water use:
  - Farming & slaughtering
  - Tanning

The most relevant life cycle stages for the sub-category RP3 (garments and gloves) in scope of this PEFCR are the following:

- Acidification
  - Farming & slaughtering
  - Tanning
- Climate change
  - Farming & slaughtering
  - Tanning
- Climate change – biogenic
  - Farming & slaughtering
  - Tanning
- Eutrophication, terrestrial
  - Farming & slaughtering
- Particulate matter
  - Farming & slaughtering
  - Tanning
- Resource use, fossils
  - Tanning
- Resource use, mineral and metals
  - Tanning

The most relevant life cycle stages for the sub-category RP4 (sole leather) in scope of this PEFCR are the following:

- Acidification
  - Farming & slaughtering
- Climate change
  - Farming & slaughtering
  - Tanning
- Climate change – biogenic
  - Farming & slaughtering
  - Tanning
- Eutrophication, terrestrial
  - Farming & slaughtering
- Land use
  - Farming & slaughtering
  - Tanning
- Particulate matter
  - Farming & slaughtering
- Resource use, fossils
  - Farming & slaughtering
  - Tanning

The most relevant processes for the product group RP1 (automotive and upholstery) in scope of this PEFCR are the following.

**Table 10 List of the most relevant processes for the product group RP1**

| Impact category | Processes |
|---|---|
| **Acidification** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| **Climate change** | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Syntetic tannins and retanning agents production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |

| Impact category | Processes |
|---|---|
| | Thermal energy from natural gas\| technology mix regarding firing and flue gas cleaning\| production mix, at heat plant\| MJ, 100% efficiency {EU-28+3} [LCI result] (from tanning) |
| **Eutrophication, terrestrial** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| **Particulate matter** | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| **Resource use, fossils** | Adipic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Aniline production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Electricity grid mix 1kV-60kV\| AC, technology mix\| consumption mix, to consumer\| 1kV - 60kV {IT} [LCI result] (from tanning) |
| | Formic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Melamine formaldehyde resin production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Sodium hydrosulphide production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] (from tanning) |
| | Sodium sulphate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Syntetic tannins and retanning agents production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Thermal energy from natural gas\| technology mix regarding firing and flue gas cleaning\| production mix, at heat plant\| MJ, 100% efficiency {EU-28+3} [LCI result] (from tanning) |

| Impact category | Processes |
|---|---|
| | Transoceanic ship, containers\| heavy fuel oil driven, cargo\| consumption mix, to consumer\| 27.500 dwt payload capacity, ocean going {GLO} [LCI result] (from tanning) |
| **Water use** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Well water, EU (from tanning) |
| | Treatment of residential wastewater, large plant\| waste water treatment including sludge treatment\| production mix, at plant\| 1m$^3$ of waste water treated {EU-28+EFTA} [LCI result] (from tanning) |

294 The most relevant processes for the product group RP2 (footwear and leather goods) in scope of this PEFCR
295 are the following.

296 **Table 11 List of the most relevant processes for the product group RP2**

| Impact category | Processes |
|---|---|
| **Acidification** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {EU-28+3} [LCI result] (from farming & slaughtering) |
| **Climate change** | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Electricity grid mix 1kV-60kV\| AC, technology mix\| consumption mix, to consumer\| 1kV - 60kV {IT} [LCI result] (from tanning) |
| | Natural tannins extracted from chestnut production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Syntetic tannins and retanning agents production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |

| Impact category | Processes |
|---|---|
| | Thermal energy from natural gas\| technology mix regarding firing and flue gas cleaning\| production mix, at heat plant\| MJ, 100% efficiency {EU-28+3} [LCI result] (from tanning) |
| **Eutrophication, terrestrial** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| **Particulate matter** | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {EU-28+3} [LCI result] (from farming & slaughtering) |
| **Resource use, fossils** | Adipic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Aniline production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Articulated lorry transport, total weight >32 t, mix Euro 0-5\| diesel driven, Euro 0 - 5 mix, cargo\| consumption mix, to consumer\| more than 32t gross weight / 24,7t payload capacity {EU-28+3} [LCI result] (from tanning) |
| | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Electricity grid mix 1kV-60kV\| AC, technology mix\| consumption mix, to consumer\| 1kV - 60kV {IT} [LCI result] (from tanning) |
| | Formic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Melamine formaldehyde resin production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Natural tannins extracted from chestnut production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Sodium sulphate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |

| Impact category | Processes |
|---|---|
| | Syntetic tannins and retanning agents production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Thermal energy from natural gas\| technology mix regarding firing and flue gas cleaning\| production mix, at heat plant\| MJ, 100% efficiency {EU-28+3} [LCI result] (from tanning) |
| | Transoceanic ship, containers\| heavy fuel oil driven, cargo\| consumption mix, to consumer\| 27.500 dwt payload capacity, ocean going {GLO} [LCI result] (from tanning) |
| **Water use** | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Citric acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Fatty acid blend\| production mix, technology mix\| at plant\| {EU+28} [LCI result] (from tanning) |
| | Treatment of residential wastewater, large plant\| waste water treatment including sludge treatment\| production mix, at plant\| 1m$^3$ of waste water treated {EU-28+EFTA} [LCI result] (from tanning) |
| | Well water, EU (from tanning) |

297 The most relevant processes for the product group RP3 (garments and gloves) in scope of this PEFCR are
298 the following.

299 **Table 12 List of the most relevant processes for the product group RP3**

| Impact category | Processes |
|---|---|
| **Acidification** | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {AU} [LCI result] (from farming & slaughtering) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {EU-28+3} [LCI result] (from farming & slaughtering) |

| Impact category | Processes |
|---|---|
| **Climate change** | Articulated lorry transport, total weight >32 t, mix Euro 0-5\| diesel driven, Euro 0 - 5 mix, cargo\| consumption mix, to consumer\| more than 32t gross weight / 24,7t payload capacity {EU-28+3} [LCI result] (from tanning) |
| | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Electricity grid mix 1kV-60kV\| AC, technology mix\| consumption mix, to consumer\| 1kV - 60kV {IT} [LCI result] (from tanning) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {AU} [LCI result] (from farming & slaughtering) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Sodium sulphate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Syntetic tannins and retanning agents production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Thermal energy from natural gas\| technology mix regarding firing and flue gas cleaning\| production mix, at heat plant\| MJ, 100% efficiency {EU-28+3} [LCI result] (from tanning) |
| **Eutrophication, terrestrial** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {EU-28+3} [LCI result] (from farming & slaughtering) |
| **Particulate matter** | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Electricity grid mix 1kV-60kV\| AC, technology mix\| consumption mix, to consumer\| 1kV - 60kV {IN} [LCI result] (from tanning) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {AU} [LCI result] (from farming & slaughtering) |

| Impact category | Processes |
|---|---|
| | Sheep\| for slaughter\| at farm\| per kg live weight {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Sodium sulphate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| **Resource use, fossils** | Adipic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Aniline production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Anionic resin production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Antifoaming agent, silicone emulsion production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] (from tanning) |
| | Articulated lorry transport, total weight >32 t, mix Euro 0-5\| diesel driven, Euro 0 - 5 mix, cargo\| consumption mix, to consumer\| more than 32t gross weight / 24,7t payload capacity {EU-28+3} [LCI result] (from tanning) |
| | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming & slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming & slaughtering) |
| | Electricity grid mix 1kV-60kV\| AC, technology mix\| consumption mix, to consumer\| 1kV - 60kV {ES} [LCI result] (from tanning) |
| | Electricity grid mix 1kV-60kV\| AC, technology mix\| consumption mix, to consumer\| 1kV - 60kV {IT} [LCI result] (from tanning) |
| | Ethoxylated alcohol (AE7) production, petrochemical\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Formic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Melamine formaldehyde resin production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Natural tannins extracted from chestnut production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Sheep\| for slaughter\| at farm\| per kg live weight {EU-28+3} [LCI result] (from farming & slaughtering) |
| | Sodium hydrosulphide production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] (from tanning) |
| | Sodium sulphate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Syntetic tannins and retanning agents production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Synthetic fatliquors production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |

| Impact category | Processes |
|---|---|
| | Thermal energy from natural gas\| technology mix regarding firing and flue gas cleaning\| production mix, at heat plant\| MJ, 100% efficiency {EU-28+3} [LCI result] (from tanning) |
| **Resource use, mineral and metals** | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] (from tanning) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming & slaughtering) |
| | PET granulates, amorphous\| Polymerisation of ethylene\| production mix, at plant\| 0.91- 0.96 g/cm$^3$, 28 g/mol per repeating unit {EU-28+EFTA} [LCI result] (from tanning) |
| | PET granulates, bottle grade\| via purified terephthalic acid (PTA) and ethylene glycol\| production mix, at plant\| 192.17 g/mol per repeating unit {EU-28+EFTA} [LCI result] (from tanning) |
| | Sodium hydrosulphide production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] (from tanning) |
| | Sodium sulphate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Sodium tripolyphosphate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Syntetic tannins and retanning agents production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |

The most relevant processes for the product group RP4 (sole leather) in scope of this PEFCR are the following.

**Table 13 List of the most relevant processes for the product group RP4**

| Impact category | Processes |
|---|---|
| **Acidification** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming and slaughtering) |
| **Climate change** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming and slaughtering) |
| | Natural tannins extracted from chestnut production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| **Eutrophication, terrestrial** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming and slaughtering) |

| Impact category | Processes |
|---|---|
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming and slaughtering) |
| **Land use** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming and slaughtering) |
| | Natural tannins extracted from chestnut production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| **Particulate matter** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming and slaughtering) |
| **Resource use, fossils** | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {GLO} [LCI result] (from farming and slaughtering) |
| | Beef, fresh hides\| at slaughterhouse\| per kg {US} [LCI result] (from farming and slaughtering) |
| | Natural tannins extracted from chestnut production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |
| | Syntetic tannins and retanning agents production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] (from tanning) |

# 5. Life cycle inventory

All newly created processes shall be EF-compliant.

In case sampling is needed, it shall be conducted as specified in this PEFCR. However, sampling is not mandatory and any applicant of this PEFCR may decide to collect the data from all the plants or farms, without performing any sampling.

## 5.1 List of mandatory company-specific data

The following data shall be company specific:

- Chemical substances consumption[18]

[18] Default values for the modelling of active substance content in chemicals are reported in Table 36.

- Energy consumption
- Water consumption
- Packaging consumption
- Waste treatment

Table 14 reports all activity data that shall be company specific, including the complete data quality ratings (DQRs) and the Universally Unique Identifier (UUIDs). For chemical substance consumptions, if a substance is missing in Table 14, the user of this PEFCR shall refer to Table 36 where to find the proxies on which to model them. The user of this PEFCR shall modify, as appropriate and where available, the geographical origin of the reported datasets to make the result of the footprint calculation more accurate.

320 **Table 14 Mandatory company-specific data**

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Inputs:** | | | | | | | | | | |
| **Yearly Acetaldehyde consumption** | 1 year average | kg / year | Acetaldehyde production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 96d48c3a-e6e9-4168-a605-0e2d529c9c2c | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Acetic acid consumption** | 1 year average | kg / year | Acetic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 09c336e4-436b-4be0-95bd-444d2295dc0d | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Acetone consumption** | 1 year average | kg / year | Acetone from isopropanol production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 6a377455-759c-4a39-a18f-6a0d58f14853 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Acrylic binder consumption** | 1 year average | kg / year | Acrylic binder production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 53fc7c4f-e1d5-4bf1-9e24-883d262fec4a | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Acrylonitrile Butadiene Styrene (ABS) consumption** | 1 year average | kg / year | Acrylonitrile Butadiene Styrene (ABS) (foreground elementary flows) \| {EU-28+EFT | http://ecoinvent.lca-data.com | ee959a93-9c41-400e-a20a-c51c0af78ad7 | n/a | n/a | n/a | n/a | n/a |
| **Yearly Activated silica consumption** | 1 year average | kg / year | Activated silica production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca-data.com | 5f01aa3d-141f-45e5-a63e-ce0e461ec5c9 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Adipic acid consumption** | 1 year average | kg / year | Adipic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 5021804d-97de-436c-a549-2b818228be87 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Alkylbenzene consumption** | 1 year average | kg / year | Alkylbenzene production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 200b9b10-8b25-4792-9c54-c72825ec6cf3 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Alkylbenzene sulfonate consumption** | 1 year average | kg / year | Alkylbenzene sulfonate production\| technology mix\| production mix, at plant\| 100 | http://ecoinvent.lca- | 85920571-c596-4cb7-b220- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | | data.com | 2cc9e5b45203 | | | | | |
| **Yearly Aluminium chloride consumption** | 1 year average | kg / year | Aluminium chloride production\| technology mix\| production mix, at plant\| 100% ac | http://ecoinvent.lca-data.com | 26d39acb-fad9-46aa-b66c-8fc9188c55cf | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Aluminium oxide consumption** | 1 year average | kg / year | Aluminium oxide production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca-data.com | b943163c-011f-4c67-9ec0-0e71d8f07657 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Aluminium sulphate consumption** | 1 year average | kg / year | Aluminium sulphate powder production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | ab02995c-cbd5-4d04-8968-461f7d3310c0 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Ammonia consumption** | 1 year average | kg / year | Ammonia, as 100% NH3 production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | b347c43a-c0c4-4249-9e55-263cae14065a | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Ammonium** | 1 year average | kg / year | Ammonium bicarbonate production\| technology mix\| | http://ecoinvent | fb72cb72-106f- | 1 | 2 | 1 | 2 | 1,5 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **bicarbonate consumption** | | | production mix, at plant\| 100% active substance {RER} [LCI result] | .lca-data.com | 40c1-8868-82e8e4c5c351 | | | | | |
| **Yearly Ammonium chloride consumption** | 1 year average | kg / year | Ammonium chloride\| Solvay process\| at plant\| per kg {EU-28+3} [LCI result] | http://ecoinvent.lca-data.com | 17be19f9-3e68-4792-9924-911fe279550b | 1,92 | 1,6 | 1,89 | 2,06 | 1,87 |
| **Yearly Ammonium sulfate consumption** | 1 year average | kg / year | Ammonium sulfate, as N\| as N\| at plant\| per kg N {EU-28+3} [LCI result] | http://ecoinvent.lca-data.com | 3ac20745-9f8d-4cce-ab3b-50ceb5059164 | 1,92 | 1,6 | 1,89 | 2,06 | 1,87 |
| **Yearly Aniline consumption** | 1 year average | kg / year | Aniline production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | df0ee86a-44ba-4717-8b5a-defb452b29a5 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Anionic resin consumption** | 1 year average | kg / year | Anionic resin production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | c00e4a3b-67b2-407c-b039-dc4c598cde63 | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Antifoaming agent, ethoxylate fatty alcohols consumption** | 1 year average | kg / year | Antifoaming agent, ethoxylate fatty alcohols production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca-data.com | 02624b75-a8ec-4703-9f25-1623eb27e3b7 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Antifoaming agent, silicone emulsion consumption** | 1 year average | kg / year | Antifoaming agent, silicone emulsion production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca-data.com | 152c8bcc-6454-45da-b80c-9a5415a870ad | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Antimony consumption** | 1 year average | kg / year | Antimony\| technology mix, primary production\| production mix, at plant\| 99.5% An | http://ecoinvent.lca-data.com | e856ebf4-daad-41c0-a531-13c7a516d350 | 2 | 2 | 1 | 2 | 1,75 |
| **Yearly Basic chrome sulfate consumption** | 1 year average | kg / year | Basic chrome sulfate production\| technology mix\| production mix, at plant\| 100% active substance {ZA} [LCI result] | http://ecoinvent.lca-data.com | 4ed59462-16f1-473a-9a53-5d1a53b6dd48 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Beeswax consumption** | 1 year average | kg / year | Beeswax\| conventional farming\| at farm\| per kg {EU-28+3} [LCI result] | http://ecoinvent.lca- | 8bce25b0-9bb1-414f-ac49- | 1,63 | 2,95 | 2,92 | 2,18 | 2,42 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | | data.com | f2014b6fe6cf | | | | | |
| **Yearly Benzene consumption** | 1 year average | kg / year | Benzene production\| technology mix\| production mix, at plant\| 100% active substa | http://ecoinvent.lca-data.com | 5f8032ff-71a3-41ff-bcf8-0e6eceb93ba2 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Benzo[thia]diazole-compound consumption** | 1 year average | kg / year | Benzo[thia]diazole-compound production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca-data.com | 653edc53-8aaf-47f6-9cae-15b800a98465 | 2 | 1 | 2 | 2 | 1,75 |
| **Yearly Bisphenol A powder consumption** | 1 year average | kg / year | Bisphenol A, powder production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 960a9902-f44f-4c28-9653-0ba6e8cd16bf | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Butanol consumption** | 1 year average | kg / year | Butanol production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 7e59f1a6-06f4-4447-bffb-b4d7d7aa9141 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Butyl acetate consumption** | 1 year average | kg / year | Butyl acetate production\| technology mix\| production mix, | http://ecoinvent.lca- | b3cc9de9-8511-4eb9- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | at plant\| 100% active substance {RER} [LCI result] | data.com | b7a5-50680b3706eb | | | | | |
| **Yearly Carbon black consumption** | 1 year average | kg / year | Carbon black, general purposes production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | fde4abff-7cd7-4535-b472-481321d7d936 | 1 | 1 | 2 | 2 | 1,5 |
| **Yearly Carbon dioxide consumption** | 1 year average | kg / year | Carbon dioxide, liquid production\| technology mix\| production mix, at plant\| 100 | http://ecoinvent.lca-data.com | f418d090-af36-4aac-a593-206e9cc3141c | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Cast iron consumption** | 1 year average | kg / year | Cast iron\| electric arc furnace route, from steel scrap, secondary production\| single route, at plant\| > 2,06 % carbon content {EU-28+EFTA} [LCI result] | http://ecoinvent.lca-data.com | 0d6cb1e0-a805-458b-9cbd-41df4e4c9d0c | 2 | 1 | 1 | 1 | 1,25 |
| **Yearly Cationic resin consumption** | 1 year average | kg / year | Cationic resin production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 0435b538-6067-40df-b932-7e5831e86b26 | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Cellulose consumption** | 1 year average | kg / year | Cellulose (excluding blowing) production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 408f01c1-8526-4f01-938e-231245ee540b | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Citric acid consumption** | 1 year average | kg / year | Citric acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | d0becc20-49c4-4e8f-9ff8-8c392d5610ed | 1 | 1 | 1 | 2 | 1,25 |
| **Yearly Corrugated board, uncoated consumption** | 1 year average | kg / year | Corrugated board, uncoated\| Kraft Pulping Process, pulp pressing and drying\| pro | http://lcdn.thinkstep.com/Node | 574bdb1e-2ed3-46f1-bd14-bb76f739bb71 | 1 | 1 | 1 | 1 | 1 |
| **Yearly Diethanolamine consumption** | 1 year average | kg / year | Diethanolamine production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 5ac9b8ce-0069-44e3-8ffe-719b066bd88f | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Dipropylene glycol monomethyl ether consumption** | 1 year average | kg / year | Dipropylene glycol monomethyl ether production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | f3e16f7f-b4f6-436c-a3d1-bfbe560c7fdd | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly EDTA consumption** | 1 year average | kg / year | EDTA production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | f8eb9518-ab48-4476-a74e-56a28b6414da | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Electricity from EU hard coal consumption** | 1 year average | kWh / year | Electricity from hard coal\| AC, mix of direct and CHP, technology mix regarding firing and flue gas cleaning\| production mix, at power plant\| 1kV - 60kV {EU-28+3} [LCI result] | http://lcdn.thinkstep.com/Node | 6d68bce7-71c6-4f30-b390-8b28983bc187 | 2 | 2 | 2 | 1 | 1,75 |
| **Yearly Electricity from EU grid consumption** | 1 year average | kWh / year | Electricity grid mix 1kV-60kV\| AC, technology mix\| consumption mix, at consumer\| 1kV - 60kV {EU-28+3} [LCI result] | http://lcdn.thinkstep.com/Node | 34960d4d-af62-43a0-aa76-adc5fcf57246 | 2 | 2 | 2 | 1 | 1,75 |
| **Yearly Enzymes consumption** | 1 year average | kg / year | Enzymes production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | c2ec381a-5480-45e3-a5e9-10e13152f2fd | 2 | 2 | 2 | 1 | 1,75 |
| **Yearly Ethanol consumption** | 1 year average | kg / year | Ethanol production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca- | 9b02d32e-8a06-41e3-9762- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | | data.com | 6438b6353009 | | | | | |
| **Yearly Ethoxylated alcohol (AE7) consumption** | 1 year average | kg / year | Ethoxylated alcohol (AE7) production, petrochemical\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 5a1a8078-73b6-484c-9393-4bcef32d0c2e | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Ethyl acetate consumption** | 1 year average | kg / year | Ethyl acetate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 8d0a1ebb-ec2d-4fce-8f3a-2494e7fbd752 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Ethylene glycol consumption** | 1 year average | kg / year | Ethylene glycol production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 8a0bea16-5e99-4411-b013-3e4b45ca1459 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Ethylene vinyl acetate copolymer consumption** | 1 year average | kg / year | Ethylene vinyl acetate copolymer\| Technology mix\| Production mix, at plant\| {GLO} [LCI result] | http://ecoinvent.lca-data.com | 0259ff8c-04c1-4caf-985b-c86f3bc435da | 2,4 | 2,6 | 2,8 | 2,7 | 2,62 |
| **Yearly Fatty acids consumption** | 1 year average | kg / year | Fatty acid blend\| production mix, technology mix\| at plant\| {EU+28} [LCI result] | http://ecoinvent.lca- | 80c1465c-9507-4887-b810- | 1,7 | 1,49 | 1,75 | 2,32 | 1,81 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | | data.com | 59ab06d819e0 | | | | | |
| **Yearly Fatty alcohols consumption** | 1 year average | kg / year | Fatty alcohols production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca-data.com | f0d6cd33-9022-4cd6-af15-9a88c1081685 | 2 | 2 | 2 | 2 | 2 |
| **Yearly Formaldehyde consumption** | 1 year average | kg / year | Formaldehyde production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 49ace041-d5cb-45c1-b963-0e954f650bd6 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Formic acid consumption** | 1 year average | kg / year | Formic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | c2b6c7f9-2a6b-416b-8e0b-c4bc7a50f2b0 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Hydrochloric acid consumption** | 1 year average | kg / year | Hydrochloric acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | d5953cab-21fd-44ea-ab3a-17a44ed3c260 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Hydrogen** | 1 year average | kg / year | Hydrogen peroxide, 50% production\| technology mix\| | http://ecoinvent | c222168e-3bf0- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **peroxide consumption** | | | production mix, at plant\| 100% active substance {RER} [LCI result] | .lca-data.com | 4adc-800b-172f3b36a662 | | | | | |
| **Yearly Iron (II) sulphate consumption** | 1 year average | kg / year | Iron (II) sulphate production\| technology mix\| production mix, at plant\| 100% ac | http://ecoinvent.lca-data.com | d681c7bd-f76b-4afa-9176-426928942776 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Iron (III) chloride consumption** | 1 year average | kg / year | Iron (III) chloride production\| technology mix\| production mix, at plant\| 100% a | http://ecoinvent.lca-data.com | caabff9b-4d10-417d-8c1a-59d38a06a14c | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Isopropanol consumption** | 1 year average | kg / year | Isopropanol production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 2e127b35-0c42-485e-9611-bddcdb0cab4a | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Kaolin consumption** | 1 year average | kg / year | Kaolin production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | f57ebfdb-d033-4e45-aa13-25bbd71bb3e3 | 1 | 1 | 1 | 2 | 1,25 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Kraft paper, bleached consumption** | 1 year average | kg / year | Kraft paper, bleached\| production mix\| at plant\| per kg paper {EU-28+3} [LCI result] | http://lcdn.thinkstep.com/Node | b5e2916f-cd5d-40da-8b5f-29e4997fc087 | 2,57 | 2,01 | 2,01 | 2,01 | 2,15 |
| **Yearly Kraft paper, unbleached consumption** | 1 year average | kg / year | Kraft paper, unbleached\| production mix\| at plant\| per kg paper {EU-28+3} [LCI result] | http://lcdn.thinkstep.com/Node | 9431095e-9602-4714-b99d-276ed71e7b7d | 2,57 | 2,01 | 2,01 | 2,01 | 2,15 |
| **Yearly Lactic acid consumption** | 1 year average | kg / year | Lactic acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 460f4294-2b1f-41d9-9596-d0168a51b10c | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Light fuel oil consumption** | 1 year average | l / year | Light fuel oil at refinery\| from crude oil\| production mix, at refinery\| 0.1 wt.% sulphur {EU-28+3} [LCI result] | http://lcdn.thinkstep.com/Node | 386821c2-309d-4019-8972-04a072082ef5 | 1 | 1 | 1 | 2 | 1,25 |
| **Yearly Lime consumption** | 1 year average | kg / year | Lime production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca- | 64e2bd59-5f61-4eb3-bfd7- | 4 | 1 | 1 | 2 | 2 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | | data.com | d19c3aec60b5 | | | | | |
| **Yearly Magnesium oxide consumption** | 1 year average | kg / year | Magnesium oxide production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 134769e1-fa36-4fcd-902b-762dcd79f24d | 1 | 1 | 1 | 2 | 1,25 |
| **Yearly Magnesium sulfate consumption** | 1 year average | kg / year | Magnesium sulfate\| at plant\| per kg {EU-28+3} [LCI result] | http://ecoinvent.lca-data.com | bb83a61d-11a6-4385-8084-04324725ff85 | 2,52 | 2,56 | 2,41 | 2,08 | 2,39 |
| **Yearly Magnetite consumption** | 1 year average | kg / year | Magnetite production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 60fef189-d64e-4cc6-a98c-303fef1c63d9 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Maize starch consumption** | 1 year average | kg / year | Maize starch, dried\| from wet milling, production mix\| at plant\| {GLO} [LCI result] | http://ecoinvent.lca-data.com | 3e59ff2f-0021-4568-a850-33ca7a4cad58 | 2,16 | 1,53 | 1,99 | 2,34 | 2,01 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Maleic anhydride consumption** | 1 year average | kg / year | Maleic anhydride production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 01a293c7-f183-40ea-b7d6-6c1b4f039462 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Melamine formaldehyde resin consumption** | 1 year average | kg / year | Melamine formaldehyde resin production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | cd18a8cb-0992-44fb-b346-d420b8c3f0bf | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Methanol consumption** | 1 year average | kg / year | Methanol production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 46a25711-f534-4dce-bd95-113f8981d2da | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Methylene diphenyldiisocyanate consumption** | 1 year average | kg / year | Methylene diphenyldiisocyanate production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca-data.com | 5c71affa-a573-42ac-af57-1d44bcf5e37b | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Monoethanolamine consumption** | 1 year average | kg / year | Monoethanolamine production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca- | 4b1d29e6-cf29-40e0-83c5- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | | data.com | 4eec44125cba | | | | | |
| **Yearly Natural tannins extracted from chestnut consumption** | 1 year average | kg / year | Natural tannins extracted from chestnut production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | f310824d-5abd-47c6-aab5-e105288a8904 | 1 | 1 | 1 | 2 | 1,25 |
| **Yearly Newsprint consumption** | 1 year average | kg / year | Newsprint\| production mix\| at plant\| per kg Newsprint {EU-28+3} [LCI result] | http://lcdn.thinkstep.com/Node | 98b2b259-83b7-4e0f-bde9-99a85b8c38cd | 2,57 | 2,01 | 2,01 | 2,01 | 2,15 |
| **Yearly Nitrocellulose consumption** | 1 year average | kg / year | Nitrocellulose\| Technology mix\| Production mix, at plant\| without ethanol {GLO} | http://ecoinvent.lca-data.com | b7e8f4dc-3c83-4995-9e75-9fde539147d3 | 2,5 | 2,6 | 3 | 3 | 2,77 |
| **Yearly Nitrogen consumption** | 1 year average | kg / year | Nitrogen liquid production\| technology mix\| production mix, at plant\| 100% activ | http://ecoinvent.lca-data.com | 085a93bb-b5b7-4137-a8de-637b4d85a93d | 1 | 1 | 1 | 2 | 1,25 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Organophosphorus-compounds consumption** | 1 year average | kg / year | Organophosphorus-compounds\| at plant\| per kg of active ingredient {EU-28+3} [LCI | http://ecoinvent.lca-data.com | f34e2646-b8b2-42fb-953a-4546cbb370b1 | 2,51 | 2,56 | 2,41 | 2,08 | 2,39 |
| **Yearly Oxi-sulphited lard oil consumption** | 1 year average | kg / year | Oxi-sulphited lard oil production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 2d7f5767-39bf-46aa-b6c5-cf3185dbeb74 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Oxygen consumption** | 1 year average | kg / year | Oxygen production\| technology mix\| production mix, at plant\| 100% active substan | http://ecoinvent.lca-data.com | b12a9897-9ebb-41e9-8c3b-18db23ecd99e | 1 | 1 | 1 | 2 | 1,25 |
| **Yearly Pallet use** | 1 year average | kg / year | Pallet, wood (80x120)\| sawing, piling, nailing\| single route, at plant\| 25 kg/piece, nominal loading capacity of 1000kg {EU-28+EFTA} [LCI result] | http://lcdn.thinkstep.com/Node | 3203d6d8-2760-4b7b-b1c6-f82681e9e2f3 | 2 | 2 | 2 | 2 | 2 |
| **Yearly PET granulates, amorphous consumption** | 1 year average | kg / year | PET granulates, amorphous\| Polymerisation of ethylene\| production mix, at plant\| 0.91-0.96 g/cm3, 28 g/mol per | http://lcdn.thinkstep.com/Node | 52ecabcf-fb6a-4d58-895c- | 3 | 3 | 3 | 3 | 3 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | repeating unit {EU-28+EFTA} [LCI result] | | 41078326bbcb | | | | | |
| **Yearly PET granulates, bottle grade consumption** | 1 year average | kg / year | PET granulates, bottle grade\| via purified terephthalic acid (PTA) and ethylene glycol\| production mix, at plant\| 192.17 g/mol per repeating unit {EU-28+EFTA} [LCI result] | http://lcdn.thinkstep.com/Node | 61042919-2439-45d0-ba10-66e221167a24 | 2 | 1 | 1 | 2 | 1,5 |
| **Yearly Phenolic resin consumption** | 1 year average | kg / year | Phenolic resin production\| technology mix\| production mix, at plant\| 100% active | http://ecoinvent.lca-data.com | 88724fad-7d7d-4eda-b7c7-658ac9fa378c | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Phenoxy-compounds consumption** | 1 year average | kg / year | Phenoxy-compounds\| at plant\| per kg of active ingredient {EU-28+3} [LCI result] | http://ecoinvent.lca-data.com | 5d88b73f-de77-4c58-9117-82fc228f201b | 2,52 | 2,56 | 2,41 | 2,08 | 2,39 |
| **Yearly Phosphoric acid consumption** | 1 year average | kg / year | Phosphoric acid production\| technology mix\| production mix, at plant\| 100% activ | http://ecoinvent.lca-data.com | 648a9abc-c1be-4c18-8c0e-e7b8d99b407a | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Phosphoryl chloride consumption** | 1 year average | kg / year | Phosphoryl chloride production\| technology mix\| production mix, at plant\| 100% a | http://ecoinvent.lca-data.com | a8f77ac7-8d7a-49cf-913a-6a05845f338d | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Phthalocyanine blue consumption** | 1 year average | kg / year | Phthalocyanine blue\| Technology mix\| Production mix, at plant\| {GLO} [LCI resul | http://ecoinvent.lca-data.com | 25c74161-b62f-4f52-932d-8b00856f6990 | 2,4 | 2,2 | 3 | 2,8 | 2,6 |
| **Yearly Phthalocyanine green consumption** | 1 year average | kg / year | Phthalocyanine green\| Technology mix\| Production mix, at plant\| {GLO} [LCI resu | http://ecoinvent.lca-data.com | 1a1e92f9-e5a8-492b-9d53-1642c0aa00ec | 2,5 | 2,3 | 2,9 | 2,9 | 2,65 |
| **Yearly Plastic consumption** | 1 year average | kg / year | Injection moulding\| plastic injection moulding\| production mix, at plant\| for PP, HDPE and PE {EU-28+EFTA} [LCI result] | http://lcdn.thinkstep.com/Node | ec9ca75e-abdb-4d2e-9e18-ca1f5709a76d | 3 | 2 | 3 | 2 | 2,5 |
| **Yearly Plastic film consumption** | 1 year average | kg / year | Plastic film , PE wrap\| raw material production, plastic extrusion\| production mix, at plant\| thickness: 25 µm, | http://ecoinvent.lca- | 0d2213f8-a115-4ce0-a1d9- | 2 | 2 | 2 | 2 | 2 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | grammage: 0,023575 kg/m2 {EU-28+EFTA} [LCI result] | data.com | 0aa66aaf51ab | | | | | |
| **Yearly Polyacrylamide consumption** | 1 year average | kg / year | Polyacrylamide production\| technology mix\| production mix, at plant\| 100% active | http://ecoinvent.lca-data.com | d1101334-074f-4495-86dd-5bd919141f21 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Polyacrylates consumption** | 1 year average | kg / year | Polyacrylates in water solution production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 9d0933de-ac53-476b-beea-bb9c0afde276 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Polyaluminium chloride consumption** | 1 year average | kg / year | Polyaluminium chloride production\| technology mix\| production mix, at plant\| 100 | http://ecoinvent.lca-data.com | 6934231e-6394-4565-a020-b9edcfa52a40 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Polycarboxylate consumption** | 1 year average | kg / year | Polycarboxylate production\| technology mix\| production mix, at plant\| 100% activ | http://ecoinvent.lca-data.com | dbdbd19e-38e7-47e7-8894-f6c51ee1a90c | 1 | 2 | 1 | 2 | 1,5 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Polyethylene terephthalate (PET) granulate consumption** | 1 year average | kg / year | Polyethylene terephthalate (PET) granulate secondary no metal fraction \| from p | http://ecoinvent.lca-data.com | 60dd82e4-46d0-4735-a8ad-94e708a2b92a | 1 | 3 | 2 | 2 | 2 |
| **Yearly Polypropylene consumption** | 1 year average | kg / year | Polypropylene (PP) fibers\| polypropylene production, spinning\| production mix, at plant\| 5% loss, 3.5 MJ electricity {EU-28+EFTA} [LCI result] | http://ecoinvent.lca-data.com | 9caa347a-4b90-4dfc-8bf1-849c1d82ca81 | 2 | 2 | 2 | 2 | 2 |
| **Yearly Polyurethane dispersion consumption** | 1 year average | kg / year | Polyurethane dispersion\| Technology mix\| Production mix, at plant\| 40% in water | http://ecoinvent.lca-data.com | 2a811ed4-f819-401d-9acd-556135fce388 | 2,5 | 2,4 | 2,7 | 2,2 | 2,45 |
| **Yearly Polyurethane flexible foam consumption** | 1 year average | kg / year | Polyurethane flexible foam\| reaction of toluene diisocyanate (TDI) with long-chain polyether polyol and foaming\| production mix, at plant\| 18- 53 kg/m3 {EU-28+EFTA} [LCI result] | http://ecoinvent.lca-data.com | c074c833-f853-4050-934a-8bac79ede282 | 2 | 1 | 1 | 2 | 1,5 |
| **Yearly Potassium permanganate consumption** | 1 year average | kg / year | Potassium permanganate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 253fbb51-6d74-44a1-9719- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | | | bff4a25bc560 | | | | | |
| **Yearly Potassium sulphate consumption** | 1 year average | kg / year | Potassium sulphate production\| technology mix\| production mix, at plant\| 100% ac | http://ecoinvent.lca-data.com | 6b7377bb-c5c2-4d0c-84e4-c9c3233c0641 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Potato protein consumption** | 1 year average | kg / year | Potato protein\| from wet milling, production mix\| at plant\| {EU+28} [LCI result] | http://ecoinvent.lca-data.com | 1bd3bd2c-a5dd-4606-8a11-39d6a9aced52 | 1,97 | 1,54 | 1,84 | 2,29 | 1,91 |
| **Yearly Sawn wood, hardwood consumption** | 1 year average | kg / year | Sawn wood, hardwood\| raw, dried\| at plant\| per kg sawn wood {EU-28+3} [LCI result] | http://ecoinvent.lca-data.com | 7acf32a4-3c31-49bd-8f91-711ffc9a47c0 | 2,02 | 2,02 | 2,02 | 2,02 | 2,02 |
| **Yearly Sawn wood, softwood consumption** | 1 year average | kg / year | Sawn wood, softwood\| raw, dried\| at plant\| per kg sawn wood {EU-28+3} [LCI result] | http://ecoinvent.lca-data.com | fb96a30b-09e9-4a0e-8ecd-96dcb36f30f5 | 2,02 | 2,02 | 2,02 | 2,02 | 2,02 |
| **Yearly Soda consumption** | 1 year average | kg / year | Soda production\| technology mix\| production mix, at plant\| | http://ecoinvent | 546d4097-a453- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | 100% active substance {RER} [LCI result] | .lca-data.com | 4706-ac17-389325a04b6f | | | | | |
| **Yearly Sodium bicarbonate consumption** | 1 year average | kg / year | Sodium bicarbonate production\| technology mix\| production mix, at plant\| 100% ac | http://ecoinvent.lca-data.com | a90aa459-4e30-4b8d-88d4-9380496b42ca | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Sodium chloride consumption** | 1 year average | kg / year | Sodium chloride powder production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | bd92e590-afa8-430c-8089-6491c32163fb | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Sodium dithionite consumption** | 1 year average | kg / year | Sodium dithionite production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 425f3c9d-1501-44a3-8f51-31c6fd7e5f56 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Sodium formate consumption** | 1 year average | kg / year | Sodium formate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | a834d568-3acd-4bca-a501-3b984b89e8ac | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Sodium hydrogen sulphite consumption** | 1 year average | kg / year | Sodium hydrogen sulphite production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 8559b1de-51ab-430e-93b8-295759b853fe | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Sodium hydrosulphide consumption** | 1 year average | kg / year | Sodium hydrosulphide production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca-data.com | 63d82b7d-3547-4240-bc8e-f2ec2832cdee | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Sodium hydroxide consumption** | 1 year average | kg / year | Sodium hydroxide production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 2ba49ead-4683-4671-bded-d52b80215e9e | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Sodium hypochlorite consumption** | 1 year average | kg / year | Sodium hypochlorite production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 1bde1cf6-9dd8-4c78-a05a-07e491913641 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Sodium percarbonate consumption** | 1 year average | kg / year | Sodium percarbonate, powder production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca- | 55a8e0ee-2acd-4167-8d2e- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | | data.com | 95300f7dfeb7 | | | | | |
| **Yearly Sodium silicate consumption** | 1 year average | kg / year | Sodium silicate powder production\| technology mix\| production mix, at plant\| 100 | http://ecoinvent.lca-data.com | 140b222f-7fe3-4efb-8692-2b387054960a | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Sodium sulphate consumption** | 1 year average | kg / year | Sodium sulphate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | a9580b7f-05dc-4015-84ad-af12afc90393 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Sodium sulphite consumption** | 1 year average | kg / year | Sodium sulphite production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | c61e11d7-8040-4aa1-be9d-432ba7674b01 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Sodium tripolyphosphate consumption** | 1 year average | kg / year | Sodium tripolyphosphate production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 92be727d-d244-415c-b207-acd19462c0c6 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Solid board consumption** | 1 year average | kg / year | Solid board, bleached\| kraft pulping process, pulp pressing, bleaching and drying\| production | http://lcdn.think | 0405501b-e12f-4d45- | 3 | 2 | 3 | 2 | 2,5 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | mix, at plant\| >220 g/m2 {EU-28+EFTA} [LCI result] | step.com/Node | ab51-c5b1f5f12620 | | | | | |
| **Yearly Steel cast consumption** | 1 year average | kg / year | Steel cast part alloyed\| electric arc furnace route, from steel scrap, secondary production\| single route, at plant\| carbon steel {EU-28+EFTA} [LCI result] | http://lcdn.thinkstep.com/Node | 366a0afd-88e4-45dc-999a-8acc20fd0ead | 2 | 3 | 3 | 3 | 2,75 |
| **Yearly Styrene consumption** | 1 year average | kg / year | Styrene production\| technology mix\| production mix, at plant\| 100% active substance {GLO} [LCI result] | http://ecoinvent.lca-data.com | 5f7619b2-662a-4068-a4b6-0da8bcf74fc8 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Sulphated acid esters consumption** | 1 year average | kg / year | Sulphated acid esters production\| technology mix\| production mix, at plant\| 100% | http://ecoinvent.lca-data.com | 3f2f1197-2035-4373-98f2-b4660bfdfc73 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Sulphonated fish oil consumption** | 1 year average | kg / year | Sulphonated fish oil production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | e3826ae2-30c2-4197-bb2e-523dbb1d1f5d | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **Yearly Sulphonated rapeseed oil consumption** | 1 year average | kg / year | Sulphonated rapeseed oil production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 1cae64ae-5605-4448-9831-269e7f38a0a6 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Sulphuric acid consumption** | 1 year average | kg / year | Sulphuric acid production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | eb6abe54-7e5d-4ee4-b3f1-08c1e220ef94 | 5 | 1 | 1 | 2 | 2,25 |
| **Yearly Synthetic fatliquors consumption** | 1 year average | kg / year | Synthetic fatliquors production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 1a552557-81d1-4c1a-92f2-96520cdc3fb7 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Synthetic tannins and retanning agents consumption** | 1 year average | kg / year | Syntetic tannins and retanning agents production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 74f41ad4-acb0-42a5-b3e5-95f5448c6414 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Tetrafluoroethane consumption** | 1 year average | kg / year | Tetrafluoroethane production\| technology mix\| production mix, at plant\| 100% act | http://ecoinvent.lca- | acfe37e4-37e8-4d95-8354- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| | | | | data.com | 157f09f6e37c | | | | | |
| **Yearly Thermal energy from natural gas consumption** | 1 year average | MJ / year | Thermal energy from natural gas\| technology mix regarding firing and flue gas cleaning\| production mix, at heat plant\| MJ, 100% efficiency {EU-28+3} [LCI result] | http://lcdn.thinkstep.com/Node | 81675341-f1af-44b0-81d3-d108caef5c28 | 1 | 1 | 1 | 2 | 1,25 |
| **Yearly Titanium dioxide consumption** | 1 year average | kg / year | Titanium dioxide production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 06fa4d7a-939c-4c42-b177-6b5bb45aaf94 | 1 | 1 | 1 | 2 | 1,25 |
| **Yearly Toluene consumption** | 1 year average | kg / year | Toluene production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 5a7445fb-8755-4ef2-947d-e41996e7c911 | 1 | 2 | 1 | 2 | 1,5 |
| **Yearly Triethylene glycol consumption** | 1 year average | kg / year | Triethylene glycol production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 87cc7437-8adc-4f69-b9af-7d69e8ddf1e3 | 1 | 2 | 2 | 2 | 1,75 |
| **Yearly Urea-formaldehyde** | 1 year average | kg / year | Urea-formaldehyde resin production\| technology mix\| | http://ecoinvent.lca- | 68f33810-f063-4f61-899a- | 1 | 2 | 2 | 2 | 1,75 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **resin consumption** | | | production mix, at plant\| 100% active substance {RER} [LCI result] | data.com | ea2bf18b5a46 | | | | | |
| **Yearly Water, completely softened consumption** | 1 year average | l / year | Water, completely softened\| technology mix\| at user\| per kg water {EU-28+3} [LCI result] | http://lcdn.thinkstep.com/Node | 5acdcd80-9e9a-46fb-8da7-791a13bfd831 | 2,42 | 2,04 | 2,02 | 2,02 | 2,12 |
| **Yearly Water, tap consumption** | 1 year average | l / year | Tap water\| technology mix\| at user\| per kg water {EU-28+3} [LCI result] | http://lcdn.thinkstep.com/Node | 212b8494-a769-4c2e-8d82-9a6ef61baad7 | 2,42 | 2,04 | 2,02 | 2,02 | 2,12 |
| **Yearly Wax consumption** | 1 year average | kg / year | Wax production\| technology mix\| production mix, at plant\| 100% active substance | http://ecoinvent.lca-data.com | 697889d5-d952-45eb-9e46-c39046c35522 | 5 | 1 | 2 | 2 | 2,5 |
| **Yearly Xylene consumption** | 1 year average | kg / year | Xylene production\| technology mix\| production mix, at plant\| 100% active substance {RER} [LCI result] | http://ecoinvent.lca-data.com | 33f98fa5-91e8-4270-aff6-bd35098515fe | 1 | 2 | 1 | 2 | 1,5 |
| **Outputs:** | | | | | | | | | | |
| **Yearly Incineration** | 1 year average | kg / year | Waste incineration of hazardous waste\| waste-to-energy plant | http://lcdn.think | fa158634-c471- | 2 | 1 | 2 | 1 | 1,5 |

| Requirements for data collection purposes | | | Requirements for modelling purposes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity data to be collected** | Specific requirements (e.g. frequency, measurement standard, etc.) | Unit of measure | Default dataset to be used | Dataset source (i.e. node) | UUID | TiR | TeR | GR | P | DQR |
| **of hazardous waste** | | | with dry flue gas treatment, including transport and pre-treatment\| production mix, at consumer\| hazardous waste {EU-28+EFTA} [LCI result] | step.com/Node | 4b0e-afef-407d1073b086 | | | | | |
| **Yearly Incineration of solid waste** | 1 year average | kg / year | Waste incineration of municipal solid waste\| waste-to-energy plant with dry flue gas treatment, including transport and pre-treatment\| production mix, at consumer\| municipal solid waste {EU-28+EFTA} [LCI result] | http://lcdn.thinkstep.com/Node | 2f07be1f-d11a-46ac-b4f0-49c5f28b5b93 | 2 | 1 | 2 | 1 | 1,5 |
| **Yearly Landfill of inert material** | 1 year average | kg / year | Landfill of inert material (other materials)\| landfill including leachate treatment and with transport without collection and pre-treatment\| production mix (region specific sites), at landfill site {EU-28+EFTA} [LCI result] | http://lcdn.thinkstep.com/Node | 448ab0f1-4dd6-4d85-b654-35736bb772f4 | 2 | 2 | 2 | 2 | 2 |
| **Yearly Treatment of wastewater** | 1 year average | kg / year | Treatment of residential wastewater, large plant\| waste water treatment including sludge treatment\| production mix, at plant\| 1m3 of waste water treated {EU-28+EFTA} [LCI result] | http://lcdn.thinkstep.com/Node | f5ec4a19-70da-406d-be31-a7eeef2f8372 | 2 | 2 | 2 | 2 | 2 |

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The applicant shall report the DQR values (for each criterion + total) for all the datasets used.

**Table 15 Mandatory company-specific emissions**

| Emissions / resources | Elementary flow | Frequency of measurement | Default measurement method |
|---|---|---|---|
| **Chlorides to water** | Chlorides, unspecified | Weekly | determined from salinity, measured from conductivity, ISO 7888:1985 or EN 27888:1994 or ISO 10304/1:2007 |
| **Chromium to water** | Chromium III | Weekly | EN ISO 15587:2002, EN ISO 11885:2010 |
| **COD to water** | COD, Chemical Oxygen Demand | Weekly | ISO 6060:1989, same as UNE 77004:2002 |
| **Nitrogen to water** | Nitrogen, total | Weekly | EN 25663:1994 |
| **Particulate matter to air** | Particles[19] | Weekly | ISO 10155: 1995 |
| **Sulphates to water** | Sulfate | Weekly | ISO 10304/1:2007 or CWA EPA chemical test method n. 375.2 |
| **Sulphides to water** | Sulfide | Weekly | ISO 13358:1997 or ASTM D4658 or DIN-38405-26 |
| **Suspended solids to water** | Total suspended solids, unspecified | Weekly | EN 872:2006 |
| **VOC to air** | Non-methane volatile organic compounds | 6 or 12 months | EN 12619:2013, EN 13526:2002 |

See excel file named "Leather PEFCR final version - Life cycle inventory" (downloadable at http://ec.europa.eu/environment/eussd/smgp/PEFCR_OEFSR.htm) for the list of all company-specific data to be collected.

The following organisations have contributed to the provision of better proxy data for chemicals: Lanxess Deutschland GmbH, Saviola Holding SRL, Silvateam S.p.A. and Stahl Palazzolo s.r.l. and the support of Associazione Conciatori S. Croce sull'Arno, Associazione Italiana Chimici del Cuoio (AICC), Consorzio Conciatori di Ponte a Egola, Consorzio Vera Pelle Italiana Conciata al Vegetale, Consorzio Vero Cuoio Italiano and Unione Nazionale Produttori Italiani Ausiliari Conciari (UNPAC).

## 5.2 List of processes expected to be run by the company

All processes expected to be run by the company, for which company-specific data are mandatory, are reported in chapter 5.1 List of mandatory company-specific data.

[19] The applicant shall collect data related to particles of any size emitted to air by the company.

## 5.3 Data gaps

Unless primary data on chemicals production and animal farming of appropriate quality (as defined in the PEF Recommendation) are made available from producers, to assure an appropriate overall quality of the PEF study and the comparability of the results, default proxies as in ANNEX 7 – Default values shall be used.

In case a chemical is not included in ANNEX 7 – Default values, the following hierarchic approach shall be followed to model it:

- To use the same PEF-compliant datasets if available in a free or commercial source not part of a Life Cycle Data Network node created in the context of the EF pilot phase LCI tendering process;
- To use another PEF-compliant dataset existing either in one of the Life Cycle Data Network nodes created in the context of the EF pilot phase LCI tendering process or in a free or commercial source dataset and considered to be a good proxy for the missing dataset.

For background data that should be used for the upstream processes see chapter 6.

If primary data or most appropriate datasets are not available, default datasets reported in chapter 6 shall be used. Any deviation shall be clearly reported in the PEF report and justified.

## 5.4 Data quality requirements

The data quality of each dataset and the total EF study shall be calculated and reported. The calculation of the DQR shall be based on the following formula with 4 criteria:

$$\mathrm{DQR} = \frac{\overline{\mathrm{Te_R}} + \overline{\mathrm{G_R}} + \overline{\mathrm{Ti_R}} + \overline{\mathrm{P}}}{4} \qquad \text{[Equation 1]}$$

Where TeR is the Technological-Representativeness, GR is the Geographical-Representativeness, TiR is the Time-Representativeness, and P is the Precision/uncertainty. The representativeness (technological, geographical and time-related) characterises to what degree the processes and products selected are depicting the system analysed, while the precision indicates the way the data is derived and related level of uncertainty.

The next chapters provide tables with the criteria to be used for the semi-quantitative assessment of each criterion. If a dataset is constructed with company-specific activity data, company -specific emission data and secondary sub-processes, the DQR of each shall be assessed separately.

### 5.4.1 Company-specific datasets

The score of criterion P cannot be higher than 3 while the score for TiR, TeR, and GR cannot be higher than 2 (the DQR score shall be ≤1.6). The DQR shall be calculated at the level-1 disaggregation, before any aggregation of sub-processes or elementary flows is performed. The DQR of company-specific datasets shall be calculated as following:

1) Select the most relevant sub-processes and direct elementary flows that account for at least 80% of the total environmental impact of the company-specific dataset, listing them from the most contributing to the least contributing one.

2) Calculate the DQR criteria TeR, TiR, GR and P for each most relevant process and each most relevant direct elementary flow. The values of each criterion shall be assigned based on Table 16.

2.a) Each most relevant elementary flow consists of the amount and elementary flow naming (e.g. 40 g carbon dioxide). For each most relevant elementary flow, evaluate the 4 DQR criteria named $Te_{R\text{-}EF}$, $Ti_{R\text{-}EF}$, $G_{R\text{-}EF}$, $P_{EF}$ in NOTE: in case the newly developed dataset has most relevant processes filled in by non-EF compliant datasets (and thus without DQR), then these datasets cannot be included in step 4 and 5 of the DQR calculation. (1) The weight of step 3 shall be recalculated for the EF-compliant datasets only. Calculate the environmental contribution of each most-relevant EF compliant process and elementary flow to the total environmental impact of all most-relevant EF compliant processes and elementary flows, in %. Continue with step 4 and 5. (2) The weight of the non-EF compliant dataset (calculated in step 3) shall be used to increase the DQR criteria and total DQR accordingly. For example:

- Process 1 carries 30% of the total dataset environmental impact and is ILCD entry level compliant. The contribution of this process to the total of 80% is 37.5% (the latter is the weight to be used).
- Process 1 carries 50% of the total dataset environmental impact and is EF compliant. The contribution of this process to all most-relevant EF compliant processes is 100%. The latter is the weight to be used in step 4.
- After step 5, the parameters $\overline{\mathrm{Te_R}}$, $\overline{\mathrm{G_R}}$, $\overline{\mathrm{Ti_R}}$, $\overline{\mathrm{P}}$ and the total DQR shall be multiplied with 1.375.

It shall be evaluated for example, the timing of the flow measured, for which technology the flow was measured and in which geographical area.

2.b) Each most relevant process is a combination of activity data and the secondary dataset used. For each most relevant process, the DQR is calculated by the applicant of the PEFCR as a combination of the 4 DQR criteria for activity data and the secondary dataset: (i) $Ti_R$ and P shall be evaluated at the level of the activity data (named $Ti_{R\text{-}AD}$, $P_{AD}$) and (ii) $Te_R$, $Ti_R$ and $G_R$ shall be evaluated at the level of the secondary dataset used (named $Te_{R\text{-}SD}$ , $Ti_{R\text{-}SD}$ and $G_{R\text{-}SD}$). As $Ti_R$ is evaluated twice, the mathematical average of $Ti_{R\text{-}AD}$ and $Ti_{R\text{-}SD}$ represents the $Ti_R$ of the most relevant process.

3) Calculate the environmental contribution of each most-relevant process and elementary flow to the total environmental impact of all most-relevant processes and elementary flows, in % (weighted using 13 EF impact categories, with the exclusion of the 3 toxicity-related ones). For example, the newly developed dataset has only two most relevant processes, contributing in total to 80% of the total environmental impact of the dataset:

- Process 1 carries 30% of the total dataset environmental impact. The contribution of this process to the total of 80% is 37.5% (the latter is the weight to be used).
- Process 1 carries 50% of the total dataset environmental impact. The contribution of this process to the total of 80% is 62.5% (the latter is the weight to be used).

4) Calculate the $Te_R$, $Ti_R$, $G_R$ and P criteria of the newly developed dataset as the weighted average of each criterion of the most relevant processes and direct elementary flows. The weight is the relative contribution (in %) of each most relevant process and direct elementary flow calculated in step 3.

5) The applicant of the PEFCR shall the total DQR of the newly developed dataset using the equation 2, where $\overline{Te_R}, \overline{G_R}, \overline{Ti_R}, \overline{P}$ are the weighted average calculated as specified in point 4).

$$DQR = \frac{\overline{Te_R}+\overline{G_R}+\overline{Ti_R}+\overline{P}}{4} \quad \text{[Equation 2]}$$

NOTE: in case the newly developed dataset has most relevant processes filled in by non-EF compliant datasets (and thus without DQR), then these datasets cannot be included in step 4 and 5 of the DQR calculation. (1) The weight of step 3 shall be recalculated for the EF-compliant datasets only. Calculate the environmental contribution of each most-relevant EF compliant process and elementary flow to the total environmental impact of all most-relevant EF compliant processes and elementary flows, in %. Continue with step 4 and 5. (2) The weight of the non-EF compliant dataset (calculated in step 3) shall be used to increase the DQR criteria and total DQR accordingly. For example:

- Process 1 carries 30% of the total dataset environmental impact and is ILCD entry level compliant. The contribution of this process to the total of 80% is 37.5% (the latter is the weight to be used).
- Process 1 carries 50% of the total dataset environmental impact and is EF compliant. The contribution of this process to all most-relevant EF compliant processes is 100%. The latter is the weight to be used in step 4.
- After step 5, the parameters $\overline{Te_R}, \overline{G_R}, \overline{Ti_R}, \overline{P}$ and the total DQR shall be multiplied with 1.375.

**Table 16 How to assess the value of the DQR criteria for datasets with company-specific information**

| | $P_{EF}$ and $P_{AD}$ | $Ti_{R\text{-}EF}$ and $Ti_{R\text{-}AD}$ | $Ti_{R\text{-}SD}$ | $Te_{R\text{-}EF}$ and $Te_{R\text{-}SD}$ | $G_{R\text{-}EF}$ and $G_{R\text{-}SD}$ |
|---|---|---|---|---|---|
| **1** | Measured / calculated and externally verified | The data refers to the most recent annual administration period with respect to the EF report publication date | The EF report publication date happens within the time validity of the dataset | The elementary flows and the secondary dataset reflect exactly the technology of the newly developed dataset | The data(set) reflects the exact geography where the process modelled in the newly created dataset takes place |
| **2** | Measured / calculated and internally verified, plausibility checked by reviewer | The data refers to maximum 2 annual administration periods with respect to the EF report publication date | The EF report publication date happens not later than 2 years beyond the time validity of the dataset | The elementary flows and the secondary dataset is a proxy of the technology of the newly developed dataset | The data(set) partly reflects the geography where the process modelled in the newly created dataset takes place |
| **3** | Measured / calculated / | The data refers to maximum three | Not applicable | Not applicable | Not applicable |

| | $P_{EF}$ and $P_{AD}$ | $Ti_{R\text{-}EF}$ and $Ti_{R\text{-}AD}$ | $Ti_{R\text{-}SD}$ | $Te_{R\text{-}EF}$ and $Te_{R\text{-}SD}$ | $G_{R\text{-}EF}$ and $G_{R\text{-}SD}$ |
|---|---|---|---|---|---|
| | literature and plausibility not checked by reviewer OR Qualified estimate based on calculations plausibility checked by reviewer | annual administration periods with respect to the EF report publication date | | | |
| **4-5** | Not applicable | Not applicable | Not applicable | Not applicable | Not applicable |

## 5.5 Data needs matrix (DNM)

All processes required to model the product and outside the list of mandatory company-specific (listed in section 5.1 List of mandatory company-specific data) shall be evaluated using the Data Needs Matrix (see Table 17). The DNM shall be used by the PEFCR applicant to evaluate which data is needed and shall be used within the modelling of its PEF, depending on the level of influence the applicant (company) has on the specific process. The following three cases are found in the DNM and are explained below:

1. **Situation 1**: the process is run by the company applying the PEFCR
2. **Situation 2**: the process is not run by the company applying the PEFCR but the company has access to (company-)specific information.
3. **Situation 3**: the process is not run by the company applying the PEFCR and this company does not have access to (company-)specific information.

**Table 17 Data Needs Matrix (DNM) . *Disaggregated datasets shall be used.**

| | | Most relevant process | Other process |
|---|---|---|---|
| **Situation 1: process run by the company applying the PEFCR** | **Option 1** | Provide company-specific data (as requested in the PEFCR) and create a company specific dataset partially disaggregated at least at level 1 (DQR ≤1.6).<br><br>Calculate the DQR values (for each criteria + total) | |
| | **Option 2** | | Use default secondary dataset in PEFCR, in aggregated form (DQR ≤3.0).<br><br>Use the default DQR values |
| **Situation 2: process not run by the company applying the PEFCR but with access to (company-)specific information** | **Option 1** | Provide company-specific data (as requested in the PEFCR) and create a company specific dataset partially disaggregated at least at level 1 (DQR ≤1.6).<br><br>Calculate the DQR values (for each criteria + total) | |
| | **Option 2** | Use company-specific activity data for transport (distance), | |

| | | Most relevant process | Other process |
|---|---|---|---|
| | | and substitute the sub-processes used for electricity mix and transport with supply-chain specific PEF compliant datasets (DQR ≤3.0).*<br><br>Re-evaluate the DQR criteria within the product specific context | |
| | **Option 3** | | Use company-specific activity data for transport (distance), and substitute the sub-processes used for electricity mix and transport with supply-chain specific PEF compliant datasets (DQR ≤4.0).<br><br>Use the default DQR values |
| **Situation 3: process not run by the company applying the PEFCR and without access to (company)-specific information** | **Option 1** | Use default secondary dataset, in aggregated form (DQR ≤3.0).<br><br>Re-evaluate the DQR criteria within the product specific context | |
| | **Option 2** | | Use default secondary dataset in PEFCR, in aggregated form (DQR ≤4.0)<br><br>Use the default DQR values |

### 5.5.1 Processes in situation 1

For each process in situation 1 there are two possible options:

- The process is in the list of most relevant processes as specified in the PEFCR or is not in the list of most relevant process, but still the company wants to provide company specific data (option 1);
- The process is not in the list of most relevant processes and the company prefers to use a secondary dataset (option 2).

**Situation 1/Option 1**

For all processes run by the company and where the company applying the PEFCR uses company specific data. The DQR of the newly developed dataset shall be evaluated as described in section 5.4.1 Company-specific datasets.

**Situation 1/Option 2**

For the non-most relevant processes only, if the applicant decides to model the process without collecting company-specific data, then the applicant shall use the secondary dataset listed in the PEFCR together with its default DQR values listed here.

If the default dataset to be used for the process is not listed in the PEFCR, the applicant of the PEFCR shall take the DQR values from the metadata of the original dataset.

### 5.5.2 Processes in situation 2

When a process is not run by the company applying the PEFCR, but there is access to company-specific data, then there are two possible options:

- The company applying the PEFCR has access to extensive supplier-specific information and wants to create a new EF-compliant dataset[20] (Option 1);
- The company has some supplier-specific information and want to make some minimum changes (Option 2).
- The process is not in the list of most relevant processes and the company prefers to use a secondary dataset (option 3).

**Situation 2/Option 1**

For all processes run by the company and where the company applying the PEFCR uses company specific data. The DQR of the newly developed dataset shall be evaluated as described in section 5.4.1 Company-specific datasets.

**Situation 2/Option 2**

Company-specific activity data for transport are used and the sub-processes used for electricity mix and transport with supply-chain specific PEF compliant datasets are substituted starting from the default secondary dataset provided in the PEFCR.

Please note that, the PEFCR lists all dataset names together with the UUID of their aggregated dataset. For this situation, the disaggregated version of the dataset is required.

The applicant of the PEFCR shall make the DQR values of the dataset used context-specific by re-evaluating $Te_R$ and $Ti_R$, using the table(s) provided Table 18. The criteria $G_R$ shall be lowered by 30%[21] and the criteria P shall keep the original value.

[20] The review of the newly created dataset is optional

[21] In situation 2, option 2 it is proposed to lower the parameter $G_R$ by 30% in order to incentivize the use of company specific information and reward the efforts of the company in increasing the geographic representativeness of a secondary dataset through the substitution of the electricity mixes and of the distance and means of transportation.

**Situation 2/Option 3**

For the non-most relevant processes, the applicant may use the corresponding secondary dataset listed in the PEFCR together with its DQR values.

If the default dataset to be used for the process is not listed in the PEFCR, the applicant of the PEFCR shall take the DQR values from the original dataset.

**Table 18 How to assess the value of the DQR criteria when secondary datasets are used.**

| | TiR | TeR | $G_R$ |
|---|---|---|---|
| **1** | The EF report publication date happens within the time validity of the dataset | The technology used in the EF study is exactly the same as the one in scope of the dataset | The process modelled in the EF study takes place in the country the dataset is valid for |
| **2** | The EF report publication date happens not later than 2 years beyond the time validity of the dataset | The technologies used in the EF study is included in the mix of technologies in scope of the dataset | The process modelled in the EF study takes place in the geographical region (e.g. Europe) the dataset is valid for |
| **3** | The EF report publication date happens not later than 4 years beyond the time validity of the dataset | The technologies used in the EF study are only partly included in the scope of the dataset | The process modelled in the EF study takes place in one of the geographical regions the dataset is valid for |
| **4** | The EF report publication date happens not later than 6 years beyond the time validity of the dataset | The technologies used in the EF study are similar to those included in the scope of the dataset | The process modelled in the EF study takes place in a country that is not included in the geographical region(s) the dataset is valid for, but sufficient similarities are estimated based on expert judgement. |
| **5** | The EF report publication date happens later than 6 years after the time validity of the dataset | The technologies used in the EF study are different from those included in the scope of the dataset | The process modelled in the EF study takes place in a different country than the one the dataset is valid for |

### 5.5.3 Processes in situation 3

When a process is not run by the company applying the PEFCR and the company does not have access to company-specific data, there are two possible options:

- It is in the list of most relevant processes (situation 3, option 1)
- It is not in the list of most relevant processes (situation 3, option 2)

**Situation 3/Option 1**

In this case, the applicant of the PEFCR shall make the DQR values of the dataset used context-specific by re-evaluating $Te_R$, $Ti_R$ and $G_r$, using the table(s) provided. The criteria P shall keep the original value.

**Situation 3/Option 2**

For the non-most relevant processes, the applicant shall use the corresponding secondary dataset listed in the PEFCR together with its DQR values.

If the default dataset to be used for the process is not listed in the PEFCR, the applicant of the PEFCR shall take the DQR values from the original dataset.

### 5.6 Which datasets to use?

The secondary datasets to be used by the applicant are those listed in this PEFCR. Whenever a dataset needed to calculate the PEF-profile is not among those listed in this PEFCR, then the applicant shall choose between the following options (in hierarchical order):

- Use an EF-compliant dataset available on one of the following nodes:
  - http://eplca.jrc.ec.europa.eu/EF-node
  - http://lcdn.blonkconsultants.nl
  - http://ecoinvent.lca-data.com
  - http://lcdn-cepe.org
  - https://lcdn.quantis-software.com/PEF/
  - http://lcdn.thinkstep.com/Node
- Use an EF-compliant dataset available in a free or commercial source;
- Use another EF-compliant dataset considered to be a good proxy. In such case this information shall be included in the "limitation" section of the PEF report.
- Use an ILCD-entry level-compliant dataset that has been modelled according to the modelling requirements included in the Guidance version 6.3. In such case this information shall be included in the "limitations" section of the PEF report.
- Use an ILCD-entry level-compliant dataset. In such case this information shall be included in the "data gap" section of the PEF report.

### 5.7 How to calculate the average DQR of the study

In order to calculate the average DQR of the EF study, the applicant shall calculate separately the TeR, TiR, GR and P for the EF study as the weighted average of all most relevant processes, based on their relative environmental contribution to the total single score (excluding the 3 toxicity-related ones). The calculation rules explained in 5.4 Data quality requirements shall be used.

### 5.8 Allocation rules

The leather life cycle, as it results from the allocation rules specifically set up for this product category in the PEFCR Guidance version 6.3, includes upstream phases of livestock breeding and slaughter. Therefore, in the leather life cycle, multi-functionality occurs at different life cycle stages:

- At the farming level, where meat and milk are produced;

- At the slaughterhouse level, where fresh meat and edible offal, raw hides and skins and other co & by-products are produced;
- At the tannery level, where finished grain split leather and other co-products (i.e. flesh splits, wool, etc.) are produced

To manage multi-functionality, the approaches reported below shall be applied. Approaches for farming and slaughtering are taken from PEFCR guidance version 6.3.

**Table 19 Allocation rules**

| Process | Allocation rule | Modelling instructions |
|---|---|---|
| **Bovine farming** | Biophysical | Subdivision shall be used for processes that can be directly attributed to certain outputs (e.g. energy use and emissions related to milking processes). When the processes cannot be subdivided due to the lack of separate data or because technically impossible, the upstream burden, e.g. feed production, shall be allocated to farm outputs using a biophysical allocation method. Default values shall be used by PEF studies unless company-specific data are collected. The change of allocation factors is allowed only when company-specific data are collected and used for the farm module. In case generic data are used for the farm module, no change of allocation factors is allowed and the ones listed below shall be used:<br>• Milk: 88,0%<br>• Live animal to slaughter: 12,0% |
| **Caprine and ovine farming** | Biophysical | Subdivision shall be used for processes that can be directly attributed to certain outputs (e.g. energy use and emissions related to milking processes). When the processes cannot be subdivided due to the lack of separate data or because technically impossible, the upstream burden, e.g. feed production, shall be allocated to farm outputs using a biophysical allocation method. Default values shall be used by PEF studies unless company-specific data are collected. The change of allocation factors is allowed only when company-specific data are collected and used for the farm module. In case generic data are used for the farm module, no change of allocation factors is allowed and the ones listed below shall be used:<br>• Milk: 73,85%<br>• Wool: 23,64%<br>• Live animal to slaughter: 2,51% |
| **Bovine slaughtering** | Economic | Subdivision shall be used for processes that can be directly attributed to certain outputs. When the processes cannot be subdivided, the remaining (e.g. excluding that already allocated to milk for milk producing system and/or to wool for wool producing system) |

| Process | Allocation rule | Modelling instructions |
|---|---|---|
| | | upstream burden shall be allocated to slaughterhouse and rendering outputs using the economic allocation method. The default values that shall be used for economic allocation are reported below:<br><br>• Fresh meat and edible offal: 92,9%<br>• Hides and skins: 3,5%<br>• Food grade fat: 1,8%<br>• Food grade bones: 1,0%<br>• Cat. 3 slaug. By-products: 0,8%<br>• Cat 1/2 material & waste: 0,0%<br><br>No change of allocation factors is allowed. |
| **Caprine and ovine slaughtering** | Economic | Subdivision shall be used for processes that can be directly attributed to certain outputs. When the processes cannot be subdivided, the remaining (e.g. excluding that already allocated to milk for milk producing system and/or to wool for wool producing system) upstream burden shall be allocated to slaughterhouse and rendering outputs using the economic allocation method. The default values that shall be used for economic allocation are reported below:<br><br>• Fresh meat and edible offal: 97,8%<br>• Hides and skins: 1,6%<br>• Cat. 3 slaug. By-products: 0,618%<br>• Food grade fat: 0,19%<br>• Food grade bones: 0,0127%<br>• Cat 1/2 material & waste: 0,0%<br><br>No change of allocation factors is allowed. |
| **Bovine raw hides tanning** | Hide substance content | Allocation in leather tanning processes between full grain leather and its co-products shall be based on the hide substance content. See Table 20. |
| **Caprine skins tanning** | Hide substance content | Allocation in leather tanning processes between full grain leather and its co-products shall be based on the hide substance content. See Table 21. |
| **Ovine skins tanning** | Hide substance content | Allocation in leather tanning processes between full grain leather and its co-products shall be based on the hide substance content. See Table 22. |

The use of allocation factors deviating from the default ones provided in the present document shall be subject to strict review by the verifier, since it greatly influence the results of the study. Indeed, if it can be demonstrated that the hides or skins are obtained from animals that have been killed for eradicating a disease or that died at the farm or that were stillborn, then such animal by-products are legally treated as waste and they shall carry a 0% allocation.

The calculation of simplified sets of average and approximate allocation factors was carried out on the basis of the mass balance of the biogenic and bio-based Protein-Nitrogen content (g-N or %) Hide Substance) in the co-products (grain and flesh/middle splits), as well as by-products (hair or wool recovered) and residues (bio-solids and solid waste) generated during the transformation of input processing materials to finished leather and Tannery effluent treatment, respectively.

The quantities of co-products, by-products and waste can vary significantly as a function of specific input material, output leather article and tannery. The thickness of the output pelts and leathers can result in significant variations of allocated hide substance content.

Allocation factors are reported in the following tables.

543 **Table 20 Allocation factors for bovine leather**

| From | Raw | | | | Semi-processed products | Raw | | |
|---|---|---|---|---|---|---|---|---|
| To | Semi-processed products, split, hair burn | Semi-processed products, split, hair save | Semi-processed products, full substance, hair burn | Semi-processed products, full substance, hair save | Crust or Finished Grain Split Leathers | Finished leather, split, hair save | Finished leather, split, hair burn | Finished Sole Leather |
| **Grain Splits** | 64% | 60% | 100% | 91% | 100% | 60% | 63% | 100% |
| **Flesh Splits** | 36% | 31% | - | - | - | 31% | 37% | - |
| **Hair** | - | 9% | - | 9% | - | 9% | - | - |

544 **Table 21 Allocation factors for caprine leather**

| From | Raw | | Semi-processed products |
|---|---|---|---|
| To | Semi-processed products or finished leather, hair save | Semi-processed products or finished leather, hair burn | Finished Leather |
| **Finished leather** | 91,2% | 100,0% | 100,0% |
| **Recovered hair** | 8,8% | - | - |

545 **Table 22 Allocation factors for ovine leather**

| From | Raw | | Semi-processed products |
|---|---|---|---|
| To | Semi-processed products or finished leather, wool save | Semi-processed products or finished leather, wool burn | Finished Leather |
| **Finished leather** | 60,4% | 100,0% | 100,0% |
| **Recovered wool** | 39,6% | - | - |

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The allocation factors proposed represent the percentages of total tanning impact that go to finished grain split leather and to recoverable losses.

The Circular Footprint formula shall be applied to all wastes deriving from the tanning processes.

### 5.9 Electricity modelling

The guidelines in this section shall only be used for the processes where company-specific information is collected (situation 1 / Option 1 & 2 / Option 1of the DNM).

In PEF studies the following electricity mix shall be used in hierarchical order:

(i) Supplier-specific electricity product shall be used if:
  (a) Available, and
  (b) The set of minimum criteria to ensure the contractual instruments are reliable is met.

(ii) The supplier-specific total electricity mix shall be used if:
  (a) Available, and
  (b) The set of minimum criteria to ensure the contractual instruments are reliable is met.

(iii) As a last option the **'country-specific residual grid mix, consumption mix'** shall be used (available at http://lcdn.thinkstep.com/Node/). Country-specific means the country in which the life cycle stage occurs. This may be an EU country or non-EU country. The residual grid mix characterizes the unclaimed, untracked or publicly shared electricity. This prevents double counting with the use of supplier-specific electricity mixes in (i) and (ii).

Note: if for a country, there is a 100% tracking system in place, case (i) shall be applied.

Note: for the use stage, the consumption grid mix shall be used.

The environmental integrity of the use of supplier-specific electricity mix depends on ensuring that contractual instruments (for tracking) **reliably and uniquely convey claims to consumers**. Without this, the PEF lacks the accuracy and consistency necessary to drive product/corporate electricity procurement decisions and accurate consumer (buyer of electricity) claims. Therefore, a set of minimum criteria that relate to the integrity of the contractual instruments as reliable conveyers of environmental footprint information has been identified. They represent the minimum features necessary to use supplier-specific mix within PEF studies.

Set of minimal criteria to ensure contractual instruments from suppliers:

A supplier-specific electricity product/mix may only be used when the applicant ensures that any contractual instrument meets the criteria specified below. If contractual instruments do not meet the criteria, then 'country-specific residual grid mix, consumption mix' shall be used in the modelling.

A contractual instrument used for electricity modelling shall:

1. Convey attributes:

- Convey the energy type mix associated with the unit of electricity produced.
- The energy type mix shall be calculated based on delivered electricity, incorporating certificates sourced and retired on behalf of its customers. Electricity from facilities for which the attributes have been sold off (via contracts or certificates) shall be characterized as having the environmental attributes of the country residual consumption mix where the facility is located.

2. Be a unique claim:
   - Be the only instruments that carry the environmental attribute claim associated with that quantity of electricity generated.
   - Be tracked and redeemed, retired, or cancelled by or on behalf of the company (e.g. by an audit of contracts, third party certification, or may be handled automatically through other disclosure registries, systems, or mechanisms).
3. Be as close as possible to the period to which the contractual instrument is applied.

Modelling 'country-specific residual grid mix, consumption mix':

Datasets for residual grid mix, per energy type, per country and per voltage have been purchased by the European Commission and are available in the dedicated node (https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/e-track_ii_guarantees_of_origin_in_europe.pdf). In case the necessary dataset is not available, an alternative dataset shall be chosen according to the procedure described in section 5.8 Allocation rules. If no dataset is available, the following approach may be used:

Determine the country consumption mix (e.g. X% of MWh produced with hydro energy, Y% of MWh produced with coal power plant) and combined them with LCI datasets per energy type and country/region (e.g. LCI dataset for the production of 1MWh hydro energy in Switzerland):

- Activity data related to non-EU country consumption mix per detailed energy type shall be determined based on:
  - Domestic production mix per production technologies
  - Import quantity and from which neighbouring countries
  - Transmission losses
  - Distribution losses
  - Type of fuel supply (share of resources used, by import and / or domestic supply)

  These data may be found in the publications of the International Energy Agency (IEA).

- Available LCI datasets per fuel technologies in the node. The LCI datasets available are generally specific to a country or a region in terms of:

  - Fuel supply (share of resources used, by import and / or domestic supply),
  - Energy carrier properties (e.g. element and energy contents)
  - Technology standards of power plants regarding efficiency, firing technology, flue-gas desulphurisation, NOx removal and de-dusting.

Allocation rules:

Table 23 Allocation rules for electricity

| Process | Physical relationship | Modelling instructions |
|---|---|---|
| **Tanning** | Hide substance content | Allocation between pre-treated raw hides/skins and their co-products shall be based on the hide substance content. |

If the consumed electricity comes from more than one electricity mix, each mix source shall be used in terms of its proportion in the total kWh consumed. For example, if a fraction of this total kWh consumed is coming from a specific supplier a supplier-specific electricity mix shall be used for this part. See below for on-site electricity use.

A specific electricity type may be allocated to one specific product in the following conditions:

a. The production (and related electricity consumption) of a product occurs in a separate site (building), the energy type physical related to this separated site may be used.
b. The production (and related electricity consumption) of a product occurs in a shared space with specific energy metering or purchase records or electricity bills, the product specific information (measure, record, bill) may be used.
c. All the products produced in the specific plant are supplied with a public available PEF study. The company who wants to make the claim shall make all PEF studies available. The allocation rule applied shall be described in the PEF study, consistently applied in all PEF studies connected to the site and verified. An example is the 100% allocation of a greener electricity mix to a specific product.

<u>On-site electricity generation:</u>

If on-site electricity production is equal to the site own consumption, two situations apply:

- No contractual instruments have been sold to a third party: the own electricity mix (combined with LCI datasets) shall be modelled.
- Contractual instruments have been sold to a third party: the 'country-specific residual grid mix, consumption mix' (combined with LCI datasets) shall be used.

If electricity is produced in excess of the amount consumed on-site within the defined system boundary and is sold to, for example, the electricity grid, this system can be seen as a multifunctional situation. The system will provide two functions (e.g. product + electricity) and the following rules shall be followed:

- If possible, apply subdivision.
- Subdivision applies both to separate electricity productions or to a common electricity production where you can allocate based on electricity amounts the upstream and direct emissions to your own consumption and to the share you sell out of your company (e.g. if a company has a wind mill on its production site and export 30% of the produced electricity, emissions related to 70% of produced electricity should be accounted in the PEF study.
- If not possible, direct substitution shall be used. The country-specific residual consumption electricity mix shall be used as substitution[22].

[22] For some countries, this option is a best case rather than a worst case.

- Subdivision is considered as not possible when upstream impacts or direct emissions are closely related to the product itself.

## 5.10 Climate change modelling

The impact category 'climate change' shall be modelled considering three sub-categories:

1. Climate change – fossil: This sub-category includes emissions from peat and calcination/carbonation of limestone. The emission flows ending with '(fossil)' (e.g., 'carbon dioxide (fossil)'' and 'methane (fossil)') shall be used if available.
2. Climate change – biogenic: This sub-category covers carbon emissions to air ($CO_2$, CO and $CH_4$) originating from the oxidation and/or reduction of biomass by means of its transformation or degradation (e.g. combustion, digestion, composting, landfilling) and $CO_2$ uptake from the atmosphere through photosynthesis during biomass growth – i.e. corresponding to the carbon content of products, biofuels or aboveground plant residues such as litter and dead wood. Carbon exchanges from native forests[23] shall be modelled under sub-category 3 (incl. connected soil emissions, derived products, residues). The emission flows ending with '(biogenic)' shall be used. A simplified modelling approach shall not be used when modelling the foreground emissions.

   All biogenic carbon emissions and removals shall be modelled separately. However, note that the corresponding characterisation factors for biogenic $CO_2$ uptakes and emissions within the EF impact assessment method are set to zero.

**Table 24 Characterization Factors (CFs) in CO2-equivalents, with carbon feedbacks**

| Substance | Compartment | GWP100 |
|---|---|---|
| **Carbon dioxide (fossil)** | Air emission | 1 |
| **Methane (fossil)** | Air emission | 36,75 |
| **Carbon monoxide (fossil)** | Air emission | 1,57 |
| **Carbon dioxide (biogenic)** | Resources from air | 0 |
| **Carbon dioxide (biogenic-100yr)** | Resources from air | -1 |
| **Carbon dioxide (biogenic)** | Air emission | 0 |
| **Methane (biogenic)** | Air emission | 34 |
| **Carbon monoxide (biogenic)** | Air emission | 0 |
| **Carbon dioxide (land use change)** | Resources from air | -1 |
| **Carbon dioxide (land use change)** | Air emission | 1 |
| **Methane (land use change)** | Air emission | 36,75 |
| **Carbon monoxide (land use change)** | Air emission | 1,57 |

The biogenic carbon content at factory gate (physical content and allocated content) shall be reported as 'additional technical information'.

[23] Native forests – represents native or long-term, non-degraded forests. Definition adapted from table 8 in Annex V C(2010)3751 to Directive 2009/28/EC.

3. Climate change – land use and land transformation: This sub-category accounts for carbon uptakes and emissions ($CO_2$, CO and $CH_4$) originating from carbon stock changes caused by land use change and land use. This sub-category includes biogenic carbon exchanges from deforestation, road construction or other soil activities (incl. soil carbon emissions). For native forests, all related $CO_2$ emissions are included and modelled under this sub-category (including connected soil emissions, products derived from native forest[24] and residues), while their $CO_2$ uptake is excluded. The emission flows ending with '(land use change)' shall be used.
   For land use change, all carbon emissions and removals shall be modelled following the modelling guidelines of PAS 2050:2011 (BSI 2011) and the supplementary document PAS2050-1:2012 (BSI 2012) for horticultural products. PAS 2050:2011 (BSI 2011): Large emissions of GHGs can result as a consequence of land use change. Removals as a direct result of land use change (and not as a result of long-term management practices) do not usually occur, although it is recognized that this could happen in specific circumstances. Examples of direct land use change are the conversion of land used for growing crops to industrial use or conversion from forestland to cropland. All forms of land use change that result in emissions or removals are to be included. Indirect land use change refers to such conversions of land use as a consequence of changes in land use elsewhere. While GHG emissions also arise from indirect land use change, the methods and data requirements for calculating these emissions are not fully developed. Therefore, the assessment of emissions arising from indirect land use change is not included.

   The GHG emissions and removals arising from direct land use change shall be assessed for any input to the life cycle of a product originating from that land and shall be included in the assessment of GHG emissions. The emissions arising from the product shall be assessed on the basis of the default land use change values provided in PAS 2050:2011 Annex C, unless better data is available. For countries and land use changes not included in this annex, the emissions arising from the product shall be assessed using the included GHG emissions and removals occurring as a result of direct land use change in accordance with the relevant sections of the IPCC (2006). The assessment of the impact of land use change shall include all direct land use change occurring not more than 20 years, or a single harvest period, prior to undertaking the assessment (whichever is the longer). The total GHG emissions and removals arising from direct land use change over the period shall be included in the quantification of GHG emissions of products arising from this land on the basis of equal allocation to each year of the period[25].

   1) Where it can be demonstrated that the land use change occurred more than 20 years prior to the assessment being carried out, no emissions from land use change should be included in the assessment.

   2) Where the timing of land use change cannot be demonstrated to be more than 20 years, or a single harvest period, prior to making the assessment (whichever is the longer), it shall be assumed that the land use change occurred on 1 January of either:

   - The earliest year in which it can be demonstrated that the land use change had occurred; or
   - On 1 January of the year in which the assessment of GHG emissions and removals is being carried out.

[24] Following the instantaneous oxidation approach in IPCC 2013 (Chapter 2).
[25] In case of variability of production over the years, a mass allocation should be applied.

The following hierarchy shall apply when determining the GHG emissions and removals arising from land use change occurring not more than 20 years or a single harvest period, prior to making the assessment (whichever is the longer):

1. where the country of production is known and the previous land use is known, the GHG emissions and removals arising from land use change shall be those resulting from the change in land use from the previous land use to the current land use in that country (additional guidelines on the calculations can be found in PAS 2050-1:2012);
2. where the country of production is known, but the former land use is not known, the GHG emissions arising from land use change shall be the estimate of average emissions from the land use change for that crop in that country (additional guidelines on the calculations can be found in PAS 2050-1:2012);
3. where neither the country of production nor the former land use is known, the GHG emissions arising from land use change shall be the weighted average of the average land use change emissions of that commodity in the countries in which it is grown.

Knowledge of the prior land use can be demonstrated using a number of sources of information, such as satellite imagery and land survey data. Where records are not available, local knowledge of prior land use can be used. Countries in which a crop is grown can be determined from import statistics, and a cut-off threshold of not less than 90% of the weight of imports may be applied. Data sources, location and timing of land use change associated with inputs to products shall be reported.

Soil carbon storage shall not be modelled, calculated and reported as additional environmental information.

The sum of the three sub-categories shall be reported.

The sub-category 'Climate change-biogenic' shall be reported separately.

The sub-category 'Climate change-land use and land transformation' shall not be reported separately.

## 5.11 Modelling of wastes and recycled content

The waste of products used during the manufacturing, distribution, the use stage or after use shall be included in the overall modelling of the life cycle of the organisation. Overall, this should be modelled and reported at the life cycle stage where the waste occurs. This section gives guidelines on how to model the End-of-Life of products as well as the recycled content.

In the case of recovery and reuse of chromium from chrome tanning waste water, the Circular Footprint Formula (CFF) shall be applied. Its parameters can greatly influence results and primary data shall be used. In case primary data are not available, default values (Table 25) shall be used.

**Table 25: Default values for chromium recovery CFF**

| Parameter | Value | Justification |
|---|---|---|
| **$R_1$**[26] | - | Process specific |

[26] $R_1$ shall be set to 0% when no application-specific data is available. See Annex C of PEFCR Guidance version 6.3.

| Parameter | Value | Justification |
|---|---|---|
| $R_2$ | 0,24[27] | Average percentage of chrome waste to recovery (Italian average) |
| $R_3$ | 0,00 | No energy recovery |
| $Q_s$ | 0,10 | Average concentration of recovered chrome |
| $Q_p$ | 0,26 | Average concentration of virgin chrome |
| $E_v = E^*_v$ | | See Table 39 |
| $E_{recycled}$ | | Use primary data |
| $E_{recycling\ EoL}$ | | Use primary data |
| ED | | See Table 39 |

In case paperboard is used as packaging for tanned leather, the complete CFF shall be used. In case primary data on recycled content of material ($R_1$) are non-available, 0,779 value shall be used (value tested within the leather screening study and used in the screening study performed by the pilot for "intermediate paper product" for the RP "packaging paper"). To model $E_v$ and $E_{recycled}$, the following dataset shall be used:

- $E_v$: Corrugated board, uncoated| Kraft Pulping Process, pulp pressing and drying| production mix, at plant| flute thickness 0.8- 2.8 mm {EU-28+EFTA} [LCI result] (UUID: 574bdb1e-2ed3-46f1-bd14-bb76f739bb71);
- $E_{recycled}$: Newsprint| production mix| at plant| per kg Newsprint {EU-28+3} [LCI result] (UUID: 98b2b259-83b7-4e0f-bde9-99a85b8c38cd).

# 6. Life cycle stages

## 6.1 Raw material acquisition and pre-processing

This life cycle stage includes the acquisition of raw hides and skins. The environmental impact of this life cycle stage is attributable to the portion of environmental impact of the farming and slaughtering phases allocated accordingly to chapter 5.8 Allocation rules and the impact of raw hides and skins transportation from the slaughterhouse/preservation site to the tannery.

The user of this PEFCR shall modify, as appropriate and where available, the geographical origin of the datasets reported in the tables below to make the result of the footprint calculation more accurate.

[27] UNIC Data, economic department.

762 **Table 26 Raw material acquisition and pre-processing (capitals indicate those processes expected to be run by the company)**

| Process name* | Unit of measurement (output) | Default | | | | UUID | Deafult DQR | | | | Most relevant process [Y/N] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R1[28] | Amount per DU | Dataset | Dataset source | | P | TiR | GR | TeR | |
| **Fresh hides from EU consumption** | kg / year | n/a | n/a | Beef, fresh hides\| at slaughterhouse\| per kg {EU-28+3} [LCI result] | https://lcdn.quantis-software.com/PEF/ | e018a5e8-c279-4c56-8b80-a6e82ed0ddd7 | 2,53 | 2,00 | 2,00 | 2,12 | Y |
| **Sheep and goats from EU consumption[29]** | kg / year | n/a | n/a | Sheep\| for slaughter\| at farm\| per kg live weight {EU-28+3} [LCI result] | https://lcdn.quantis-software.com/PEF/ | 3ec70437-8366-4129-8dc7-8b9cbbb58fec | 2,30 | 1,89 | 1,47 | 2,20 | Y |

763 The applicant shall report the DQR values (for each criterion + total) for all the datasets used.

764 **Table 27 Transport (capitals indicate those processes expected to be run by the company)[30]**

| Process name* | Unit of measurement (output) | Default | | | | UUID | Deafult DQR | | | | Most relevant process [Y/N] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R1[31] | Amount per FU | Dataset | Dataset source | | P | TiR | GR | TeR | |
| **Transportation of raw hides / skins on lorry** | kgkm / year | n/a | n/a | Articulated lorry transport, total weight >32 t, mix | http://lcdn.thinkstep.co | 328984f2-4a54-419a- | 2,00 | 1,00 | 3,00 | 1,00 | Y |

[28] In case no specific values are available R1 shall be set to 0%.
[29] If no primary data are available to model caprine and ovine slaughtering, LCI reported in Table 37 shall be used and related allocation rule, as reported in 5.8 Allocation rules, shall be applied.
[30] If no primary data on transportation distances are available, the default values reported in Table 38 shall be used.
[31] In case no specific values are available R1 shall be set to 0%.

| Process name* | Unit of measurement (output) | Default | | | | UUID | Deafult DQR | | | | Most relevant process [Y/N] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R1[31] | Amount per FU | Dataset | Dataset source | | P | TiR | GR | TeR | |
| | | | | Euro 0-5\| diesel driven, Euro 0 - 5 mix, cargo\| consumption mix, to consumer\| more than 32t gross weight / 24,7t payload capacity {EU-28+3} [LCI result] | m/Node / | b88a-5426a75d0b27 | | | | | |
| **Transportation of raw hides / skins on transoceanic ship** | kgkm / year | n/a | n/a | Transoceanic ship, containers\| heavy fuel oil driven, cargo\| consumption mix, to consumer\| 27.500 dwt payload capacity, ocean going {GLO} [LCI result] | http://lcdn.thinkstep.com/Node/ | 6ca61112-1d5b-473c-abfa-4accc66a8a63 | 2,00 | 1,00 | 2,00 | 2,00 | Y |

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*The applicant of this PEFCR shall always check the utilisation ratio applied in the default dataset and adapt it accordingly.

***Modelling the recycled content (if applicable)***

The following formula is used to model the recycled content:

$$(1 - R_1)E_V + R_1 \times \left( AE_{recycled} + (1 - A)E_V \times \frac{Q_{Sin}}{Q_p} \right)$$

The $R_1$ values applied shall be supply-chain or default as provided in the table above, in relation with the DNM. Material-specific values based on supply market statistics are not accepted as a proxy. The applied $R_1$ values shall be subject to PEF study verification.

When using supply-chain specific $R_1$ values other than 0, traceability throughout the supply chain is necessary. The following general guidelines shall be followed when using supply-chain specific $R_1$ values:

- The supplier information (through e.g., statement of conformity or delivery note) shall be maintained during all stages of production and delivery at the converter;
- Once the material is delivered to the converter for production of the end products, the converter shall handle information through their regular administrative procedures;
- The converter for production of the end products claiming recycled content shall demonstrate through his management system the [%] of recycled input material into the respective end product(s).
- The latter demonstration shall be transferred upon request to the user of the end product. In case a PEF profile is calculated and reported, this shall be stated as additional technical information of the PEF profile.
- Company-owned traceability systems can be applied as long as they cover the general guidelines outlined above.

The PEF profile shall be calculated and reported using A equal to 1.

### 6.2 Manufacturing

Processes expected to be run by the company at manufacturing stage, for which company-specific data are mandatory, are reported in chapter 5.1 List of mandatory company-specific data.

## 7. PEF results

### 7.1 Benchmark values

Benchmark is not applicable for leather since it is an intermediate product.

### 7.2 PEF profile

The applicant shall calculate the PEF profile of its product in compliance with all requirements included in this PEFCR. The following information shall be included in the PEF report:

- full life cycle inventory;
- characterised results in absolute values, for all impact categories (including toxicity; as a table);
- normalised and weighted result in absolute values, for all impact categories (including toxicity; as a table);
- the aggregated single score in absolute values

Together with the PEF report, the applicant shall develop an aggregated EF-compliant dataset of its product in scope. This dataset shall be made available on the EF node (http://eplca.jrc.ec.europa.eu/EF-node). The disaggregated version may stay confidential.

### 7.3 Additional technical information

- The recycled content (R1) shall be reported.
- Results with application-specific A-values, if relevant.

### 7.4 Additional environmental information

Additional environmental information shall include the carbon storage in the leather at the tannery gate, as described in ANNEX 6 – Downstream scenarios.

Biodiversity is already captured by the land use impact category. It is indeed proposed by the UN Environment as a good proxy for the impact on biodiversity.

Biodiversity is not considered as relevant for this PEFCR.

## 8. Verification

The verification of an EF study/report carried out in compliance with this PEFCR shall be done according to all the general requirements included in Section 8 of the PEFCR Guidance 6.3 and the requirements listed below.

The verifier(s) shall verify that the EF study is conducted in compliance with this PEFCR.

These requirements will remain valid until an EF verification scheme is adopted at European level or alternative verification approaches applicable to EF studies/report are included in existing or new policies.

The verifier(s) shall validate the accuracy and reliability of the quantitative information used in the calculation of the study. As this can be highly resource intensive, the following requirements shall be followed:

- The verifier shall check if the correct version of all impact assessment methods was used. For each of the most relevant impact categories, at least 50% of the characterisation factors (for each of the most relevant EF impact categories) shall be verified, while all normalisation and weighting factors of all ICs shall be verified. In particular, the verifier shall check that the characterisation factors

correspond to those included in the EF impact assessment method the study declares compliance with[32];

- All the newly created datasets shall be checked on their EF compliancy (for the meaning of EF compliant datasets refer to Annex H of the Guidance). All their underlying data (elementary flows, activity data and sub processes) shall be validated;
- The aggregated EF-compliant dataset of the product in scope (meaning, the EF study) is available on the EF node (http://eplca.jrc.ec.europa.eu/EF-node).
- For at least 70% of the most relevant processes in situation 2 option 2 of the DNM, 70% of the underlying data shall be validated. The 70% data shall including all energy and transport sub processes for those in situation 2 option 2;
- For at least 60% of the most relevant processes in situation 3 of the DNM, 60% of the underlying data shall be validated;
- For at least 50% of the other processes in situation 1, 2 and 3 of the DNM, 50% of the underlying data shall be validated.

In particular, it shall be verified for the selected processes if the DQR of the process satisfies the minimum DQR as specified in the DNM.

The selection of the processes to be verified for each situation shall be done ordering them from the most contributing to the less contributing one and selecting those contributing up to the identified percentage starting from the most contributing ones. In case of non-integer numbers, the rounding shall be made always considering the next upper integer.

These data checks shall include, but should not be limited to, the activity data used, the selection of secondary sub-processes, the selection of the direct elementary flows and the CFF parameters. For example, if there are 5 processes and each one of them includes 5 activity data, 5 secondary datasets and 10 CFF parameters, then the verifier(s) has to check at least 4 out of 5 processes (70%) and, for each process, (s)he shall check at least 4 activity data (70% of the total amount of activity data), 4 secondary datasets (70% of the total amount of secondary datasets), and 7 CFF parameters (70% of the total amount of CFF parameters), i.e. the 70% of each of data that could be possible subject of check.

The verification of the EF report shall be carried out by randomly checking enough information to provide reasonable assurance that the EF report fulfils all the conditions listed in section 8 of the PEFCR Guidance.

## 9. References


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# ANNEX 1 – List of EF normalisation and weighting factors

Global normalisation factors are applied within the EF. The normalisation factors as the global impact per person are used in the EF calculations.

889 **Table 28 List of EF normalisation and weighting factors**

| Impact category | Unit | Normalisation factor | Normalisation factor per person | Impact assessment robustness | Inventory coverage completeness | Inventory robustness | Comment |
|---|---|---|---|---|---|---|---|
| **Climate change** | kg $CO_{2\ eq}$ | 5.35E+13 | 7.76E+03 | I | II | I | |
| **Ozone depletion** | kg CFC-11 $_{eq}$ | 1.61E+08 | 2.34E-02 | I | III | II | |
| **Human toxicity, cancer** | CTUh | 2.66E+05 | 3.85E-05 | II/III | III | III | |
| **Human toxicity, non-cancer** | CTUh | 3.27E+06 | 4.75E-04 | II/III | III | III | |
| **Particulate matter** | disease incidence | 4.39E+06 | 6.37E-04 | I | I/II | I /II | NF calculation takes into account the emission height both in the emission inventory and in the impact assessment. |
| **Ionising radiation, human health** | kBq $U^{235}{}_{eq}$ | 2.91E+13 | 4.22E+03 | II | II | III | |
| **Photochemical ozone formation, human health** | kg NMVOC $_{eq}$ | 2.80E+11 | 4.06E+01 | II | III | I/II | |
| **Acidification** | mol H+ $_{eq}$ | 3.83E+11 | 5.55E+01 | II | II | I/II | |
| **Eutrophication, terrestrial** | mol N $_{eq}$ | 1.22E+12 | 1.77E+02 | II | II | I/II | |
| **Eutrophication, freshwater** | kg P $_{eq}$ | 1.76E+10 | 2.55E+00 | II | II | III | |
| **Eutrophication, marine** | kg N $_{eq}$ | 1.95E+11 | 2.83E+01 | II | II | II/III | |
| **Land use** | pt | 9.20E+15 | 1.33E+06 | III | II | I I | The NF is built by means of regionalised CFs. |

| Impact category | Unit | Normalisation factor | Normalisation factor per person | Impact assessment robustness | Inventory coverage completeness | Inventory robustness | Comment |
|---|---|---|---|---|---|---|---|
| **Ecotoxicity, freshwater** | CTUe | 8.15E+13 | 1.18E+04 | II/III | III | III | |
| **Water use** | $m^3$ world $_{eq}$ | 7.91E+13 | 1.15E+04 | III | I | II | The NF is built by means of regionalised CFs. |
| **Resource use, fossils** | MJ | 4.50E+14 | 6.53E+04 | III | I | II | |
| **Resource use, minerals and metals** | kg Sb $_{eq}$ | 3.99E+08 | 5.79E-02 | III | I | II | |

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## Weighting factors for Environmental Footprint

Table 29 Weighting factors for Environmental Footprint

| WITHOUT TOX CATEGORIES | Aggregated weighting set (50:50) | Robustness factors (scale 1-0.1) | Calculation | Final weighting factors |
|---|---|---|---|---|
| | A | B | C=A*B | C scaled to 100 |
| **Climate change** | 15.75 | 0.87 | 13.65 | **22.19** |
| **Ozone depletion** | 6.92 | 0.6 | 4.15 | **6.75** |
| **Particulate matter** | 6.77 | 0.87 | 5.87 | **9.54** |
| **Ionizing radiation, human health** | 7.07 | 0.47 | 3.3 | **5.37** |
| **Photochemical ozone formation, human health** | 5.88 | 0.53 | 3.14 | **5.1** |
| **Acidification** | 6.13 | 0.67 | 4.08 | **6.64** |
| **Eutrophication, terrestrial** | 3.61 | 0.67 | 2.4 | **3.91** |
| **Eutrophication, freshwater** | 3.88 | 0.47 | 1.81 | **2.95** |
| **Eutrophication, marine** | 3.59 | 0.53 | 1.92 | **3.12** |
| **Land use** | 11.1 | 0.47 | 5.18 | **8.42** |
| **Water use** | 11.89 | 0.47 | 5.55 | **9.03** |
| **Resource use, minerals and metals** | 8.28 | 0.6 | 4.97 | **8.08** |
| **Resource use, fossils** | 9.14 | 0.6 | 5.48 | **8.92** |

# ANNEX 2 - check-list for the PEF study

Each PEF study shall include this annex, completed with all the requested information.

Table 30 Check-list for the PEF study

| ITEM | Included in the study (Y/N) | Section | Page |
|---|---|---|---|
| **Summary** | | | |
| **General information about the product** | | | |
| **General information about the company** | | | |
| **Diagram with system boundary and indication of the situation according to DNM** | | | |
| **List and description of processes included in the system boundaries** | | | |
| **List of co-products, by-products and waste** | | | |
| **List of activity data used** | | | |
| **List of secondary datasets used** | | | |
| **Data gaps** | | | |
| **Assumptions** | | | |
| **Scope of the study** | | | |
| **(Sub)category to which the product belongs** | | | |
| **DQR calculation of each dataset used for the most relevant processes and the new ones created.** | | | |
| **DQR (of each criteria and total) of the study** | | | |

# ANNEX 3 - Critical review report of the PEFCR

**Table 31 Critical review report of the PEFCR**

| Comment # | Reviewer | Paragraph | Figure / Table | Type of comment (i.e. G, T, E) | Comment (justification for change) | Proposed change | TS response (first review) | Closure (first review) | TS final response | Final closure |
|---|---|---|---|---|---|---|---|---|---|---|
| **1** | Ugo Pretato | All | grey texts | E | The grey texts taken from the PEF Guidance 5.2 and put in brackets at the beginning of each chapter shall be removed | Delete all grey texts in the final PEFCR | Deleted. | Accepted | | |
| **2** | SSIP | 3.3 | | T, E | It is unclear whether it is meant only for uppers, or also other footwear components (e.g. liners) are included. | In case you want to refer only to the uppers, change to "footwear uppers". In case you want to refer to all the components for footwear, eliminate the word "upper". | Changed with: "Leather for footwear excluding soles". | Accepted, YOU HAVE TO CHANGE ALSO AT LINE 280 | Changed | |
| **3** | Ugo Pretato | 3.3 | PCR | G | The list of PCR taken into consideration to support the PEFCR elaboration is missing | Provide a list of PCR considered, e.g. in a table in this paragraph or in an Annex. | Provided in this paragraph. | Accepted | | |
| **4** | Ugo Pretato | 3.4 | Issue papers | G | The PEFCR conformance shall be also declared against the TAB issue papers which are significant for the leather sector. | List all finalized issue papers applicable to these PEFCR and make sure appropriate reference to them is made throughout the document. As a minimum the list should include the followings:<br>• Biodiversity 2.3<br>• Biogenic carbon 2.2<br>• Electricity modelling 12<br>• Indium contribution<br>• Baseline approaches for the cross-cutting issues of the cattle related PEF pilots. Check also provisions in the new PEF guidance v6" | Listed. | Accepted. Compliance with the new guidance 6.0 will be sufficient as the guidance incorporates all issue papers | | |
| **5** | Ugo Pretato | 4.1 | Table 2 | T | There is a bit of confusion in the functional unit description. Actually, leather is an intermediate product hence it would be more appropriate to refer to a declared unit and a reference flow of 1 $m^2$ | Clarify that the PEFCR refer to a declared unit of 1 $m^2$. The additional specifications put in table 2 may be kept as an example, but it shall be clearly stated that the actual functional unit of leather products can be fully defined only within a cradle-to-grave approach, i.e. when the use and EoL stages are identified. | We have eliminated line 252 and changed the functional unit to declared unit. We also added: "Leather is an intermediate product elaborated to customers specifications that define the intended application and therefore the function it fulfil. However, whether a leather is actually used for the | Accepted | | |

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| | | | | | | | intended function can only be fully established in a cradle to grave approach where the use and EoL stages are identified." | | | |
| **6** | SSIP | 4.1 | Table 2 | E | The Italian word "Caratteristiche" has been translated in different ways from standard to standard. Some standards are not updated. For some standards, only a part of the title has been reported. | Harmonize the title of the technical standards and check the date of publication | This point is already specified in footnote 2: "The most recent version of the enlisted as above standards should be employed during the implementation of these PEFCR." Phrase added to the footnote: "The related level of compliance does not imply market acceptance from customer requirements that in some cases could deviate from those standards" | Accepted | | |
| **7** | Ugo Pretato | 4.4 | Processes | G | It is unclear why the "supply of raw hides and skins" is a foreground process, while farming, slaughtering and preservation (which altogether make up the supply of raw hides and skin) are background processes. | Clarify the process classification. Add the concept that along leather production processes, also raw hides and skins may be supplied from different parts of the world, therefore this shall be reflected in the PEF scope and data collection | This phrase and Table 9 were removed following EF Team request. | Accepted | | |
| **8** | Ugo Pretato | 4.4 | Outputs | T | The output list shall mention the relevant co-products from tanneries, which are important for allocation rules. In addition, the carbon content of leather products should be included as relevant information of the core process | Add these items to the output list | Added:<br>• Splits when applicable (flesh and middle splits) i.e. when destined to leather<br>• "For carbon content please refer to annex V" | Accepted | | |
| **9** | Legambiente | 4.4 | | T | Stock farming, cattle–breeding above all, causes in several geographical areas radically different impacts on various | Not in accordance to the guidance. Rejected. Initial phrase of the paragraph modified as follows: "Even if the positions of the scientific | Not accepted, It's important to consider the different impacts related to the origin of | Now included in the new impact category "land use". | | |

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| | | | | | ecosystems." Integrare con il punto specifico: perdita di ecosistemi.<br>To complete with specific point: ecosystem consumption | community are not definitively settled yet, the life cycle of leather starts in this PEFCR ..." | raw materials in this document. It need to be further revised in the final version after the remodeling | | | |
| **10** | SSIP | 4.5 | Table 5 | G | It's perplexing that among the categories of significant impact for the product leather there are "Human toxicity, cancer effects" and "Human toxicity, non-cancer effects". If preliminary studies have highlighted this anomalous situation, it is believed that these results are due to the limitations mentioned in section 4.7 and evident in the data shown in Annex IX. As it is completely wrong to assume that we can model the impact, in terms of human toxicity, of a chemical substance by the combination of the impacts of substances that have reacted to produce it, the lack of specific data of the substances used in the tanning process produces an incorrect assessment of "Human toxicity" on the leather product. The presentation of a PEFCR on the leather that is based on these assumptions, or that leads to these results, especially when they relate to RP4, namely the vegetable tanned leathers, represents a risk not only for the tanning industry but also for the credibility of your work." | It is suggested to consider "not relevant" the impacts of "Human toxicity" for all RPs, due to the lack of specific data on actual chemicals used in the tanning industry. | Categories removed, but Table 5 is to be modified after remodelling." | Accepted | | |
| **11** | Legambiente | 4.5 | table 5 | T | Significant impact of tanning stage on water resources has to be considered also in relation to chemicals used in treatment processes that are found in the wastewater and which are likely to pollute and compromise the natural water resources (rivers and groundwater) | To consider the water depletion factor in all RPs. | Chemical's impacts on water resources are already taken care appropriately in this study according to the PEF methodology. | Not accepted (we didn't find explicit references about this) | There are specific environmental indicators included in the study that are focused on this topic: acidification, freshwater and marine eutrophication and water use (see Table 9, page 29). The PEFCR also requires to include | |

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| | | | | | | | | | in the study all water emissions (table 17, 18 and 19, page 57-58) and indicates the standard methods to use for data collection. The impact of chemical substances production on water resources is included in the default datasets indicated for modelling in Annex 7 (page 114). | |
| **12** | Legambiente | 4.5 | table 6 | T | Different ways of stock farming cause several impacts on biodiversity and, related to habitats where stock farms are placed, act on many different components of biodiversity. | To complete with specific point: biodiversity consumption | Biodiversity is not a specific ILCD impact category and it is addressed in paragraph "4.6. Additional environmental information". | Not accepted, It's important to consider the different impacts related to the origin of raw materials in this document. | Biodiversity impact is now included in the land use impact category. It is in fact proposed as a good proxy for biodiversity by the United Nations Environment Programme (UNEP). The following statement will be included: "Biodiversity is already captured by the land use impact category. It is indeed proposed by the United Nations Environment Programme (UNEP) as a good proxy for the impact on biodiversity" | |
| **13** | SSIP | 4.6 | | T, E | Specify that chromium tanning systems are based on trivalent chromium | | Word "trivalent" added before "chromium". | Accepted | | |
| **14** | Ugo Pretato | 4.6 | Carbon content | G | Additional environmental information shall include the carbon storage in the leather | Add carbon storage as mandatory additional environmental information | Added. | Accepted | | |

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| | | | | | product at the tannery gate, as declared in Annex XI and other sections of the PEFCR | and a reference to Annex V for the calculation of carbon content | | | | |
| **15** | Ugo Pretato | 4.6 | Biodiversity | G | The description of the interactions of the leather supply chain with biodiversity is to some extent unclear and incomplete. The following issues need to be addressed:<br>a) Possible hotspots for biodiversity (lines 411-412) might be also generated in tannery operations, in case plants would be located nearby protected areas or areas with a high biodiversity value;<br>b) The paragraph 413-424 contradicts what have been established within the cattle working group and implemented in these PEFCR, i.e. the share of animal breeding impacts allocated to leather applies also to biodiversity impacts;<br>c) The sentence on chrome tanning (lines 444-447) is misleading: we cannot say that chrome tanning ""had a positive impact on biodiversity"" just because of the displacement of vegetable tanning. Also potential impacts on biodiversity due to the supply chain of chrome tanning products shall be assessed before making this assertion." | Revise the section accordingly:<br>a) Include the option to assess biodiversity impacts at the tannery level, e.g. through a mapping of high biodiversity areas close by the site and the potential interactions with site activities and relevant emissions<br>b) Clarify the concept, provide references to other PEFCR (meat, feed, dairy) which may have addressed biodiversity issues and try to harmonize the rules as far as possible<br>c) Revise the sentence" | a) According to our assessment tannery operations have no specific impact on biodiversity other than those refer to different impact categories. Moreover it is not to our PEFCR to define what are areas with high biodiversity value<br>b) Lines 413 to 424 modified as follows: ""Livestock breeding may affect biodiversity as described in the corresponding PEFCR of feed, meat and dairy, and probably through land changes induced by production. These may have adverse effects on the biosphere when those changes contribute to loss of biodiversity. In Brazil, risks for biodiversity have been flagged in relation to deforestation of the Amazonian rainforest for | Partly accepted. Ok for points a) and c), point b) is still a bit ambiguous, since any impacts on biodiversity related to livestock breeding shall be borne by leather products like all other impacts according to the established allocation rules. This is independent from the influence exerted by leather industry on the upstream stages. Lines 375-394 need to be further revised in the final version after the remodelling | See reply to comment #12. | "Accepted, but change the paragraph at lines 1429-1437 as follows: Cattle hides from animals originating from these areas, under the current allocation rules, bring to the corresponding leather a share of the impact. However, the determining product of livestock breeding is meat and the demand for hides or skins has no or little influence on their offer. For this reason, leather industry cannot exert a direct control on potential impact sources for biodiversity. Indeed, the demand for meat is the main driver for livestock production." |

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| | | | | | | | creating grazing and breeding areas for cattle. Cattle hides from animals originating from these areas would attribute, under the current allocation rules, to the corresponding leather a share of the impact. However, having regard that the determining product of livestock breeding is meat and that demand for hides or skins has no influence on their offer to ascribe to leather responsibilities with regard to biodiversity on this count. Indeed, only demand for meat drives livestock production."<br>c) Modified as follows: "Furthermore, the introduction of trivalent chrome tanning in the XX century, which constitutes today typically 85-90% of all leather produced globally, | | | |

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| | | | | | | | displaced vegetable tanning from the main product categories, limiting it too few applications (e.g. sole leather). Consequently the impacts on biodiversity derived from vegetable tannins remained limited." | | | |
| **16** | Legambiente | 4.6 | | G | The use of chromium and other chemicals and their possible presence in waste water and air emissions should be considered as relevant for the assessment of impacts on biodiversity. | To include this stage in hotspots too. | These emission are not to be considered in biodiversity. | Not accepted (refer to reference documents that chromium has no impact on biodiversity) | See reply to comment #12. | |
| **17** | Legambiente | 4.6 | | G | Stock farming and butchers are territorially connected to each other so that tanneries' choices about raw materials areas of origin can significantly decrease a portion of impact on ecosystems and biodiversity. Furthermore, European market more and more cares about animal welfare and sharing choices to decrease or get rid of animal suffering is going to work. Tannery can achieve this goal by selecting raw materials suppliers that take account of management arrangements of stock farms and butchers who provide such raw materials. | To highlight the need not "to drag" into the tanning field impacts caused by stock farming and slaughter in relation to loss of biodiversity and animal welfare. To encourage choice of raw materials by geographical areas and by management arrangements of stock farms and butchers. | Tanning sector has no influence on livestock farming and slaughter and therefore no capacity to influence eventual impacts on biodiversity and animal welfare. Traceability of hides and skins is today possible up to the slaughterhouse only for the vast majority of raw materials. | Not accepted, It's important to consider the different impacts related to the origin of raw materials in this document. It need to be further revised in the final version after the remodelling | See reply to comment #12. | |
| **18** | Legambiente | 4.6 | | G | Also vegetable tanning could contribute to preservation of biodiversity, eliminating or reducing the use of chromium and other highly polluting chemicals that persist in the environment. Promote the vegetable tannin extraction from | To be considered it. | Vegetable tannins from fruits residues and renewable resources are considered from line 439 to 443. Chemical impacts are considered in the | Partially accepted (We think it is better to explain both these aspects in the two parts of the document) | See reply to comment #12. | |

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| | | | | | agricultural wastes or by-products, has no weight on biodiversity. Indeed it reduces the impacts of the same waste or by-products. So the statements on vegetable tanning or chrome depend on possible scenarios. | | impact category "Ecotoxicity" and they are specific for each type of chemical. | | | |
| **19** | Legambiente | 4.6 | | G | We don't agree with the claim concerning the chrome where it says "has had a positive impact on biodiversity", because the chromium used in the manufacturing process has been in years cause of contamination, through the wastewater, (especially in rivers or ground waters) with consequent damage to biodiversity, as well as to the healthiness of the water. | You need to motivate this statement | See response to comment # 15. | Partially accepted. You have to highlight also the chromium's impact | See reply to comment #12. | |
| **20** | Legambiente | 4.6 | | G | It could be useful a follow-up about current potential, in the light of different existing experiences, to evaluate if actually it's again a trend or a consolidated experience. | | Unfortunately we do not have information on the industrial production of such tannins and therefore it is still experimental. | Pending, to be explored with companies working on this | It was not possible to cooperate with companies producing these chemical substances. | |
| **21** | Ugo Pretato | 4.7 | Chemicals | E | The statement at the first bullet point sounds like "the tannery industry does not know which chemical products are used in tannery processes" | Clarify/reword | Substituted "limited" with "incomplete" and rephrased: "… and provenance, such safety data sheet do not provide a full disclosure" | Accepted | | |
| **22** | SSIP | 4.7 | | G | The indicated gaps lead to an incorrect assessment of the impacts related to the product Leather (see Comment n. 10). This should be clearly stated in this section, and may be the basis for a greater involvement of technicians and operators in the sector and a greater willingness to provide primary data, or at least information necessary to a better modelling, with particular reference to the chemicals. | Add a disclaimer about the incorrect assessment of the impacts to the product Leather, deriving from the lack of primary data and of LCI on chemicals used in tannery | Phrase added at the end of the paragraph: "For overcoming these limitations default values are provided in Annex IX. These default values have been developed with suppliers and selected for minimizing erratic or disparate values." | Accepted | | |
| **23** | Legambiente | 4.7 | | G | The mentioned limitations concern priority information about the PEF calculation. So these aspects must be resolved through closer involvement of operators and a greater | | See response to comment # 22. | Partially accepted, you have to highlight that there will be a greater commitment to | During the remodelling phase both the leather pilot and the European Commission | |

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| | | | | | willingness to provide the necessary data, as well as the integration of the various existing studies about it. | | | communication and data sharing | worked at the collection of primary data of high quality. We now have PEF Compliant datasets of high quality. See Annex 7 page 113. | |
| **24** | Legambiente | 4.7 | | G | The statement is not consistent with description contained in Annex IX and the current scientific knowledge on the behaviour of chemicals listed | To be explored. | See response to comment # 22. | Partially accepted, you to have highlight that there will be a greater commitment to communication and data sharing | See reply to comment #23. There are still some substances of minor relevance for the leather industry for which there still are no primary data, but good approximations with other substances data have been made. | |
| **25** | Legambiente | 5.1 | | T | In choosing the plants, have you considered those who apply best available technologies (BAT) and all the modern technologies to minimize the impact? Have you considered even the best experiences of vegetable tanned using natural dyes, products obtained from the recovery of agricultural waste, etc. | To be explored. | This is to follow once the PEFCR is approved and more PEF studies are available. | Accepted | | |
| **26** | Ugo Pretato | 5.2 | DQR | G | The PEFCR do not follow the Dataset Need Matrix of the PEF Guidance Annex E, but apply the default DQR of the PEF Guide. This approach is allowed, but chapter 5.2 shall specify the quality rating to be achieved for each of the five quality levels (e.g. what is the minimum score for being "very good, "good", etc.). Moreover, the PEFCR should already identify which processes need to achieve good or fair quality level, based on the hotspot analysis of the screening study | State that the default DQR of the PEF guide are applied and provide full information on DQR parameters and related processes. Check also provisions in the new PEF guidance v6 | "Stated. The full information on DQR parameters and related processes will be provided after remodelling given data PEF compliant datasets are not known yet" | Pending, to be addressed in the final version after the remodelling | Updated and made compliant with the latest directives included in Guidance v. 6.3. See tables 31, 32 and 34, page 79-90. | Accepted |
| **27** | Ugo Pretato | 5.2 | Criteria | T | The DQR criteria for TiR, TeR and GR are not suitable for | Revise the criteria to be more in line with the properties of primary data for | Revised according to Guidance v6.0 | Accepted | | |

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| | | | | | application to newly created datasets as the score should be given against the real situation, not against generic metadata | the foreground system. Check also provisions in the new PEF guidance v6 | | | | |
| **28** | Ugo Pretato | 5.3 | Transport datasets | T | All PEFCR shall refer to the official secondary datasets provided by the Commission when available. Datasets for transportation processes are already available and accessible via the PEF wiki website | Refer to the official datasets provided by the Commission for any transportation and electricity processes. Check all PEFCR sections where corrections are needed. Complementary datasets shall be used for processes not covered in the Commission official set. | To be done after PEF compliant datasets are made available. | Pending, to be addressed in the final version after the remodelling | Updated and made compliant with the latest directives included in Guidance v. 6.3. See annex 7 page 113. | Accepted. Datasets identified in tables 44-45. Perhaps EURO 3 standard is not fully representative of all countries involved |
| **29** | Ugo Pretato | "5.3 and Annex VIII" | Primary data collection | T | The requirements for primary data collection are overall incomplete. Several information are missing (see next column with proposed change). Annex VIII shall not be limited to elementary flows, but cover also all activity data and related secondary data needed to perform a comprehensive inventory. | "Revise these sections and expand the content with the following elements:<br>• Provide at least two separate templates for the processes identified in table 9 to be filled with primary data, i.e. raw hides transportation and tanning;<br>• List all activity data and elementary flows to be investigated in the inventory: note that the current elementary flow list is incomplete, e.g. regionalized water input are missing. Ideally all relevant elementary flows identified during the screening for these two processes should be characterized and pre-defined in the template.<br>• The activity data should be complemented by secondary datasets listed in Annex IX<br>• Co-products from tannery operations shall be also included in the template in order to do a correct allocation; put in the template relevant information from tables 18-19-20 in §5.9<br>• Flow names shall be in line with ILCD nomenclature<br>• Provide details on data collection procedures, e.g. period of coverage, methods of measurement, multi-site coverage etc. | Please indicate where in the guidance it is required to provide these detailed templates. | The old guidance 5.2 was requesting these information e.g. in B.5.3 and B.12 (Annex B-VIII). In the new guidance 6.0, minimum information to be provided are specified in 2.15.2. The reviewer moreover feels that a detailed template would be helpful to guide applicants and to ensure higher consistency and comparability in PEF information. To be further discussed in the final version after the remodelling | Updated and made compliant with the latest directives included in Guidance v. 6.3. See section 5.1, page 42. | Accepted |

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| | | | | | | • Ensure consistency with the DQR established for the foreground system (see comment 27)" | | | | |
| **30** | Ugo Pretato | 5.3 | Electricity modelling | T | The procedure for modelling primary data collection shall apply the electricity modelling rules identified in the related issue paper released in January 2016 v.12. | Add a reference to the issue paper for modelling electricity use horizontally across the system. Specify rules for on-site electricity generation. Check also provisions in the new PEF guidance v6 | Added. | Accepted. The electricity modelling rules are however incorporated in the guidance 6.0 (§2.8) | | |
| **31** | Legambiente | 5.3 | | G | It's important that it be taken into account the content and the recommendations arising from BAT's documents for different steps considered. | To include an explicit reference to BAT. | BATs apply for tanneries of specific size and significance (class A with daily output greater than 12 tons of product) therefore regard only a segment of tanning plants. On the other hand PEFCRs are meant to cover the whole spectrum of tanning activities and plants of all sizes. Finally BATs have not been assessed with an LCA methodology. | Accepted | | |
| **32** | Legambiente | 5.3 | | G | It's important that it be taken into account the content and the recommendations arising from BAT's documents for different steps considered | To include an explicit reference to BAT. | See response to comment # 31. | Accepted | | |
| **33** | Legambiente | 5.3 | | G | Why have you taken only these two cases into account? | | During the screening study we decided to test only those recycling processes that are most widely applied at a global scale. | Pending. it's necessary to integrate the final document with other examples related to various case studies | It was not possible to further test the formula, also because it was modified during the remodelling phase. | |
| **34** | Legambiente | 5.3 | | G | Over the type and quantity of emissions it is important to evaluate the territorial and environmental context in which they occur, the population involved, uses of water bodies affected by wastewater, etc. | To include these parameters in the necessary information. | The permit of the installation of the related industrial activity takes into account and reports all of the requested evaluation criteria. It is not required to report them here. | Not accepted. In the impact assessment it is important to consider the environmental context in which the activity takes place | Out of the scope of the PEF initiative. | |

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| **35** | SSIP | 5.3 | Table 10 | T | "The dataset used to describe the Basic Chromium Sulphate (BCS) seems incorrect. The chromium oxide CrO3, is the oxide of hexavalent chromium that is not involved in the production of the chrome tanning salt. In fact it's known that all the chromium salts are prepared from chromite, mineral of formula FeOCr2O3, found in relatively abundant form in the earth's crust. After an oxidation reaction, carried out in closed reactors that provide the formation of dichromate as an intermediate, the chromium basic sulfate is obtained by reduction with sulfur dioxide or sulfite. Since the oxidation and reduction reactions cancel each other, also in terms of residues, the overall reaction, starting from the Chromite can be written as follows: Cr2O3 (from Chromite) + 2H2SO4 = 2Cr(OH)SO4 + H2O. According to this reaction, for the production of 1g of Basic Chromium Sulphate 0,46g of Cr2O3 from Chromite and 0,59g of Sulphuric Acid are needed. However they are still to quantify the use of sodium carbonate, soda, air and reducing agent, as well as the amount of heat needed to melt the chromite. As Chromite (as ""ore concentrate"") is present in the Ecoinvent dataset of LCI for chemicals, a better evaluation of BCS could be carried out. Alternatively you might consider the BSC production reaction carried out by reduction of sodium dichromate in acid medium with glucose, sulfur dioxide or sulfite. For these processes, you can found useful information in the literature to allow better modeling for BSC." | Change the modelling of the BCS, starting from Chromite or from Sodium Dichromate | Proxy for BCS replaced with primary data from the producer. | "Pending, to be addressed in the final version after the remodelling. At the moment it doesn't seem that you have replaced the proxy for BCS with primary data for the producer. Maybe, in short time, you are able to include such data?" | During the remodelling phase both the leather pilot and the European Commission worked at the collection of primary data of high quality. We now have EF Compliant datasets of high quality also for BCS. | Accepted |

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| **36** | Ugo Pretato | 5.4 and Annex IX | Background secondary data | T | The requirements for secondary background data application are overall incomplete. Several information are missing (see next column with proposed change) | "Revise these sections and expand the content with the following elements:<br>• The list in Annex IX shall include all datasets officially provided by the Commission once available<br>• At the moment, official datasets for transportation and electricity are already available, hence these shall be referenced in Annex IX<br>• All datasets shall be accompanied by a DQR assessment, including the values of each of the individual parameters of the DQR formula; this is essential for the PEFCR applicants in order to determine the total DQR of their product systems<br>• If a process is not covered by the official Commission datasets, alternative datasets shall be provided meeting the PEF requirements and accompanied by DQR information. The representative product modelling datasets of other ongoing PEF pilots (e.g. meat, feed) could be also used to complement the background datasets list. Check also provisions in the new PEF guidance v6" | See response to comment # 28. | Pending, to be addressed in the final version after the remodelling | Updated and made compliant with the latest directives included in Guidance v. 6.3 See annex 7 page 113 and tables 31, 32 and 34, page 79-90. | Accepted |
| **37** | Ugo Pretato | 5.5 | chemicals and animal farming | T | "Unless primary data on chemicals production and animal farming are made available" means that the PEFCR should also provide templates and related information for collecting primary data for this processes. This would be fine but may demand high efforts | Clarify the use of primary data for chemicals production and animal farming | To be done after remodelling in order to evaluate the use of primary data based on the effective relevance of each process. | Pending, to be addressed in the final version after the remodelling | Updated and made compliant with the latest directives included in Guidance v. 6.3. See section 5.1, page 42. | Accepted |
| **38** | Legambiente | 5.8 | | T | EoL formula not consistently applied throughout the supply chain (it is often applied merely to the final product and not to manufacturing waste). | Update on the ongoing work (ppt presentation).<br>Consider this statement set out in the document by Dr. Michele Galatola "Update on the ongoing work" (ppt presentation). Check also provisions in | Paragraph 5.8 refers to the final product (e.g. shoes, garments, etc.) end of life, not to the end of life formula. | Accepted | | |

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| | | | | | | the new PEF guidance v6 (The CFF formula is now required) | | | | |
| **39** | Ugo Pretato | 6 | Tables 21-22-23-24 | T | The benchmark values will have to be updated after the remodelling exercise in 2017. An introduction to the benchmark description is also missing, before presenting the tables. | Add a comment/introduction on the final benchmark results. Add to the tables separate values for climate change due to dLUC, as foreseen in §4.5Check also provisions in the new PEF guidance v6 | According to the latest recommendation issued by Dr. Galatola, the benchmark will not be applicable to intermediate products. | The benchmark will not be allowed, but the final PEFCR will have to report the characterized results for each representative product, updated after the remodelling (see guidance 6.0, §2.16.1). To be checked in the final version | Updated and made compliant with the latest directives included in Guidance v. 6.3. Benchmark excluded since the guidance states: "No benchmarking is allowed for intermediate products. The reporting of the characterised results calculated for each intermediate RP is optional in the PEFCR, but mandatory in the PEF study and PEF report." | Noted and accepted |
| **40** | Legambiente | 6 | | G | To refer comments to this section to final data update | | See response to comment # 39. | See closure to #39 | | |
| **41** | Legambiente | 6 | | G | To comments to this section should refer when the final data updates will be available | | See response to comment # 39. | See closure to #39 | | |
| **42** | Ugo Pretato | 7 | Interpretation | G | The whole section on interpretation has some unclear aspects and needs improvement:<br>• The applicability of these PEFCR for external comparisons/comparative assertions is not fully clear and somehow contradictory; for example it is discouraged in the benchmark section (lines 829-832) while it seems to be allowed here in section 7 (lines 898-899) and also in section 1;<br>• The statement in lines 901-902 about the supposed recycling nature of hides and skins in the context of meat industry is not in line with the agreed allocation | Expand the section and provide clarification. In particular, state clearly whether and under what circumstances these PEFCR support or forbid comparisons and comparative assertions between leather products. The reviewer does not support comparisons between intermediate products, therefore recommends keeping the content as in section 6 at lines 829-832 | The benchmark will be removed therefore the noted contradiction does no longer emerge<br>• Ok, sentence removed from "as the processing" to "only the chemical data"<br>• We don't understand why the reviewer does not support comparison. | Pending, to be addressed in the final version after the remodelling. Note: the reviewer does not support comparisons and comparative assertions when the systems are not equivalent. This would be the case of intermediate products, unless the use and EoL stages are fully characterized. | Updated and made compliant with the latest directives included in Guidance v. 6.3. Interpretation section excluded. | Noted, however section 3.6 does not specify whether and how comparisons are allowed. Comparisons should be allowed only when the downstream life cycle stages are included in the system boundaries. Please add this information |

| Comment # | Reviewer | Paragraph | Figure / Table | Type of comment (i.e. G, T, E) | Comment (justification for change) | Proposed change | TS response (first review) | Closure (first review) | TS final response | Final closure |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | rules at the slaughterhouse (see also comment 8 point b)<br>• the last paragraph in lines 921-925 about the decreasing order or reliability is unclear" | | | | | |
| **43** | Ugo Pretato | 8 | Communication | G | This section is still incomplete. Results from the communication tests are missing. Furthermore, it is unclear why "focusing on products environmental footprint improvement should be misleading (lines 956-957)" | Complete this section. Assess whether the establishment of performance classes is meaningful and update accordingly section 6 (lines 833-834). The reviewer is quite sceptical about the opportunity to fix performance classes, hence a robust justification would be needed in case the TS wishes to do so. In addition, review the position on performance tracking. In the reviewer's opinion, this should be always a default application in any PEFCR | This section will be removed from the PEFCR and provided as a separate document as defined in Guidance v6.0. | Accepted | | |
| **44** | Ugo Pretato | 9 | Verification | G | The whole section on verification is still to be developed. | Add verification requirements based on the indications of PEF guide and differentiating according to the intended application. Check also provisions in the new PEF guidance v6 | This section will be removed from the PEFCR as defined in Guidance v6.0. | Accepted | | |
| **45** | Ugo Pretato | 11 | Screening | E | Supporting information shall include the final screening report with consolidated results and hotspot analysis after the remodelling exercise | List the screening report as key supporting information to the PEFCR. Make sure the final screening report will be available with the PEFCR after the representative products remodelling | Will be included after the remodelling exercise. | Pending, to be addressed in the final version after the remodelling | "Updated and made compliant with the latest directives included in Guidance v. 6.3. Mandatory sentence included: ""The screening study is available upon request to the TS coordinator that has the responsibility of distributing it with an adequate disclaimer about its limitations."""" | Accepted |
| **46** | Ugo Pretato | Annex III | Benchmark | G | The description of the steps undertaken to define the benchmark is too vague | Expand the annex. Keep the same structure in bullet points and fill with information from the screening report | Not relevant after the removal of the benchmark. | Pending, to be addressed in the final version after the remodelling | Updated and made compliant with the latest directives included in Guidance v. 6.3. Benchmark excluded since "No benchmarking | Accepted |

| Comment # | Reviewer | Paragraph | Figure / Table | Type of comment (i.e. G, T, E) | Comment (justification for change) | Proposed change | TS response (first review) | Closure (first review) | TS final response | Final closure |
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| | | | | | | | | | is allowed for intermediate products. The reporting of the characterised results calculated for each intermediate RP is optional in the PEFCR, but mandatory in the PEF study and PEF report." | |
| **47** | Ugo Pretato | Annex IV | Upstream scenarios | G | As above, the description looks too vague and not really useful for the PEFCR applicant | Expand the annex. Refer to the screening report for the description of processes included in the upstream stages of the four representative products. In alternative, copy and paste relevant information from the screening report, e.g. from chapter 4 (life cycle inventory analysis) | Inserted graphs from chapter 4 of the screening report. | Accepted | | |
| **48** | Legambiente | Annex VIII | | T | Tanning industry is often associated with presence in wastewater of perfluoroalkylated substances | Complete the list with perfluoroalkylated substances | There is no official standard method to measure PFAS in tannery wastewaters. These substances are restricted in EU legislation. | Not accepted, It's important to consider PFAS in this document. | The PFAS problem is not connected to the leather sector. It affected Arzignano tanning district because of a company producing pans which released PFAS in the water which was then entering in tanneries. See POP regulation 850/2004, Reg 1907/2006 SVHC, Reg 1907/2006-REACH Annex XVII Entry 68, DM 06/07/2016, Regione Veneto: provvedimento 37/2016 e 5/2016, Regione Veneto: D Reg 101 2017 and EN ISO 23702-1 Leather - Organic fluorine -- Part 1: Determination of the non-volatile compound | |

| Comment # | Reviewer | Paragraph | Figure / Table | Type of comment (i.e. G, T, E) | Comment (justification for change) | Proposed change | TS response (first review) | Closure (first review) | TS final response | Final closure |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | content by extraction method using liquid chromatography. | |
| **49** | SSIP | Annex IX | | G, T | This Annex presents some correlations between "Representing Substances" and "Process from Database," which leave some doubt (for example that relating to the BCS already discussed before, or those related to dyes and pigments,). However taking into account the lack of LCI data and the poor quality of available data, a better result could be achieved through the contribution of technical experts of chemical tanning products, professional associations and research institutes. As it is expected a long process, you should schedule immediate actions to improve This Annex, even in relation to the importance of these data on the validity of the PEF. | | Annex improved with primary data from major producers. | Pending, to be addressed in the final version after the remodelling. A big effort has to be carried out to improve the quality of data addressed by Annex IX. | During the remodelling phase both the leather pilot and the European Commission worked at the collection of primary data of high quality. We now have PEF Compliant datasets of high quality. See Annex 7 page 113. | Accepted |
| **50** | Ugo Pretato | Annex X | Test of the EoL formula on by-products | G | Annex X shall include any further EoL formula applied in addition to the baseline formula. The exercise on the EoL formula applied to by-products, although formally correct and well documented, can be perceived as misleading regarding the allocation approach implemented in these PEFCR. It is moreover in contrast with the provision of the cattle working group report which is horizontally adopted across PEF pilots affected by cattle issues | Remove the exercise from Annex X. The content may be kept in a separate document and brought to the discussion within the PEF SC, TAB or other working groups | Ok, removed. We have inserted a note at the beginning of paragraph 5.9. | Accepted | | |
| **51** | Carlo Brondi | Acronyms | | E | Some mistake in CH definition | Add proper definition | | | Removed. This acronym was not necessary | |
| **52** | Carlo Brondi | All | | E | The grey text from PEF Guidance is still present | Delete grey text | | | Removed. | |
| **53** | Carlo Brondi | Definitions | | G | Despite the fact PEF is oriented to leather specialists, is better to avoid ambiguity by using only EN15897:2014 extract. | Please indicate leather origin as source from animal species | | | Definitions of "hide" and "skin" added to the list. | |

| Comment # | Reviewer | Paragraph | Figure / Table | Type of comment (i.e. G, T, E) | Comment (justification for change) | Proposed change | TS response (first review) | Closure (first review) | TS final response | Final closure |
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| **54** | Carlo Brondi | 2.2 | | E | The reference to web pages could be included in reference paragraph or as footnote | Please put the mention to web page as footnote or reference. | | | Done. | |
| **55** | Carlo Brondi | 2.3 | | E | Please revise the review panel description | Please add within the table: "Carlo Brondi, CNR - National Research Council, Researcher/Life Cycle Assessment (LCA) expert" | | | Done. | |
| **56** | Carlo Brondi | 2.4 | | G | The PEF guide is intended to provide also a support for the foreground sector such as footwear and fashion sector. It could be important to emphasize such focus. | Please add "Furthermore PEF studies provide the basis to systematize environmental knowledge in the foreground sectors (e.g. fashion sector). PEF review has been intended to provide transparency and clearness to PEF studies in order to be modularly implemented within other sectoral PEF." | | | Approved. Phrase added. | |
| **57** | Carlo Brondi | 3.2 | | T | PEF guidance states in product and scope classification that in preferable to perform different screening studies in case PEF application is different. | In case the screening study is performed for a limited set of leather type is important to emphasize within paragraph 3.2 that reference products have a very similar function or application. Otherwise explicit mentions have to be reported (e.g. sole leather vs fashion leather) | | | In the screening study performed, all 4 Representative Products were separately evaluated. It was performed based on primary data collected at more than 30 tanneries producing products covering all RPs possible combinations. | |
| **58** | Carlo Brondi | 3.2 | | T | PEF guidance states that other similar product categories that are not included in the PEF scope should be explicitly mentioned | Please consider to include descriptions of other similar products that are not covered by the present PEF (i.e. categories including polymeric fabric similar to leather) | | | Added the following phrase: "Are excluded from the present PEFCR all leathers produced from hides or skins of animals other than those slaughtered for human consumption, as well as any synthetic substitute material to leather." | |
| **59** | Carlo Brondi | 3 | | T | PEF should justify why bovines that are raised for milk and meat production represent the 99% of the global production. | Please introduce a brief reference as footnote explaining such assumption. | | | The phrase refers not only to bovine, but also to ovine and caprine leathers. It is | |

| Comment # | Reviewer | Paragraph | Figure / Table | Type of comment (i.e. G, T, E) | Comment (justification for change) | Proposed change | TS response (first review) | Closure (first review) | TS final response | Final closure |
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| | | | | | | | | | meant to state that leathers from those animal origins cover 99% of the leather market. It is not an assumption. Source added: "(source ICT)" | |
| **60** | Carlo Brondi | 3 | | T | Furthermore no explanation for modelling intermediate situations (meat production without milk production etc.) hasn't been provided | If possible provide brief indication for modelling intermediate situations. | | | This comment seems to refer to the allocation method for upstream phase which was defined by the Cattle Model Working Group and which cannot be modified. | |
| **61** | Carlo Brondi | 3.3 | table 6 | T | In general terms foreground sector can use data on leather both in terms of square meter and mass. PEFCR is unclear about the way to assess weight. In particular PEFCR seems to compel weight calculation by a compulsory use of square/mass conversion factor. It could be instead relevant to include an explicit invitation to declare leather weight by specifying that producers can preferably use conversion factors or other methods that are based on primary data. In all such cases, such methods need to be strictly justified to the PEF reviewer. | "Please include the phrase ""1 square metre of finished leather as routinely measured at tannery including its weight"" Please provide a better description on how declare leather weight and how calculate leather weight (e.g. in case producer can provide direct weighting of the finished leather)" | Already specified before Table 7 (reference flows per representative product) there is a phrase specifying that conversion factors shall be used only in case there are no primary data: "Unless specific conversion factors from weight of raw hides and skins to surface of finished leather are available, the ones reported in Table 7 shall be used. The conversion factors provided are average for each kind of animals and do not differentiate for different provenience or different species." | | | |
| **62** | Carlo Brondi | 3.3 | | E | mistake | Please correct "whether" | | | Corrected | |
| **63** | Carlo Brondi | 3.4 | | T | Provision of quantitative data for general process can create ambiguity. Preservation can vary from company to company and include specific operational conditions. As reported, | Please delete quantitative data on hide/skin preservation in the table. | | | Deleted. | |

| Comment # | Reviewer | Paragraph | Figure / Table | Type of comment (i.e. G, T, E) | Comment (justification for change) | Proposed change | TS response (first review) | Closure (first review) | TS final response | Final closure |
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| | | | | | preservation activity is normally performed by slaughterhouse or by specific companies. Nevertheless, its execution is specifically devoted for raw hide tanning process. For such reason, prospectively, such operation should be included in the core process. | | | | | |
| **64** | Carlo Brondi | 3.5 | | E | The reference to web pages and Annex could be included in reference paragraph or as footnote | Please put the mention to web page and annex as footnote or reference. | | | Done. | |
| **65** | Carlo Brondi | 3.6 | | G | Commercial database can present also lack in dismissal process for specific sectoral waste flows | Please include a sentence mentioning the lack in commercial database of data for dismissal of specific chemical waste flow | | | Done. | |
| **66** | Carlo Brondi | 5.3 | Table 20 | G | The use of default value should be conservative, political or scientifically sounded | Please provide a brief description for criteria according to quantitative default distances for transportation have been determined. | | | Table included in Annex 7. | |
| **67** | Carlo Brondi | 5.3 | | G | "Raw hides and skin preservation could be not included in general datasets. Two scenarios cold be considered<br>A. In case preservation is included as part of slaughtering phase by a general allocation, such could be incorrect. In fact, preservation activities should be allocated for the 100% to leather life cycle.<br>B. In case preservation activities are not included in the slaughtering phase and dataset is referred to fresh hides without preservation a further modelling shall be performed. Such modelling should be based on assumptions." | Please clarify if preservation phase has been included in general dataset and how has been allocated. In case B provide general assumptions for raw hides and skin preservation phase in paragraph 5.3. | | | Preservation phase impact was quantified in the screening study with primary data. It resulted to be not relevant and was then excluded from requirements of the PEFCR. For this reason, no datasets were made available by the Commission. | |
| **68** | Carlo Brondi | 5.8 | table 24 | E | The use of default value should be conservative, political or scientifically sounded | Please provide a brief reference or description for the calculation method for default allocation values for animal farming co-products according to process type. | | | This is already described in the Guidance. We were explicitly asked not to | |

| Comment # | Reviewer | Paragraph | Figure / Table | Type of comment (i.e. G, T, E) | Comment (justification for change) | Proposed change | TS response (first review) | Closure (first review) | TS final response | Final closure |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | further analyse topics that are already regulated by the Guidance, but to just include a reference to the Guidance itself. | |
| **69** | Carlo Brondi | 5.8 | table 25 | E | Mistake | Please correct mistake in the antepenult line. | | | Corrected. | |
| **70** | Carlo Brondi | 6.1 | | E | Use the word shall instead than is | Please use the phrase "The following formula shall be used to model the recycled content" | | | This was a mandatory section written by the European Commission. We will inform the Commission about the mistake and ask for a change. | |
| **71** | Carlo Brondi | 7.3 | | G | The problem of assessing biodiversity loss is an issue for leather sector and can be a raising issue to public opinion to clearly address local problems together with global chain issues. A partial solution could be the use of the USE-Tox model to address biodiversity loss. Such indicator is accepted at global level, furthermore it involves a reliable scientific basis and can be used to further address knowledge in leather chain | Please consider to prospectively elaborate USE-tox indicator in order to define a target impact category on biodiversity loss | | | USEtox model was already excluded from the PEF initiative because of some methodological mistakes. For this reason, it cannot be used to quantify biodiversity. | |
| **72** | Carlo Brondi | 9 | | G | The list of references appears to be quite limited compared to the number of works that have been mentioned | Please verify the completeness of references, by including eventual footnote literature. i.e. study from Bakalis et al (page 149) seems to miss | | | References added. | |
| **73** | Carlo Brondi | ANNEX 4 | | E | PEFCR should provide support to sectoral specialists and LCA specialist. Prescription in its use should be a common asset for all PEFCRs and not for a single PEFCR. Strict prescriptions can limit the use of the PEF. | Please substitute the phrase "the results for leather should never be used be used as an argument for preferring another material" "this PEFCR guide is intended to provide support in proper identification of environmental issues and bottlenecks for leather chain and not for a direct comparison with other substituting materials " | | | Modified with the following phrase "This PEFCR shall not be used for a direct comparison with other substituting materials." | |
| **74** | Carlo Brondi | ANNEX 6 | "TABLE 39 TABLE 41" | G | PEFCR could address close collaboration between different players within leather chain and further standard development in this sector. However standardization by animal type or | "Prospectively table 39 and table 41 for the calculation of carbon storage should be refined by introducing: | We do not have information and data of such detail. | | | |

| Comment # | Reviewer | Paragraph | Figure / Table | Type of comment (i.e. G, T, E) | Comment (justification for change) | Proposed change | TS response (first review) | Closure (first review) | TS final response | Final closure |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | representative compound substance could discriminate green policies of specific producers on the same area | • Differences between animal type within each mammal category (e.g. bovine type)<br>• Differences according to sectoral standards and agreements for the identification of the carbon content according to a more reliable chemical composition" | | | | |
| **75** | Carlo Brondi | ANNEX 7 | | E | mistake | Correct "Ecoinvent" | | | Corrected. | |
| **76** | Carlo Brondi | ANNEX 7 | TABLE 42 | E | Use the same nomenclature for chemicals | "Please substitute ""NA3HEDTA"" with ""<br>Droxyethylethylenediaminetriaacetate (Na3HEDTA)""remove CAS code or add CAS code for all chemicals" | NA3HEDTA substituted. CAS number removed. | | | |
| **77** | Carlo Brondi | ANNEX 8 | | E | mistake | please clarify origin | | | Corrected. | |
| **78** | Carlo Brondi | ANNEX 8 | TABLE 51 | E | mistake | please correct "effluent" in the bottom line | | | Corrected. | |
| **79** | Carlo Brondi | ANNEX 8 | | G | It's unclear why to add a reference to an alternative mass allocation method 50/50 while the proposed PEFCR method constitutes an overcoming of such allocation method. Such mention can introduce confusion by suggesting alternative methods within the same certification scheme | The title can be changed in "Differences between PEFCR and EPD allocation methods for grain and flesh bovine/calf pelts and leather assessments." | | | Title changed: "Differences between PEFCR and EPD allocation methods for bovine grain and split leather". Also added the definitions of "grain" and "split" in definitions section. | |
| **80** | Carlo Brondi | ANNEX 8 | | G | Allocation uncertainty for raw material (average distribution of co-products, by-products and waste) can seriously alter the results | Prospectively it could be useful to assess uncertainty value from allocation due to raw material separation in order to compare such uncertainty with other uncertainty sources | | | We do not have information and data of such detail. | |

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# ANNEX 4 - Reasoning for development of PEFCR

This PEFCR document aims at setting the rules for evaluating the EF for the following type of leather used in the EU:

- Leather for automotive interiors and furniture upholstery;
- Leather for leather goods and footwear excluding soles;
- Leather for garment and gloves;
- Sole leather.

Assuring that the methodology used to assess the environmental impact is compliant with the PEF Guide and the PEFCR guidance and therefore the results are comparable across products with the same functionality and using this specific PEFCR. Notably, results cannot meaningfully be used for comparison to those for synthetic substitutes to leather or other products used for the same application. This PEFCR shall not be used for a direct comparison with other substituting materials.

An extensive methodological comparison has been carried out against the existing Product Category Rules (PCR) for leather, which have been taken into consideration as a basis to set the rules of this PEFCR:

- PCR 2011:13 Finished bovine leather (Version 2.0 Draft for open consultation) (Aequilibria for Giada Agency, 2014);
- PCR 2011:13 Finished bovine leather (Version 1.0) (Aequilibria for Giada Agency, 2011) (expired 2014-09-28; being updated);
- Leather - Environmental footprint - Product Category Rules (PCR) - Part 1- Carbon footprints (CEN/TC 289-WG4-Leather-Technical specifications on the use of leather and terminology).

# ANNEX 5 – Representative Products

Leathers vary significantly in terms of animal origin, process type, particularly the tanning method used (Cr-tanning, Free-of-Chrome tanning, Vegetable tanning), destination (shoe upper, furniture upholstery, automotive interiors, leather goods, garment, lining, desk covers, parchments, orthopaedic and medical uses, book binding etc.), organoleptics (softness, handle, colour, grain pattern etc.). The end user usually sets specifications.

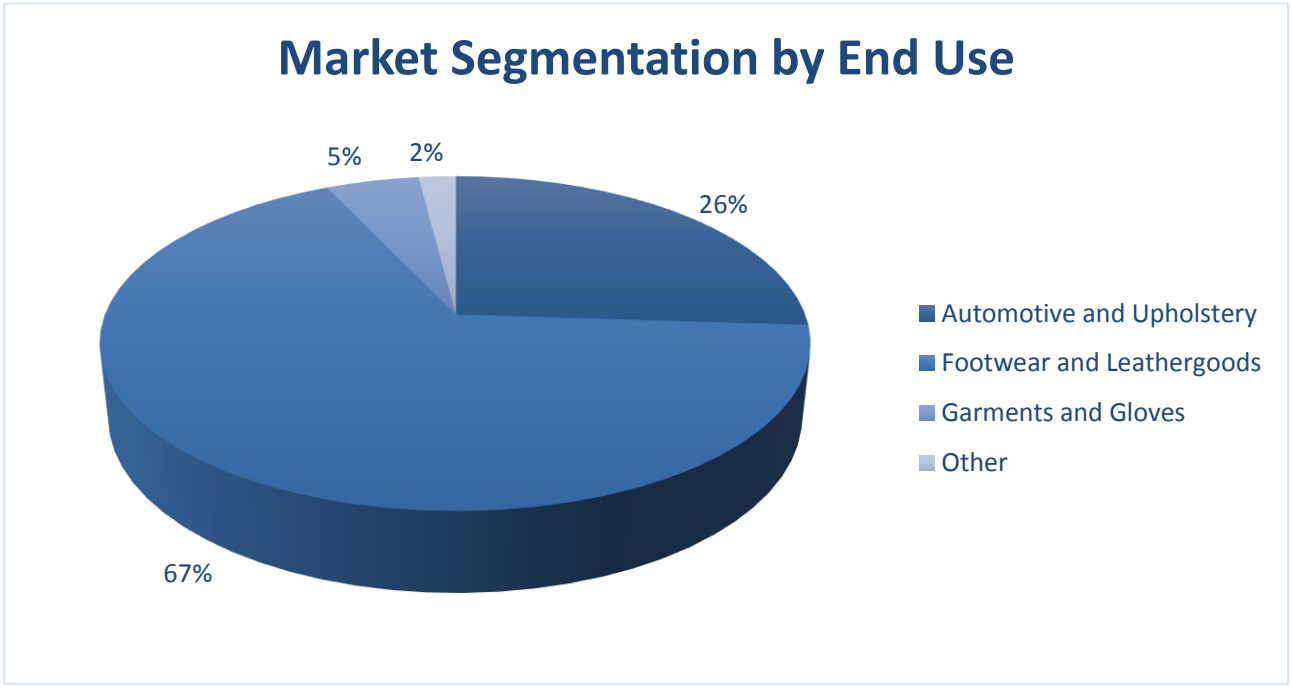
Statistical weighing factors necessary for the definition of the four virtual RPs were calculated using market data.

Annual data available for the Italian Tanning Industry (*Source: UNIC Servizi, 2013*) were used as Italy accounts for 66% of the total European finished leather production output value and 17% of the global output value, respectively, and, therefore, constitute a valid proxy for the European market.

## Use and Application Mix

The average Italian market share (percentage) of finished leathers per end use and destination is illustrated in Figure 4 (excluding leathers for sole which are measured in kg); the relevant application specific quota constituted the starting point for the calculation of estimates with the inclusion of sole leather.

**Figure 4 Italian finished leather market segmentation (estimated output volume) by destination (end use)**




## Technological Mix

The most notable technological differentiation of finished leathers is the Tanning Technology employed. In broad terms, the tanning systems utilised can be itemised depending on the chemical nature of the tanning substances used in two main types:

1. Mineral Tannage, obtained through the use of mineral tanning agents, like Cr(III)-, Al-, Ti- or/and Zr-salts, as well as their appropriate mixes;

2. Organic tannage further defined into natural and synthetic organic tannages, using vegetable tannins, synthetic tanning agents (syntans) or natural and synthetic oils for this purpose. Vegetable Tannage, in particular, is the tanning method used for the production of all finished sole leather, as well as a significant share of luxury leather goods finished leathers. Again, there are two (2) variants of vegetable tanning, the slow pit tannage (traditional) and the rapid drum tannage. Moreover, there is a product diversity, namely flexible vegetable tanned leathers and sole leathers, light vegetable tanned leathers for leather goods and book binding leathers, reflecting compositional variation of the finished product obtained through different manufacturing operations and chemistry applied. The critical parameter for these leathers is the degree of tannage.

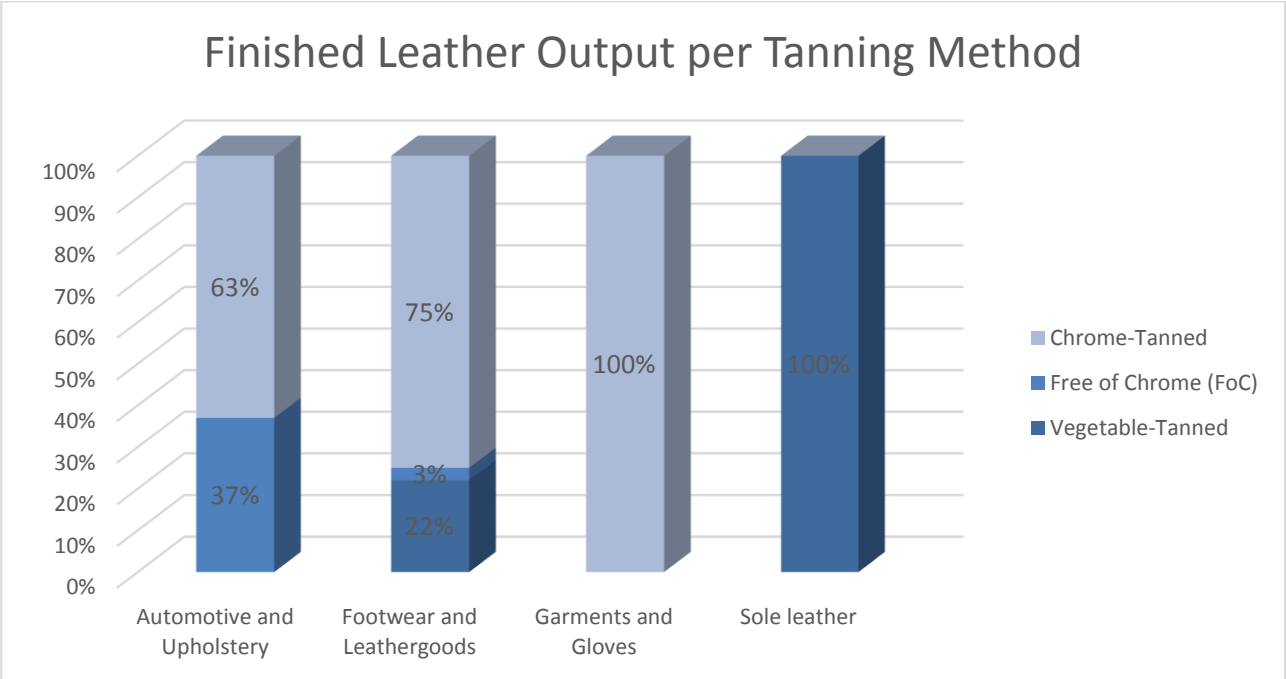
More recently, finished leathers processed without the use of Cr-tanning or retanning agents constitute a product class known as FoC leathers.

Initial global market estimates for the relative output volume of Cr(III)-tanned finished leather range from 70% to 80% of the global finished leather production volume, with some gains during the last decade for the FoC or vegetable tanned leathers, particularly for automotive and furniture end use.

At this early stage, and for the purposes of the virtual product definition, it is proposed to use the average relative quota (%) of production volume output per finished leather destination further partitioned by tanning technology applied, namely Cr(III)-tanning, Vegetable tanning and FoC tanning, respectively.

A graphic illustration of a typical semi-quantitative partition of global finished leather market for the most-prominent types of tannages is given in Figure 5.

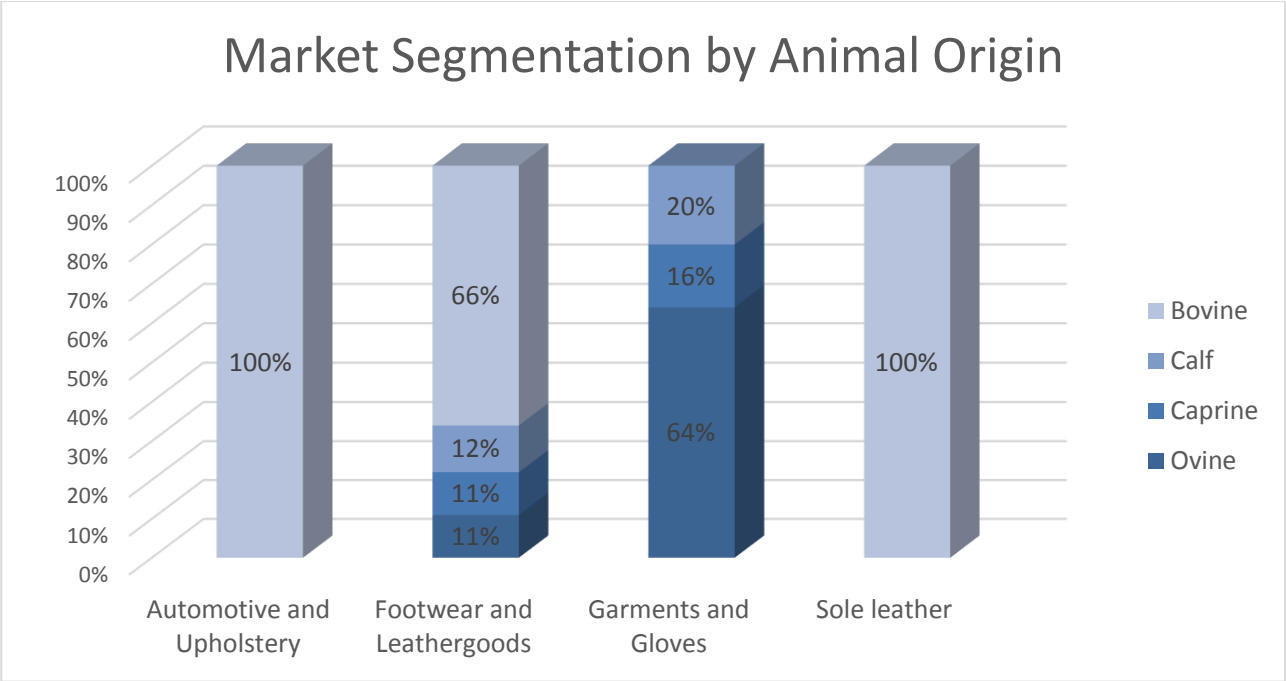
**Figure 5 Finished Leather volume output partition on the basis of tanning method applied**




## Animal Mix - Origin of Input Processing Items and Finished Leather

The total input processing materials (bovine, ovine and caprine rawstock) considered for the definition of the RP composition (Animal mix) is shown in Figure 6.

968 Figure 6 Finished leather market segmentation (input volume) by animal origin of hides and skins

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970 ## RPs Specification

971 To define a representative virtual product the applications of finished leathers, tanning technology and
972 animal mix have been considered, as proposed above, with respect to their relevance for defining the PEFCR
973 rules.

974 The required characteristics of the RP can be summarised as shown in Table 5.

975 To make the selected RPs representative of the actual leather consumed in Europe, EU leather consumption
976 mix has been calculated based on Eurostat for trade and the data for production from EU national
977 associations of tanners (notably UNIC Economic Department) as:

978 • Total EU tanners' sales of finished leather in the EU market 2014: 5,909 million €ur (as difference
979 between EU tanners' total turnover (8,267 million €ur) and EU tanners' export to extra-EU (2,358
980 million €ur]);
981 • Total Extra-EU import of finished leather in 2014: 1,244 million €ur;
982 • Total apparent consumption of finished leather in the EU market: 7,153 million €ur.

983 The consumption mix details per main Country, based on EU members tanning turnovers, extra-EU export of
984 finished leather of EU members and extra-EU import of finished leather per extra-EU Countries is reported
985 in Table 32. The same consumption mix is used for all the RPs due to the lack of data for the identification of
986 a specific consumption mix for each RP.

987 Table 32 EU Leather consumption mix (Countries contribution for less than 55 million €ur have been excluded)

| Producing/Exporting Country | Finished leather sales in EU28 market (million €ur) | Percentage |
|---|---|---|
| **Italy** | 3 661 | 57,7% |
| **Spain** | 608 | 9,6% |
| **Germany** | 377 | 5,9% |
| **France** | 311 | 4,9% |

| Producing/Exporting Country | Finished leather sales in EU28 market (million €ur) | Percentage |
|---|---|---|
| **Austria** | 305 | 4,8% |
| **Portugal** | 302 | 4,8% |
| **Brazil** | 247 | 3,9% |
| **India** | 223 | 3,5% |
| **United Kingdom** | 214 | 3,4% |
| **Pakistan** | 101 | 1,6% |
| **Total** | **6 349** | **100,0%** |

Since it is not possible to know the end use of a specific leather at the moment of its trade, the mean market values have been used as a baseline to model all of the RPs.

# ANNEX 6 – Downstream scenarios

Downstream processes are not included into the system boundaries of the intermediate product "finished leather". However, the carbon stored in finished leather shall be calculated as a relevant information for the modelling of downstream scenarios.

Carbon stored in finished leather derives from two different sources:

- The carbon stored in raw hides and skins (the calculation of the amount of Biogenic Stored Carbon (BSC) is mandatory);
- The biogenic carbon stored in chemicals products that remain fixed on finished leather.

If primary data are not available, the methodology described below shall be used.

## Calculations of Stored Carbon Content in Finished Leather Products

Inventories for each RP have been compiled using primary specific data for this purpose. These, in turn, comprise the average quantities of chemical ancillary products employed during finished leather manufacture.

On the other hand, the calculation of the quantities of added chemicals administered, as well as of the products of their reaction with the processing input materials would require:

- Analytical compositional data – it is unrealistic to try and implement a systematic analytical effort for the various finished leathers and manufacturing plants. Moreover, such data already available, relate to the content of monitored, regulated or restricted substances in the finished leathers, as routinely applied for the Tanneries and end users. Finally, in several cases analytical methods do not exist or the exact chemical nature of the compounds found in leather cannot be identified with any precision;
- Measurement or calculation of the main organic component of the finished leather, namely collagen and of other proteins and biopolymers. Hide substance, also used for the allocation of environmental impacts to the various co-products in this survey, is measured from N-TKN (Kjedahl Total Nitrogen Content, IUC 10), whereas N-NH4+ can be determined separately.

Concomitantly, and in view, of the lack of a BOM for the finished leather or detailed and complete compositional data the stored carbon content in the various RPs was calculated as follows:

## Biogenic Stored Carbon (BSC)[33]

This is equal, in general terms, to the collagen (corium) quantities recovered from input processing materials and ennobled during leather manufacture. The average hide substance content for the procurement mix (animal origins) is known from generic data available in the world wide sectoral literature and the corresponding values are reported with Table 33.

[33] The complete calculation sheet and results for BSC for each RP and animal origin are reported in Table 34.

1021 **Table 33 Hide substance content per kg of raw hide / skin**

| Raw material | Wet Salted Bovine Hides [>20 kg] | | Wet salted Bovine (Calf-Veals) [< 20 kg] | | Air Dried Sheep Skins [0,65 kg/piece] | | Wet Salted Sheep Skins [1,5 kg/piece] | | Pickled Sheep Skins [1 kg/piece] | | Caprine Air-Dried Skins [0,45 kg/piece] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ingredients** | Quantity [g] | g-N | Quantity [g] | g-N | Quantity [g] | g-N | Quantity [g] | g-N | Quantity [g] | g-N | Quantity [g] | g-N |
| **Humidity** | 450 | - | 450 | - | 200 | - | 450 | - | 550 | - | 200 | - |
| **Collagen** | 280 | 50 | 300 | 53 | 400 | 71 | 180 | 32 | 230 | 41 | 650 | 116 |
| **Hair - Wool and other Proteins** | 60 | 10 | 50 | 8 | 300 | 48 | 130 | 21 | - | - | 120 | 19 |
| **Natural Grease** | 60 | - | 50 | - | 100 | - | 45 | - | 150 | - | 25 | - |
| **Inorganic Substances & Preservation Salt** | 150 | - | 150 | - | - | - | 195 | - | 70 | - | - | - |
| **Sub Totals** | **1 000** | **60** | **1 000** | **61** | **1 000** | **119** | **1 000** | **53** | **1 000** | **41** | **1 000** | **135** |

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On the other hand, the average reference flow per DU (kg of raw hide or skin / $m^2$) has been determined for the various procurement mixes and finished products, as cited in Table 7.

It is therefore possible to calculate the total quantity of hide substance processed and partially recovered in the finished leather, as follows:

*Equation 1*: ***Biogenic protein content valorised*** *[g / kg raw hides or skins] =* ***Biogenic protein content*** *[g / kg raw hides or skins] x* ***Quota of bio-based protein content valorised*** *[%]*

*Equation 2*: ***Biogenic protein content (hide substance)*** *[g / $m^2$ of finished leather] =* ***Reference flow*** *(Table 7) [kg raw hides or skins / $m^2$ of finished leather] x* ***Biogenic protein content valorised*** *[g / kg raw hides or skins]*

In order to calculate the equivalent amount of Carbon Stored per DU, it was necessary to assume that:

- Bulk protein content is collagen of Type I, namely a biopolymer with an average molecular weight of 300 kDa (as determined by Sodium Dodecyl Sulphate - PolyAcrylamide Gel Electrophoresis (SDS-PAGE) analysis and literature published data);
- The monomer building block of hide substance is tropocollagen and the % content of hide substance in carbon is equal to the % carbon content of tropocollagen, respectively.

Along these lines, the Biogenic content in each RP was determined by employing the following formula:

*Equation 3*: ***Biogenic stored carbon content g-c*** *[g / $m^2$ of finished leather] =* ***Biogenic protein content (hide substance)*** *[g / $m^2$ of finished leather] * 51.8%*

Table 34 provides a more detailed description of the calculation method. Values provided in the table can be used as default by the user of the PEFCR.

1043 **Table 34 Calculation sheet for BSC[34]**

| RP ID | Animal origin | 1 kg of wet salted hides or skins (Table 33) | | | | | | | | 1 m² of finished leather | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Collagen content [g] | Hair & other proteins content [g] | Biogenic protein content [g] | g-c from collagen [g] | g-c hair [g] or g-c wool [g] | Total protein c [g] | Quota of bio-based protein content valorised [%] | Biogenic protein content valorised [g] | Reference flow [kg raw hides or skins] (Table 7) | Biogenic protein content (hide substance) [g] | Biogenic stored carbon content g-c [g] |
| | | C | HP | BP = C+HP | GCC = C*51,8% | GCH = HP*45,2% or GCW = HP*50% | TPC = GCC+GCH or TPC = GCC+GCW | BPV | BPVR = BP*BPV | RF | BPHS = BPVR*RF | BSC = BPHS*51,8% |
| **1** | Bovine | 280 | 60 | 340 | 145 | 27,12 | 172 | 31,8 | 108 | 7,06 | 762 | 395 |
| **2** | Bovine | 280 | 60 | 340 | 145 | 27,12 | 172 | 36,5 | 124 | 7,41 | 920 | 476 |
| **2** | Calf | 300 | 50 | 350 | 155 | 22,60 | 178 | 30,7 | 107 | 5,74 | 617 | 319 |
| **2** | Caprine | 293 | 54 | 347 | 152 | 24,00 | 176 | 56,1 | 195 | 2,42 | 471 | 244 |
| **2** | Ovine | 180 | 130 | 310 | 93 | 65,00 | 158 | 46,9 | 145 | 3,06 | 445 | 230 |
| **3** | Calf | 300 | 50 | 350 | 155 | 22,60 | 178 | 30,7 | 107 | 5,74 | 617 | 319 |
| **3** | Caprine | 293 | 54 | 347 | 152 | 24,00 | 176 | 56,1 | 195 | 2,42 | 471 | 244 |
| **3** | Ovine | 180 | 130 | 310 | 93 | 65,00 | 158 | 46,9 | 145 | 3,79 | 551 | 285 |
| **4** | Bovine | 280 | 60 | 340 | 145 | 27,12 | 172 | 52,8 | 180 | 7,71 | 1 384 | 717 |

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[34] Additional information:

- g-C Hair = 45,2% (http://www.texascollaborative.org/hildasustaita/module%20files/topic3.htm);
- g-C Wool = 50,0% (http://www.iwto.org/campaigns/world-wool-award/);
- g- C-Collagen calculated from monomer Tropocollagen Molecular Formula;
- For RP1: Salted Hides Weight = Fresh Hides Weight - 9%.

### Stored Carbon from Chemicals (SCC)

The remaining quantities of fixed and stored carbon in finished RPs stems from the quantities of derivatives and products of the chemical reaction or/and physical deposition of chemical ancillaries utilised for the manufacture of finished leather.

These, in turn, can vary significantly, as a result of:

- Customised recipes (reagents, stoichiometry and physical conditions of reactions) for processing steps applicable;
- The plethora of ancillary products utilised routinely by each manufacturing plant, often of unknown exact composition;
- Analytical contents and identity of chemical nature of substances and compositions used, is seldom known or reliable;
- The quantity of input ancillaries taken up and irreversibly fixed on the collagenic matrix and leather is only broadly known and generic data for this purpose quite often vary depending on the source, whilst when reliable are commercial auxiliary product specific. Generally applicable exhaustion quota are reported in Tannery BREF 2013, often challenged by the producers of the chemical auxiliaries themselves;
- The chemical nature of the products of the reactions of ancillaries with leather are poorly known.

Concomitantly, it will be necessary to use for the purposes of the in-hand calculations:

- The average quantities obtained from primary data for each RP (Inventories);
- A representative chemical reactive substance was selected and identified for each chemical ancillary product family;
- The dry solids and active substance contents employed were sourced from the Technical Data Sheets for bulk commercial auxiliary products.

The assumption made at this point was that the biogenic SCC content, namely carbon stored in each RP, was equal to the amount of Biogenic carbon contained in the amount of representative substances administered during processing and eventually fixed on the product finished leathers.

The complete set of the assumptions in conjunction to clarifications for the formulas used for the calculation of SCC per chemical ancillary product family is presented with Table 35.

**Table 35 Assumptions for the calculation of the chemical stored carbon**

| Chemicals | Active Substance [Average %] | Fixed on leather [%] | Representative Compound - Substance - Monomer | Average Carbon Content [%] | Notes |
|---|---|---|---|---|---|
| **Protein** | 21% | 100% | Sodium caseinate | 52,12% | Assumption: Exact synthesis for food additive published - In order to simplify calculation Poly-proline (Mw:1000-10.000 Da) is used as the representative substance |
| **Natural pigments** | 100% | 80% | Carbon Black | 100,00% | Assumption Active Substance Content of Pigments=100% - No reliable market data available |

| Chemicals | Active Substance [Average %] | Fixed on leather [%] | Representative Compound - Substance - Monomer | Average Carbon Content [%] | Notes |
|---|---|---|---|---|---|
| **Natural filler** | 100% | 75% | Starch | 44,44% | Active substance content and exhaustion % from chemical companies' literature data and Technical Data Sheets |
| **Natural tannins, System** | 62% | 80% | Pyrogallol | 57,10% | Assumption: Powder form of Vegetable tannin extract quantities - Contents from Commercial product Mimosa FS - Dry substance:92% - Tans content:67% |
| **Natural fatliquors** | 90% | 85% | Oleic acid | 76,47% | See assumptions as above - Active substance content and exhaustion % from chemical companies' literature data |
| **Enzymatic Product** | | 0% | | 0,00% | Reacting and excess washed away |

Briefly, the general calculation rules of SCC and equation employed is as follows:

*Equation 4*: ***SCC, g per F.U*** *[g / m²] = ∑ (****Inventory Quantity of Chemical Offer*** *[g / m²] x* ***Active chemical substance content*** *[%] x* ***Fixed quota of chemical substance*** *[%] x* ***Carbon Content in Representative Chemical Reactive Substance*** *[%])*

### Biogenic Stored Carbon (BSC)

The total amount of stored carbon in each RP was the sum of of BSC and SCC respectively, determined as above for each RP:

*Equation 5*: ***TSS*** *[g of total stored Carbon / m²] =* ***BSC*** *[g / m²] +* ***SCC*** *[g of synthetic stored carbon /m²]*

# ANNEX 7 – Default values

The table below reports the default composition of chemical substances to be used in case primary data on the active substance content are not available.

1086 **Table 36 Chemicals modelling**

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| Acids | Hydroxy-carboxylic acids (Deliming agents) | Adipic | Adipic acid | 100,0% | 1 |
| | | Citric | Citric acid | 50,0% | 1 |
| | | | Water, tap | 50,0% | |
| | | Lactic | Lactic acid | 80,0% | 1 |
| | | | Water, tap | 20,0% | |
| | Strong mineral acids | Hydrochloric acid | Hydrochloric acid | 30,0% | 1 |
| | | | Water, tap | 70,0% | |
| | | Phosphonic acid | Phosphoric acid | 17,0% | 3 |
| | | | Water, tap | 83,0% | |
| | | Phosphoric acid | Phosphoric acid | 100,0% | 1 |
| | | Sulfuric acid | Sulphuric acid | 100,0% | 1 |
| | Strong organic acids (fixing agent) | Acetic acid | Acetic acid | 98,0% | 1 |
| | | | Water, tap | 2,0% | |
| | Strong organic acids (clearing agent) | Oxalic acid dehydrate | Adipic acid | 100,0% | 4 |
| | Strong organic acids (pickling and fixing agent) | Formic acid | Formic acid | 85,0% | 1 |
| | | | Water, tap | 15,0% | |
| Antifoam / slip agents | Silicone and siloxans | Modified polysaccharides | Maize starch | 100,0% | 2 |
| | | Polyacrylamide | Polyacrylamide | 50,0% | 1 |
| | | | Water, tap | 50,0% | |
| | | Silicone products | Antifoaming agent, silicone emulsion | 100,0% | 3 |
| | | Sodium Metasilicate | Sodium silicate | 37,0% | 2 |
| | | | Water, tap | 63,0% | |
| Bases | | Ammonia | Ammonia | 23,0% | 1 |
| | | | Water, tap | 77,0% | |
| | | Calcium formate | Sodium formate | 100,0% | 2 |
| | | Lime (calcium hydroxide) | Lime | 100,0% | 1 |
| | | Magnesium oxide | Magnesium oxide | 100,0% | 1 |
| | | Sodium acetate trihydrate | Sodium formate | 100,0% | 3 |

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| | | Sodium bicarbonate | Sodium bicarbonate | 100,0% | 1 |
| | | Sodium carbonate | Sodium bicarbonate | 98,0% | 1 |
| | | | Water, tap | 2,0% | |
| | | Sodium formate | Sodium formate | 100,0% | 1 |
| | | Sodium hydroxide | Sodium hydroxide | 50,0% | 1 |
| | | | Water, tap | 50,0% | |
| Degreasing agents | ABS | | Alkylbenzene sulfonate | 100,0% | 1 |
| | Alkyl-polyglycol Ethers (APEOs) | | Dipropylene glycol monomethyl ether | 85,0% | 3 |
| | | | Water, tap | 15,0% | |
| | Ethoxylated fatty amines | | Ethoxylated alcohol (AE7) | 39,0% | 3 |
| | | | Water, tap | 61,0% | |
| | Ethoxylated fatty alcohol (nonyl ethoxylated phenol) | | Ethoxylated alcohol (AE7) | 70,0% | 2 |
| | | | Water, tap | 30,0% | |
| | Fatty alcohol sulphate | | Ethoxylated alcohol (AE7) | 80,0% | 4 |
| | | | Water, tap | 20,0% | |
| Dyestuff (aqueous based) | Acid azodyes | Acid Black 210 - C34H25K2N11O11S3 | Aniline | 100,0% | 5 |
| | Basic azodyes | Basic Green 1 (100%) | Aniline | 100,0% | 5 |
| | Direct dyes | C.I. Direct Black 100% | Aniline | 100,0% | 5 |
| | Metal complex dyes | Chromium, 3-hydroxy-4-[(2-hydroxy-1-naphthalenyl)azo]-7-nitro-1-naphthalenesulfonic acid complex | Aniline | 10,0% | 5 |
| | | Sodium 2-anilino-5-(2,4-dinitroanilino)benzenesulphonate | Alkylbenzene sulfonate | 15,0% | |
| | | Sodium 6-amino-5-[[4-chloro-2-(trifluoromethyl)phenyl]azo]-4-hydroxynaphthalene-2-sulphonate | Alkylbenzene sulfonate | 5,0% | |
| | | Sodium sulfate | Sodium sulphate | 35,0% | |
| | | Starch | Maize starch | 35,0% | |
| | Reactive dyes | Covered by trade secret | Aniline | 75,0% | 5 |
| | | | Water, tap | 25,0% | |
| | Sulfur dyes | Solubilised Sulphur Black 1 | Aniline | 100,0% | 5 |

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| **Dyestuff (Solvent Based for finishing)** | **Azodyes or Azo, metal complex dyes or Anthraquinones** | Solvent orange 11 2,5%, Solvents: ethanol 48%, isopropanol 3%, oleic acid 7,5%, xylene 7,5%, ethylacetate 7,5%, 2-phenoxyethanol 3%, 2-(2-ethoxy)ethanol 21% | Aniline | 2,5% | 5 |
| | | | Ethanol | 48,0% | |
| | | | Ethoxylated alcohol (AE7) | 21,0% | |
| | | | Ethyl acetate | 7,5% | |
| | | | Fatty acids | 7,5% | |
| | | | Isopropanol | 3,0% | |
| | | | Phenoxy-compounds | 3,0% | |
| | | | Xylene | 7,5% | |
| **Fatliquors and oils** | **Natural fatliquors** | Coconut, soya, reepseed, castor oil, etc. | Sulphonated rapeseed oil | 100,0% | 1 |
| | | Fish oil (raw, sulphited, sulphated, sulphonated) | Sulphonated fish oil | 100,0% | 1 |
| | | Lanoline | Fatty acids | 50,0% | 5 |
| | | | Water, tap | 50,0% | |
| | | Lard oil | Oxi-sulphited lard oil | 100,0% | 1 |
| | | Lecithin | Fatty acids | 90,0% | 5 |
| | | | Water, tap | 10,0% | |
| | | Sulphated neatsfootoil (raw or sulphited or sulphated) | Fatty acids | 60,0% | 5 |
| | | | Water, tap | 40,0% | |
| | **Synthetic fatliquors** | Butanedioic acid, sulfo-, C-C10-18-alkyl esters, disodium salts, ethoxylated | Synthetic fatliquors | 100,0% | 1 |
| | | Phosphor Esters | Organophosphorus-compounds | 94,0% | 4 |
| | | | Water, tap | 6,0% | |
| | | Sulphited / Sulphated fatty acid esters | Sulphated acid esters | 100,0% | 1 |
| | | Sulphochlorinated paraffins | Synthetic fatliquors | 67,0% | 5 |
| | | | Water, tap | 33,0% | |
| **Fillers** | **Inorganic fillers** | | Kaolin | 100,0% | 3 |
| | **Organic fillers** | Co-polymers | Acrylonitrile Butadiene Styrene (ABS) | 100,0% | 3 |
| | | Proteins | Maize starch | 100,0% | 5 |
| | | Resins (Dicyandiamide resin) | Anionic resin | 100,0% | 4 |
| | | Starch | Maize starch | 100,0% | 1 |
| **Gases** | | Carbon dioxide | Carbon dioxide | 100,0% | 1 |
| | | Nitrogen | Nitrogen | 100,0% | 3 |

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| | | Oxygen | Oxygen | 100,0% | 3 |
| Lacquers | Acrylic polymers | | Acrylic binder | 34,0% | 3 |
| | | | Water, tap | 66,0% | |
| | Nitrocellulose | Nitrocellulose | Nitrocellulose | 100,0% | 1 |
| | Polyurethane dispersions | | Polyurethane dispersion | 55,0% | 1 |
| | | | Water, tap | 45,0% | |
| Matting agents | Inorganic | Silicas | Activated silica | 40,0% | 4 |
| | | | Water, tap | 60,0% | |
| | Organic | Thermoplastic Polymers | Polyurethane dispersion | 62,5% | 4 |
| | | | Water, tap | 37,5% | |
| Mineral tanning agents | Aluminium tanning agents | Aluminium chloride (17% Al2O3) | Aluminium chloride | 83,6% | 1 |
| | | | Water, tap | 16,4% | |
| | | Aluminium potassium sulphate (KAl(SO4)2.12 H2O) | Aluminium sulphate | 50,0% | 3 |
| | | | Potassium sulphate | 50,0% | |
| | | Aluminium sulfate | Aluminium sulphate | 100,0% | 1 |
| | | Ammonium aluminium sulfate | Aluminium sulphate | 50,0% | 3 |
| | | | Ammonium sulfate | 50,0% | |
| | Chromium sulphate (chromium oxide 14%) | 33%/50% basic chromium sulphate formate masked (33%) | Basic chrome sulfate | 100,0% | 3 |
| | Chromium sulphate (chromium oxide 26%) | 33%/50% basic chromium sulphate formate masked (33%) | Basic chrome sulfate | 100,0% | 2 |
| | Zirconium tanning salts | Zirconium sulphate tetrahydrate | Aluminium chloride | 30,0% | 5 |
| | | | Sodium sulphate | 70,0% | |
| Organometallic synthetic tanning agents | Aluminium syntans | Aluminium triformate | Aluminium oxide | 76,3% | 4 |
| | | | Water, tap | 23,7% | |
| | Chromium syntans | Chromium-containing condensation product of phenolic sulphonic acids (12,5% chromium oxide) | Basic chrome sulfate | 12,5% | 4 |
| | | | Sodium sulphate | 80,5% | |
| | | | Water, tap | 7,0% | |
| Penetration, Levelling, Build up and Fixing | Aryl sulphonic acid derivatives | Napthalenosulphonic acid / Formaldehyde condensation products | Alkylbenzene sulfonate | 30,0% | 5 |
| | | | Water, tap | 70,0% | |
| | Fatty Alcohols | Polyoxyethylene derivatives of fatty alcohols | Fatty alcohols | 53,5% | 4 |
| | | | Water, tap | 46,5% | |

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| Dyeing Auxilliaries | Fatty amine derivatives | Ethoxylated fatty amine sulphate / Polyoxyethylene fatty amine derivatives | Fatty alcohols | 56,0% | 5 |
| | | | Water, tap | 44,0% | |
| | Glycols | Polyethyleneglycol (PEG) | Triethylene glycol | 100,0% | 4 |
| | Quaternary Ammonium derivatives | (2-methoxymethylethoxy)propanol 10% | Ethoxylated alcohol (AE7) | 10,0% | 4 |
| | | | Water, tap | 20,0% | |
| | | Ammonium mercaptoacetate | Ammonium sulfate | 10,0% | |
| | | Ethanolamine | Monoethanolamine | 60,0% | |
| Pigments | Inorganic pigments (ion oxide) | Magnetite | Magnetite | 100,0% | 1 |
| | Inorganic pigments (titanium dioxide) | Aluminium hydroxide | Aluminium oxide | 7,0% | 4 |
| | | Silica dioxide | Activated silica | 7,0% | |
| | | Titanium dioxide | Titanium dioxide | 86,0% | |
| | Organic and metal-complex pigments | [2,3'-Bis[[(2-hydroxyphenyl)methylene]amino]but-2-enedinitrilato(2-)-N2,N3,O2,O3]nickel | Carbon black | 100,0% | 4 |
| | | Carbon Black N330 | Carbon black | 100,0% | 1 |
| | | Nanodispersions | Carbon black | 100,0% | 5 |
| | | Phthalocyanines (ca. 25% of all pigments derivatives of Copper Phthalocyanine - CuPc); Sodium or ammonium salts of CuPc-sulphonic acid | Phthalocyanine blue | 50,0% | 1 |
| | | | Phthalocyanine green | 50,0% | |
| Proteins | Bating and other enzymes | Proteases, lipases, elastases, cellulases | Enzymes | 100,0% | 1 |
| | Binders | Albumin | Acrylic binder | 10,0% | 5 |
| | | | Water, tap | 90,0% | |
| | | Casein | Acrylic binder | 21,0% | 5 |
| | | | Water, tap | 79,0% | |
| Resins | Various | Butadiene resins | Acrylonitrile Butadiene Styrene (ABS) | 32,0% | 4 |
| | | | Water, tap | 68,0% | |
| | | Formaldehyde - melamine resins | Melamine formaldehyde resin | 98,0% | 1 |
| | | | Water, tap | 2,0% | |
| | | Polyacrylic resin | Polyacrylates | 100,0% | 2 |

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| | | Polyurethane Resins | Polyurethane dispersion | 98,0% | 5 |
| | | | Water, tap | 2,0% | |
| | | Styrene - Maleic anhydride copolymers | Styrene | 12,5% | 3 |
| | | | Maleic anhydride | 12,5% | |
| | | | Ethoxylated alcohol (AE7) | 2,0% | |
| | | | Water, tap | 73,0% | |
| | | Urea - aldehyde Resins | Urea-formaldehyde resin | 98,0% | 3 |
| | | | Water, tap | 2,0% | |
| | | Vinyl Chloride-Vinyl Acetate Copolymer | Ethylene vinyl acetate copolymer | 100,0% | 4 |
| Salts | Various applications | Ammonium bicarbonate | Ammonium bicarbonate | 100,0% | 1 |
| | | Ammonium chloride | Ammonium chloride | 100,0% | 1 |
| | | Ammonium sulfate | Ammonium sulfate | 21,0% | 1 |
| | | | Water, tap | 79,0% | |
| | | Ferric chloride | Iron (III) chloride | 40,0% | 1 |
| | | | Water, tap | 60,0% | |
| | | Ferrous chloride | Iron (III) chloride | 40,0% | 3 |
| | | | Water, tap | 60,0% | |
| | | Ferrous sulphate | Iron (II) sulphate | 48,0% | 1 |
| | | | Water, tap | 52,0% | |
| | | Magnesium sulfate | Magnesium sulfate | 100,0% | 1 |
| | | Polyphosphates | Sodium tripolyphosphate | 100,0% | 3 |
| | | Sodium bisulfite | Sodium hydrogen sulphite | 100,0% | 1 |
| | | Sodium chloride | Sodium chloride | 100,0% | 1 |
| | | Sodium chlorite | Sodium hypochlorite | 15,0% | 3 |
| | | | Water, tap | 85,0% | |
| | | Sodium hydrosulphide | Sodium bicarbonate | 1,0% | 1 |
| | | | Sodium hydrosulphide | 72,0% | |
| | | | Water, tap | 27,0% | |
| | | Sodium hypochlorite | Sodium hypochlorite | 15,0% | 1 |
| | | | Water, tap | 85,0% | |
| | | Sodium phthalate | Polyethylene terephthalate (PET) granulate | 100,0% | 4 |

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| | | Sodium polyphosphate | Sodium tripolyphosphate | 100,0% | 3 |
| | | Sodium sulfate | Sodium sulphate | 100,0% | 1 |
| | | Sodium sulfide | Sodium hydrosulphide | 61,0% | 1 |
| | | | Water, tap | 39,0% | |
| | | Sodium sulfite | Sodium sulphite | 100,0% | 1 |
| | | Sodium thiosulfate | Sodium dithionite | 100,0% | 1 |
| **Sequestering agents** | **Chelators** | Droxyethylethylenediaminetriaacetate (Na3HEDTA) | EDTA | 39,0% | 1 |
| | | | Sodium hydroxide | 2,0% | |
| | | | Water, tap | 59,0% | |
| | | Nitrilotriacetic acid | EDTA | 100,0% | 4 |
| **Solvents** | **Degreasing solvent** | Perchloroethylene (PERC) | Ethylene glycol | 100,0% | 3 |
| | **Finishing solvent** | Acetone | Acetone | 100,0% | 1 |
| | | Butyl Acetate | Butyl acetate | 100,0% | 1 |
| | | Butyl Alcohol | Butanol | 100,0% | 1 |
| | | Dipropylene glycol methyl ether | Dipropylene glycol monomethyl ether | 100,0% | 1 |
| | | Ethanol | Ethanol | 100,0% | 1 |
| | | Ethyl acetate | Ethyl acetate | 100,0% | 1 |
| | | Isopropanol | Isopropanol | 100,0% | 1 |
| | | Methoxyisopropanol - Isopropylic alcohol | Isopropanol | 100,0% | 4 |
| | | Methylic Alcohol | Methanol | 100,0% | 1 |
| | | Toluene | Benzene | 1,0% | 1 |
| | | | Toluene | 96,0% | |
| | | | Xylene | 3,0% | |
| **Synthetic organic tanning agents** | **Aldehydes** | 2, 2-bis hydroxymethyl propionaldehyde solution | Acetaldehyde | 45,0% | 5 |
| | | | Water, tap | 55,0% | |
| | | Formaldehyde | Formaldehyde | 100,0% | 1 |
| | | Glutardialdehyde | Acetaldehyde | 100,0% | 4 |
| | | Polyaldehydes | Acetaldehyde | 45,0% | 5 |
| | | | Water, tap | 55,0% | |
| | **Dihydroxydiphenyl-sulfones (DDS)** | Methylene-linked condensation product of aryl sulphonic acids and hydroxyaryl sulfone | Synthetic tannins and retanning agents | 100,0% | 4 |

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| | Phenolic | Hydroxyaryl derivatives (eg. Phenolsuphonates) | Phenolic resin | 95,0% | 5 |
| | | | Water, tap | 5,0% | |
| | Polymers | Acrylic polymers | Acrylic binder | 34,0% | 4 |
| | | | Water, tap | 66,0% | |
| | | Maleic/Styreic Copolymers | Maleic anhydride | 50,0% | 4 |
| | | | Styrene | 50,0% | |
| | | Modified polyamide carboxylic acid | Polycarboxylate | 40,0% | 4 |
| | | | Water, tap | 60,0% | |
| | | Polycarbamoyl Sulfonate (PCMS) | Alkylbenzene | 100,0% | 5 |
| | | Polycarboxylates | Polycarboxylate | 40,0% | 1 |
| | | | Water, tap | 60,0% | |
| | Triazine derivatives | Sodium p-[(4,6-dichloro-1,3,5-triazin-2-yl)-amino]benzosulphonate] | Synthetic tannins and retanning agents | 100,0% | 5 |
| Vegetable tannins | Condesed | Extracts of Quebracho, mimosa, etc. | Natural tannins extracted from chestnut | 100,0% | 3 |
| | Hydrolysable | Extract of chestnut, myrobalan, sumac, oak wood, tara, etc. | Natural tannins extracted from chestnut | 100,0% | 2 |
| Waxes | Finishing waxes | Beeswax | Beeswax | 100,0% | 1 |
| | | Carnauba wax | Wax | 32,0% | 5 |
| | | | Water, tap | 68,0% | |
| | | Paraffin and polyethilene wax | Wax | 28,0% | 3 |
| | | | Water, tap | 72,0% | |
| | | Paraffin wax | Wax | 40,0% | 3 |
| | | | Water, tap | 60,0% | |
| Others | Antifoam agents | | Antifoaming agent, silicone emulsion | 100,0% | 1 |
| | Antiwrinkle products | Amines | Diethanolamine | 23,0% | 3 |
| | | | Water, tap | 77,0% | |
| | Biocides | (Benzothiazol-2-ylthio)methylthiocyanat (TCMTB) | Benzo[thia]diazole-compound | 35,0% | 4 |
| | | | Water, tap | 65,0% | |
| | | 2-Octyl-2H-isothiazol-3-one (OIT) | Benzo[thia]diazole-compound | 18,0% | 5 |
| | | | Bisphenol A powder | 22,0% | |
| | | | Water, tap | 60,0% | |

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| | | N,N-dimethyl-dithiocarbamic acid, Na salt Sodium Dimethyldithiocarbamate (SDDC) | Benzo[thia]diazole-compound | 15,0% | 5 |
| | | | Bisphenol A powder | 15,0% | |
| | | | Water, tap | 70,0% | |
| | | Ortho-Phenylphenol and Sodium (OPP) | Bisphenol A powder | 13,1% | 5 |
| | | | Water, tap | 86,9% | |
| | | Para-chloro-meta-cresol | Benzo[thia]diazole-compound | 19,0% | 5 |
| | | | Bisphenol A powder | 19,0% | |
| | | | Water, tap | 62,0% | |
| | | Sulphur compounds | Sodium dithionite | 40,0% | 3 |
| | | | Water, tap | 60,0% | |
| | **Bleaching or dehairing agent** | Hydrogen peroxide | Hydrogen peroxide | 100,0% | 1 |
| | | Potassium permanganate aquox | Potassium permanganate | 97,5% | 1 |
| | | | Water, tap | 2,5% | |
| | | Sodium dithionite | Sodium dithionite | 70,0% | 1 |
| | | | Water, tap | 30,0% | |
| | | Sodium percarbonate | Sodium percarbonate | 85,0% | 1 |
| | | | Sodium bicarbonate | 15,0% | |
| | | Organic dehairing agents (Mercaptides) | Sodium hydrosulphide | 100,0% | 5 |
| | **Crosslinkers (finishing)** | Aliphatic reactive polyisocyanates and ethyl 3-ethoxypropionate | Methylene diphenyldiisocyanate | 100,0% | 5 |
| | | Aziridine | Diethanolamine consumption | 100,0% | 5 |
| | | Carbodiimides | Methylene diphenyldiisocyanate | 40,0% | 5 |
| | | | Water, tap | 60,0% | |
| | **Effluent Treatment Plant (ETP) polymeric Flocculants, polyelectrolytes and coagulants** | Polyacrylamide | Polyacrylamide | 85,0% | 1 |
| | | | Water, tap | 15,0% | |
| | | Polyaluminium chloride | Polyaluminium chloride | 45,0% | 1 |
| | | | Water, tap | 55,0% | |
| | **Flame retardant agents** | Minerals | Antimony | 100,0% | 4 |
| | | Organohalogen compounds | Antimony | 50,0% | 5 |
| | | | Phosphoryl chloride | 50,0% | |
| | | Organophosphorous compounds | Phosphoryl chloride | 100,0% | 4 |

| Category | Family | Representative substance | Process (see Table 14 for related dataset) | Composition | Modelling accuracy |
|---|---|---|---|---|---|
| | **Halide Compounds** | Fluorochemical acrylate polymers | Tetrafluoroethane | 28,0% | 5 |
| | | | Triethylene glycol | 8,5% | |
| | | | Fatty alcohols | 1,0% | |
| | | | Water, tap | 62,5% | |
| | **Handle modifiers** | Water based silicones | Antifoaming agent, silicone emulsion | 30,0% | 4 |
| | | | Water, tap | 70,0% | |
| | | Waxes and oils | Wax | 8,5% | 5 |
| | | | Water, tap | 91,5% | |
| | **Render** | Acrylic polymers | Acrylic binder | 11,0% | 4 |
| | | Polyurethane | Polyurethane dispersion | 14,5% | |
| | | Inorganic fillers (silica) | Activated silica | 14,5% | |
| | | | Water, tap | 60,0% | |

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1088 **Table 37 Default LCI for slaughterhouse to be used (Data refers to 1 kg of live weight)**

| | Amount | Unit | Process (see Table 14 and Table 27 for related datasets) |
|---|---|---|---|
| **Electricity** | 33,89 | KJ | Electricity from grid consumption |
| **Natural Gas** | 4,18 | l | Thermal energy from natural gas consumption |
| **Well Water** | 0,37741 | l | Water, tap consumption |
| **Wastewater**[35] | 0,37720 | l | Treatment of wastewater |
| **Transport**[36] | 90,00 | kgkm | Transportation of raw hides / skins on lorry |

1089 **Table 38 Default distances to consider for transportation**

| Route | Distance [km] |
|---|---|
| **Slaughterhouse to raw hides and skins preservation** | 50 |
| **Raw hides and skins preservation to tannery**[37] | 500 |

1090 **Table 39 Chromium recovery CFF**

| Parameter | Process (Table 14) | Composition |
|---|---|---|
| $E_v = E^*v$ | Basic chrome sulfate consumption | 0,26 |
| | Sodium sulphate consumption | 0,74 |
| $E_d = E_{d^*}$ | Waste incineration of hazardous waste | 0,50 |
| | Waste incineration of solid waste | 0,50 |

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[35] Only one of the reported datasets shall be selected.
[36] Transport from farm to slaughterhouse.
[37] Default data to be used only in case of purchase of semi-processed materials and unavailability of primary data.

# ANNEX 8 – Background information on methodological choices

All impact categories required by the ILCD and the PEF methodology have been evaluated. Most relevant impact categories have been defined based on normalised results and sectorial relevance.

Since leather is a bio-based intermediate product, the carbon storage of leather has to be considered as a relevant additional environmental information.

## Allocation Step-by-Step Methodology Description

### *Overture*

Mass allocation of environmental impacts for the core leather manufacturing processes and for the various input processing materials will be based on the biobased and biogenic protein content (primary collagen, but also elastin, keratin, other types of sclero-proteins and proteoglycans) recovered or/and valorised with all possible core processes outputs which bear an economic value and are not classified as waste. N-proteic content, can be directly and reliably quantified and measured as Proteic-Nitrogen content, whilst routinely and systematically expressed as "hide substance" (in other languages the term used is "dermal substance" and in some cases "dermal matter").

*Equation 1*: ***Hide Substance*** *[g] =* ***N-proteic content*** *[g] x* ***5.62***

The Standard Leather Testing method applicable for both the Nitrogen content determination and the calculation of Hide substance content thereof is ISO 5397:1984, whilst quick and reliable measurements of protein content can be carried out on site using the most recently developed and commercialised SpectraMax® QuickDrop™ Micro-Volume Spectrophotometer - see attached technical data sheet.

### *Vade Mecum*

Starting point for all the calculations were published and industrial average data regarding the main ingredients composition of the raw materials of various animal origins and preservation methods.

Along these lines, the average of biobased protein and N-proteic contents, expressed in g, have been quantified and reported in the literature for the main products, by-products and waste-effluent generated. The most comprehensive and complete protein and N-proteic mass balance and the related values for bovine, calf, and ovicaprine hides/skins, pickled pelts – when applicable - and leathers (semi-processed, semi-finished and finished) can be found in Table 40 and in the one reported below.

Moreover, the N-Mass Balance for all outputs (products, by-products, waste, biolsolids and effluent generated at the ETP) for four (4) production lines and raw materials from four (4) animal origins (bovine, calf, lamb and kid) have been reported in the literature ([1]. In particular, the outputs' quantities and the corresponding quota of N-proteic contents (%) can be found in the table reported below.

These, in turn, constituted the starting point the generation of the complete inventory of default allocation factors to be employed, when primary datasets were not collected or available for the purposes of a PEF-study.

In general, data for bovine leather production are abundant in the literature, whereas, for ovi-caprine skins processing, this information is scarce and seldom published, accordingly (Table 40).

1128 **Table 40 Preliminary N-proteic and hide substance quantities for input and outputs of Leather making process**

| Proteinous-N Mass Balance | | Wet Salted Bovine Hides, Splitting in Blue ([>20 kg] | | Wet salted Calf-Veals, Splitting in Lime [<20 kg] | | Pickled Sheep Skins, No splitting [1 kg/piece] | | Wet Salted Sheep Skins, No splitting [1,5 kg/piece] | | Air Dried Goat Skins, No splitting [0,45 kg/piece] | | Heavy Wet Salted Bovine Hides, No splitting | | Bovine N-protein Allocation from Wet Salted Bovine Hides | Calves N-protein Allocation from Wet-salted Calf/Veal Skins | Ovine N-protein Allocation from Wet-salted Ovine Skins | Ovine N-protein Allocation from Pickled Ovine Pelts | Caprine N-protein Nitrogen Allocation from Air-Dried Skins | Bovine N-protein Allocation from Wet Salted Bovine Hides |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity | | | | | | | | | | | | Tanning | | | | | |
| | | g | g-N | g | g-N | g | g-N | g | g-N | g | g-N | g | g-N | Cr | Cr | Cr | Cr | Cr | Veg |
| **Trimmings** | Wet Salted | 40 | 2,4 | 30 | 1,8 | | | 60 | 1,9 | | | 40 | 2,4 | 4% | 3% | 3,1% | | | 4% |
| | Air-dried | | | | | | | | | 140 | 18,9 | | | | | | | 25% | |
| | Pickled | | | | | 30 | 1,2 | | | | | | | | | | 2,9% | | |
| **Hair - wool (recovered)** | | Hair Burn - In Sludge | | Hair Burn - In Sludge | | | | 130 | 21 | Hair Burn - In Sludge | | Hair Burn - In Sludge | | | | 34,7% | | | |
| **Fleshings** | Green | | | 70 | 3,2 | | | | | | | | | | 5,2% | | | | |
| | Lime | 170 | 2,7 | | | | | 110 | 1,4 | 240 | 3,8 | | | 4,5% | | 2,3% | | | |
| | Pickle | | | | | 50 | 1,2 | | | | | | | | | | 2,9% | | |
| **Reject splits and trimmings** | Limed | | | 160 | 6,2 | | | | | | | 160 | 6,2 | | 10,2% | | | | 10,3% |
| | Cr | 120 | 9,6 | | | | | | | | | | | 16% | | | | | |
| **Shavings (+buffing dust)** | Cr-tanned | 50 | 4,3 | 60 | 5,2 | 10 | 0,8 | 10 | 0,8 | 60 | 5,2 | | | 7,2% | 8,5% | 1,3% | 2% | 6,9% | |
| | Veg-tanned | | | | | 20 | 1,5 | | | | | 87 | 7,5 | | | | | | 12,5% |
| **Trimmings** | Finished Cr-tanned | 10 | 1,2 | 20 | 2,4 | 10 | 1,2 | 10 | 1,2 | 50 | 6 | | | 2% | 3,9% | 2% | 2,9% | 7,9% | |
| | Finished Veg-tanned | | | | | 20 | 1,5 | | | | | 62,5 | 7,5 | | | | | | 12,5% |
| | Total Protein-N in Raw Skin /Hide/ Picled Pelt/Wet blue | | 60 | | 61 | | 41 | | 60,6 | | 135 | | 60 | | | | | | |
| | Protein-N in limed or wet blue flesh splits | | 9,6 | | 10,6 | | | | | | | | | 16% | 17,4% | | | | |

| Proteinous-N Mass Balance | | Wet Salted Bovine Hides, Splitting in Blue ([>20 kg] | | Wet salted Calf-Veals, Splitting in Lime [<20 kg] | | Pickled Sheep Skins, No splitting [1 kg/piece] | | Wet Salted Sheep Skins, No splitting [1,5 kg/piece] | | Air Dried Goat Skins, No splitting [0,45 kg/piece] | | Heavy Wet Salted Bovine Hides, No splitting | | Bovine N-protein Allocation from Wet Salted Bovine Hides | Calves N-protein Allocation from Wet-salted Calf/Veal Skins | Ovine N-protein Allocation from Wet-salted Ovine Skins | Ovine N-protein Allocation from Pickled Ovine Pelts | Caprine N-protein Nitrogen Allocation from Air-Dried Skins | Bovine N-protein Allocation from Wet Salted Bovine Hides |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity | | | | | | | | | | | | Tanning | | | | | |
| | | g | g-N | g | g-N | g | g-N | g | g-N | g | g-N | g | g-N | Cr | Cr | Cr | Cr | Cr | Veg |
| | Protein-N in finished grain split | | 19,1 | | 20,6 | | 28,4 | | 28,4 | | 75,7 | | 25,3 | 31,8% | 33,8% | 69,3% | 46,9% | 56,1% | 42,2% |
| | Total Protein-N in Solid Waste, not including recovered wool | | 20,2 | | 18,8 | | 7,1 | | 5,3 | | 33,9 | | 23,6 | 33,7% | 30,8% | 17,3% | 8,7% | 25,1% | 39,3% |
| | Total Protein-N in ETP-Sludge | | 5,7 | | 5,9 | | 2,5 | | 2,9 | | 13,5 | | 5,7 | 9,5% | 9,7% | 6,1% | 4,8% | 10% | 9,5% |
| | Total Protein-N recoverable Losses (e.g. Hair or Wool if recovered for skins) | | 5,4 | | 5,1 | | 3 | | 24 | | 11,9 | | 5,4 | 9% | 8,4% | 7,3% | 39,6% | 8,8% | 9% |
| | | | | | | | | | | | | | | 100% | 100% | 100% | 100% | 100% | 100% |

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The obtained preliminary results for the quantities of N-proteic Nitrogen, and equally hide substance, were summarised for all four (4) types of raw materials in the following Table 41.

**Table 41 Preliminary N-proteic contents for 1 kg of raw input material**

| Raw material [1 kg] | Wet salted bovine hides [>20 kg] | Wet salted calf-veals [<20 kg] | Caprine air-dried skins | Pickled sheep skins | Wet salted sheep skins |
|---|---|---|---|---|---|
| **Protein-N in finished leather [g-N]** | 28,7 | 31,2 | 75,7 | 28,4 | 19,0 |
| **Protein-N in solid waste [g-N]** | 20,2 | 18,8 | 33,9 | 7,1 | 3,5 |
| **Protein-N in ETP sludge [g-N]** | 5,7 | 5,9 | 13,5 | 2,5 | 1,9 |
| **Recoverable losses (e.g. Hair, if saved)** | 5,4 | 5,1 | 11,9 | 3,0 | 2,0 |
| **Wool recovered [g-N]** | - | - | - | - | 14,0 |
| **Sub totals** | **60** | **61** | **135** | **41** | **40** |
| **% in finished leather (including splits)** | **48** | **52** | **56** | **69** | **47** |

The corresponding calculated quota (%) hide substance and N-proteic content are reported in Table 42.

**Table 42 Preliminary N-proteic and hide substance % partition for the various raw materials**

| Proteinous-N Mass Balance | | Bovine N-protein Allocation from Wet Salted Bovine Hides | Calves N-protein Allocation from Wet-salted Calf/Veal Skins | Ovine N-protein Allocation from Wet-salted Ovine Skins | Ovine N-protein Allocation from Pickled Ovine Pelts | Caprine N-protein Nitrogen Allocation from Air-Dried Skins | Bovine N-protein Allocation from Wet Salted Bovine Hides |
|---|---|---|---|---|---|---|---|
| | | Tanning | | | | | |
| | | Cr | Cr | Cr | Cr | Cr | Veg |
| **Trimmings** | Wet Salted | 4% | 3% | 3,1% | | | 4% |
| | Air-dried | | | | | 25% | |
| | Pickled | | | | 2,9% | | |
| **Hair - Wool (recovered)** | | | | 34,7% | | | |
| **Fleshings** | Green | | 5,2% | | | | |
| | Lime | 4,5% | | 2,3% | | | |
| | Pickle | | | | 2,9% | | |
| **Reject Splits and Trimmings** | Limed | | 10,2% | | | | 10,3% |
| | Cr | 16% | | | | | |
| **Shavings (+Buffing Dust)** | Cr-tanned | 7,2% | 8,5% | 1,3% | 2% | 6,9% | |
| | Veg-tanned | | | | | | 12,5% |
| **Trimmings** | Finished Cr-tanned | 2% | 3,9% | 2% | 2,9% | 7,9% | |
| | Finished Veg-tanned | | | | | | 12,5% |

| Proteinous-N Mass Balance | | Bovine N-protein Allocation from Wet Salted Bovine Hides | Calves N-protein Allocation from Wet-salted Calf/Veal Skins | Ovine N-protein Allocation from Wet-salted Ovine Skins | Ovine N-protein Allocation from Pickled Ovine Pelts | Caprine N-protein Nitrogen Allocation from Air-Dried Skins | Bovine N-protein Allocation from Wet Salted Bovine Hides |
|---|---|---|---|---|---|---|---|
| | | Tanning | | | | | |
| | | Cr | Cr | Cr | Cr | Cr | Veg |
| | Total Protein-N in Raw Skin /Hide/ Picled Pelt/Wet blue | | | | | | |
| | Protein-N in limed or wet blue flesh splits | 16% | 17,4% | | | | |
| | Protein-N in finished grain split leather | 31,8% | 33,8% | 69,3% | 46,9% | 56,1% | 42,2% |
| | Total Protein-N in Solid Waste, not including recovered wool | 33,7% | 30,8% | 17,3% | 8,7% | 25,1% | 39,3% |
| | Total Protein-N in ETP-Sludge | 9,5% | 9,7% | 6,1% | 4,8% | 10% | 9,5% |
| | Total Protein-N recoverable Losses (e.g. Hair or Wool if recovered for skins) | 9% | 8,4% | 7,3% | 39,6% | 8,8% | 9% |
| | | 100% | 100% | 100% | 100% | 100% | 100% |

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However, it soon, became apparent however, that it was necessary:

- To integrate average primary high quality data from the latest and complete LCA for the Italian and Spanish Tanneries. This was particularly important for the quantities of Hide substance and thereof N-proteic contents for the bovine and calf leathers production, since all previous reports the total quantity of protein and N-proteic content was determined for grain and flesh splits but a clear division of hide substance content between the two co-products was presented in United Nations Industrial Development Organization (UNIDO) benchmark for the Tanning Sector, as shown below;

**Table 43 Collagen distribution wet salted hide, finished leather and solid waste (Starting material: 1 000 kg wet salted raw hides, splitting in chrome)**

| Component | | Amount of collagen | | |
|---|---|---|---|---|
| | | kg | % of corium collagen | % of total collagen |
| **Input** | Corium (leather building) collagen | 280 | 100,0 | 92,0 |
| | Subcutis collagen | 24 | - | 8,0 |
| | Total collagen input | 304 | - | 100,0 |
| **Output** | Grain leather | 113 | 40,0 | 37,2 |
| | Split leather | 36 | 13,0 | 11,8 |
| **Total collagen in finished leather** | | 149 | 53,0 | 49,0 |
| **Fleshing** | | 24 | From subcutis | 8,0 |
| **Trimmings** | | 18 | 6,5 | 6,0 |
| **Unusable chrome split** | | 49 | 17,5 | 16,1 |
| **Shavings** | | 45 | 16,0 | 15,0 |
| **Wet blue trimmings** | | 9 | 3,0 | 2,8 |
| **Crust leather waste** | | 5 | 1,8 | 1,6 |
| **Buffing dust** | | 1 | 0,4 | 0,3 |
| **Finished leather off-cuts** | | 4 | 1,6 | 1,3 |
| **Total collagen in solid waste** | | **155** | **47,0** | **51,0** |
| **Total collagen output** | | **304** | **100** | **100** |

- These data were compared and corrected Preliminary by integrating the corresponding partition of N-proteic contents determined from primary data during the LCA carried out for a Romanian Tannery[38] and the related partitioned values of hide substance are highlighted with yellow shading in Table 41.
- To extend the N-mass balance and default values sets with average sector specific N-proteic content values for all possible intermediate products, by-products and the solid waste biosolids generated by the core processes. This primarily concerned full vegetable tanned sole leather with preliminary industrial data were integrated for this purpose in Table 4, as well as all possible input processing materials commercialised as limed pelts, split leathers, pickled pelts and crust leathers.

[38] Romanian Tannery LCA [(PIELOREX) Systematic analytical survey of the composition of raw hides, pelts, semi-processed and finished leathers and waste generated during industrial scale production: Innovaleather Project - www.innovaleather.ro, 2014, Bucharest, Romania] and a commercial lot

- To enable the calculation of allocation factors in function of the following chemical and mechanical operations deployed in the Tannery:
    - The dehairing/dewooling chemical operations ("hair burn" or "hair save" and "wool save" respectively);
    - The various splitting mechanical operations, when applicable – namely splitting in lime, blue splitting and splitting in pickle, whereas green splitting is a Best Available Technique (BAT) but only seldom applicable hitherto and skiving (dry-splitting has not been incorporated as a possible scenario usually employed by downstream end users);
    - The various fleshing operations ("green fleshing" or/and "lime fleshing");
    - The broad tanning technologies categories, which very much determine process efficiency, composition and quantities of outputs.

"Dry-shaving" of some types of semi-finished and finished leathers has not been yet included since such primary or generic data are not available.

Along these lines, Sector specific N-proteic contents and protein quantities for waste and by-products were sourced from various sources. These in several cases came from National Sectoral surveys undertaken by Trade Associations, UNIDO. On the other hand, the partition of hide substance for the whole production cycle for the manufacture of finished upper bovine leathers and Italian Tanneries was sourced by the only previously existing LCA studies for the Italian and Spanish Sectors[39]. The flow chart and values reported with the LCA were converted into a practical table, used for the determination of the allocation factors for bovine leather production.

[39] Rita Puig et al, Industrial ecology in the cattle-to-leather supply chain, pages 42-43 - ISBN 978-88-464-9696-6,, Francoangeli srl, 2007, Milano. Italy

1174 **Table 44 Italian Tanneries input and outputs quantities**

| Raw Material, Intermediate & Finished Products | | Raw Hide Wet Salted | Soaked Hide | Limed Pelt (full substance) | Fleshed Limed Pelt | Grain Lime Split Pelts | Delimed / Degreased / Bated Pelts | Wet Blue Leathers | Pressed Wet Blue Leathers | Shaved Wet Blue Leathers | Retanned-Dyed-Fatliquored Leathers | Crust Leathers | Trimmed Crust Leathers | Finished Leather |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Weight [kgs]** | | 1 000 | 1 139 | 1 460 | 1 147,7 | 665,4 | 604,2 | 571,3 | 342,8 | 296,2 | 663,6 | 195,2 | 182,9 | 200 |
| **Weight Conversion Factor** | | 1 | 1,14 | 1,46 | 1,15 | 0,67 | 0,6 | 0,57 | 0,34 | 0,3 | 0,66 | 0,2 | 0,18 | 0,2 |
| **Water [dm³]** | | | 3 500 | 3 000 | 150 | 330 | 3 400 | 1 600 | | | 4 000 | | | 210 |
| **Material And Products: Quantities - Ingredients** | Humidity [kg] | 450 | 793 | 1 168 | 895,2 | 505,7 | 459,2 | 399,9 | 171,4 | 148,1 | 497,7 | 29,3 | 27,4 | 30 |
| | Sodium Chloride [kg] | 180 | | | | | | | | | | | | |
| | Hide Substance | 370 | 340 | 280 | 242,5 | 154,2 | 145 | 145 | 145 | 125,3 | 125,3 | 125,3 | 117,5 | 117,5 |
| | Other Substances | | | | | | | | | 22,8 | 40,6 | 40,6 | 3,4 | |
| | Lime | | | 12 | 10 | 5,5 | | | | | | | | |
| | Mineral Substances | | | | | | | 14,9 | 14,9 | | | | | |
| | Added Chemical Products | | | | | | | | | | | | | 38 |
| | Chromium (III) | | | | | | | 11,5 | 11,5 | | | | 6,8 | |
| | Added Fatty Substances | | | | | | | | | | | | 13,9 | |
| | Added Retanning Agents | | | | | | | | | | | | 13,9 | |
| | Added Finishing Products | | | | | | | | | | | | | 14,5 |
| **By-Products & Wastes: Quantities - Ingredients** | Hair | | | 100 | | | | | | | | | | |
| | Humidity | | | 70 | 158 | 218,4 | | | | 23,3 | | | 19 | |
| | Dermal Material | | | 30 | | | | | | | | | | |
| | Fleshings | | | | 197,5 | | | | | | | | | |
| | Hide Substance | | | | 37,5 | 88,3 | | | | 19,7 | | | 7,8 | |

| Raw Material, Intermediate & Finished Products | | Raw Hide Wet Salted | Soaked Hide | Limed Pelt (full substance) | Fleshed Limed Pelt | Grain Lime Split Pelts | Delimed / Degreased / Bated Pelts | Wet Blue Leathers | Pressed Wet Blue Leathers | Shaved Wet Blue Leathers | Retanned-Dyed-Fatliquored Leathers | Crust Leathers | Trimmed Crust Leathers | Finished Leather |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lime | | | | 2 | 4,5 | | | | | | | | |
| | Flesh Split | | | | | 331,2 | | | | | | | | |
| | Fat | | | | | 9,2 | | | | | | | | |
| | Limed Trimmings | | | | | 40 | | | | | | | | |
| | Water | | | | | 30 | | | | | | | | |
| | Shavings | | | | | | | | | 46,6 | | | | |
| | Other | | | | | | | | | 3,6 | | | 2,6 | |
| | Trimmings | | | | | | | | | | | | 12,3 | |
| **Effluent Volume [dm³]** | | | 2 857 | 2 855 | 265 | 440 | 3 450 | 1 720 | 230 | | 3 650 | 185 | | 207 |

1175 **Table 45 Calculated hide substance and N-proteic contents' quota for bovine wet salted hides input and all process outputs[40]**

| Lime - Fleshing & Splitting | | Raw Hide | Soaked Hides | Limed Pelts - Unsplit | Fleshed in Lime Pelts | Grain Splits | Bated Grain Split Pelts | Grain split Wet Blue Leather | Pressed Grain Split Leather | Shaved Wet blue Grain Splits | Cust Lreather | Finished leather |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hide Substance** | Recovered | 100% | 92% | 76% | 66% | 42% | 39% | 39% | 39% | 34% | 32% | 32% |
| | [kg] | 370 | 340 | 280 | 243 | 154,2 | 145 | 145 | 145 | 125,3 | 117,5 | 117,5 |
| **Flesh Split** | Recovered | | | | | 22% | | | | | | |
| | [kg] | | | | | 78,8 | | | | | | |
| **Hair** | Recovered | | | 8,1 | | | | | | | | |
| | [kg] | | | 30 | | | | | | | | |
| **Fleshings** | Recovered | | | | 10% | | | | | | | |
| | [kg] | | | | 37,5 | | | | | | | |
| **Reject Lime Splits & Trimmings** | Recovered | | | | | 3% | | | | | | |
| | [kg] | | | | | 9,5 | | | | | | |
| **Shavings** | Recovered | | | | | | | | | 5% | | |
| | [kg] | | | | | | | | | 19,7 | | |
| | Recovered | | | | | | | | | | 2% | |

[40] Recovered hide substance quota (%) for each output – including flesh splits – calculated from the primary dataset of Table 44.

| Lime - Fleshing & Splitting | | Raw Hide | Soaked Hides | Limed Pelts - Unsplit | Fleshed in Lime Pelts | Grain Splits | Bated Grain Split Pelts | Grain split Wet Blue Leather | Pressed Grain Split Leather | Shaved Wet blue Grain Splits | Cust Lreather | Finished leather |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Crust Finished Leather Trimmings** | [kg] | | | | | | | | | | 7,8 | |

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The preliminary set of allocation values used during the Screening Survey had then undergone corrections and improvements based on primary datasets gathered for the quantities of the various outputs and each RP with most pronounced the revision of values for Sole leather production – the quantities used are the average of primary datasets generated at 7 Sole leather manufacturing plants. The Allocation Factors Default values were consequently updated and simplified as requested and recommended by the TS, namely various categories of the original allocation default values were merged and consolidated with an average value cited in its final version. This was necessary as the variations of allocation factor values for several scenarios and processes varied in most cases less than 3% and in any case by less than 10%.

In practise, when Tannery primary datasets exist regarding the quantities of generated waste, then the actual biobased protein content and hide substance can be calculated as shown with Equation 2

Equation 2: ***N-proteic content of output per DU*** *[g/m²]* = ***Quantity per DU*** *[g of output per m²]* x ***Average N-proteic content*** *[g-N-proteic per g of output]*

At this point, it becomes apparent, that output and Tannery specific allocation factors can be calculated from collected Sector specific datasets of high quality for all variables in Equation 1, or, by using primary data for the quantities of outputs and the sector specific high quality average values for their N-proteic average content per declared unit. This, in turn, is possible, since the reference flow value for each processing input material is calculated or the default values cited in Table 41 are used for this purpose – see Equation 3.

Equation 3: ***Allocation factor per output*** *[%] = 100 x* ***Quantity of N-proteic content or Hide Substance of output*** *[g / m²]* / ***N-proteic or hide substance content of input processing material****, [g / m²]*

**Differences between PEFCR and EPD allocation methods for bovine grain and split leather**

It has been proposed and applied for all previous Environmental Product Declarations (EPDs) the use of a theoretical 50/50 allocation between the flesh splits and the grain split generated during the splitting mechanical operation, regardless if applied, in green, lime, pickled or limed state.

This option is based on an alleged equal division (slicing) of the limed pelts or wet blue leathers in parallel to the grain surface of its full substance. In a nutshell, a presumed, but not measured, whilst for split in lime pelts and lime flesh splits a Standard Testing Method or Device (Measuring Machine) does not exist. This methodology is a simplification and risks in certain cases not reflecting the reality, as graphically demonstrated by Figure 7 of UNIDO Mass Balance in Leather Processing.

**Figure 7 Area yield of grain leather and split leather (green - raw hide, brown - grain leather, blue - split leather)**

Moreover, according to UNIDO benchmark and mass balance for leather processing the output products for bovine leathers with average surface area 4 $m^2$ / hide are: 60 $m^2$ of split against 138 $m^2$ of grain finished leathers, namely 30.3% for flesh split and 69.7% for grain split allocation, based on relative surface area measurements, but also the average allocation factors that we have used based on average N-protein content, respectively.

The allocation factor of 50/50, between the grain and flesh split ignores thus the UNIDO benchmark and mass balance for tanneries. On the other hand, the allocation factors proposed are in close agreement with the default allocation factors proposed with the PEFCR for the hair burn system - where there is no hair by product is recovered (29.1% and 70.9%, prior to consolidation and averaging respectively.

### *Conclusions*

Literature data as used for the purposes of the calculations have been reviewed and incorporated in the "Feasibility survey and technical preliminary study for the recovery and reuse of Chromium as well as the Management of biosolids and solid waste of the IN.PA of Leather" (National Bank for Industrial Development S.A., August 1997, Athens, Study offices: M. Bakalis, Dr. P. Markantonatos and Dr. A. Paraskevopoulou.

However, it ought to be noted that:

1. The itemised list of references for specific data is given as required with specific reference to the data used;
2. A step-by-step description of the allocation methodology applied for the generation of the default allocation factors in conjunction with the equations applicable for the determination of product and Tannery specific allocation factors starting from complete or partial primary data can be found in the previous sections;
3. The preliminary allocation factors calculated for the Screening Survey and their consolidated and simplified final version together have been provided;
4. Corrections regarding heavy full vegetable tanned sole leather were integrated (Screening Survey results from 7 tanneries) in the current version of the PEFCRs;
5. Specific and verified allocation factors were calculated for the various semi-processed input processing materials with and without allocation to the process residues.

Otherwise, it is rather simple: the sum of quotas (%) input to the process with raw or semi-processed materials that is recovered in finished or semi-processed grain split leather products, ending up in by-products, solid waste, biosolids and effluent of the ETP is equal to the respective allocation factor for the impacts of the grain split leather. The allocation factor for the flesh split and recovered hair or wool have been determined and are equal to the relative quota (%) of N-protein content (quantifying hide substance content respectively) of flesh split, recovered hair or wool accordingly.

These are average values for the balance of proteic-Nitrogen for the full or partial finished leather production cycle; when primary datasets exist these should be used instead.

Conclusively, bio-based protein content measured or hide substance determined is de facto and as shown not only the most appropriate, but also the only transparent and verifiable measure of process efficiency of the product and value and production unit.

Finally, it must be emphasised at this point, that the quantities of co-products, by-products and waste reported can vary significantly as a function of specific input material, output leather article and tannery. The thickness of the output pelts and leathers can result in significant variations of allocated hide substance content and need to be validated in future studies and values updated accordingly.