Product Environmental Footprint Category Rules for Dry pasta

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ACRONYMS

AIDEPI: Associazione delle Industrie del dolce e della pasta italiane

BOM: Bill Of Materials

CPA: Classification of product by activity

CPC: Central Product Classification

DG-ENV: Directorate-General for Environment

DQR: Data Quality Rating

EC. European Commission

ELCD: European reference Life Cycle Database

EF: Environmental Footprint

EFTA: European Free Trade Association

EOL: End of Life

EPD: Environmental Product Declaration

FAO: Food and Agriculture Organization of the United Nations

EU: European Union

IES: International EPD System

ILCD: International Reference Life Cycle Data System

ISO: International Organization for Standardization

JRC: Joint Research Centre

LCA: Life Cycle Assessment

LCI: Life Cycle Inventory

LCIA: Life Cycle Impact Assessment

NACE: Nomenclature statistique des activités économiques

NGO: Non-governmental organization

OEF: Organisation Environmental Footprint

OEFSR: Organisation Environmental Footprint Sector Rule

PCR: Product Category Rules

PEF: Product Environmental Footprint

PEFCR: Product Environmental Footprint Category rules

PM: Particulate matter

PP: Polypropylene

PWG: Packaging Working Group

SC: Steering Committee

TAB: Technical Advisory Board

TS: Technical Secretariat

UNAFPA: Union de Associations de Fabricants de Pates Alimentaires de la Union Européenne (Union of Organisations of Manufacturers of Pasta Products of the EU)

DEFINITIONS

For all terms used in this Guidance and not defined below, please refer to the most updated version of the Product Environmental Footprint (PEF) Guide, ISO 14025:2006, ISO 14040-44:2006, and the ENVIFOOD Protocol.

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 1-1). 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 1-1[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: UNEP/SETAC “Global Guidance Principles for LCA Databases"

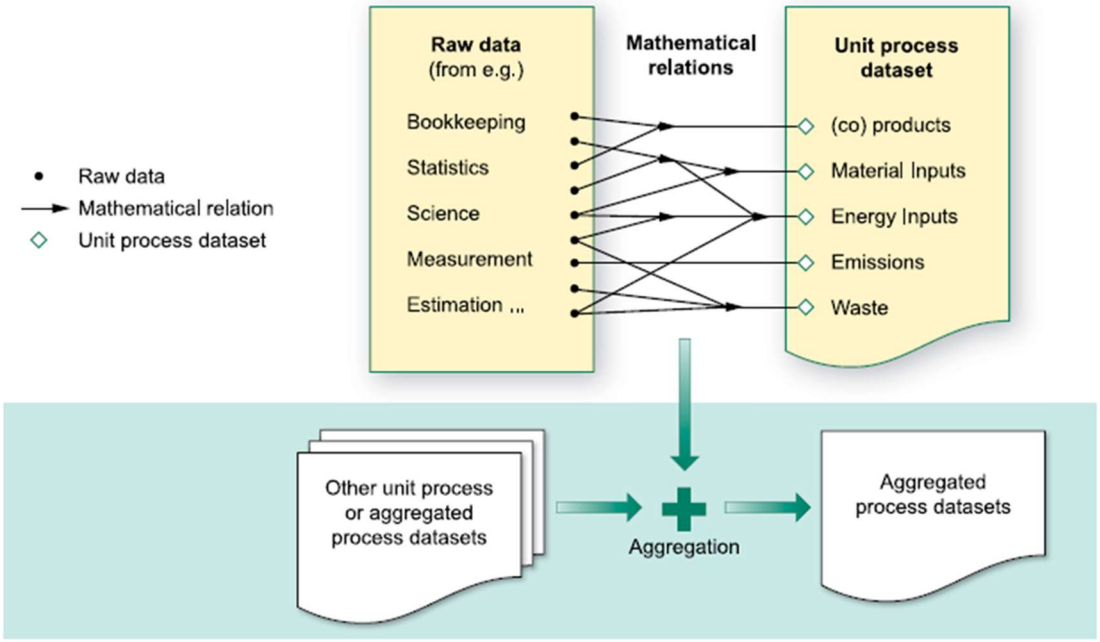

Figure 1-1 Definition of a unit process dataset and an aggregated process dataset

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".

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.

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.

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 1-2**.

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

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

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.

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.

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

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

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.

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 underlaying dataset are in their aggregated form (see an example in **Figure 1-2**).

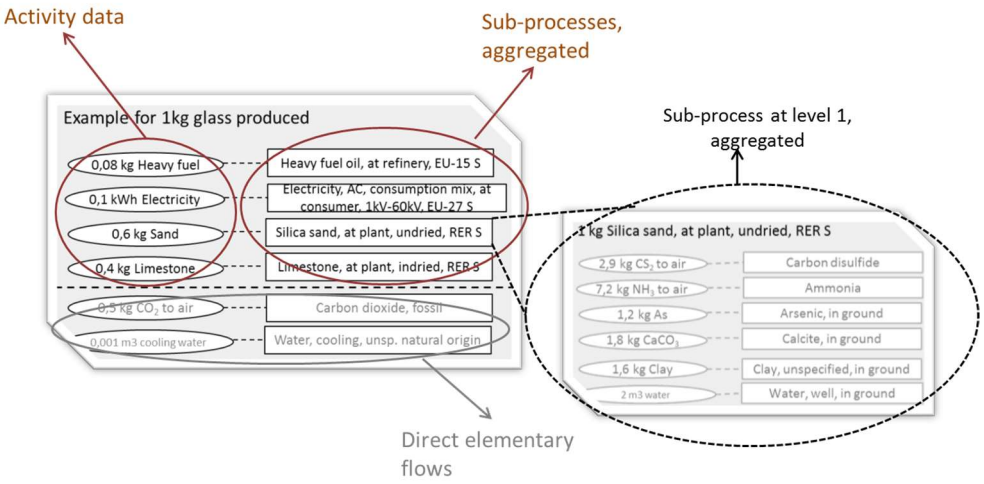

Figure 1-2: An example of a partially aggregated dataset, at level 1. The activity data and direct elementary flows are to the left, and the complementing sub-processes in their aggregated form are to the right. The grey text indicates elementary flows

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[4] - 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.

Secondary data[5] - 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

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

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

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”.

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 1-2).

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 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).

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

In Table 2-1 the members of the Technical Secretariat of the PEF pilot on pasta are listed.

Table 2-1 - Members of the Technical Secretariat

Name of the organization	Type of organization	Name of the members
UN.A.F.P.A.	Association	Luigi Cristiano Laurenza
Barilla G. e R. Fratelli S.p.A.	Industry	Luca Fernando Ruini
Pasta Zara S.p.A.	Industry	Sara Verbini
Pastificio Lucio Garofalo S.p.A.	Industry	Sergio De Gennaro
Life Cycle Engineering	Consultant	Paola Borla

The technical secretariat is under the lead of the Union of Organisations of Manufacturers of Pasta Products of the EU (UN.A.F.P.A.). The contact person of this pilot is Luigi Cristiano Laurenza (UN.A.F.P.A. Secretary general).

The other members of the technical secretariat are industry representatives and LCA consultant.

2.2. CONSULTATION AND STAKEHOLDERS

The PEF pilot on pasta production includes stakeholders throughout all stages of the process, the supply chain and neighbouring business sectors, as well as non-governmental organisations and industrial associations.

The first consultation was held from October 31st to December 15th, 2014. The TS received 6 comments from International EPD System and FEFAC. The physical meeting took place on November 14th, 2014, in Brussels. The minutes of the meeting are available in the Stakeholder space of the Wiki.

The second consultation was held from December 16th 2015 to January 20th 2016. The TS received 42 comments from International EPD System, Belgium - Federal Ministry of public Health and Environment, Environmental Footprint Team and ADEME/InVIVO.

The third consultation was held from July 20th 2016 to August 30th 2016. The TS received 30 comments from DG ENV - European Commission, MEDDE French environment ministry and FEFAC.

The stakeholders have access to this PEF pilot and all the open consultation related documents via the following website https://webgate.ec.europa.eu/fpfis/wikis/display/EUENVFP/PEFCR+Pilot%3A+Pasta .

At the time the present document was drafted 88 stakeholders were registered in the stakeholder workspace of the pilot. Some information about the stakeholders is reported in Figure 2-1 and Figure 2-2.

Figure 2-1 – Geographical distribution of stakeholders

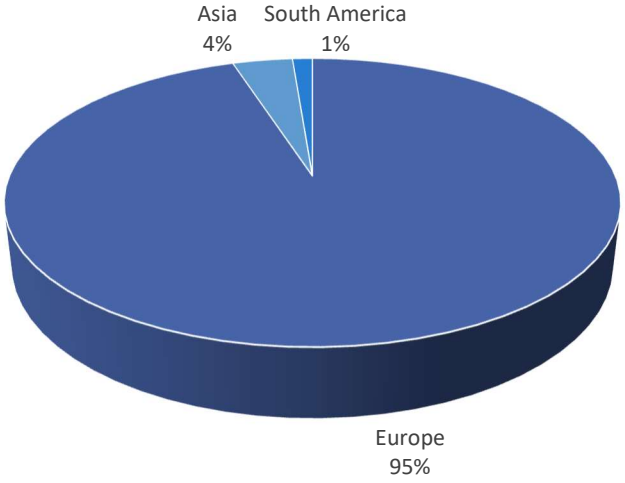
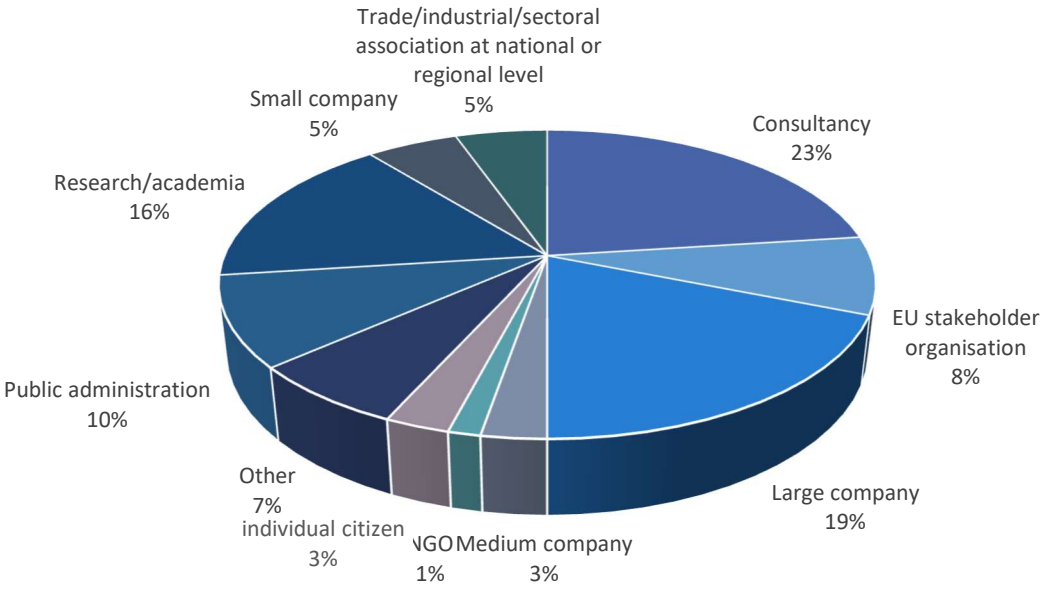


Figure 2-2 - Typology of stakeholders



2.3. REVIEW PANEL AND REVIEW REQUIREMENTS OF THE PEFCR

The Technical Secretariat set up an independent third-party panel composed of three members for the PEFCR review.

Name of the member	*Affiliation*	*Role*
Kristian Jelse	The International EPD System	LCA expert, chair of the review panel
Eva Alessi	WWF	NGO representative
Lucio De Gennaro	Pastificio Mennucci s.p.a.	industry expert

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 most recent approved version of the PEF Guide, and supports creation of credible and consistent PEF profiles,
- The functional 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 [indicate the version the PEFCR is in conformance with] 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.

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 April 2013.

The representative product(s) correctly describe 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 and the information included therein may be used to make comparisons and comparative assertions under the prescribed conditions (see chapter on limitations).

2.5. GEOGRAPHICAL 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(S) OF PEFCR

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 version 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
- PCR 2010:01 Uncooked pasta (Version 3), International EPD System (www.environdec.com) [6]

[6] Environdec, 2016. PCR 2010:01 Uncooked pasta (Version 3). Available at http://www.environdec.com/en/PCR/Detail/pcr2010-01#.Vkrw6_kveUk

3. PEFCR SCOPE

The scope of this PEFCR is **dry pasta**, which is defined as follows:

Dry pasta is pasta whose humidity content does not generally exceed 13% on dry solids[7]. Pasta is any kind of shaped product obtained by extruding or forming a dough prepared with durum wheat semolina/flour or whole durum wheat semolina/flour, and water and/or eggs. Other cereal flours can be used; other ingredients (such as vegetables or spices) may be added to the dough.

The above definition has been endorsed as pasta descriptor in the framework of the food additives categorization system as per EU Regulation 1333/2008[8].

Pasta is a carbohydrates based food generally served with sauces or other seasonings, which are not however included in the scope of this study.

Fresh pasta, filled pasta and pre-cooked pasta are out of the scope of this PEFCR.

The full life cycle (cradle to grave) of pasta sold on the EU-28 market is included in the scope of this PEFCR.

3.1. PRODUCT CLASSIFICATION

The CPA code for the products included in this PEFCR is 10.73 Manufacture of macaroni, noodles, couscous and similar farinaceous products.

The PEFCR for dry pasta focuses dry pasta produced with wheat semolina/flour and water and/or eggs because it is the predominant industrial product sold in the EU market.

Following this reasoning, the following products do not formally belong to the scope of this PEFCR, although there are no methodological reasons for treating them differently when assessing their impact as dry pasta product:

- Pasta made with other cereals flour (e.g. maize flour)
- Pasta made with bean flour (e.g. soybean flour)
- Pasta not to be boiled (e.g. lasagne)

The dry pasta PEFCR provides consistent methodological requirements for the entire cradle to grave LCA of wheat-based pasta. Therefore, this PEFCR may also be used as a reference by the operators that produce dry pasta, either with other cereal/bean flour or pasta needed to be cooked in other form than boiling. PEF studies done in such cases cannot claim compliance with this PEFCR.

3.2. REPRESENTATIVE PRODUCT

The representative product is a **single virtual product** based on:

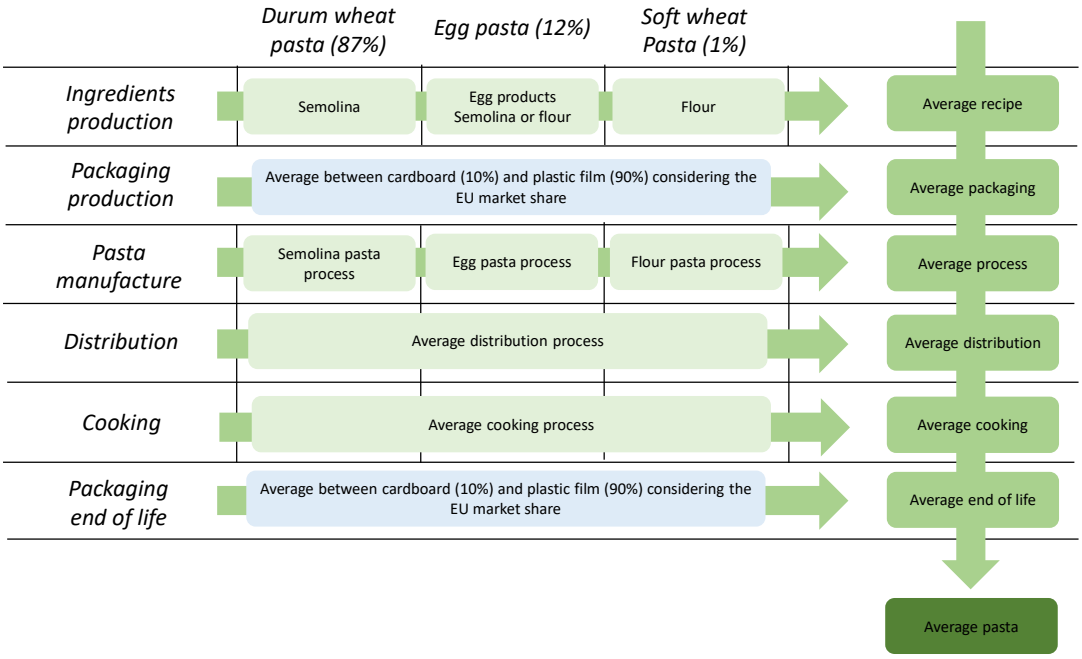
- the main typologies of dry pasta sold in the EU market (Source: AIDEPI, IRI, ACNielsen).
- the pasta packaging mix in the EU market (Source: manufacturers members of the Technical Secretariat).

[7] The humidity content requested for dry pasta varies from country to country. Included in the scope of this PEFCR is pasta with a humidity content lower than the maximum allowed by the applicable law.

[8] Guidance document describing the food categories in Part E of Annex II to Regulation (EC) No 1333/2008 on Food Additives

A scheme of the representative product is provided in Figure 3-1.

Figure 3-1 – Representative product



The reference flow was 1 kg of dry pasta being cooked at home with boiling setting. The weight of packaging and the product loss during distribution and cooking (total loss rate 3%) were not included in the 1 kg but were in the scope of the analysis.

The representative product is further described in Annex 4 – Representative product and in the screening study report prepared during the development of this PEFCR. The screening study is available upon request to the TS coordinator[9] that has the responsibility of distributing it with an adequate disclaimer about its limitations.

3.3. FUNCTIONAL UNIT AND REFERENCE FLOW

The functional unit of this PCR is 1 kg of dry pasta ready to be cooked at home or at restaurant.

Table 3-1 defines the key aspects used to define the functional unit.

Table 3-1 Key aspects of the Functional Unit

What?	Dry pasta, packaged, bought at the retail and cooked for the time suggested by the producer
How much?	1 kg of dry pasta. The weight of the packaging is not included in the 1 kg but in scope of the analysis
How well?	The product shall fulfil the legal quality requirements for selling at retail This aspect could not be incorporated so far. This limitation is recognized and requires further developments in order to improve fair comparisons.
How long?	Available for consumption before the expiry date. The average shelf life of pasta is 24 months Pasta is normally consumed in a short period after purchase and do not affect the functional unit. Losses during storage are uncommon and may be neglected.

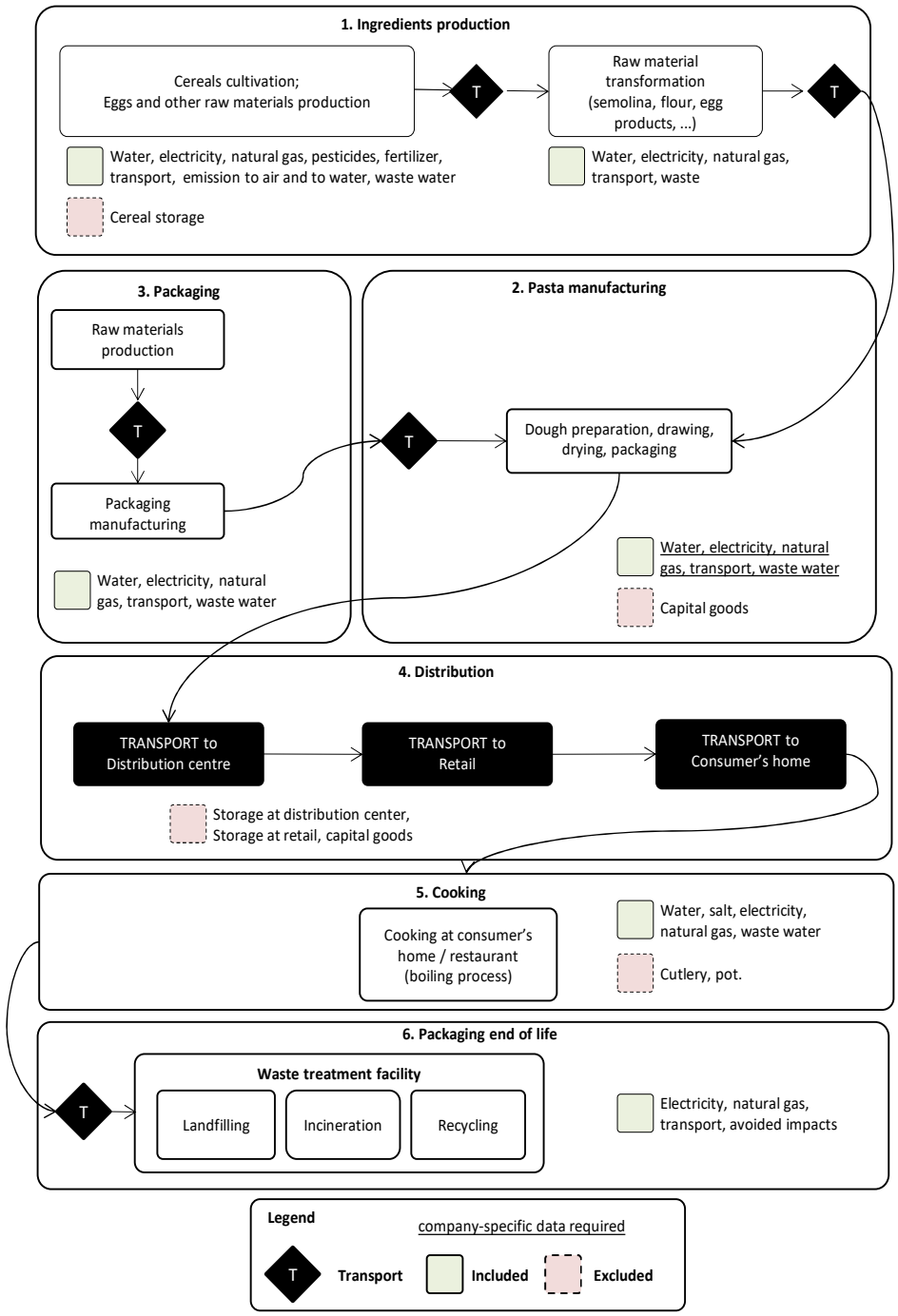
[9] unafpa@pasta-unafpa.org

The reference flow is 1 kg of dry pasta being cooked, considering also the cooking and packaging end of life impact. All quantitative input and output data collected in the study shall be calculated in relation to this reference flow.

3.4. SYSTEM BOUNDARY

Figure 3-2 presents the system diagram indicating the processes that are included in the product system. For pasta manufacturing primary data shall be collected. For all the other processes secondary or primary data may be used depending on the level of control, following the data needs matrix.

Figure 3-2 - Processes included in the product system



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

537 Table 3-2 Life cycle stages

Life cycle stage	Short description of the processes included
Ingredient production	The cultivation of cereals The production of semolina and/or flour (from cereals) The production of eggs (for egg pasta) The production of egg products (for egg pasta) The production of other ingredients The transportation of ingredients to the processing plant
Packaging manufacturing	Packaging raw materials production The transportation of packaging raw materials to the processing plant Packaging manufacturing
Pasta manufacturing	Energy consumption Water consumption Waste production
Distribution	The transport from the pasta production plant to the distribution centre; The transport from the distribution centre to the retailer; The transport from the distribution centre to the retailer and to the final consumer
Cooking	Water consumption; Energy consumption; Salt consumption; EOL of water used for cooking
Packaging end of life	Packaging waste management/treatment

538 According to this PEFCR, the following processes may be excluded based on the cut-off rule: capital
539 goods for processing of pasta, distribution centre/retail operation and pasta cooking.

540

541 Table 3-3 – Processes excluded based on the results of the screening study

Life cycle stage	Exclusions	Justification
Ingredients production	Cereal storage	Cereals may be stored before being transported to the mill. Energy has been identified as the main contributor to the environmental impacts, but its value is lower than 0,003 kWh/kg of grain stored. For this reason, it has been considered negligible.
Pasta manufacture	Capital goods	Considering the long life of buildings and machineries and the huge amount of pasta produced during this period, the production of machineries and buildings is considered negligible.
Distribution	Storage at distribution centre and at retail	Dry pasta does not require any particular storage conditions.
	Capital goods at distribution centre and at retail	These are allocated to numerous products. It is common practice in LCA not to include capital goods from the background systems, when not already included in secondary data.
Cooking	Cutlery and pot	Considering the long life of kitchen utensils and their allocation to numerous food preparation, the production of cutlery and pot is considered negligible.

542 Each PEF study done in accordance with this PEFCR shall provide in the PEF study a diagram indicating
543 the organizational boundary, to highlight those activities under the control of the organization and
544 those falling into Situation 1, 2 or 3 of the Data Needs Matrix.

545 3.5. EF IMPACT ASSESSMENT

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

548 Table 3-4 List of the impact categories to be used to calculate the PEF profile

Impact category	Indicator	Unit	Recommended default LCIA method
Climate change[10]	Radiative forcing as Global Warming Potential (GWP100)	kg $CO_{2\ eq}$	Baseline model of 100 years of the IPCC (based on IPCC 2013)
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	UNEP 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)

[10] The sub-indicators 'Climate change - biogenic' and 'Climate change - land use and land transformation' shall not be reported separately because their contribution to the total climate change impact, based on the benchmark results, is less than 5% each.

Impact category	Indicator	Unit	Recommended default LCIA method
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[11] • Biotic production • Erosion resistance • Mechanical filtration • Groundwater replenishment	• Dimensionless (pt) • kg biotic production[12] • kg soil • m^3 water • m3 groundwater	• Soil quality index based on LANCA (EC-JRC)[13] • LANCA (Beck et al. 2010) • LANCA (Beck et al. 2010) • LANCA (Beck et al. 2010) • 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

*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.

**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.

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

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

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

The full list of normalization factors and weighting factors are available in Annex 1 - List of EF normalisation factors and weighting factors.

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

3.6. LIMITATIONS

This PEFCR refers only to dry pasta sold in retail and consumed after domestic or restaurant cooking (boiling process).

The main limitation when assessing the environmental footprint of dry pasta is the lack of information about the production of ingredients. Pasta manufacturing companies often buy semolina, flour, egg products and the other ingredients from suppliers, without having control or influence on the agricultural raw materials production and sourcing. Only a few big companies own mills. Suppliers buy cereals and other raw materials on the market, usually from traders or cooperatives, and therefore there is often no possibility for pasta manufacturers to have primary data about the agricultural production with a reasonable sample.

Results of a PEF study may be used for comparison with results of PEF studies realized on products belonging to the same product category and using the same PEFCR.

This PEFCR is technology-neutral from the perspective of the production of pasta ingredients. If there are differences between production techniques (such as tillage versus no-tillage for the crop production, or rainfed versus irrigated agriculture) in terms of environmental performance and if the PEFCR is applied properly with sufficient access to data, these differences will be identified in the results.

4. MOST RELEVANT IMPACT CATEGORIES, LIFE CYCLE STAGES AND PROCESSES

The most relevant impact categories for the product group in scope of this PEFCR are the following:

- Climate change
- Particulate matter
- Acidification
- Eutrophication, terrestrial
- Land use
- Resource use, fossils

The most relevant life cycle stages for the product group in scope of this PEFCR are the following:

- Ingredient production
- Pasta manufacturing
- Cooking phase

The most relevant processes for the product group in scope of this PEFCR are the following

Table 4-1 List of the most relevant processes

Impact category	Processes
Climate change	Durum wheat grain (from Ingredients production life cycle stage)
	Thermal energy from natural gas (from Pasta manufacturing and Cooking phase life cycle stages)
	Eggs (from Ingredients production life cycle stage)
	Electricity grid mix 1kV-60kV (from Ingredient production, Pasta manufacturing and Cooking phase life cycle stages)
Particulate matter	Eggs (from Ingredients production life cycle stage)
	Durum wheat grain (from Ingredients production life cycle stage)
Acidification	Eggs (from Ingredients production life cycle stage)
	Durum wheat grain (from Ingredients production life cycle stage)
Eutrophication, terrestrial	Eggs (from Ingredients production life cycle stage)
	Durum wheat grain (from Ingredients production life cycle stage)
Land use	Durum wheat grain (from Ingredients production life cycle stage)
	Eggs (from Ingredients production life cycle stage)
Resource use, fossils	Thermal energy from natural gas (from Pasta manufacturing and Cooking phase life cycle stages)
	Durum wheat grain (from Ingredients production)
	Electricity grid mix 1kV-60kV (from Ingredient production, Pasta manufacturing and Cooking phase life cycle stages)
	Eggs (from Ingredients production life cycle stage)

5. LIFE CYCLE INVENTORY

All newly created processes shall be EF-compliant.

Sampling procedure is allowed in order to limit the data collection only to a representative sample of raw materials, since ingredients usually come from multiple sites/geographical areas.

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.

The following procedure shall be applied in order to select a representative sample:

1) define the population
2) define homogenous sub-populations (stratification)
3) define the sub-samples at sub-population level
4) define the sample for the population starting from the definition of sub-samples at sub-population level.

Aspects at least to be taken into consideration in the identification of the sub-populations:

- Geographical distribution of sites
- Technologies/farming practices involved
- Production capacity of the companies/sites taken into consideration
- Climatic area

The number of sub-populations may be identified as:

$$Nsp = g * t * c \qquad \text{[Equation 1]}$$

- Nsp: number of sub-populations
- g : number of countries in which the sites/plants/farms are located
- t : number of technologies/farming practices
- c : number of classes of capacity of companies

In case additional aspects are taken into account, the number of sub-populations is calculated using the formula just provided and multiplying the result with the numbers of classes identified for each additional aspect (e.g., those sites which have an environmental management or reporting systems in place).

Once the sub-populations have been identified, for each sub-population the size of sample shall be calculated (the sub-sample size) based on the number of sites/farms/plants involved in the sub-population.

The required sub-sample size shall be calculated using the square root of the sub-population size.

$$n_{SS} = \sqrt{n_{SP}} \qquad \text{[Equation 2]}$$

- n_{SS}: required sub-sample size
- n_{SP}: sub-population size

More information about sampling procedure are reported in Annex 5 – Sampling procedure examples.

5.1. LIST OF MANDATORY COMPANY SPECIFIC DATA

There are three data-points for which it is mandatory to use company-specific data (i.e. primary data). Not using primary data for these processes means that the PEF study is not compliant with this PEFCR. These three data points are:

- The list of pasta ingredients and packaging materials (Bill of Materials, BoM)
- Energy consumption in pasta plant operation
- Outbound transport to distribution centre / retail

LIST OF PASTA INGREDIENT AND PACKAGING MATERIALS

The list of ingredients entails the following data:

- Types and quantity of flour
- Types and quantity of eggs
- Types and quantity of water
- Type and quantity of packaging materials

The country of origin of ingredients shall be recorded, if this information is provided in the transaction with the raw materials business operator.

It is not a requirement to use primary data for the production the different ingredients, but this option remains nevertheless available (see sections 6.1 and 6.2 for further details). If no primary data is used on the production of pasta ingredients, the next step in the modelling of the pasta is to connect each ingredient in the list to a default dataset.

ENERGY CONSUMPTION IN PASTA PLANT OPERATIONS

The data should be recorded according to the format in the table. In the fourth column, the method of measurement shall be explained. This includes the sources of information and any conversion of information and related assumptions.

Table 5-1 data collection requirements for mandatory Pasta manufacturing

Activity data to be collected	Specific requirements (e.g. frequency, measurement standard, etc)	Unit of measure	Quantity	Source and method of measurement (if relevant)
Yearly pasta production	1 year	t/year		
yearly electricity use	1 year	kWh/year		
yearly natural gas use	1 year	MJ/year		
yearly lubricant oil use	1 year	kg/year		

The activity data need then to be linked with the secondary data for energy provided in the excel file "Dry pasta PEFCR_3.0 – Life Cycle Inventory", accompanying this PEFCR and available on http://ec.europa.eu/environment/eussd/smgp/PEFCR_OEFSR.htm.

OUTBOUND TRANSPORT

The data to be collected for outbound transport (i.e. pasta delivery from the manufacturer plant to the distribution centre or retail) are:

- mass of pasta transported per year
- distribution centre/retail specific delivery distance
- transport type (truck, ship, train, airplane, etc) and payload

The next step is to link the data collected to the parameterized transport datasets as available in the EC datasets on transport http://lcdn.thinkstep.com/Node/.

5.2. LIST OF PROCESSES EXPECTED TO BE RUN BY THE COMPANY

In the case the pasta manufacturer produces itself the flour used in the recipe, it should use company specific data for milling process if available.

Table 5-2 data collection requirements for milling process

Activity data to be collected	Specific requirements (e.g. frequency, measurement standard, etc)	Unit of measure	Quantity		Source and method of measurement (if relevant)
Yearly flour and coproduct production	1 year	t/year			
yearly electricity use	1 year	kWh/year			
yearly natural gas use	1 year	MJ/year			
yearly water use	1 year	kg/year			

The activity data need then to be linked with the secondary data for water consumption provided in the excel file "Dry pasta PEFCR_3.0 – Life Cycle Inventory", accompanying this PEFCR and available on http://ec.europa.eu/environment/eussd/smgp/PEFCR_OEFSR.htm.

5.3. DATA GAPS

According to the PEF guide, data gaps exist when there is no specific or secondary (default) data available that is sufficiently representative of the given process in the product's life cycle.

When modelling the life cycle of dry pasta, if no primary data are available, secondary data may be used according to the recommendation given in this document. The only data gaps in default datasets listed in the PEFCR is related to plastic packaging material recycling, proxy data should be used:

- Recycling of polypropylene (PP) plastic – UUID 47a967ec-a648-4ede-afb6-23a2289baef9.

Data gaps on the company-specific data to be collected that most frequently are encountered by companies in the pasta sector are related to ingredients (e.g. spices) and cleaning agents, for which there may be no secondary data available. In such cases, according to the PEF guide, data gaps shall be filled using the best available generic or extrapolated data, following the rules in chapter 5.6 – Which datasets to use. The contribution of such data (including gaps in generic data) shall not account for more than 10% of the overall contribution to each EF impact category considered. This is reflected in

689 the data quality requirements, according to which 10% of the data can be chosen from the best
690 available data (without any further data quality requirements).

691 5.4. DATA QUALITY REQUIREMENTS

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

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

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

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

703 5.3.1 COMPANY SPECIFIC DATASETS

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

708 1) Select the most relevant sub-processes and direct elementary flows that account for at least
709 80% of the total environmental impact of the company-specific dataset, listing them from the
710 most contributing to the least contributing one.
711 2) Calculate the DQR criteria TeR, TiR, GR and P for each most relevant process and each most
712 relevant direct elementary flow. The values of each criterion shall be assigned based

3) Table 5-3.
    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 TeR-EF, TiR-EF, GR-EF, PEF in

b) Table 5-3. It shall be evaluated for example, the timing of the flow measured, for which technology the flow was measured and in which geographical area.

c) 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.

4) 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).
5) 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.
6) 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.
7) 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.
8) The applicant of the PEFCR shall the total DQR of the newly developed dataset using the Equation 2, where $\overline{\mathrm{Te_R}}, \overline{\mathrm{G_R}}, \overline{\mathrm{Ti_R}}, \overline{\mathrm{P}}$ are the weighted average calculated as specified in point 4).

Equation 2 $$\mathrm{DQR} = \frac{\overline{\mathrm{Te_R}}+\overline{\mathrm{G_R}}+\overline{\mathrm{Ti_R}}+\overline{\mathrm{P}}}{4}$$

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 $\overline{Te_R}, \overline{G_R}, \overline{Ti_R}, \bar{P}$ and the total DQR shall be multiplied with 1.375.

766 Table 5-3 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/literature and plausibility not checked by reviewer OR Qualified estimate based on calculations plausibility checked by reviewer	The data refers to maximum three annual administration periods with respect to the EF report publication date	Not applicable	Not applicable	Not applicable
4-5	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

767 ## 5.5. DATA NEEDS MATRIX (DNM)

768 All processes required to model the product and outside the list of mandatory company-specific (listed
769 in section 5.1) shall be evaluated using the Data Needs Matrix (see Table 5-4). The DNM shall be used
770 by the PEFCR applicant to evaluate which data is needed and shall be used within the modelling of its
771 PEF, depending on the level of influence the applicant (company) has on the specific process. The
772 following three cases are found in the DNM and are explained below:

773 1. Situation 1: the process is run by the company applying the PEFCR
774 2. Situation 2: the process is not run by the company applying the PEFCR but the company has
775 access to (company-)specific information.
776 3. Situation 3: the process is not run by the company applying the PEFCR and this company does
777 not have access to (company-)specific information.
778

779 Table 5-4 Data Needs Matrix (DNM)[14]. *Disaggregated datasets shall be used

780

		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 level 1 (DQR≤1.6) Calculate the DQR values (for each criterion + total)	
	Option 2		Use default secondary dataset in PEFCR, in aggregated form (DQR≤3.0) 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 level 1 (DQR≤1.6) Calculate the DQR values (for each criterion + total)	
	Option 2	Use company-specific activity data for transport (distance), and substitute the sub-processes used for electricity mix and transport with supply-chain specific EF compliant datasets (DQR≤3.0) 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 EF compliant datasets (DQR≤4.0) 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 data set in aggregated form (DQR≤3.0) Re-evaluate the DQR criteria within the product specific context	
	Option 2		Use default secondary data set in aggregated form (DQR≤4.0) Use the default DQR values

781

[14] The options described in the DNM are not listed in order of preference

5.4.1 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.

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.

5.4.2 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[15] (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.

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.

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

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. The criteria G_R shall be lowered by 30%[16] and the criteria P shall keep the original value.

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 5-5 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*

5.4.3 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)

[16] 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 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 chapter 5.4 shall be used.

5.8. ALLOCATION RULES

The main multi-output processes individuated in the life cycle of dry pasta are those reported in Table 5-6.

Table 5-6 - By-products/co-products considered in the different processes

Process	Main product	By-products/co-products
Cereals cultivation	Grain	Straw
Eggs production	Eggs	Hens for slaughter and manure from hens (when it is a valuable output of the farm)
Milling	Semolina/flour	Bran, germ, middling
Pasta production	Pasta	Pasta scraps

In case the applicant has other multi-functional processes, they shall follow the hierarchy below:

1) wherever possible, allocation should be avoided by dividing the unit process to be allocated into two or more sub-processes and collecting the input and output data related to these sub-processes; system expansion should be avoided because it can lead to arbitrary choices.
2) where allocation cannot be avoided and subdivision cannot be applied, the inputs and outputs of the system shall be partitioned between its different products in a way that reflects relevant underlying physical relationships between them.
3) Allocation based on some other relationship may be possible. For example, economic allocation refers to allocating inputs and outputs associated with multi-functional processes to the co-product outputs in proportion to their relative market values.

Allocation shall be conducted according to Table 5-7.

Table 5-7 – Allocation methods to be used

Process	Allocation	Modelling instructions
Cereals cultivation	Economic allocation	The economic value of the different outputs shall be used.
Milling	Economic allocation	The economic value of the different outputs shall be used.
Eggs production	Economic allocation	The economic value of the different outputs shall be used.
Pasta manufacturing	Physical allocation	The mass of the different outputs shall be used.

Default factors reported in Table 5-8 shall be used.

882 Table 5-8 - Default allocation factor to be used in case no primary data are available

Process	Main product	Allocation	Default allocation factor for the main product	Source
Cereals cultivation	Grain	Economic	100%	Worst case scenario. Straw is not harvested. All the environmental burden to grain.
Eggs production	Eggs	Economic	98.6%	Worst case scenario for manure (it is not sold to be used as fertilizer out of farm or fuel) and Agri-footprint database to hens for slaughter.
Milling	Semolina/flour	Economic	84%	Agri-footprint database
Pasta production	Pasta	By mass	100%	Worst case scenario. Pasta scraps are not sold and become waste. All the environmental burden to pasta. EoL formula shall be applied to pasta scraps.

883 ## 5.9. ELECTRICITY MODELLING

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

886 The following electricity mix shall be used in hierarchical order:

887 (i) Supplier-specific electricity product shall be used if:
888 (a) available, and
889 (b) the set of minimum criteria to ensure the contractual instruments are
890 reliable is met.
891 (ii) The supplier-specific total electricity mix shall be used if:
892 (a) available, and
893 (b) the set of minimum criteria that to ensure the contractual instruments are
894 reliable is met.
895 (iii) As a last option the 'country-specific residual grid mix, consumption mix' shall be used
896 (available at http://lcdn.thinkstep.com/Node/). Country-specific means the country in
897 which the life cycle stage occurs. This may be an EU country or non-EU country. The residual
898 grid mix characterizes the unclaimed, untracked or publicly shared electricity. This prevents
899 double counting with the use of supplier-specific electricity mixes in (i) and (ii).

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

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

902 The environmental integrity of the use of supplier-specific electricity mix depends on ensuring that
903 contractual instruments (for tracking) reliably and uniquely convey claims to consumers. Without this,
904 the PEF lacks the accuracy and consistency necessary to drive product/corporate electricity
905 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 (http://lcdn.thinkstep.com/Node/). In case the necessary dataset is not available, an alternative dataset shall be chosen according to the procedure described in section B.5.8. 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:

To subdivide the electricity consumption among multiple products for each process and to reflect the ratios of production/ratios of sales between EU countries/regions when a product is produced in different locations or sold in different countries follow the indication in Table 5-9. Where such data are not available, the average EU mix (EU-28 +EFTA), or region representative mix, shall be used.

Table 5-9 Allocation rules for electricity

Process	Physical relationship	Modelling instructions
Milling	Mass	Mass shall be used to calculate the ratios of production between EU countries/regions when a product is produced in different locations
Pasta production	Mass	Mass shall be used to calculate the ratios of production between EU countries/regions when a product is produced in different locations
Distribution	Mass	Mass shall be used to calculate the ratios of sales between EU countries/regions when a product is sold in different locations

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.

On-site electricity generation:

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[17].
- 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[18] 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 be used when modelling the foreground emissions: only the emission 'methane (biogenic)' is modelled, while no further biogenic emissions and uptakes from atmosphere are included. When methane emissions can be both fossil or biogenic, the release of biogenic methane shall be modelled first and then the remaining fossil methane

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

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

[18] 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.

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[19] 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.

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[20].

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

[19] Following the instantaneous oxidation approach in IPCC 2013 (Chapter 2).

[20] In case of variability of production over the years , a mass allocation should be applied.

- on 1 January of the year in which the assessment of GHG emissions and removals is being carried out.

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 be modelled, calculated and reported as additional environmental information: [to be answered by the TS: Yes/No] [If yes, the PEFCR shall specify which proof needs to be provided and include the modelling rules.]

The sum of the three sub-categories shall be reported. The sub-categories 'climate change – biogenic' and '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, retail, 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.

The Circular Footprint Formula is used to model the End-of-Life of products as well as the recycled content and is a combination of "material + energy + disposal", i.e.:

Material $(1 - R_1)E_V + R_1 \times \left(AE_{recycled} + (1 - A)E_V \times \frac{Q_{Sin}}{Q_p}\right) + (1 - A)R_2 \times \left(E_{recyclingEoL} - E_V^* \times \frac{Q_{Sout}}{Q_P}\right)$

Energy $(1 - B)R_3 \times (E_{ER} - LHV \times X_{ER,heat} \times E_{SE,heat} - LHV \times X_{ER,elec} \times E_{SE,elec})$

Disposal $(1 - R_2 - R_3) \times E_D$

With the following parameters:

A: allocation factor of burdens and credits between supplier and user of recycled materials.

B: allocation factor of energy recovery processes: it applies both to burdens and credits. It shall be set to zero for all PEF studies.

Qs_{in}: quality of the ingoing secondary material, i.e. the quality of the recycled material at the point of substitution.

Qs_{out}: quality of the outgoing secondary material, i.e. the quality of the recyclable material at the point of substitution.

Q_p: quality of the primary material, i.e. quality of the virgin material.

R_1: it is the proportion of material in the input to the production that has been recycled from a previous system.

R_2: it is the proportion of the material in the product that will be recycled (or reused) in a subsequent system. R2 shall therefore take into account the inefficiencies in the collection and recycling (or reuse) processes. R2 shall be measured at the output of the recycling plant.

R_3: it is the proportion of the material in the product that is used for energy recovery at EoL.

$E_{recycled}$ (E_{rec}): specific emissions and resources consumed (per functional unit) arising from the recycling process of the recycled (reused) material, including collection, sorting and transportation process.

$E_{recyclingEoL}$ (E_{recEoL}): specific emissions and resources consumed (per functional unit) arising from the recycling process at EoL, including collection, sorting and transportation process.

E_v: specific emissions and resources consumed (per functional unit) arising from the acquisition and pre-processing of virgin material.

E^*_v: specific emissions and resources consumed (per functional unit) arising from the acquisition and pre-processing of virgin material assumed to be substituted by recyclable materials.

EER: specific emissions and resources consumed (per functional unit) arising from the energy recovery process (e.g. incineration with energy recovery, landfill with energy recovery, …).

$E_{SE,heat}$ and $E_{SE,elec}$: specific emissions and resources consumed (per functional unit) that would have arisen from the specific substituted energy source, heat and electricity respectively.

ED: specific emissions and resources consumed (per functional unit) arising from disposal of waste material at the EoL of the analysed product, without energy recovery.

$X_{ER,heat}$ and $X_{ER,elec}$: the efficiency of the energy recovery process for both heat and electricity.

LHV: Lower Heating Value of the material in the product that is used for energy recovery.

Default values for the parameters A, Q_{sin}/Q_p and Q_{sout}/Q_p are provided in Table 5-10. The source for the parameter A is annex C of the Product Environmental Footprint Guidance.

1122 Table 5-10 Default values for the parameters A, Q_{sin}/Q_p and Q_{sout}/Q_p

Material	A	Q_{sin}/Q_p	Q_{sout}/Q_p
Cardboard	0.2	0.85	0.85
Plastic film	0.5	0.75	0.75

1123 Default data for waste logistics are provided in Table 5-11. The source of this data is the document
1124 "Default data for End of Life (EOL), version 1.2" prepared in the context of the PEF pilots.

1125 Table 5-11 – Default data for EoL logistic

Parameter	Transport modality	Distance (km)
Transport to disposal or incineration	Municipal waste collection truck	30
Transport to recycling	Truck	100

1126 Energy recovery shall be considered for incineration, with default recovery rates of 10% as electricity
1127 and 20% as heat.

1128 Specific data shall be used for post-consumer recycled content (R_1). Post-consumer recycled content is
1129 0% if this company-specific is not available.

1130 R2 is 0% for the product material, since no material in the product can be recycled (or reused) in a
1131 subsequent system; about packaging materials, R2 default value is 0.75 for the packaging paper and
1132 0.29 for the plastic packaging generic.

1133 Please refers to Annex C of PEFCR Guidance v 6.3 to R default values.

6. LIFE CYCLE STAGES

6.1. RAW MATERIAL ACQUISITION AND PRE-PROCESSING

Cereals cultivation and egg production are relevant processes for all the impact categories.

The following hierarchy shall be considered when collecting data:

1. specific data should be collected and used whenever they are available (i.e. when the commissioner of PEF study has access to cereals suppliers);
2. if specific data for cereals cultivation is not available, default datasets may be used.

Cereals milling is not a relevant process, but in some cases it is a under operational control.

Specific data should be used to model cereals milling if available (i.e. when the commissioner of PEF study has access to mill). In this case the specific data for cereal milling shall be used.

When specific data for milling process, cereal cultivation and egg production are not available, default dataset for flour may be used.

Table 6-1 Raw material acquisition and processing (capitals indicate those processes expected to be run by the company

Process name*	Unit of measurement (output)	Default				UUID	Default DQR				Most relevant process [Y/N]
		R_1	Amount per FU	Dataset	Dataset source		P	TiR	GR	TeR	
Egg acquisition	kg/kg	0%	0.0176	Eggs production mix at farm per kg	https://lcdn.quantis-software.com/PEF/	9191d0da-c27d-4066-9840-6efa7549e946	1.63	2.03	2.84	2.18	Y
Wheat flour	kg/kg	0%	1.03	Wheat flour; from dry milling, production mix at plant	http://lcdn.blonkconsultants.nl	a001c25c-13ef-4f0d-a2df-293817e598da	2.27	2.12	1.79	1.4	Y

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

For the different ingredients transported from supplier to factory, the default values for transport are provided in the table below.

Table 6-2 Raw material transport

Process name	Unit of measurement (output)	Default (per FU)			Default dataset	Dataset source	UUID	Default DQR				Most relevant [Y/N]
		Distance - km	Utilisation ratio	Empty return				P	TiR	GR	TeR	
Semolina /flour and egg transport to manufacturing plant	tkm	315	85% (as in the default dataset)	Included	Articulated lorry transport, Total weight 20-26 t, mix Euro 0-5 diesel driven, Euro 0 - 5 mix, cargo consumption mix, to consumer 20 - 26t gross weight / 17,3t payload capacity	http://lcdn.thinkstep.com/Node/	2a2b6056-87fe-4bc4-bcc6-c4c684b36a05	2	1	1	1	N

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

The reuse rate affects the quantity of transport that is needed per FU. The transport impact shall be calculated by dividing the one-way trip impact by the number of times this packaging is reused.

6.2. AGRICULTURAL MODELLING

Use of crop type specific and country-region-or-climate specific data for yield, water and land use, land use change, fertiliser (artificial and organic) amount (N, P amount) and pesticide amount (per active ingredient), per hectare per year, if available.

Cultivation data shall be collected over a period of time sufficient to provide an average assessment of the life cycle inventory associated with the inputs and outputs of cultivation that will offset fluctuations due to seasonal differences:

- For annual crops, an assessment period of at least three years shall be used (to level out differences in crop yields related to fluctuations in growing conditions over the years such as climate, pests and diseases, et cetera). Where data covering a three-year period is not available i.e. due to starting up a new production system (e.g. new greenhouse, newly cleared land, shift to other crop), the assessment may be conducted over a shorter period, but shall be not less than 1 year. Crops/plants grown in greenhouses shall be considered as annual crops/plants, unless the cultivation cycle is significantly shorter than a year and another crop is cultivated consecutively within that year. Tomatoes, peppers and other crops which are cultivated and harvested over a longer period through the year are considered as annual crops.
- Where the different stages in the cultivation cycle are known to be disproportional, a correction shall be made by adjusting the crop areas allocated to different development stages in proportion to the crop areas expected in a theoretical steady state. The application of such

correction shall be justified and recorded. The life cycle inventory of perennial plants and crops shall not be undertaken until the production system actually yields output.

- For crops that are grown and harvested in less than one year (e.g. spinach produced in 2 to 4 months) data shall be gathered in relation to the specific time period for production of a single crop, from at least three recent consecutive cycles. Averaging over three years can best be done by first gathering annual data and calculating the life cycle inventory per year and then determine the three years average.

Pesticide emissions shall be modelled as specific active ingredients. As default approach, the pesticides applied on the field shall be modelled as 90% emitted to the agricultural soil compartment, 9% emitted to air and 1% emitted to water.

Fertiliser (and manure) emissions shall be differentiated per fertilizer type and cover as a minimum:

- NH_3, to air (from N-fertiliser application)
- N_2O, to air (direct and indirect) (from N-fertiliser application)
- CO_2, to air (from lime, urea and urea-compounds application)
- NO_3, to water unspecified (leaching from N-fertiliser application)
- PO_4, to water unspecified or freshwater (leaching and run-off of soluble phosphate from P-fertiliser application)
- P, to water unspecified or freshwater (soil particles containing phosphorous, from P-fertiliser application).

The LCI for P emissions should be modelled as the amount of P emitted to water after run-off and the emission compartment 'water' shall be used. When this amount is not available, the LCI may be modelled as the amount of P applied on the agricultural field (through manure or fertilisers) and the emission compartment 'soil' shall be used. In this case, the run-off from soil to water is part of the impact assessment method.

The LCI for N emissions shall be modelled as the amount of emissions after it leaves the field (soil) and ending up in the different air and water compartments per amount of fertilisers applied. N emissions to soil shall not be modelled. The nitrogen emissions shall be calculated from Nitrogen applications of the farmer on the field and excluding external sources (e.g. rain deposition).

Table 6-3 Parameters to be used when modelling nitrogen emission in soil

Emission	Compartment	Value to be applied
N_2O (synthetic fertiliser and manure; direct and indirect)	Air	0.022 kg N_2O/ kg N fertilizer applied
NH_3 (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.1* (17/14)= 0.12 kg NH_3/ kg N fertilizer applied
NH_3 (manure)	Air	kg NH_3= kg N*FracGASF= 1*0.2* (17/14)= 0.24 kg NH_3/ kg N manure applied
NO_3^- (synthetic fertiliser and manure)	Water	kg NO_3^-= kg N*FracLEACH = 1*0.3*(62/14) = 1.33 kg NO_3^-/ kg N applied
P based fertilisers	Water	0.05 kg P/ kg P applied

Heavy metal emissions from field inputs shall be modelled as emission to soil and/or leaching or erosion to water. The inventory to water shall specify the oxidation state of the metal (e.g., Cr^{+3}, Cr^{+6}). As crops assimilate part of the heavy metal emissions during their cultivation clarification is needed on how to model crops that act as a sink. The following modelling approach shall be used:

The final fate of the heavy metals elementary flows are not further considered within the system boundary: the inventory does not account for the final emissions of the heavy metals and therefore shall not account for the uptake of heavy metals by the crop. For example, heavy metals in agricultural crops cultivated for human consumption end up in the plant. Within the EF context human consumption is not modelled, the final fate is not further modelled and the plant acts as a heavy metal sink. Therefore, the uptake of heavy metals by the crop shall not be modelled.

Methane emissions from rice cultivation shall be included on basis of IPCC 2006 calculation rules.

Drained peat soils shall include carbon dioxide emissions on the basis of a model that relates the drainage levels to annual carbon oxidation.

The following activities shall be included:

- Input of seed material (kg/ha)
- Input of lime (kg $CaCO_3$/ha, type)
- Machine use (fuel consumption in litres through time and field operation type)
- Crop yield (kg/ha)
- Input of fertilisers (NPK)
- Input of pesticides (herbicides, insecticide, fungicide) (specific active ingredient in kg/ha)
- Input of irrigation water (m^3/ha)

6.3. PACKAGING MATERIAL PRODUCTION

Packaging material production has been separated from the ingredient production because ingredient phase is a hot spot of the representative product.

The model of packaging material production should be based on company-specific data; a company-specific dataset should be created.

If specific data for packaging manufacturing are not available, default values in Table 6-4 shall be used.

1235 Table 6-4 Packaging material acquisition and processing (capitals indicate those processes expected to be run by
1236 the company

Process name*	Unit measureme (output)	Default				UUID	Default DQR				Most relevant process [Y/N]
		R_1	Amount per FU	Dataset	Dataset source		P	TiR	GR	TeR	
Packaging carton board acquisition	kg/kg	0%	0.0598	Carton board Kraft Pulping Process, pulp pressing and drying, box manufacturing production mix, at plant 280 g/m^2	http://lcdn.thinkstep.com/Node/	d05c4b39-2e68-43bb-9875-fba8fd1333a6	2	2	2	2	N
Packaging corrugated box	kg/kg	0%	0.0587	Corrugated box, uncoated Kraft Pulping Process, pulp pressing and drying production mix, at plant 280 g/m^2, R1=88%	http://lcdn.thinkstep.com/Node/	95051bb3-46cc-40c1-8b6d-6d58ac334bb9	2	1	1	1	N
Packaging plastic acquisition	m^2/kg	0%	0.264	Plastic Film, PP strapping raw material production, plastic extrusion production mix, at plant grammage: 0.576 kg/m^2, thickness: 630 µm	http://lcdn.thinkstep.com/Node/	a6c537ae-c15c-4802-b614-3ec30c2a7168	2	2	2	2	N

1237 The applicant shall report the DQR values (for each criterion + total) for all the datasets used.

1238 For the different ingredients transported from supplier to factory, the default values for transport are
1239 provided in the table below.

1240

1241 Table 6-5 packaging material transport

Process name	Unit of measurement (output)	Default (per FU)			Default dataset	Dataset source	UUID	Default DQR				Most relevant [Y/N]
		Distance - km	Utilisation ratio	Empty return				P	TiR	GR	TeR	
Packaging material transport to manufacturing plant	tkm	252	85% (as in the default datasets)	Included	Articulated lorry transport, Total weight 20-26 t, mix Euro 0-5 diesel driven, Euro 0 - 5 mix, cargo consumption mix, to consumer 20 - 26t gross weight / 17,3t payload capacity	http://lcdn.thinkstep.com/Node/	2a2b6056-87fe-4bc4-bcc6-c4c684b36a05	2	1	1	1	N

1242 *The applicant of this PEFCR shall always check the utilisation ratio applied in the default dataset and
1243 adapt it accordingly.

1244 The reuse rate affects the quantity of transport that is needed per FU. The transport impact shall be
1245 calculated by dividing the one-way trip impact by the number of times this packaging is reused.

1246 6.4. MANUFACTURING

1247 Pasta manufacturing is a relevant process.

1248 Activity data listed in Table 6-6 shall be collected for every plant involved in the manufactory of the
1249 analysed product. If data referring to the production lines used for the analysed product are available,
1250 they may be used, if not data referring to the whole production of the plant should be used. Activity
1251 data shall be gathered over a period of 12 months.

1252 Table 6-6 *Manufacturing (capitals indicate those processes expected to be run by the company)*

Activity data	Unit of measurement (output)	Quantity	Source and method of measurement (if relevant)
Electricity Use	kWh		
Fuel Consumption for Thermal Energy	MJ		
Water Consumption	L		
Auxiliary Material Consumption	Kg		
Transport Of Ingredients, Materials And Waste	kgkm		

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

The waste of products used during the manufacturing shall be included in the modelling.

Default loss rates per dry pasta is 10%, if no specific data are available. These shall be considered in the manufacturing stage in the raw material input quantity.

The pasta loss at production plant is assumed to be 50% trashed (i.e., incinerated and landfilled), 25% composting, 25% methanisation, if no specific data are available.

6.5. DISTRIBUTION STAGE

The transport from factory to final client (including consumer transport) shall be modelled within this life cycle stage. The final client is defined as pasta consumer.

In case supply-chain-specific information is available for one or several transport parameters, they may be applied following the Data Needs Matrix.

Specific data should be collected at least from the transport between the pasta manufacturer and the distribution centre. Specific data to be collected is the average distance for which the product is transported. When primary data on distribution are not available, the default data are: 300 km from the distribution centre to the point of sale and 0.38 km from the point of sale to consumer's home.

Table 6-7 *Distribution*

Activity data to be collected	Unit of measure	Quantity	Technology (EURO-class 1, 2, 3, 4, 5, 6)	Utilisation ration	Source and method of measurement (if relevant)
Transport from production plant to dc	kgkm				
Transport from production plant to dc	kgkm				
Transport from dc plant to retail	kgkm				
Transport from retail to consumer	km				

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

The waste of products during the distribution and retail shall be included in the modelling.

Default loss rates during distribution (due to broken product, not returning to the manufacturer) for pasta product is 1%; the raw material input quantity in the manufacturing stage shall be increased considering this loss.

6.6. USE STAGE

Since dry pasta does not require cold storage, only the preparation shall be considered in the use stage when developing a PEF study.

Pasta is prepared by cooking it in boiling salted water.

In the case of dry pasta cooking is:

- product dependent (cooking instruction are provided by the producer through label)
- a relevant process
- with low uncertainty for what concerns the inputs of energy, water and salt[21]

Cooking shall therefore be modelled applying the main function approach and results shall be reported separately from those of the other life cycle stages and not as additional environmental/technical information.

The hypothesis[22] to be considered for energy requirements are those reported in the IES PCR in the paragraph 9.1:

- Boiling phase: 0,18 kWh per kg of water;
- Cooking phase: 0,05 kWh per minute of cooking.

Hobs for cooking pasta can work with gas or electricity. The energy mix in the use phase should reflect ratios of sales between countries or regions. In case data are not available, the average European scenario to be considered is 83% gas and 17% electricity hobs. In this case, EU average datasets for gas and electricity shall be used for modelling.

Cooking time shall be considered as provided by the producer, usually provided on the pack.

The amount of water to be considered for cooking, in absence of indications provided by the producer, is 1 l every 100 g of pasta.

The amount of salt to be considered for cooking, in absence of indications provided by the producer, is 10 g for litre of water.

Dressing is not included in the system boundaries.

[21] Cooking time is usually provided by the producer, the amount of water and salt to be used are standard value for the sector and the energy consumption is derived from the PCR of the International EPD System. These factors are therefore considered with low uncertainty. No reliable data were found about waste water treatment. This process is therefore considered with high uncertainty.

[22] The cooking hypothesis come from in the IES PCR for uncooked pasta and they are reported in the paragraph 9.1 - http://www.environdec.com/en/PCR/Detail/?Pcr=5874

1301 Table 6-8 Use stage (capitals indicate those processes expected to be run by the company)

*Name of the process**	*Unit of measurement (output)*	*Default amount per FU*	*Default dataset to be used*	*Dataset source*	*UUID*	*Default DQR*				*Most relevant process (Y/N)*
						P	*TiR*	*GR*	*TeR*	
Tap water	*Kg*	10	Tap water| technology mix| at user| per kg water {EU-28+3}]	*https://lcdn.quantis-software.com/PEF/*	*212b8494-a769-4c2e-8d82-9a6ef61baad7*	*2,02*	*2,42*	*2,025*	*2,038*	*N*
Salt	*kg*	0.07	Sodium chloride powder production technology mix production mix, at plant 100% active substance	*http://ecoinvent.lca-data.com/*	*bd92e590-afa8-430c-8089-6491c32163f*	*2*	*1*	*2*	*2*	*N*
Cooking energy consumption	*kWh*	0,5	Electricity grid mix 1kV-60kV| AC, technology mix| consumption mix, at consumer| 1kV - 60kV {EU-28+3}	http://lcdn.thinkstep.com/node/	*34960d4d-af62-43a0-aa76-adc5fcf57246*	*2*	*1*	*1*	*1*	*Y*
Cooking energy consumption	*kWh*	2,3	Thermal energy from natural gas| technology mix regarding firing and flue gas cleaning| production mix, at heat plant| MJ, 100% efficiency {EU-28+3}	http://lcdn.thinkstep.com/node/	*81675341-f1af-44b0-81d3-d108caef5c28*	*2*	*1*	*1*	*1*	*Y*
Waste water treatment	*kg*	10	Waste water treatment, domestic waste water according to the Directive 91/271/EEC concerning urban waste water treatment plant EU-27 S	http://lcdn.thinkstep.com/Node/	*f5ec4a19-70da-406d-be31-a7eeef2f8372*	*2*	*2*	*2*	*2*	*N*

1302 The applicant shall report the DQR values (for each criterion + total) for all the datasets used.

1303 For the use stage the consumption grid mix shall be used. The electricity mix shall reflect the ratios of
1304 sales between EU countries/regions. To determine the ratio a physical unit shall be used (e.g. number
1305 of pieces or kg of product). Where such data are not available, the average EU consumption mix (EU-
1306 28 +EFTA), or region representative consumption mix, shall be used.

1307 Default pasta loss rates at consumer is 2%; the loss shall be considered in the raw material input
1308 amount.

1309 The pasta loss at home is assumed to be 50% trashed (i.e., incinerated and landfilled), 25% composted
1310 and 25% methanised.

6.7. PACKAGING END OF LIFE STAGE

The packaging end-of-Life stage is a life cycle stage that in general includes the waste of primary packaging. Transport from collection place to EOL treatment is included in the landfill, incineration and recycling datasets tendered by the EC.

Table 6-9 Packaging end of Life (capitals indicate those processes expected to be run by the company)

*Name of the process**	*Unit of measuremen*	*Default dataset to be used*	*Dataset source*	*UUID*	*Default DQR*				*Most relevant*
					P	*Ti_R*	*G_R*	*Te_R*	
Waste incineration of paper and board	*kg*	*Waste incineration of paper and board waste-to-energy plant with dry flue gas treatment, including transport and pre-treatment production mix, at consumer paper waste*	*http://lcdn.thinkstep.com/Node/*	*b6ce954d-deb4-4c16-907a-c67b71e1e8*	*2*	*1*	*1*	*2*	*N*
Landfill of paper and paperboard waste	*kg*	*Landfill of paper and paperboard waste landfill including leachate treatment and with transport without collection and pre-treatment production mix (region specific sites), at landfill site. The carbon and water content are respectively of 30%C and 22% Water (in weight %)*	*http://lcdn.thinkstep.com/Node/*	*86ff0001-4794-4df5-a1d4-083a9d986b6*	*2*	*2*	*2*	*2*	*N*
Waste incineration of plastics	*kg*	*Waste incineration of plastics (unspecified)| waste-to-energy plant with dry flue gas treatment, including transport and pre-treatment| production mix, at consumer| unspecified plastic waste*	*http://lcdn.thinkstep.com/Node/*	*8137b889-a1d8-4109-8aa7-e2aaee38fa5f*	*2*	*1*	*1*	*2*	*N*
Landfill of plastic waste	*kg*	*Landfill of plastic waste landfill including leachate treatment and with transport without collection and pre-treatment production mix (region specific sites), at landfill site. The carbon and water content are respectively of 62%C and 0% Water (in weight %)*	*http://lcdn.thinkstep.com/Node/*	*f2bea0f5-e4b7-4a2c-9f34-4eb32495cbc*	*2*	*2*	*2*	*2*	*N*

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

The end of life shall be modelled using the formula and guidance provided in chapter 'End of life modelling' of PEFCR Guidance version 6.3 together with the default parameters listed in the table below.

Before selecting the appropriate R_2 value, an evaluation for recyclability of the material shall be done. The evaluation for recyclability includes evidence for the following three criteria (as described by ISO 14021:1999, section 7.7.4 'Evaluation methodology'):

1. The collection, sorting and delivery systems to transfer the materials from the source to the recycling facility are conveniently available to a reasonable proportion of the purchasers, potential purchasers and users of the product;
2. The recycling facilities are available to accommodate the collected materials;
3. Evidence is available that the product for which recyclability is claimed is being collected and recycled.

Point 1 and 3 can be proven by recycling statistics (country specific) derived from industry associations or national bodies. Approximation to evidence at point 3 can be provided by applying for example the design for recyclability evaluation outlined in EN 13430 Material recycling (Annexes A and B) or other sector-specific recyclability guidelines if available[23].

Following the evaluation for recyclability, the appropriate R_2 values (supply-chain specific or default) shall be used. If one criteria is not fulfilled or the sector-specific recyclability guidelines indicate a limited recyclability an R_2 value of 0% shall be applied.

Company-specific R_2 values (measured at the output of the recycling plant) shall be used when available. If no company-specific values are available and the criteria for evaluation of recyclability are fulfilled (see below), application-specific R_2 values shall be used as listed in the table below,

- If an R_2 value is not available for a specific country, then the European average shall be used.
- If an R_2 value is not available for a specific application, the R_2 values of the material shall be used (e.g. materials average).
- In case no R_2 values are available, R_2 shall be set equal to 0 or new statistics may be generated in order to assign an R_2 value in the specific situation.

The applied R_2 values shall be subject to the PEF study verification.

The reuse rate determines the quantity of packaging material (per product sold) to be treated at end of life. The amount of packaging treated at end of life shall be calculated by dividing the actual weight of the packaging by the number of times this packaging was reused.

For the representative products, all secondary and tertiary packaging is assumed to be 100% recycled.

Data used for end-of-life logistics and treatment are summarized Table 6-10 based on Eurostat statistics (European Commission, 2017). The lower heating values (LHVs) for each type of packaging material are also included.

Table 6-10 Default parameters for waste collection and treatment

Packaging material	Recycling (R2)	Incineration	Landfill	LHV (MJ/kg)
Mixed plastics	29%	32%	39%	30.79
Cardboard	75%	11%	14%	15.92
Paper	75%	11%	14%	14.12

[23] E.g. the EPBP design guidelines (http://www.epbp.org/design-guidelines), or Recyclability by design (http://www.recoup.org/)

7. PEF RESULTS

7.1. BENCHMARK VALUES

In this section benchmark results are provided.

Table 7-1 Characterised benchmark values for 1 kg of dry pasta

Impact category	Unit	Life cycle excl. use stage	Use stage
Climate change	kg $CO_{2\ eq}$	2.11E+00	8.11-01
Ozone depletion	kg CFC-11 $_{eq}$	6.26E-08	1.22E-10
Particulate matter	disease incidence	3.30E-07	8.34E-09
Ionising radiation, human health	kBq $^{235}U_{eq}$	1.740-01	9.18E-02
Photochemical ozone formation, human health	kg NMVOC $_{eq}$	8.25E-03	8.57E-04
Acidification	mol $H^{+}{}_{eq}$	4.48E-02	1.06E-03
Eutrophication, terrestrial	mol N $_{eq}$	1.90E-01	2.74E-03
Eutrophication, freshwater	kg P $_{eq}$	4.63E-04	1.37E-05
Eutrophication, marine	kg N $_{eq}$	1.77E-02	3.34E-04
Land use	Dimensionless (pt)	6.40E+02	5.34E-01
Water scarcity	m^3 deprivation	9.80E-01	3.62E-01
Resource use, minerals and metals	kg Sb $_{eq}$	6.28E-06	9.69E-08
Resource use, fossils	MJ	2.30E+01	1.30E+01

Table 7-2 Normalised benchmark values for 1 kg of dry pasta

Impact category	Life cycle excl. use stage	Use stage
Climate change	2.72E-04	1.05E-04
Ozone depletion	2.68E-06	5.24E-09
Particulate matter	5.19E-04	1.31E-05
Ionising radiation, human health	4.13E-05	2.18E-05
Photochemical ozone formation, human health	2.03E-04	2.11E-05
Acidification	8.06E-04	1.91E-05
Eutrophication, terrestrial	1.07E-03	1.55E-06
Eutrophication, freshwater	1.82E-04	5.36E-06
Eutrophication, marine	6.25E-04	1.18E-05
Land use	4.80E-04	4.00E-07
Water Scarcity	8.54E-05	3.15E-05
Resource use, minerals and metals	1.09 E-04	1.67 E-06
Resource use, fossils	3.53E-04	1.99E-04

Table 7-3 Weighted benchmark values for 1 kg of dry pasta

Impact category	Life cycle excl. use stage	Use stage
Climate change	6.03E-05	2.32E-05
Ozone depletion	6.03E-05	2.32E-05
Particulate matter	4.95E-05	1.25E-06
Ionising radiation, human health	2.22E-06	1.17E-06
Photochemical ozone formation, human health	1.04E-05	1.08E-06
Acidification	5.35E-05	1.27E-06
Eutrophication, terrestrial	4.19E-05	6.06E-07
Eutrophication, freshwater	5.36-06	1.59E-7
Eutrophication, marine	1.95E-05	3.69E-07
Land use	4.04E-05	3.37E-08
Water scarcity	7.72E-06	2.85E-06
Resource use, minerals and metals	8.77E-06	1.35E-07
Resource use, fossils	3.15E-05	1.77E-05
TOTAL	**3,91E-04**	**7,30E-05**

The toxicity impact categories are excluded from the hot spot analysis, as per PEF guidance 6.3.

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 additional technical information listed in Table 7-4 shall be reported in the PEF study.

Table 7-4 Additional technical information that shall be reported

Information	How to report the information
Geographical origin of the ingredients (i.e. agricultural raw materials)	Indication of country of origin of primary ingredient and other ingredients shall be given. In such event, provisions of art. 26, Regulation (EU) n. 1169/2011 apply.
Biogenic carbon content	Physical content and allocated content of biogenic carbon stored at the factory gate

7.4. ADDITIONAL ENVIRONMENTAL INFORMATION

The additional environmental information listed in Table 7-5 shall be reported in the PEF study.

Table 7-5 Additional environmental information that shall be reported

Information	How to report the information
Environmental certifications of the plants (e.g. ISO 14001, EMAS)	Percentage of plants producing the product subject to PEFCR having a certified EMS

The company should also report the results of verified studies carried out to assess the benefit due to practices adopted to reduce the environmental impact of cooking (e.g. use of less water).

Biodiversity is a relevant issue for pasta production and it is measured through 6 impact categories assessed by the EF method (climate change, eutrophication aquatic freshwater, eutrophication aquatic marine, acidification, water use, land use). Biodiversity should also be measured through the percentage of ingredients coming from organic production.

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 version 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 with24;
- 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

[24] Available at: http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml

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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The International EPD System (2016)	The International EPD System (2016). Product Category Rules 2013:05 Arable crops (Version 2.0)
The International EPD System (2016)	The International EPD System (2016). Product Category Rules 2013:04 Grain mill product (Version 2.0)

10. ANNEX 1 – LIST OF EF NORMALISATION AND WEIGHTING FACTORS

10.1. NORMALISATION FACTORS FOR ENVIRONMENTAL FOOTPRINT

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

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.
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			

1443 ## 10.2. 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**

1444

11. ANNEX 2 – 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			

12. ANNEX 3 – CRITICAL REVIEW REPORT OF THE PEFCR

Only the comments have been reported here. The editorial comments have not been reported here.

First round of review: Draft PEFCR dry pasta – version of 24/11/2016 for remodelling and review

Subject	Page	Line number	Section	Figure / Table / Note	Type of comment (i.e. G, T, E)[1]	Comment (justification for change)	Proposed change	Answer from the TS
Format	-	-			G	The format of the draft PEFCR is written in a way that is a mix of guidance and documentation of the pilot project. Some of the information could probably be left out, or moved to appendix B-XI (currently missing). The document should also be checked for inconsistencies in spacing, subscript, figures and more.	Remove or move unneccessary contents from the main part of the PEFCR.	The document has been revised accordingly. Some contents have been moved to the annex BACKGROUND INFORMATION ON METHODOLOGICAL CHOICES TAKEN DURING THE DEVELOPMENT OF THE PEFCR
System boundaries	19	444	4,4	-	T	Other cereals are used for several reasons rather than in some countries	Replace the text as follow: "Other cereals or different ingredients are used in the production of gluten-free pasta, multigrain pasta, high-protein pasta. These products even if widely present on the market are not significant for this study".	The proposal has been accepted
By-products considered in the different processes	20	473	4,4	Table 2	T	Because of the increasing importance as raw material in the biogas production, manure from hens has to be considered as byproduct of the egg production.	Add "manure" in the list of by-products of egg production.	The proposal has been accepted
Cut-off	23	487	4.4	-	T	Cut-offs are not allowed according to the PEF Guide (see e.g. page 138)	Include all processes in system boundaries, including capital goods, etc. If not, this should be highlighted in the submission for approval by SC/TAB.	These cuts-off have been already subjected to vote by SC

Impact on biodiversity	27-28	588 to 604	4,6		T	While the specific environmental impacts are often difficult to measure it is clear that food supply, production and consumption has a direct impact on biodiversity. The food system, largely through primary production, contributes to biodiversity pressures. Agriculture, by necessity, involves an altering of natural vegetation, and as a result, production in agriculture systems has an impact on land and water on and around the farm, with consequences for native biodiversity. Agricultural activities such as the introduction of exotic species, the use of pesticides and fertilisers, and land clearing lead to increate vulnerability to pests, habitat loss and destruction and overall biodiversity decline.	This issue shoud be discussed, because it is central to the national and international policy debate, and for general understanding of the risks that resource limitation and declining biodiversity pose to our societies' well-being and economic stability. Even if supply-chain data is currently lacking, the PEFCR should contain requirements that strive for future lower impact on biodiversity and for the development of systems for better tracability and indicators. A suggestion could be to use a multi-year average if different agricultural sources with different impact on biodiversity vary greatly between different years.	The TS discussed on this. Currently there are not widespreaf methodologies to assess and monitoring biodiversity. It can not be the role of the TS of the pilot to provide requirements to lower the impact of biovidersity in the future and to develop.systems for better tracability and indicators.
Food waste impact	28	606	4,6	Table 6	T	Avoiding food waste is an important issue. Food waste and/or by-products at production and at use phase should be considered somehow.	Add qualitative requirements regarding food waste and/or by-products.	By-products during the production phase is accounted according to the allocation rules provided in the PEFCR. No food waste occurs during the production phase. Food waste during the use phase is something out of control of the companies. Furthermore dry pasta is a product with a very long shelf life (more than 2 years), therefore food waste during the use phase is supposed to be minimal.
Food waste impact	44	892	5,3		T	In the end-of-life stage paragraph it would be interesting to consider the environmental impact of pasta waste	Add requirement to describe how food waste in the use phase is handled, e.g. as additional information.	Food waste during the use phase is something out of control of the companies. Furthermore dry pasta is a product with a very long shelf life (more than 2 years), therefore food waste during the use phase is supposed to be minimal.
Use phase scenario	45	906	5.3	-	T	The defined use phase scenario is an average European mix. Different manufacturers and products may, however, be sold in different ratio to different countries. According to the PEF Guide, the energy mix in the use phase shall reflect ratios of sales between countries or regions.	Modify scenario to allow companies to define their own scenario based on ratio sold in different countries (energy mix, cooking time, pot material, etc.)	The sentence has been rephrased to allow companies to use the specific mix.

System expansion	49	1020	5,5	-	T	System expansion is a preferred method in the PEF Guide to solve multifunctionality rather than allocation (PEF Guide page 59).	Include system expansion in decision hierarchy above allocation. If not, this should be highlighted in the submission for approval by SC/TAB.	The document with this hierarchy has been already voted by the SC
System expansion	50	1033	5,5	-	T	System expansion is a preferred method in the PEF Guide to solve multifunctionality rather than allocation (PEF Guide page 59).	Include system expansion in decision hierarchy above allocation. If not: subject to approval by SC/TAB.	The document with this hierarchy has been already voted by the SC
Benchmark	51	1040	6,1	-	T	Benchmark is missing. Confirming benchmarks (and performance, classes if relevant) shall be part of at least one consultation step with the relevant stakeholders (PEF Guidance v5.2 §3.2).	Include benchmark in PEFCR and allow stakeholders to comments on the proposal in a new open consultation. If not, this should be highlighted in the submission for approval by SC/TAB.	How the benchmark willl be calculated has been now reported. The TS doesn't want to disclose the benchmark values since they will change after remodelling.
Comparisons	52	1059	7	-	T	According to this table, comparisons of PEF profiles are not possible for all products covered by the scope of the PEFCR. This is contradictory to the choice of scope of PEFCR and purpose of the PEFCR (incl. a single representative product) to allow comparisons.	Remove statement that comparisons are not possible, or adjust PEFCR to allow for comparisons (quantitative or qualitative) to allow comparisons to be made.	The statement has been rephrased to allow comparison within the product category
PEF label	52	1078	8	Table 29	T	Justification missing for choosing the three selected impact categories in a PEF label. Required by PEF Guidance v5.2 §3.12.1.	Add justification for choice of three environmental impacts for PEF label in §4.5. Currently, only a justification for seven impact categories are available (page 25).	Jstification has been added in parapraph 4.5
Ingredient composition	58	1201	12,1	Annex 1	T	The moisture content of liquid pasteurized egg is about 75%. A product with dry matter of 35% in not available on the market.	Replace "65%" with "75%"	"65%" has been repèhrased with "75%"
Cooking procedure	57	1222	12,1	Annex 1	T	The default scenario considers a stainless steel pot for cooking the pasta. The diffusion of aluminum pots in the European market should be considered, but no data is shown	The default scenario should consider the most common tools in the European market.	Pot is not considered in the system boundaries. To avoid misundrstatements the worfs "stainless steel" have been removed
Benchmark	69	1469	14	-	T	Benchmark is missing. See above.	-	See answer above
Data set for avoided virgin production	75	1594	18	-	E	Data is missing for what default data to use to model.	Add reference to upcoming data recommendation for avoided virgin production from crosscutting Packaging Working Group.	In table 36 it is now specified that those datasets can be used also for avoided impacts in the EoL stage

Second round of review: Draft PEFCR dry pasta – version of 22/12/2017 for remodelling and review

Subject	Page	Line number	Section	Figure / Table / Note	Type of comment (i.e. G, T	Comment (justification for change)	Proposed change	Answer from the TS
Envifood	18	452	2,7	-	T	Envifood is missing as a reference. It shall be used as complementary guidance according to the PEFCR Gudiance v6.3, page 23.	Clarify reference to Envifood (even if it has not been used).	The Envifood protocol has not been used as a reference.
Limitations of scope	19	464	3	-	T	The following limitations in scope (from other parts of the PEFCR) appear to be missing from the list (PEFCR Guidance page 33): - Only pasta made from wheat (e.g. not mixed in with bean flour) - Only pasta sold in retail - Only pasta where the use phase is in a domestic setting - Only pasta where the use phase is boiling of the product (e.g. not plates of lasagne)	Add limitations to Section 3, or add/update guidance elsewhere in document regarding upstream (e.g. bean cultivation and flour production) and downstream processes (transportation and use phase requirements in non-domestic use).	The section has been updated and the limitation has been added
Functions not captured by FU	20	485	3,3	-	T	Are there any functions of the product not captured by the chosen FU (long shelf life, nutritional benefits, etc.)? If so, they should be listed according to the PEFCR Guidance (page 44).	Add list of functions not captured by the FU, if any	The TS doesn't see function not caputured by the FU
Definition of reference flow	20	486	3,3	-	T	The reference flow is not fully defined: 1 kg leaving the factory, 1 kg leaving retail, 1 kg being cooked, 1 kg being consumed. With losses, these amounts may differ. According to the PEFCR Guidance (page 44), it shall be defined at the product consumption level.	Specify where 1 kg reference flow is to be defined (at consumption according to PEF Guidance).	The reference flow as it is, has been verified and validated by the SC, so we can not change it. An additional sentence specifying that it is not relevant for results has been added.
Justification for excluded processes	22	500	3,4	Table 3-3	T	The justification in the table do not refer back to the results of the screening study.	Add references to the screening study, where the results have demonstrated that these processes are negligible.	The justification has been changed.
Processes run by the company applying the PEFCR	29	598	5,2	-	T	The current text seem to imply that only companies with in-house cereal cultivation and egg production may use the PEFCR to perform a study (PEFCR Guidance page 23)	Revise text unless this exclusion of companies to use the PEFCR is intentional.	The text has been revised
By-products considered in the different processes	38	806	5,8	Table 5-8	T	Because of the increasing importance as raw material in the biogas production, manure from hens has to be considered as byproduct of the egg production.	Add "manure" in the list of by-products of egg production. This addition may require a change to the allocation procedure used for egg production (Table 5-9) if mass allocation is no longer the best option.	The proposal has been accepted
Decision hierarchy for multifuntional processes	38	812	5,8	-	T	There is a missing step in the decision hierarchy. Direct substitution is a preferred options to solve allocation problems that cannot be avoided in the PEFCR Guidance v6.3 (page 62).	Add missing step in decision hierarchy in accordance with PEF Guidance.	The hierarchy step has been moved from the end of the paragraph.

Allocation factors	38	815, 817	5,8	Table 5-10	T	The text specifies that primary data for allocation factors shall be used if available. This is not allowed by the PEFCR Guidance v6.3 (page 64), which says that these factors shall be fixed for all PEF studies based on the PEFCR.	Remove text that primary data for allocation factors shall be used if available.	The proposal has been accepted
R2	44	1022	5,11	-	T	Default values for R2 for packaging is missing.	Add missing default R2 values for packaging.	Missing values have been added
Agricultural modelling	48	1069	6,2	-	T	Perennial plants are not involved in the production of raw material for dry pasta	Review if it is necessary to report this part and in case add any suitable example As this is part of the PEFCR template, perhaps a footnote may be added with a more relevant example?	The reference has been removed
Agricultural modelling	48	1078	6,2	-	T	Lettuce is not of interest in producing dry pasta	It could be used a different example: e.g. spinach powder is widly used as secondary ingredient in dry green pasta As this is part of the PEFCR template, perhaps a footnote may be added with a more relevant example?	The proposal has been accepted
Losses during distribution	51	1048	6,4	-	T	Default losses of 1% during distribution (PEFCR Guidance v 6.3, Annex H) are missing.	Add default losses of 1%. See also comment about definition of reference flow.	The loss has been added
Waste management of losses during distribution	51	1048	6,4	-	T	Add assumption regarding waste management of losses during distribution (PEFCR Guidance v6.3, Annex H): *Food losses at distribution center, during transport and at retail place, and at home: assumed to be 50% trashed (i.e., incinerated and landfilled), 25% composting, 25% methanisation.*	Add missing assumptions	Assumption has been added
Language	49	1106	6,2	-	T	"Cr+3 and Cr+6" have been used for Cr^{+3} and Cr^{+6}	Please use: Cr^{+3} and $Cr^{+6:}$ or "Cr(III) and Cr (VI) As this is part of the PEFCR template, perhaps it may be communicated to the EC?	The proposal has been accepted
Text	50	1133	6,3	Table 6-3	T	You can read: "water conumption"	Replace with: "water consumption"	The proposal has been accepted
Data set for salt	53	1175	6,5	Table 6-5	T	Default data set for salt is missing.	Add default data set for salt	The data has been added
Waste water management	53	1181	6,5	-	T	Instructions on whether to include waste water management or not is missing. See PEFCR Guidance page 108 and the example they include for pasta.	Add instructions on whether to include waste water management. If not, add to excluded processes (section 3.4).	Wastewater treatment has been added
Losses during use phase	53	1181	6,5	-	T	Default losses of 2% during consumer phase (PEFCR Guidance v 6.3, Annex H) are missing.	Add default losses of 2%. See also comment about definition of reference flow.	The loss has been added
Waste management of losses during use phase	53	1181	6,5	-	T	Add assumption regarding waste management of losses during use phase (PEFCR Guidance v6.3, Annex H): *Food losses at distribution center, during transport and at retail place, and at home: assumed to be 50% trashed (i.e., incinerated and landfilled), 25% composting, 25% methanisation.*	Add missing assumptions	Assumption has been added

Waste management of losses during distribution and use phase	53	1184	6,6	-	T	The exclusion of waste management of food waste appears to be inconsistent with the PEF Guidance.	Remove sentence that food waste is not considered.	The proposal has been accepted
Benchmark value water scarcity	56	1235	7,1	Table 7-1	T	Benchmark value for water scarcity missing.	Add benchmark value.	Benchmark value has been added after latest remodelling results
Ionising radiation, Human health	56	1235	7,1	Table 7-1	T	You can read: kBq $U^{235}{}_{eq}$	Replace with: kBq $^{235}U_{eq}$ As this is part of the PEFCR template, perhaps it may be communicated to the EC?	The proposal has been accepted
Benchmark value eutrophication	56	1235	7,1	Table 7-1, Table 7-2, Table 7-3	T	Benchmark values for eutrophication for use phase are below zero. How should this number be used?	Add clarification on use	Error in the remodelling, corrected with the latest remodelling results
Biodiversity	58	1262	7,4	-	T	Justification for exclusion of biodiversity is missing in accordance with the PEFCR Guidance v6.3 (section 7.12). Impact on biodiversity of non-organic agriculture is missing; it should be explained why, at least. The impact categories reported does not cover all aspects of e.g. pesticide use in agriculture where endocrine disruptor effect may be relevant.	Add biodiversity or justify its exclusion. Consider if any additional environmental information may be added related to pesticide use.	The TS already discussed on biodiversity issue after during the first review. Currently PEF method includes at least 6 impact categories that have an effect on biodiversity and the TS prefers not to add a specific biodiversity indicators, since there are not widespreaf methodologies to assess and monitoring this indicators. An explanatin has been added in 7,4 paragraph
Text	58	1262	7,4	-	E	It seems to be present a note of the editing: "Biodiversity is considered relevant for this PEFCR: NO]"	remove: "Biodiversity is considered relevant for this PEFCR: NO]" As this is part of the PEFCR template, perhaps it may be communicated to the EC?	The proposal has been accepted
Version number	59	1269	8	-	E	Version number of PEFCR Guidance (6.3) missing.	Add version number.	The version number has been added
Ionising radiation, Human health	62	1319	10,1	-	T	You can read: kBq $U^{235}{}_{eq}$	Replace with: kBq $^{235}U_{eq}$ As this is part of the PEFCR template, perhaps it may be communicated to the EC?	The proposal has been accepted
Acidification	62	1319	10,1	-	T	You can read: mol $H+_{eq}$	Replace with: mol $H^{+}{}_{eq}$ As this is part of the PEFCR template, perhaps it may be communicated to the EC?	The proposal has been accepted

13. ANNEX 4 – REPRESENTATIVE PRODUCT

REPRESENTATIVE PRODUCT

The Technical Secretariat performed an analysis on the European market to individuate the representative product. One of the main issue was the lack of EU overall data. Data available about production, consumption, export and import in the main pasta producing and consuming countries are reported in Figure 13-1Error! Reference source not found..

Figure 13-1 Pasta market in the main European countries in 2013 (Source: UNAFPA)

	Austria	Belgium	Czech Republic	France [1]	Germany	Greece	Italy [3]	Netherlands [5]	Portugal	Spain	Sweden [6]	United Kingdom [7]
Manufacturers	n.a.	1	2	8	20	4	120	1	1	7	1	8
Employees	n.a.	n.a.	300	1,121	2,000	n.a.	7,500	57	n.a.	n.a.	35	n.a.
Production *(tons)*	n.a.	n.a.	70,000	241,573	[2] 334,179	170,000	3,408,499	23,335	77,500	260,288	20,200	35,000
Export *(tons)*	52,437	[4] 136,306	[4] 36,036	32,639	42,131	55,324	1,901,354	[4] 34,469	[4]15,694	40,326	[4] 6,775	[4] 10,911
- Third countries	2,710	4,240	498	14,380	10,760	18,925	641,927	2,222	6,225	4,184	4,933	708
- U.E.	49,727	132,066	35,540	18,259	31,995	36,399	1,259,426	32,247	9,469	36,142	1,842	10,203
Import *(tons)*	64,830	[4] 81,973	[4] 29,800	307,419	359,846	12,077	35,959	[4] 100,197	[4]21,916	31,654	[4] 54,212	[4]169,989
- Third countries	11,281	4,127	1,061	12,283	10,760	533	3,405	6,221	325	3,771	2,648	6,819
- U.E.	53,549	77,846	28,739	295,136	349,086	11,544	32,554	93,976	21,591	27,883	51,564	163,170
Total consumption *(tons)*	n.a.	n.a.	60,000	512,465	[2] 654,371	127,000	1,507,145	n.a.	70,000	251,616	81,000	135,000
Per capita consumption *(kg)*	[8] 5.6	n.a.	6.0	8.1	[2] 8.0	11.5	25.3	n.a.	6.7	5.3	9.0	2.5
Raw materials:												
- wheat *(tons)*	n.a.	n.a.										n.a.
- durum wheat	-	-	20%	367,244	500,000	255,000	4,300,000	10,112	100,500	369,608	11,900	-
- soft wheat	-	-	70%	-	-	-	-	12,774	-	-	8,800	-
- eggs *(tons)*	n.a.	n.a.	10%	8,127	46,000	60	111,500	-	n.a.	2,180	n.a.	n.a.

Pasta imported from non-EU countries represents the 2% of the amount consumed (Source of Data: Eurostat/Global Trade Atlas). In the study production of pasta outside Europe will not therefore be considered, but it's reasonable to estimate that technologies used are not so different from those used in Europe.

Data for the definition of the representative product were asked to all the national associations of pasta producers. Some production data were available also from all the countries, but some were found available only from Italy. Since the 81% of pasta consumed in Europe is produced in Italy, they can be considered representative for the EU market. The experts of the TS agreed that there are not relevant differences of technologies between Italy and the other European countries.

Table 13-1 Dry pasta production in Italy in 2013 (Source: AIDEPI)

	Amount (tons)	Economic value (million €)	Sales share
Dry semolina pasta	2.972.064	3.122	88%
Dry egg pasta	165.047	435	12%
Total	3.137.111	3.557	100%

The two main typologies of dry pasta produced are dry pasta from durum wheat semolina (without eggs) and dry egg pasta. Their shares considering Italian production are those reported in Table 13-1.

The Technical Secretariat, based on data about raw materials consumption reported in **Error! Reference source not found.**, agreed on the fact that most of the dry egg pasta in Europe is made with durum wheat semolina.

It was therefore estimated that a little share of the whole European production is made with soft wheat flour (in Italy by law pasta can be made only with durum wheat, but in other countries there is not this limitation). Using the information of raw materials consumption reported in **Error! Reference source not found.Error! Reference source not found.** this share was estimated to be 1% of the total dry pasta production.

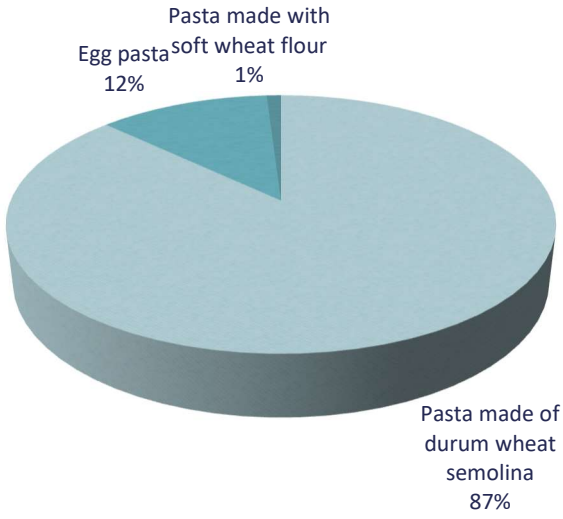
According to the guidance for PEFCR development: the representative product represents all products covered by the PEFCR. The representative product may or may not be a real product that one can buy on the EU market. When the market is made up of different technologies, the "representative product" may be a virtual (non-existing) product with the average EU sales-weighted characteristics of all technologies around. The representative product is the basis of the PEF screening which provides insight into the relevant life cycle stages, processes and impact categories of the product category (including the identification of processes for which primary data are requested).

The TS decided to individuate a single virtual representative product, since relevant differences among technologies were not individuated to justify the definition of different representative products.

The representative product is therefore being a **single virtual product**, constituted by the main typologies of dry pasta weighted according to their share in the market (Figure 13-2). The main typologies are:

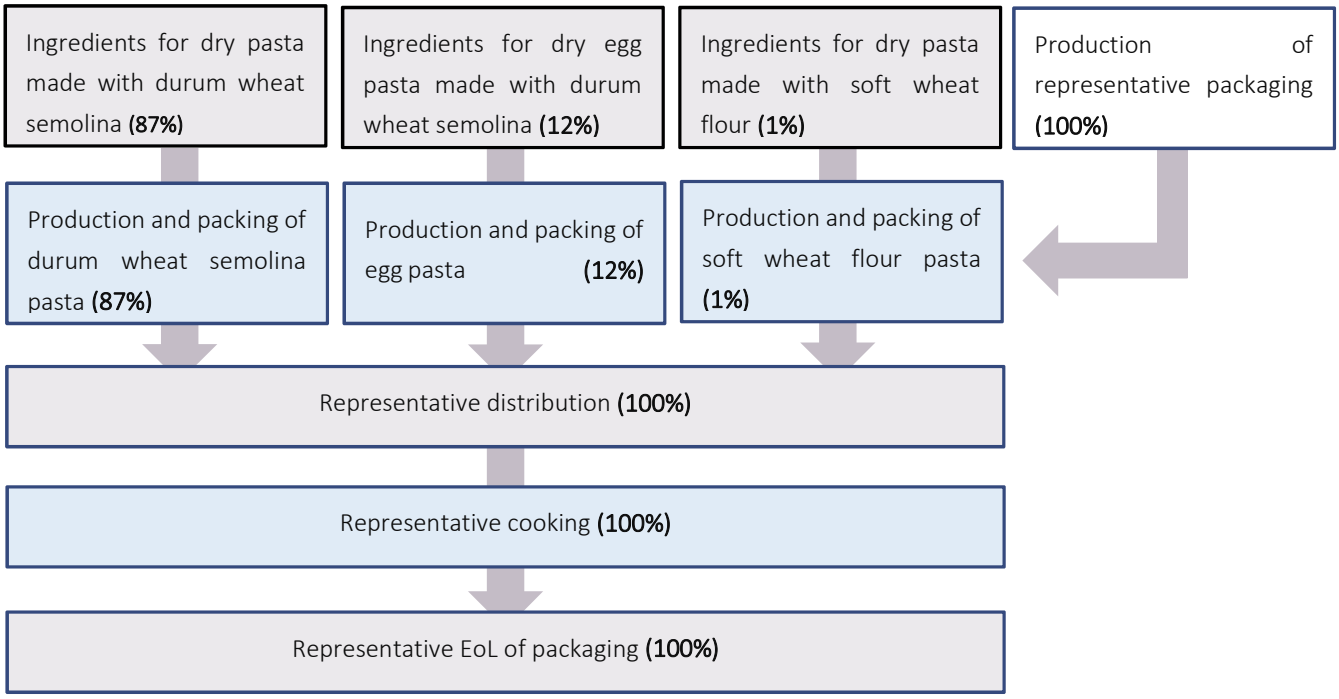
- pasta made with durum wheat semolina;
- pasta made with soft wheat flour;
- egg pasta (mainly made with durum wheat semolina).

Figure 13-2 Market shares of the different typologies of pasta (Source: AIDEPI, IRI, ACNielsen)



The model used for the analysis is represented in Figure 13-3. Packaging production, distribution, cooking and EoL of packaging are considered to be independent on the type of pasta.

Figure 13-3 Representative product model



INGREDIENTS

In Table 13-2 the lists of ingredients for the main typologies of pasta are reported. These are standard value confirmed by the experts of the TS.

Table 13-2 - List of ingredients

	Pasta made of durum wheat semolina	Pasta made with soft wheat flour	Egg pasta
Durum wheat semolina (kg/kg of pasta)	1,05		0,981
Soft wheat flour (kg/kg of pasta)		1,05 (Soft wheat)	
Eggs without shells or liquid egg product (kg/kg of pasta)[25]			0,167

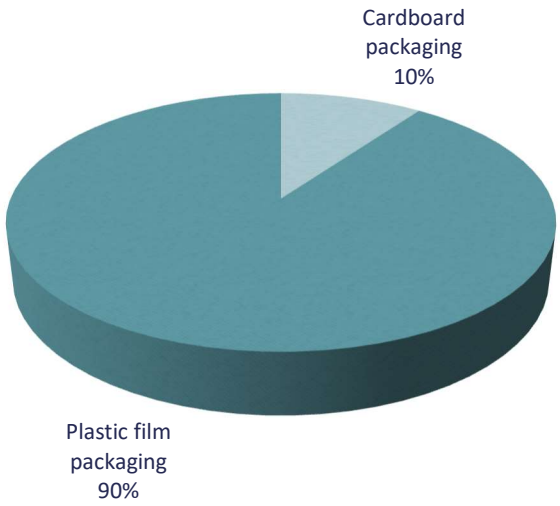
To produce 1 kg of pasta more than 1 kg of ingredients is needed. This because semolina and flour have a moisture content of about 15%, eggs of about 75%, while dry pasta of about 13%. In the production process, in fact, water is added in the kneading phase, but it is also evaporated during the drying phase to reach the final moisture content as defined by the different national laws.

[25] Example according to Italian legislation

PACKAGING

The most common types of pack for pasta are the cardboard box and the plastic film pack. A representative packaging was estimated by the experts of the Technical Secretariat taking into account the sales data of the companies of the TS and reported in**Error! Reference source not found.**.

Figure 13-4 – Representative primary packaging



COOKING

Cooking is considered in the use stage.

The hypothesis considered for energy requirements are those reported in the IES PCR in the paragraph 9.1[26] :

- Boiling phase: 0,18 kWh per kg of water;
- Cooking phase: 0,05 kWh per minute of cooking.

The default scenario is:

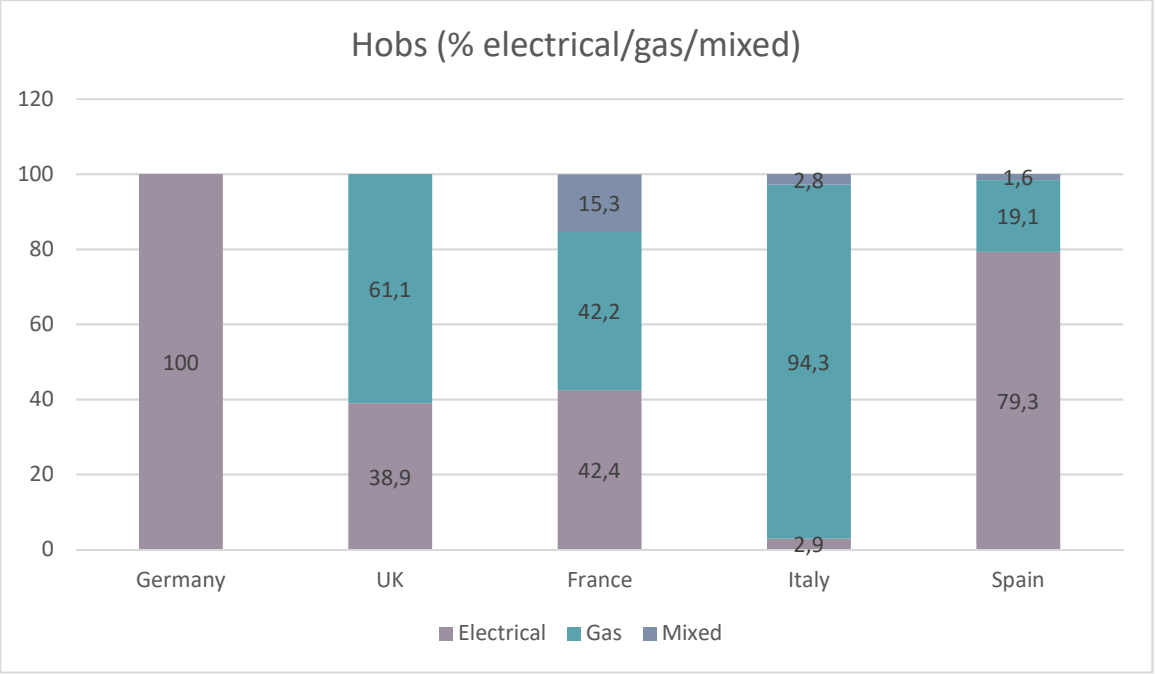
- the cooking in a pot of 500 g of pasta at a time;
- the use of 1 litre of water for 100 g of pasta;
- a cooking time of ten minutes.

For cooking electricity or gas can be used. Since data about the whole EU were not available, a representative way of cooking was elaborated by the TS considering statistics for the five main pasta consuming countries (Italy, France, Germany, Spain, UK) reported in Figure 13-5.

In these five countries the 90% of European pasta consumption occur.

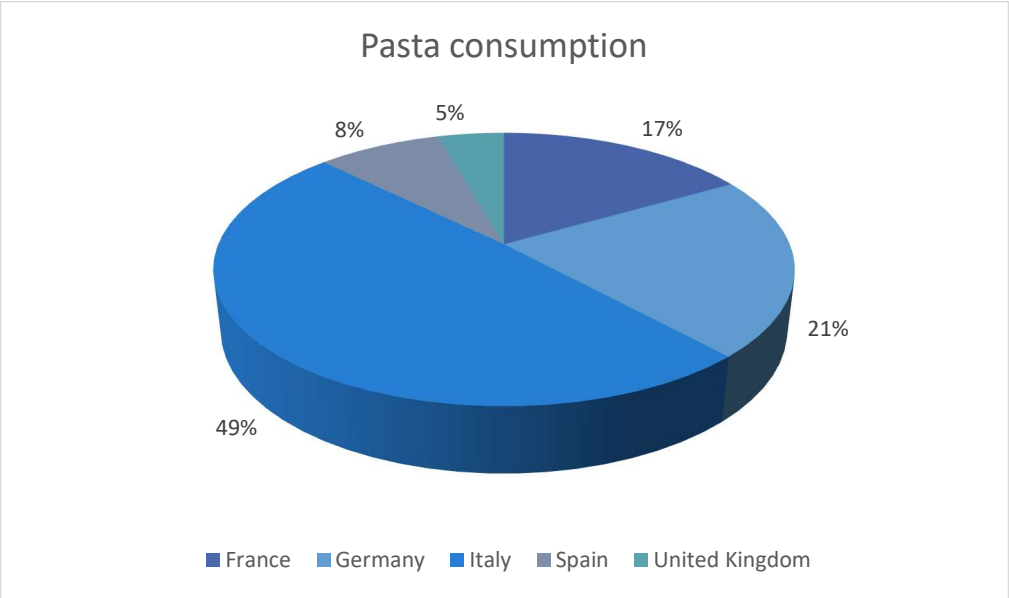
[26] The International EPD System (2013). Product Category Rules 2010:01 Uncooked pasta, not stuffed or otherwise prepared (Version 2.01)

Figure 13-5 – Energy sources for hobs in the five main EU pasta consuming countries (Source: *GFK, 2006. Sales trend in cooking and other Major Domestic Appliances in an enlarged Europe*)



It was hypothesized that for mixed hobs gas is primarily used.

Figure 13-6 - Pasta consumption in five considered countries



Weighting the information of Figure 13-6 for the consumption share reported in Figure 13-6 it is obtained that on average 83% of the pasta consumed in Europe is cooked with gas and 17% with electricity.

14. ANNEX 5 – SAMPLING PROCEDURE EXAMPLES

14.1. HOW TO DEFINE HOMOGENOUS SUB-POPULATIONS (STRATIFICATION)

Stratification is the process of dividing members of the population into homogeneous subgroups (sub-populations) before sampling. The sub-populations should be mutually exclusive: every element in the population shall be assigned to only one sub-population.

Aspects at least to be taken into consideration in the identification of the sub-populations:

- Geographical distribution of sites
- Technologies/farming practices involved
- Production capacity of the companies/sites taken into consideration

Additional aspects to be taken into consideration may be added by the TS for a specific product category.

The number of sub-populations may be identified as:

$$Nsp = g * t * c$$

- Nsp: number of sub-populations
- g : number of countries in which the sites/plants/farms are located
- t : number of technologies/farming practices
- c : number of classes of capacity of companies

In case additional aspects are taken into account, the number of sub-populations is calculated using the formula just provided and multiplying the result with the numbers of classes identified for each additional aspect (e.g., those sites which have an environmental management or reporting systems in place).

Example 1

Identify the number of sub-populations for the following population:

350 farmers located in the same region in Spain, all the farmers have more or less the same annual production and are characterized by the same harvestings techniques.

In this case:

- g=1 : all the farmers are located in the same country
- t=1 : all the framers are using the same harvesting techniques
- c=1 : the capacity of the companies is almost the same (i.e. the have the same annual production)

$$Nsp = g * t * c = 1 * 1 * 1 = 1$$

Only one sub-population may be identified that coincides with the population.

Example 2

350 farmers are distributed in three different countries (100 in Spain, 200 in France and 50 in Germany). There are two different harvesting techniques that are used that differ in a relevant way (Spain: 70 technique A, 30 technique B; France: 100 technique A, 100 technique B; Germany: 50 technique A). The capacity of the farmers in term of annual production varies between 10000t and 100000t.

According to expert judgement/relevant literature, it has been estimated that farmers with an annual production lower than 50000t are completely different in terms of efficiency compared to the farmers with an annual production higher than 50000t. Two classes of companies are defined based on the annual production: class 1, if production is lower than 50000 and class 2, if production if higher than 50000. (Spain: 80 class 1, 20 class 2; France: 50 class 1, 150 class 2; Germany: 50 class 1). In Table 14-1 are included the details about the population.

Table 14-1 Identification of the sub-population for Example 2

Sub-population	Country		Technology		Capacity	
1	Spain	100	Technique A	70	Class 1	50
2	Spain		Technique A		Class 2	20
3	Spain		Technique B	30	Class 1	30
4	Spain		Technique B		Class 2	0
5	France	200	Technique A	100	Class 1	20
6	France		Technique A		Class 2	80
7	France		Technique B	100	Class 1	30
8	France		Technique B		Class 2	70
9	Germany	50	Technique A	50	Class 1	50
10	Germany		Technique A		Class 2	0
11	Germany		Technique B	0	Class 1	0
12	Germany		Technique B		Class 2	0

In this case:

- g=3 : three countries
- t=2 : two different harvesting techniques are identified
- c=2 : two classes of production are identified

$$Nsp = g * t * c = 3 * 2 * 2 = 12$$

It is possible to identify maximum 12 sub-populations that are summarized in Table 14-2:

Table 14-2. Summary of the sub-population for example 2.

Sub-population	Country	Technology	Capacity	Number of companies in the sub-population
1	Spain	Technique A	Class 1	50
2	Spain	Technique A	Class 2	20
3	Spain	Technique B	Class 1	30
4	Spain	Technique B	Class 2	0
5	France	Technique A	Class 1	20
6	France	Technique A	Class 2	80
7	France	Technique B	Class 1	30
8	France	Technique B	Class 2	70
9	Germany	Technique A	Class 1	50
10	Germany	Technique A	Class 2	0
11	Germany	Technique B	Class 1	0
12	Germany	Technique B	Class 2	0

14.2. HOW TO DEFINE SUB-SAMPLE SIZE AT SUB-POPULATION LEVEL

The required sub-sample size shall be calculated using the square root of the sub-population size.

$$n_{SS} = \sqrt{n_{SP}} \qquad \text{[Equation 2]}$$

- n_{SS}: required sub-sample size
- n_{SP}: sub-population size

Example

Table 14-3. Example – how to calculate the number of companies in each sub-sample.

Sub-population	Country	Technology	Capacity	Number of companies in the sub-population	Number of companies in the sample (sub-sample size, [n_{SS}])
1	Spain	Technique A	Class 1	50	7
2	Spain	Technique A	Class 2	20	5
3	Spain	Technique B	Class 1	30	6
4	Spain	Technique B	Class 2	0	0
5	France	Technique A	Class 1	20	5
6	France	Technique A	Class 2	80	9
7	France	Technique B	Class 1	30	6
8	France	Technique B	Class 2	70	8
9	Germany	Technique A	Class 1	50	7
10	Germany	Technique A	Class 2	0	0
11	Germany	Technique B	Class 1	0	0
12	Germany	Technique B	Class 2	0	0